Annual report 2023

The Swedish Arthroplasty Register

SWEDISH
ARTHROPLASTY REGISTER

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Content

Glossary

Adverse event	An unexpected negative event, in this case, as a consequence of joint replacement surgery, for example an infection.
Ahlbäck classification	Radiological classification of knee osteoarthritis.
ASA class	American Society of Anesthesiologist physical status classification: classification of patients regarding medical comorbidity. The higher the ASA class, the grater the degee of comorbidity.
Aseptic loosening	Loosening of prosthesis component(s) without proven infection.
Bilateral prosthesis	Prosthesis in both right and left hip/knee respectively.
Bipolar head	Composite femoral head used for hemiarthroplasty where a smaller head is fixated on the prosthesis cone, and a larger head is snapped on to the smaller head. The result is that movement can take place in two joints, one between the smaller and the larger head, and one between the larger head and the acetabulum.
BMI	Body mass index = weight divided by length squared (kg/m^2).
Case-mix profile	Case-mix or distribution of patient characteristics at each unit respectively.
CE	Conformité Européenne (in free translation: European conformity).
Charnley class	Classification of comorbidity that mainly relates to mobility. Class A refers to unilateral hip/knee disease, class B refers to bilateral hip/knee disease, and class C refers to multiple joint disease or other medical conditions that affect the walking ability.
Closed reduction	Return body part or fracture to proper position without surgical incision.
Computer assisted surgery (CAS)	A surgical concept and set of methods that use computer technology for surgical planning and for guiding or performing surgical interventions.
Confidence Interval (CI)	An estimate of a calculated value's uncertainty indicating the lower and upper limit.
Consumption	Refers to the number of hip/knee replacements per 100,000 inhabitants regardless of where the surgery has been performed.
Cox regression	Regression model used for investigating the effect of several variables upon the time a specified event takes to happen.
CPUA	Central Personal Data Controller
Cruciate retaining (CR)	Minimally stabilizing, posterior cruciate retaining type of prosthesis.
Custom made instruments	Instruments or saw blocks specially made for the patient based on MRI or CT.
DAIR	Debridement, Antibiotics, Implant Retention; Surgical procedure in case of deep infection if the implant is stable, with the aim to retain the prosthesis by debridement, rinsing and administrating antibiotics to heal the infection.
Dislocation	For hip prostheses, this means that the joint head jumps out of the center of the joint cup. For knee prostheses, this usually means that the patella jumps to the side, but it does occur also that the prosthetic components of the femur and lower leg separate from each other.
DMC	Dual Mobility Cup have two points of articulation, one between the shell and the polyethylene (external bearing) and one between the polyethylene and the femoral head.

Elective surgery	Planned surgery.
EQ-5D	A standardized instrument, questionnaire, to measure general health.
European standard population (ESP)	A theoretical population used to be able to compare information from different countries.
Fast track	Care consept based on accurate preoperative information, early mobilization and effective pain relief to minimize length of stay while maintain high quality of care.
HA	Hydroxyapatite
Hardinge approach	Direct lateral approach in supine position.
Hazard ratio (HR)	Ratio of the hazard rates corresponding to the conditions described by two levels of an explanatory variable in a survival analysis.
Hinged prosthesis	Knee prosthesis that only allow for flexion and extension through a fixed axis.
HKA (hip-knee-ankle) angle	A measure of lower limb alignment from x-ray, defined as the angle between the mechanical axes of the femur and the tibia.
HOOS	Hip dysfunction and Osteoarthritis Outcome Score. A standardized instrument, questionnaire, to measure knee-related pain, function and quality of life.
Hybrid prosthesis	Total hip prosthesis with uncemented cup and cemented stem or knee prosthesis with uncemented tibial plate and cemented femur.
ICD-10	The 10th edition of the International Statistical Classification of Diseases and Related Health Problems governed by World Health Organisation
Incidence	The number of events in a given population over a limited period of time.
ISAR	International Society of Arthroplasty Registries.
Kaplan-Meier	Statistical method for estimating the probability of not having experienced a specific event (eg. death or revision) at a certain given time.
Knee osteotomy	Re-angeling of the knee joint to unload the diseased/injured part of the knee. Joint preserving surgery.
KOOS	Knee injury and Osteoarthritis Outcome Score. A standardized instrument, questionnaire, to measure hip related pain, function and quality of life.
KVÅ	Swedish Classification system of surgical procedures based on the Nordic Medico-Statistical Committee (NOMESCO) classification of surgical procedures.
Lateral position	Side position during surgery.
Likert	A scale where the responder’s different attitudes are measured Linkert scales usually have five levels, but seven levels also exist.
Linked knee implants	(Linked/Rotating hinge) Have a mechanical coupling between the femoral and tibial components allowing for flexion and extension as well as for a varying amount of rotation.
Local infiltration analgesia (LIA)	A multimodal concept for postoperative local pain relief.
Logrank-test	Statistical method to compare the difference between two or several survival distributions (Kaplan-Meier) where the hypothesis is that the distributions are equal.

MDR	Medical Device Regulation. Regulation on medical devices within the EU.
Minimal invasive surgery (MIS)	This implies a (small) arthrotomy used to gain access to the joint without the patella having to be everted.
NARA	The Nordic Arthroplasty Register Association.
NOAK	Non vitamin-k Orala AntiKoagulantia
NPO	A national program for knowledge management.
One-stage surgery	An operation performed in one occasion.
Osteoarthritis (OA)	Osteoarthritis is a joint disease that affects the entire joint. The division in primary and secondary osteoarthritis is questionable as osteoarthritis is a complex condition that can have many contributing factors.
Osteolysis	Loosening of bone tissue.
Osteosynthesis	Repair a fracture with, for example, plates, screws, nails or steel wire.
NPR (PAR)	The national patient register of the National Board of Health and Welfare.
Partial knee resurfacing implant (PRKA)	"Buttons" that only replace a part of a knee compartment.
Patello-femoral knee replacement (PF)	A replacement which resurfaces the patello-femoral compartment.
Posterior stabilized knee replacement (PS)	A type of stabilizing knee prostesis that requires resection of the posterior cruciate ligament.
PPFF	Periprosthetic femoral fracture.
Prevalence	Refers to the proportion of individuals who suffer from a certain disease or having a certain condition.
Production	Refers to the number of total hip/knee replacements per 100,000 inhabitants regardless of where the patient being operated lives.
PROM	Patient-Reported Outcome Measurement.
p-value	Measure that indicate the probability that, for example, two mean values differ. Given that the hypothesis that two or more groups have the same mean is true, the p-value is the probability to have an outcome at least as extreme as the outcome that is actually observed.
Reoperation	Reoperation includes all kinds of surgical intervention that can be directly related to an inserted hip/knee arthroplasty irrespective of whether the prosthesis or one of its parts has been exchanged, removed or left untouched. For knee replacements this also includes mobilisation under anaesthesia.
Reverse hybride	Total hip prosthesis with cemented cup and uncemented stem or knee prosthesis with cemented tibial plate and uncemented femur.
Revision	Exchange, addition or extraction of one or more inserted prosthesis components (including arthrodesis and amputation).
Rheumatoid arthritis (RA)	Inflammatory joint disease.
Risk ratio (RR)	The probability that some event will be observed in one group relative to the probability that it will be observed in another group.

SALAR (SKR)	Swedish Association of Local Authorities and Regions.
SD	Standard deviation.
Sequelae	Impairment after disease, injury or trauma.
SHAR	Swedish Hip Arthroplasty Register
SKAR	Swedish Knee Arthroplasty Register
SOASP	Supported OsteoArthritis Self-management Programme. A structured way of conveying first-line treatment for osteoarthritis, which means information and exercise.
Stabilized knee prosthesis	The term stabilizing is used only for a group of TKA-type prostheses that use the shape of the femur and the tibial component to restrict movement in the varus/valgus and rotation.
Standard patient	Male or female 55-85 years with primary osteoarthritis, ASA class I–II and BMI less than 30 operated on with a primary hip replacement.
Swedish Arthroplasty Register (SAR)	Merger of the Swedish Hip Arthroplasty Register and the Swedish Knee Arthroplasty Register.
THR	Total hip replacement
TKR	Total knee replacement
TKR revision models	TKRs that are mainly used for revision or severe primary cases.
Two-stage surgery	An operation performed in two occasions.
Unicompartmental knee replacement (UKR)	Provide only the medial or lateral femorotibial compartment (medial UKR and lateral UKR respectively).
Unilateral prosthesis	Prosthesis only in one hip/knee.
Unipolar head	Femoral head that is fixated to the prosthesis cone, which articulates against acetabulum.
Unit	Clinic
Vancouver classification	Classification system for periprosthetic fractures. Type A: Trochanteric fractures that do not affect the prosthesis. Type B: Fracture in direct proximity to the prosthesis, subdivided into B1 (good bone-anchoring), B2 (loosening of the prosthesis), and B3 (loosening of the prosthesis and/or osteolysis). Type C: Fracture distally of the prosthesis.
VAS	Visual analogue scale. A 100 mm long horizontal scale where the value for a condition is given. Instrument for self-assessment.
Watson-Jones surgical approach	A type of antero-lateral surgical approach.

“All time high”

1. Introduction

The Swedish Arthroplasty Register's annual report of 2023 is the third report in which we present hip and knee replacements together. Even though the number of primary hip and knee replacements reached record levels in 2022, Swedish orthopaedics is struggling with a large unmet need for care and long waiting times as a result of the cut downs during the pandemic. This applies especially to patients with comorbidity and those who demand more advanced surgery – revisions and complex primary surgery. An increasing proportion of patients are operated on by privately driven health care providers. It is of course good that the capacity to perform joint replacements has increased. Unfortunately, the shift to more replacements being performed by privately driven units has meant that the public care is drained of resources to such extent that the sickest and those in need of advanced surgery have suffered unreasonably long waits for surgery.

The first robot-assisted knee replacements in Sweden

In 2022, the first robot-assisted knee replacements were performed in Sweden. Within a research collaboration between Sahlgrenska University hospital and Örebro University hospital, the first operations were performed in Mölndal and Lindesberg. This is a good example of stepwise introduction of new technology in joint replacement surgery. The register recently added variables for robot-assisted operations, and we look forward with excitement to presenting robotic surgery data in the future.

Continued harmonisation in the presentation of hip and knee data

In the work on this year's report, we have continued our effort to present data from hip and knee replacements in a uniform manner as far as possible. In several chapters, hip and knee replacement data are presented together. We believe, that viewing and evaluating hip and knee data together gives a better overview of joint replacement surgery in Sweden.

Production of the year – all-time high

The Swedish Arthroplasty Register's annual report 2023 contains information on surgeries performed until 31st of December 2022. In 2022, 20,568 total hip replacements, 4,842 hemiarthroplasties, 17,002 knee replacements and 102 knee osteotomies were registered. In addition, 2,324 reoperations after hip replacement and 1,339 reoperations after knee replacement were registered.

For primary procedures, this was an "all-time high" for both hip and knee replacements. So it appears to be a post-pandemic recovery effect. Compared with a forecast made in 2013 the total hip replacement production was 12 % higher than predicted (Nemes et al. Projections of total hip replacement in Sweden from 2013 to 2030. Acta Orthop. 2014 Jun;85(3):238-43.). For knee replacements, however, the production has not increased to the extent forecasted; in 2022 the production was 8 % lower than forecast (Nemes et al. Historical view and future demand for knee arthroplasty in Sweden. Acta Orthop. 2015;86(4):426-31.).

In 2022, the Swedish Arthroplasty Register exceeded the staggering figure of one million registered surgeries. The total number of registered primary hip and knee replacements was 885,627 divided into 344,549 knee replacements from 1975 to 2022, and 541,078 hip replacements (total and hemi) from 1979 to 2022. The corresponding figure for reoperations was 127,081 divided into 95,373 reoperations of hip replacements and 31,708 reoperations of knee replacements (figure 1.1–1.6).

Completeness and adverse events

Again, this year the National Board of Health and Welfare has been able to deliver completeness analysis in good time. The Swedish Arthroplasty Register continues to have a very high completeness in terms of primary procedures. In 2022, the completeness was 98 % for both knee and total hip replacements while it was 97 % for hemiarthroplasties. To our delight, together with register service at the National Board of Health and Welfare we have been able to develop a method for presenting adverse events. The problem is that the National Board of Health and Welfare does not disclose aggregated data if there have been only single or a few events per unit. We have solved this by the National Board of Health and Welfare disclosing figures in intervals of five events. For most calculations this has no bearing on the interpretation of results. The uncertainty in the estimation is only affected for units with few operations and few adverse events.

A continued high research production

In 2022, 29 scientific papers and three PhD-students, whose thesis works wholly or in part were based on data from what is now the Swedish Arthroplasty Register, defended their thesis. Delightfully, we have scientific collaborations with all medical faculties in Sweden and many international research collaborations.

Autumn meeting – Contact surgeons' meeting with the Swedish Hip and Knee Association

It was a great success when we together with the Swedish Hip and Knee Association arranged an autumn meeting on November 10–11 in Stockholm. The usual "Contact surgeons' meeting" was woven into the program that otherwise offered research presentations and exciting symposia on current topics within joint replacement surgery. In 2023, the meeting will be held November 9–10 in Stockholm – everyone with an interest in replacement surgery is warmly welcome.

Thanks to contact secretaries and contact surgeons

A prerequisite for the register to function is that units register and provide necessary information. We appreciate all the engagement and work that contact secretaries and contact surgeons around the country contribute with – at the end of the report you will find a list of all contact surgeons and contact secretaries. We look forward to a continued good collaboration in the future. Many thanks for all contributions in the past year!

June 2023, Register management

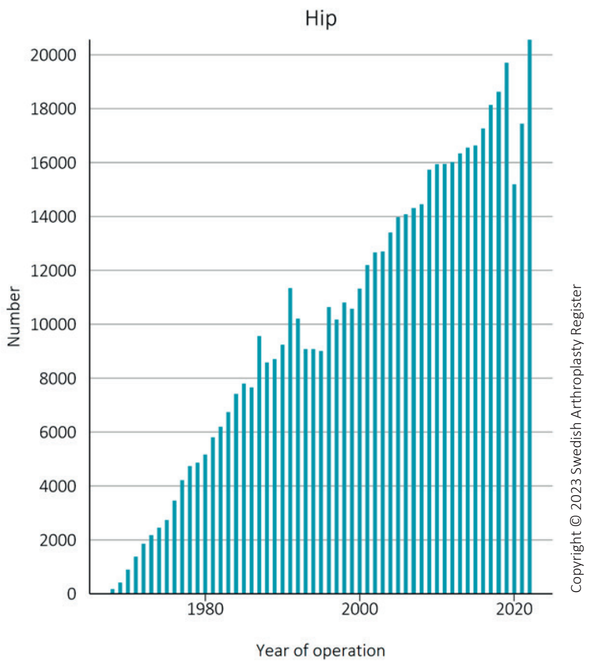

Figure 1.1. Primary total hip replacement surgery 1968–2022.

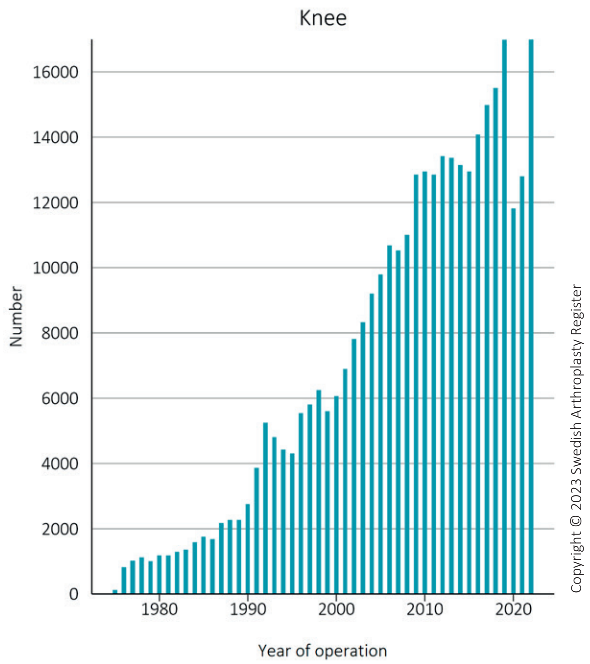

Figure 1.2. Primary knee replacement surgery 1975–2022

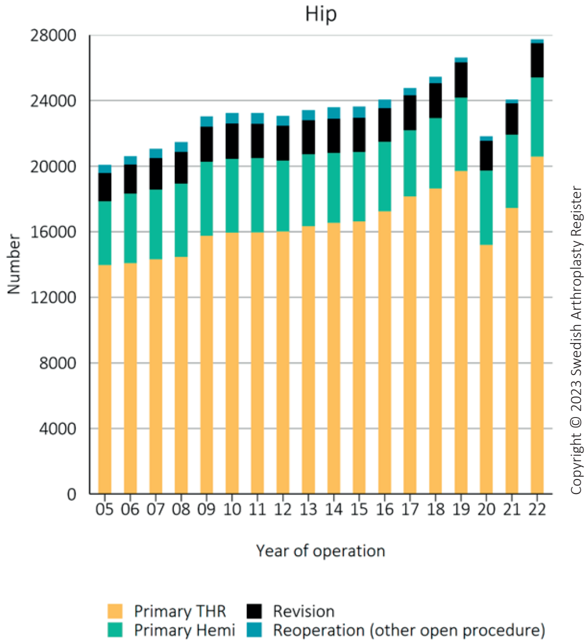

Figure 1.3. All hip replacements 2005–2022.

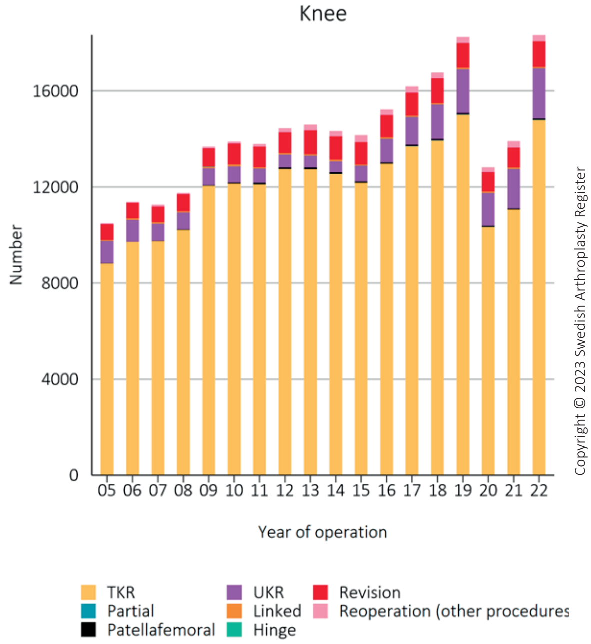

Figure 1.4. All knee replacements 2005–2022.

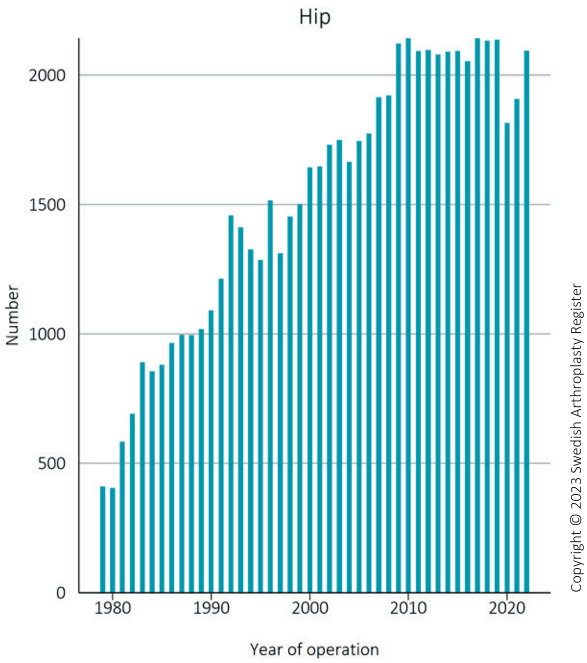

Figure 1.5. All hip revisions 1979–2022.

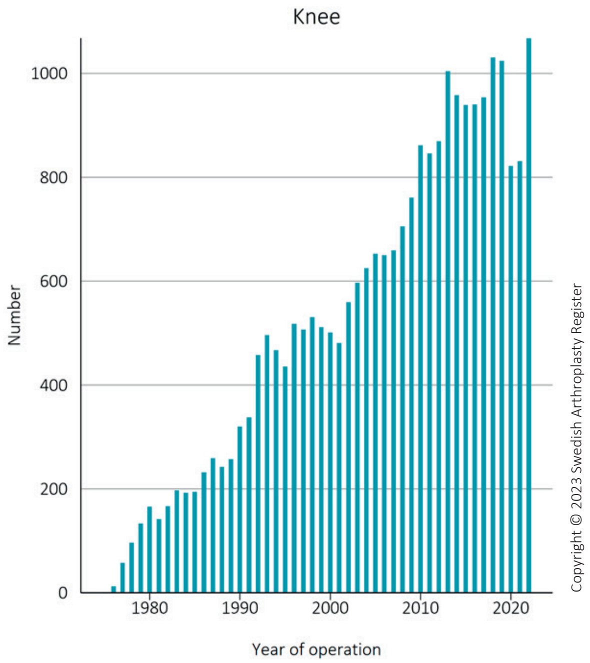

Figure 1.6. All knee revisions 1975–2022.

High data quality is essential to draw reliable conclusions, make correct recommendations and to achieve successful results in clinical improvement work.

2. Data Quality

Completeness analysis

Authors: Annette W-Dahl and Ola Rolfson

An important part of the validity work is the yearly completeness analysis that is made in cooperation with the National Patient Register (NPR) of the National Board of Health and Welfare. By comparing the number of admissions and by assuming that the true number of admissions is the combined number in both registries the completeness can be estimated. The method is explained in table 2.1. The analysis comprises all primary operations, divided into total hip replacement and hemi arthroplasty and knee replacement, as well as hip and knee revisions. The NPR contains Swedish personal identity numbers and temporary identity numbers while the Swedish Arthroplasty Register only contains Swedish personal identity numbers. Previously, there has been a delay before the data from the NPR for the previous year were complete but in the last two years, the data have been available early and the completeness analysis for operations performed 2022 can already be published in this year's report.

Ensuring the accuracy of data entered into quality registries and health data registries is essential to guarantee high-quality and reliable results and analyses. It also facilitates more effective and equitable monitoring. Of the operations registered in the Swedish Arthroplasty Register, we can very likely say that they are hip or knee replacements. We also know which intervention that has been reported since the registration among other things is based on information from the bar code stickers of the components in both primary operations and revisions. Moreover, medical records are sent in for review for reoperations. However, units can fail to register operations in both the Swedish Arthroplasty Register and in the NPR, and some registrations in the NPR can be operations on individuals with temporary identity number that the Swedish Arthroplasty Register does not register. An example of an error source that has been noted is that surgical codes for revision have been reported to the NPR when in fact it was not a revision but another type of reoperation. In those cases, the operation appears as a revision in the NPR but not in the Swedish Arthroplasty Register.

In order to investigate trends in the reporting frequency, we have presented numbers for the last ten years (2013–2022). The completeness for total hip replacements has consistently been around 98 % during this period, and in 2022, it was 97.9 % (see figure 2.1a). For hemiarthroplasties, the completeness was 97.2 % in 2022 and ranged between 94 % and 98 % over the ten-year period. As for knee replacements, the completeness was 97.5 % in 2022 and remained between 97 % and 98 % throughout the ten-year period (see figure 2.1b).

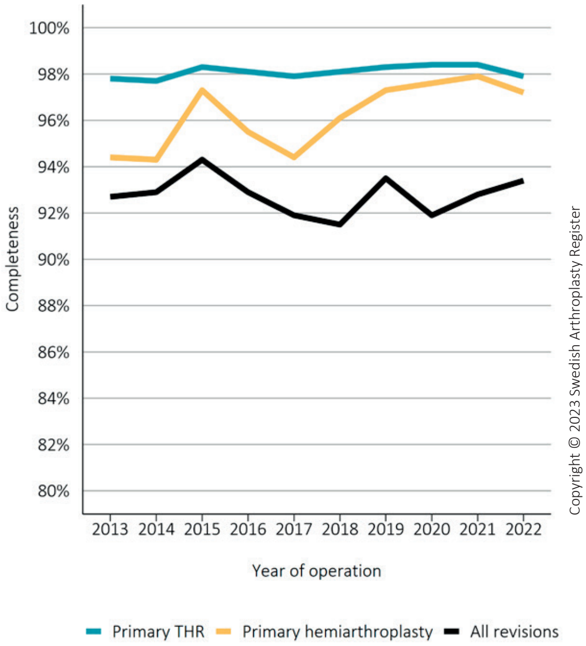

Figure 2.1 a. Completeness for hip replacement 2013–2022.

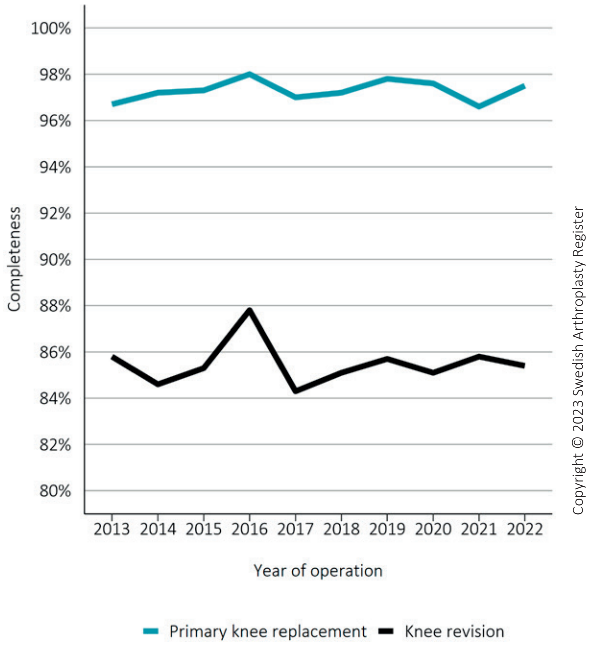

Figure 2.1 b. Completeness for knee replacement 2013–2022.

The completeness for hip and knee revisions is presented with operations that we have classified as revisions, that is removal, exchange or addition of any component. Codes for classification of care measures (abbreviated KVÅ in Swedish which is based on the Nordic Medico-Statistical Committee classification NOMESCO) for revision are presented in table 2.1. The completeness for hip revisions has been presented since 2017 and for knee revisions since 2021. From 2013 to 2022 the completeness for hip revisions has been between 93 and 96 % and in 2022 it was 93.4 % (figure 2.1 a). For knee revisions the completeness in the period has varied between 84 and 88 % and was 85.4 % in 2022 (figure 2.1 b). In this year's completeness analyses, we have tried to compensate for the error source that reoperations (other interventions than revisions) are registered as revisions in the NPR. However, it has been noticed that units that perform few or no revisions sometimes have reported a considerable number of revisions (27 to 39 revisions) to the NPR. We have started to look closer into this in order to be able to get a more reliable validation against the NPR in the future.

Completeness analysis per unit

Completeness is presented for primary total hip replacement (table 2.2), hemiarthroplasty (table 2.3), knee replacement (table 2.4) and hip revision (table 2.5), and knee revision (table 2.6) per unit. Observe that the percentages for units with few operations may be misleading. Operations where the unit is not clear from the information from the National Board of Health and Welfare or as being performed at a specific hospital but by an administrative body containing several hospitals are reported aggregated as "other units". There are units that do not report to the NPR but report to the Swedish Arthroplasty Register which thus entails that the completeness analysis for these units is not possible. If the completeness rate is below 96 % it is marked in red. For units with low completeness there is reason to investigate if the reporting of operations has been missed and if the coding of surgical procedure is correct in as much that revision codes are only used for revisions and not for reoperations that do not involve removal, exchange or addition of any component.

Response rate of PROM-questionnaires

The PROM-programs for hip and knee replacements differ. PROMs for hip replacements are followed by person while operation is followed by knee replacements (see chapter 8). For hip replacements, individuals that have been reoperated or been operated in the other hip in the follow-up year, are excluded, while knee replacements are followed up one year postoperatively with or without reoperation in the follow-up year. When the two registries were merged into the Swedish Arthroplasty Register, the PROM-questionnaires for hip and knee replacements were harmonised. This implies that PROM-questionnaires for operations carried out in 2020 and in 2021 have been out of step, especially for knee replacements where most of the changes have been done (see chapter 8). The questionnaire for knee replacements consists of 24 questions while the questionnaire for individuals operated with a hip replacement consists of 25 questions. An additional question, satisfaction with the operation, is added to the postoperative questionnaires for both hip and knee. The PROM program for hip replacements has been in operation nationally since 2008 and for knee replacements the program has been available since 2009 for units who have wanted to participate (approximately 50 % of the knee replacements in 2020). In this year's report the response rates the last five years are presented (table 2.7) and this shows that the response rate has varied over the years and that it is lower in 2020 and 2021 than in previous years for both hip and knee. Reasons for the reduction may be that the handling of PROM has been affected by both the merger of the registers and of the pandemic. In 2022, only preoperative responses are available. The response rate is lower for knee (68 %) than for hip (78 %), likely due to that several units not previously participating in the knee replacement PROM program have not start collecting PROM and we see opportunity for future improvement.

Description of the completenss analysis

Completeness
Primary hip replacements (total and hemi), primary knee replacements and hip and knee revisions in the Swedish Arthroplasty Register (SAR) are compared with corresponding in the National Patient Register (NPR), in 2020 and 2021. The completeness is calculated as a percentage of: **Nominator** All replacements/revisions in the SAR, performed in the current year. **Denominator** The total number of replacements/revisions either in the SAR or in the NPR, performed in the current year. A maximum of one procedure per individual and date has been included.
Selection from the Swedish Arthroplasty Register
Hip and knee replacement surgeries and revisions of hip and knee replacements, performed in the current year.
Selection from the National Patient Register
Hip and knee replacements and revisions of hip and knee replacements registered in the NPR inpatient care, performed in the current year. Registrations with procedure codes for each type of surgery were included; primary total hip replacements NFB29, NFB39, NFB49, NFB62 eller NFB99 primary hemi hip replacements NFB09 eller NFB19 primary knee replacements NGB09, NGB19,NGB29,NGB39,NGB49,NGB53,NGB59 eller NGB99 revisions of hip replacements NFC, NFU09 eller NFU19 revision of knee replacements NGC, NGU03, NGU09, NGU19 eller NGU59 Maximum one procedure per individual and date has been included.
Matching criteria
Operations in the SAR were matched against the NPR by the unique personal identification number and procedure date +/- 7 days.
More about the processing
Information on the unit was obtained primarily from the SAR and secondary from the NPR. Only registrations with a Swedish personal identification number or temporary number were included in the sample selection from each register.Operations classified as hip or knee revisions in the NPR but as other reoperations for knee and hip replacements in the SAR were excluded as they were probably misclassified.

Table 2.1. Description of the completeness analysis.

Completeness for primary hip replacement 2022

	Total number	SAR %	NPR %
Country	**21,015**	**97.9**	**92.8**
Akademiska sjukhuset	278	99.6	97.8
Aleris Specialistvård Nacka	542	99.4	**84.1**
Aleris Specialistvård Ängelholm	715	98.5	**91.3**
Art Clinic Göteborg	276	100	98.9
Art Clinic Jönköping	264	100	98.1
Arvika	307	99.3	98
Bollnäs	354	98.3	**94.1**
Borås-Skene	370	97.3	97.3
Capio Artro Clinic and Sophiahemmet	713	99.9	**91.3**
Capio Movement	473	100	**26.2**
Capio Ortopedi Motala	454	100	99.1
Capio Ortopediska Huset	827	96	98.7
Capio S:t Göran	411	97.1	98.1
Carlanderska	675	**85.9**	97.3
Danderyd	307	97.4	97.1
Eksjö	337	99.1	99.4
Enköping	529	100	99.8
Eskilstuna	98	100	100
Falun	208	99	98.6
Frölundaortopeden	13		0
GHP Ortho Center Göteborg	313	99	99
GHP Ortho Center Stockholm	857	99.9	100
Gällivare	53	100	100
Gävle	157	96.8	**84.1**
Halmstad-Varberg	402	**91.8**	98.8
Helsingborg	95	98.9	98.9
Hermelinen	38		0
Hudiksvall	92	97.8	**88**
Hässleholm	635	99.8	99.8
Jönköping	184	96.2	98.4
Kalmar	116	**95.7**	100
Karlshamn-Karlskrona	332	100	99.4
Karlstad	108	100	98.1
Karolinska Huddinge	343	99.4	**95.9**
Karolinska Solna	64	**71.9**	96.9

The table continues on the next page.

Completeness for primary hip replacement 2022, cont.

	Total number	SAR %	NPR %
Kristianstad	20	95	**90**
Kullbergska sjukhuset	357	99.7	99.2
Kungälv-Alingsås	340	98.5	97.6
Lidköping-Skövde	367	98.4	98.4
Linköping	106	99.1	99.1
Ljungby	128	96.9	**94.5**
Lycksele	241	98.3	98.8
Mora	298	98.7	98.3
Norrköping	189	97.4	99.5
Norrtälje	177	100	99.4
Nyköping	163	97.5	96.3
Oskarshamn	425	99.3	99.5
Piteå	413	99.3	99
SU/Mölndal	576	98.6	99
SUS/Lund	95	96.8	96.8
SUS/Malmö	21	100	100
Skellefteå	166	98.2	98.8
Sollefteå	380	99.7	99.5
Specialistcenter Scandinavia, Eskilstuna	124		0
Sunderby sjukhus	73	89	97.3
Sundsvall	46	**95.7**	97.8
Södersjukhuset	262	98.9	98.9
Södertälje	189	100	99.5
Torsby	136	100	100
Trelleborg	289	99.3	99.3
Uddevalla	390	99.7	99.5
Umeå	113	**73.5**	**93.8**
Visby	134	**94.8**	96.3
Värnamo	173	98.3	96.5
Västervik	139	**95.7**	97.1
Västerås	530	97	97.9
Växjö	223	96.9	97.8
Örebro-Lindesberg-Karlskoga	503	99.2	99.8
Örnsköldsvik	192	96.4	96.4
Östersund	239	97.5	97.5
Other units	7	**0**	100

Table 2.2. The completeness for primary total hip replacement per unit 2022.

Completeness for primary hemiarthroplasty hip 2022

	Total number	SAR %	NPR %
Country	**4,988**	**97.2**	**94.8**
Akademiska sjukhuset	166	100	96.4
Borås-Skene	81	98.8	**95.1**
Capio S:t Göran	177	**93.8**	97.7
Danderyd	255	97.3	97.3
Eksjö	47	100	**95.7**
Eskilstuna	92	100	97.8
Falun	131	98.5	99.2
Gällivare	46	100	97.8
Gävle	95	97.9	**76.8**
Halmstad-Varberg	209	**93.8**	96.7
Helsingborg	155	98.7	96.1
Hudiksvall	59	100	**74.6**
Jönköping	59	96.6	**94.9**
Kalmar	101	99	**94.1**
Karlshamn-Karlskrona	123	98.4	**91.9**
Karlstad	123	97.6	**97.6**
Karolinska Huddinge	89	96.6	**95.5**
Karolinska Solna	22	**90.9**	**90.9**
Kristianstad	128	99.2	**95.3**
Kungälv-Alingsås	114	**93**	**92.1**
Lidköping-Skövde	144	97.9	**93.8**
Linköping	160	99.4	**93.8**
Ljungby	22	100	**90.9**
Lycksele	21	**95.2**	**76.2**

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Completeness for primary hemiarthroplasty hip 2022, cont.

	Total number	SAR %	NPR %
Mora	56	**87.5**	**87.5**
Norrköping	70	**85.7**	97.1
Norrtälje	28	96.4	96.4
Nyköping	44	**95.5**	**90.9**
SU/Mölndal	276	98.9	**93.8**
SUS/Lund	170	97.1	**94.1**
SUS/Malmö	218	98.6	**91.3**
Skellefteå	47	100	**95.7**
Sunderby sjukhus	112	**95.5**	97.3
Sundsvall	101	96	**93.1**
Södersjukhuset	256	99.2	98
Torsby	27	96.3	96.3
Uddevalla	238	99.2	97.1
Umeå	96	100	99
Visby	42	**85.7**	**83.3**
Värnamo	48	**93.8**	**95.8**
Västervik	55	96.4	100
Västerås	16	**93.8**	**81.3**
Växjö	74	**95.9**	**94.6**
Ystad	112	99.1	100
Örebro-Lindesbergs-Karlskoga	163	96.3	96.9
Örnsköldsvik	56	98.2	96.4
Östersund	55	98.2	**94.5**
Other units	9	**44.4**	**88.9**

Table 2.3. The completeness for primary hemiarthroplasty hip per unit 2022.

Completeness for primary knee replacement 2022

	Total number	SAR %	NPR %
Country	**17.191**	**97.5**	**91.6**
Akademiska sjukhuset	105	**95.2**	100
Aleris Specialistvård Nacka	529	99.1	**87.1**
AlerisSpecialistvård Ängelholm and Helsingborg	878	98.9	**92.3**
Art Clinic Göteborg	353	100	100
Art Clinic Jönköping	250	99.2	**95.6**
Arvika	285	98.9	96.8
Bollnäs	380	98.2	**92.1**
Borås-Skene	248	96.8	96.8
Capio Artro Clinic and Ortopediskt Center Sophiahemmet	1 008	99.6	**67.7**
Capio Movement	535	99.4	**25.4**
Capio Ortopedi Motala	475	97.3	99.8
Capio Ortopediska Huset	845	99.4	99.5
Capio S:t Göran	304	**94.4**	99.3
Carlanderska	731	**79.5**	95.8
Danderyd	191	99.5	97.9
Eksjö	314	99.7	99.4
Enköping	508	100	100
Eskilstuna	58	**94.8**	98.3
Falun	199	98	99
Frölundaortopeden	27		0
GHP Ortho Center Göteborg	295	99	99
GHP Ortho Center Stockholm	878	99.7	99.9
Gällivare	29	100	100
Gävle	65	**95.4**	**90.8**
Halmstad-Varberg	245	**93.1**	97.6
Hermelinen	35		0
Hudiksvall	40	97.5	**87.5**
Hässleholm	673	98.4	99
Kalmar	93	96.8	97.8
Karlshamn-Karlskrona	245	97.6	97.1
Karlstad	15	100	100
Karolinska Huddinge	178	96.6	98.3
Karolinska Solna	63	**77.8**	98.4
Kullbergska sjukhuset	340	99.7	100

The table continues on the next page.

Completeness for primary knee replacement 2022, cont.

	Total number	SAR %	NPR %
Kungälv-Alingsås	312	98.1	96.8
Lidköping-Skövde	135	97.8	97.8
Lindesberg	325	98.8	99.7
Ljungby	116	96.6	**95.7**
Lycksele	224	99.6	100
Mora	230	98.7	98.7
Norrköping	118	99.2	100
Norrtälje	170	99.4	98.8
Nyköping	110	99.1	98.2
Oskarshamn	354	98.3	98.6
Piteå	330	99.7	99.1
SU/Mölndal	310	97.7	98.1
SUS/Lund	19	**89.5**	**94.7**
Skellefteå	73	98.6	100
Sollefteå	147	98.6	98.6
Specialistcenter S:t Johanniskliniken	90	96.7	**67.8**
Specialistcenter Scandinavia, Eskilstuna	119		0
Sundsvall	19	100	**89.5**
Södersjukhuset	153	98	98.7
Södertälje	135	100	100
Torsby	128	100	100
Trelleborg	312	99.7	99.4
Uddevalla	155	99.4	100
Umeå	15	**93.3**	**93.3**
Visby	81	**93.8**	98.8
Värnamo	198	99.5	99.5
Västervik	120	**94.2**	**93.3**
Västerås	245	98.8	99.2
Växjö	126	**95.2**	99.2
Örnsköldsvik	211	97.2	**95.7**
Östersund	106	96.2	96.2
Other units	10	**10**	100

Table 2.4. The completeness for primary knee replacement per unit 2022.

Completeness for hip revisions 2022

	Total number	SAR %	NPR %
Country	**2,275**	**93.4**	**88.6**
Akademiska sjukhuset	124	100	**94.4**
Borås-Skene	39	97.4	**92.3**
Capio Ortopedi Motala	24	100	**95.8**
Capio S:t Göran	89	**71.9**	**87.6**
Danderyd	133	100	97.7
Eksjö	36	**86.1**	**75**
Eskilstuna	56	100	98.2
Falun	39	94.9	**87.2**
Gällivare	7	**85.7**	**71.4**
Gävle	74	97.3	**83.8**
Halmstad-Varberg	53	**86.8**	**92.5**
Helsingborg	76	**94.7**	**81.6**
Hudiksvall	8	**87.5**	**75**
Hässleholm	50	98	**92**
Jönköping	31	**87.1**	**77.4**
Kalmar	27	**88.9**	**81.5**
Karlshamn-Karlskrona	53	**94.3**	**92.5**
Karlstad	68	**95.6**	**94.1**
Karolinska Huddinge	139	98.6	**90.6**
Karolinska Solna	20	**30**	**90**
Kristianstad	6	**83.3**	**33.3**
Kungälv-Alingsås	35	**91.4**	**74.3**
Lidköping-Skövde	63	96.8	**77.8**

The table continues on the next page.

Completeness for hip revisions 2022, cont.

	Total number	SAR %	NPR %
Linköping	38	**94.7**	**81.6**
Ljungby	14	**85.7**	**64.3**
Norrköping	22	**86.4**	100
Norrtälje	25	96	**92**
Nyköping	15	**93.3**	**86.7**
Piteå	63	98.4	96.8
SU/Mölndal	149	96.6	**90.6**
SUS/Lund	111	96.4	**91**
Skellefteå	10	100	100
Sunderby sjukhus	16	**50**	**87.5**
Sundsvall	13	**84.6**	100
Södersjukhuset	76	98.7	**94.7**
Trelleborg	21	100	100
Uddevalla	67	**92.5**	**88.1**
Umeå	56	**94.6**	**92.9**
Visby	24	**75**	**58.3**
Västervik	30	**90**	**83.3**
Västerås	81	**95.1**	**92.6**
Växjö	42	**95.2**	**66.7**
Örebro-Lindesberg-Karlskoga	54	**92.6**	**92.6**
Örnsköldsvik	9	**77.8**	**77.8**
Östersund	47	100	**87.2**
Other units	42	**83.3**	**71.4**

Table 2.5. The completeness for hip revisions per unit 2022.

Completeness for knee revisions 2022

	Total number	SAR %	NPR %
Country	**1.248**	**85.4**	**83.3**
Akademiska sjukhuset	48	97.9	**83.3**
Aleris Specialistvård Ängelholm and Helsingborg	20	95	**55**
Arvika	6	**83.3**	**66.7**
Bollnäs	17	**94.1**	**88.2**
Borås-Skene	21	**90.5**	**95.2**
Capio Artro Clinic	26	100	**42.3**
Capio Ortopedi Motala	76	**86.8**	96.1
Capio Ortopediska Huset	14	**64.3**	**57.1**
Capio S:t Göran	64	**64.1**	**85.9**
Danderyd	41	**95.1**	**85.4**
Eksjö	30	**80**	**86.7**
Eskilstuna	34	**91.2**	**79.4**
Falun	31	**93.5**	**77.4**
GHP OrthoCenter Stockholm	14	100	**92.9**
Gävle	22	100	**54.5**
Halmstad-Varberg	28	**89.3**	**82.1**
Hässleholm	100	**87**	**85**
Kalmar	16	**93.8**	**75**
Karlshamn-Karlskrona	13	**92.3**	100
Karlstad	11	100	100
Karolinska Huddinge	35	**91.4**	**85.7**
Karolinska Solna	18	**38.9**	**88.9**
Kullbergska sjukhuset	10	**40**	**80**

The table continues on the next page.

Completeness for knee revisions 2022, cont.

	Total number	SAR %	NPR %
Kungälv-Alingsås	23	**91.3**	**82.6**
Lidköping-Skövde	26	96.2	**92.3**
Lindesberg	43	**86**	**83.7**
Ljungby	7	100	**85.7**
Lycksele	40	**10**	97.5
Norrköping	17	**94.1**	**88.2**
Norrtälje	13	**53.8**	**92.3**
Nyköping	10	**80**	**90**
Piteå	24	**91.7**	**87.5**
SU/Mölndal	68	97.1	**88.2**
SUS/Lund	28	96.4	**89.3**
Sundsvall	10	**90**	**80**
Södersjukhuset	30	**80**	96.7
Södertälje	7	100	**85.7**
Trelleborg	15	100	**93.3**
Uddevalla	9	**77.8**	**88.9**
Umeå	33	**90.9**	**93.9**
Visby	13	**61.5**	**69.2**
Västervik	7	**85.7**	**57.1**
Västerås	42	97.6	**78.6**
Växjö	11	**90.9**	**63.6**
Örnsköldsvik	6	100	**33.3**
Östersund	19	100	**68.4**
Other units	52	**84.6**	**73.1**

Table 2.6. The completeness for knee revisions per unit 2022.

PROM, response rate

Surgical year	2018	2019	2020	2021	2022
Avaliable data for all elective total hip replacements					
Total number of replacements	16,373	17,519	13,134	15,323	18,339
Diceased within one year (as first event), n	118	140	103	113	
Reopererated within one year (as first event) , n	314	295	210	263	
Included in the one-year follow-up, n	15,941	17,084	12,821	14,947	
Preoperative response, n	13,553	14,117	10,093	11,624	14,289
Proportion of all, %	83	81	77	76	78
One-year postoperative response, n	13,109	13,583	9,954	12,003	
Proportion of those included in the follow-up routine, %	82	80	78	80	
Pre- and one-year postoperative resopnde, n	10,895	11,011	7,618	9,347	
Proportion of those included in the follow-up routine, %	68	65	59	63	
Available data for all knee replacements					
Total number of replacements for units included in the PROM project	7,621	9,365	6,565	9,489	17,000
Diceased within one year (as first event), number	34	41	23	61	
Included in the one-year follow-up, number	7,587	9,324	6,542	9,428	
Preoperative response, number	6,500	8,002	5,075	6,090	11,576
Proportion of all, %	86	86	78	65	68
One-year postoperative response, n	6,101	6,868	5,741	7,526	
Proportion of those included in the follow-up routine, %	80	84	88	80	
Pre- and one-year postoperative resopnde, n	5,109	6,120	4,021	5,007	
Proportion of those included in the follow-up routine, %	67	74	61	53	

The table continues on the next page.

PROM, response rate, cont.

Surgical year	2018	2019	2020	2021	2022
Available data for total knee replacements					
Total number of replacements for units included in the PROM project	6,920	8,242	5,748	8,158	14,847
Diceased within one year (as first event), number	29	34	18	55	
Included in the one year follow-up, n	6,891	8,208	5,730	8,103	
Preoperative response, n	5,937	7,108	4,497	5,178	10,123
Proportion of all, %	86	87	78	64	68
One-year postoperative response, n	5,547	6,102	5,070	6,508	
Proportion of those included in the follow-up routine, %	80	74	88	80	
Preoperative and one year postoperative response, n	4,676	5,123	3,595	4,268	
Proportion of those included in the follow-up routine, %	68	62	63	53	
Available data in unicompartmental knee replacements					
Total number of replacements for units included in the PROM project	647	876	770	1,252	2,085
Diceased within one year (as first event), number	1	2	2	3	
Included in the one year follow-up, n	646	874	768	1,249	
Preoperative response, n	537	735	556	880	1,371
Proportion of all, %	83	81	84	70	66
One-year postoperative response, n	518	722	648	967	
Proportion of those included in the follow-up routine, %	80	83	84	77	
Pre- and one-year postoperative response, n	416	577	412	718	
Proportion of those included in the follow-up routine, %	64	66	54	57	

Table 2.7. PROM, response rate 2018–2022.

Demography (from Greek demos – people and gráfo – writing) is the science of the distribution, size and composition of a population.

3. Demography

Authors: Annette W-Dahl and Ola Rolfson

All hip and knee replacements

In 2022, 18,339 primary elective hip replacements, 6,986 primary hip replacements due to fracture, 17,002 primary knee replacements and 2,039 hip revisions and 974 knee revisions, were reported.

Sex

Females have a primary hip or knee replacement more often than males. The proportion of females having a primary elective hip replacement has been stable since 2005 and varied between 56 and 58 % (figure 3.1 a), while the proportion of females having a hip replacement due to fracture has decreased from 73 % in 2005 to 64 % in 2022 (figure 3.1 b). In primary knee replacement the proportion of females has decreased from 60 % in 2005 to 55 % in 2022 (figure 3.1 c). The proportion of females was somewhat higher than the proportion of males for both hip and knee revisions (table 3.1).

Age

The mean age for primary elective hip replacement was 69 years, 81.2 years for hip replacement due to fracture and 69.2 years for all primary knee replacements in 2022 (table 3.1). The mean age for males and females respectively has remained mainly unchanged from 2005 to 2022 for primary elective hip replacement. In primary knee replacement the mean age for males has been the same while the mean age for females has decreased with one year (figure 3.2 a-b). The same applies for total knee replacement (TKA) (figure 3.3 a). In unicompartmental knee replacement (UKA) the mean age has increased with approximately two years for both males and females (figure 3.3 b). The mean age for primary hip replacement due to fracture was 80 years for males and 81 years for females in 2005 and has since then increased with one year for both males and females (figure 3.4). For hip revision the mean age was roughly four years higher than for primary elective hip replacement and for knee revision just over one year higher than for primary knee replacement in 2022.

For primary elective hip replacement there have been relatively small changes in the distribution of age groups since 2005–2006 up to 2021–2022. It has increased slightly in the age groups 55–64 years and 75–84 years (figure 3.5 a). In primary hip replacement due to fracture approximately 80 % are 75 years or older. A change has occurred since 2005–2006 in the older age groups with an increase in the proportion of ≥ 85 years and a decrease in the age group 75–84 years (figure 3.5 b). In primary TKA the proportion < 65 years has increased from 27 % to just over 29 % while the proportion < 65 years in primary UKA has decreased from 55 % in 2005–2006 to just over 42 % in 2021–2022 (figure 3.5 c-d).

BMI

Mean BMI in primary hip replacement surgery is lower (BMI 27.3) compared with primary knee replacement surgery (BMI 28.7) (table 3.1). The proportion defined as obese (BMI ≥ 30) according to the WHO classification is considerably higher in primary knee replacement (36.3 %) than in primary elective hip replacement (25.6 %) and at hip replacement due to fracture (8.7 %) (table 3.1). In primary elective hip replacement surgery males are overrepresented in BMI class 25–29.9 (overweight) while the proportion of obese is mainly the same for females and males (figure 3.6 a) with approximately the same proportions in hip replacement due to fracture. Even in primary knee replacement surgery males are overrepresented in BMI class 25–29.9 (overweight) while the proportion of obese is higher for females than for males. In both hip and knee revision the proportion of obese is more or less the same as in primary elective hip and knee replacement.

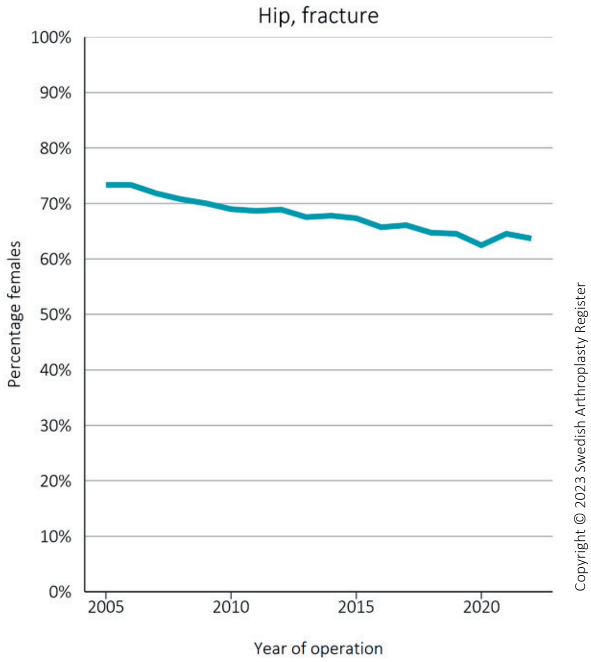


Figure 3.1 b. Proportion of females in primary hip replacement due to fracture 2005–2022.

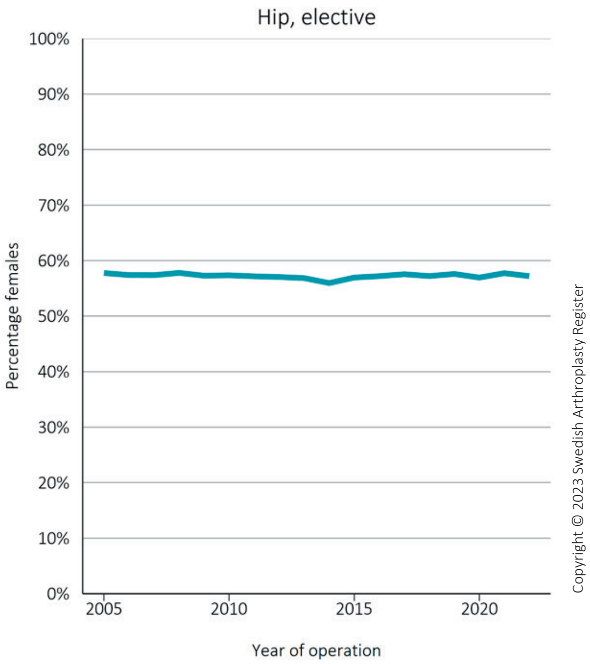


Figure 3.1 a. Proportion of females in elective primary hip replacement 2005–2022.

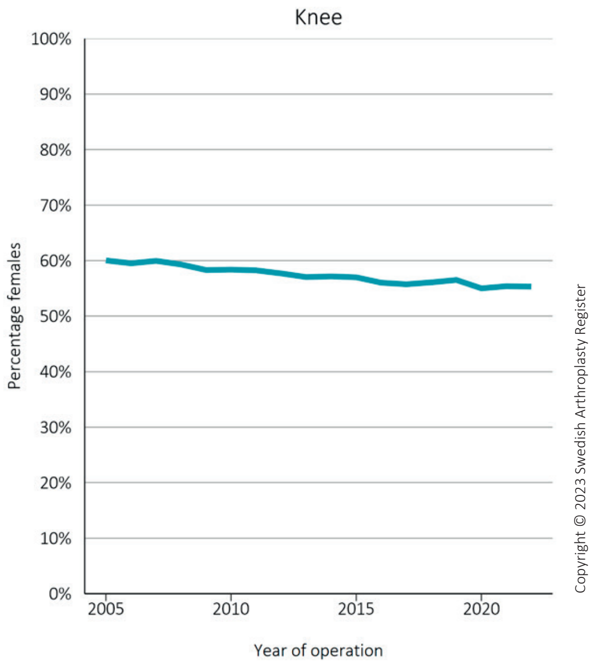


Figure 3.1 c. Proportion of females in primary knee replacement 2005–2022.

Demography in hip and knee replacements 2022

	Elective primary total hip	Primary hip fracture	Revision hip	Primary knee	Revision knee
Number	**18,339**	**6,986**	**2,039**	**16,999**	**974**
Females n (%)	10,490 (57.2)	4,449 (63.7)	1,047 (51.3)	9,403 (55.3)	521 (53.5)
Mean age (SD)	69.0 (10.8)	81.2 (9.3)	73.5 (11.3)	69.2 (9.1)	70.5 (9.7)
Age group n (%)					
< 45 years	322 (1.8)	22 (0.3)	20 (1.0)	70 (0.4)	7 (0.7)
45–54 years	1,487 (8.1)	42 (0.6)	117 (5.7)	957 (5.6)	55 (5.6)
55–64 years	4,123 (22.5)	267 (3.8)	276 (13.5)	4,114 (24.2)	197 (20.2)
65–74 years	6,013 (32.8)	1,157 (16.6)	545 (26.7)	6,587 (38.7)	341 (35.0)
75–84 years	5,532 (30.2)	2,741 (39.2)	767 (37.6)	4,793 (28.2)	320 (32.9)
≥85 years	862 (4.7)	2,757 (39.5)	314 (15.4)	478 (2.8)	54 (5.5)
Mean BMI (SD)	27.3 (4.4)	24.1 (4.2)	27.2 (4.9)	28.7 (4.3)	29.0 (4.5)
BMI n (%)					
< 18.5	140 (0.8)	422 (7.1)	30 (1.5)	33 (0.2)	1 (0.1)
18.5–24.9	5,732 (31.6)	3,282 (55.1)	671 (34.3)	3,300 (19.6)	179 (18.8)
25–29.9	7,611 (42.0)	1,736 (29.1)	749 (38.2)	7,396 (43.9)	385 (40.5)
30–34.5	3,661 (20.2)	430 (7.2)	376 (19.2)	4,808 (28.5)	282 (29.7)
35–39.9	855 (4.7)	71 (1.2)	106 (5.4)	1,174 (7.0)	91 (9.6)
≥ 40	120 (0.7)	17 (0.3)	27 (1.4)	134 (0.8)	12 (1.3)
ASA-class n (%)					
ASA I	3,317 (18.2)	211 (3.1)	133 (6.6)	2,546 (15.0)	75 (7.8)
ASA II	11,303 (61.9)	2,283 (33.5)	931 (46.2)	11,238 (66.3)	573 (59.4)
ASA III	3,555 (19.5)	3,856 (56.6)	886 (43.9)	3,130 (18.5)	309 (32.0)
ASA IV	76 (0.4)	464 (6.8)	66 (3.3)	24 (0.1)	8 (0.8)
Diagnosis n (%)					
Osteoarthritis	17,089 (93.2)			16,549 (97.6)	
Acute hip fracture		6,627 (94.9)			
Sequele fracture/trauma		359 (5.1)		89 (0.5)	
Osteonecrosis	607 (3.3)			109 (0.6)	
Sequele childhood hip disease	276 (1.5)				
Inflamatory joint disease	43 (0.2)			174 (1.0)	
Tumor	0 (0.0)			9 (0.1)	
Acute trauma/Other	52 (0.3)			27 (0.2)	
Other joint diseases	271 (1.5)			7 (0.0)	

Table 3.1. Demography in elective primary hip replacement, hip replacement due to fracture, knee replacement, hip revision and knee revision 2022.

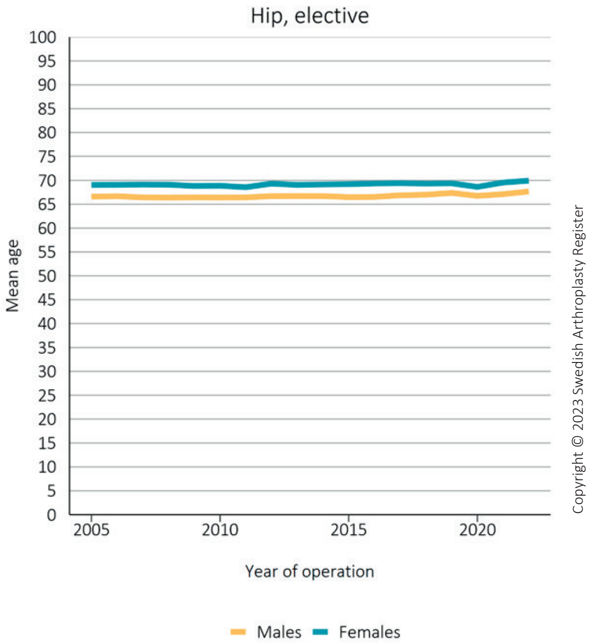


Figure 3.2a. Mean age in elective primary hip replacement 2005–2022.

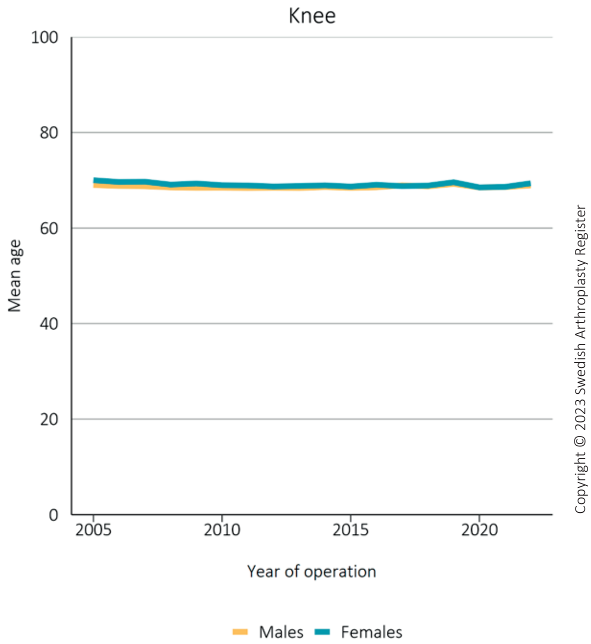


Figure 3.2b. Mean age in primary knee replacement 2005–2022.

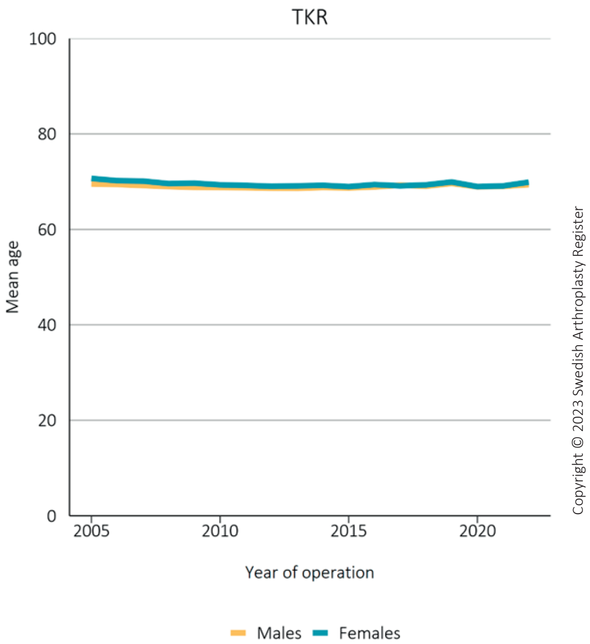


Figure 3.3a. Mean age in primary TKR 2005–2022.

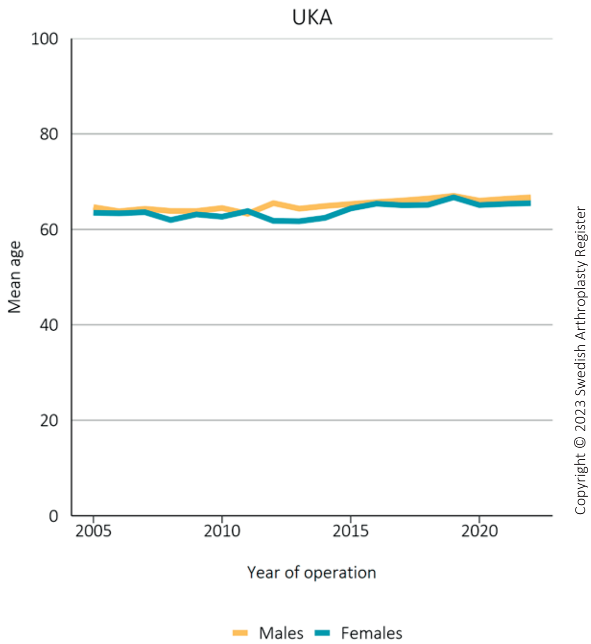


Figure 3.3b. Mean age in primary UKR 2005–2022.

ASA class

The proportion classed as ASA III–IV in primary elective hip replacement (19.9) and in primary knee replacement (18.6 %) is relatively similar while the proportion in hip replacement due to fracture is considerably higher (63.4 %). The proportion of ASA class III–IV is somewhat higher in males than in females both in primary hip and knee replacement (figure 3.7 a and c). Even in hip replacement due to fracture the proportion of ASA class III–IV is somewhat higher in males but the difference is slightly larger. In hip revision the proportion of ASA III–IV is more than twice as high as in primary elective hip replacement, and it is almost twice as high in knee revision as in primary operation.

Diagnosis

Osteoarthritis is by far the most common diagnosis in primary elective hip and knee replacement surgery (93 % and 98 % respectively). Osteoarthritis as reason for primary surgery is followed by osteonecrosis (3.3 %) in hip replacement and inflammatory joint disease (1 %) in knee replacement (table 3.1).

The proportion operated on with a primary hip replacement due to osteoarthritis has increased somewhat since 2005–2006 for females and is mainly the same for males, while osteoarthritis has increased from the period 2005–2006 to the period 2021–2022 for both females and males in primary knee replacement (figures 3.8 a-b, 3.9 a-b).

The proportion of acute hip fracture as reason for primary hip replacement has increased from 2005–2006 to 2021–2022 and is more common in females than males. The proportion of acute hip fracture has been mainly unchanged from 2005–2006 (30.2 %) in females until 2021–2022 (29.0 %) but has increased in males from 17.4 % to 23.8% over the corresponding period (figures 3.8 a-b).

Inflammatory joint disease that includes rheumatoid arthritis has decreased as reason for primary hip and knee replacement since the introduction of the modern medical treatments, which is reflected by the lower proportion in 2021–2022 compared with 2005–2006 (figures 3.8 a-b, 3.9 a-b).

The proportion of acute hip fracture as reason for primary hip replacement has varied slightly in the last five years with slightly higher proportion during the pandemic years but the proportion is the same in 2022 as in 2018 while the proportion of osteoarthritis has increased slightly from 2018 to 2022 with a lower proportion during the pandemic years (table 3.2). Osteoarthritis as reason for primary knee replacement has remained largely unchanged over the past five years (table 3.3).

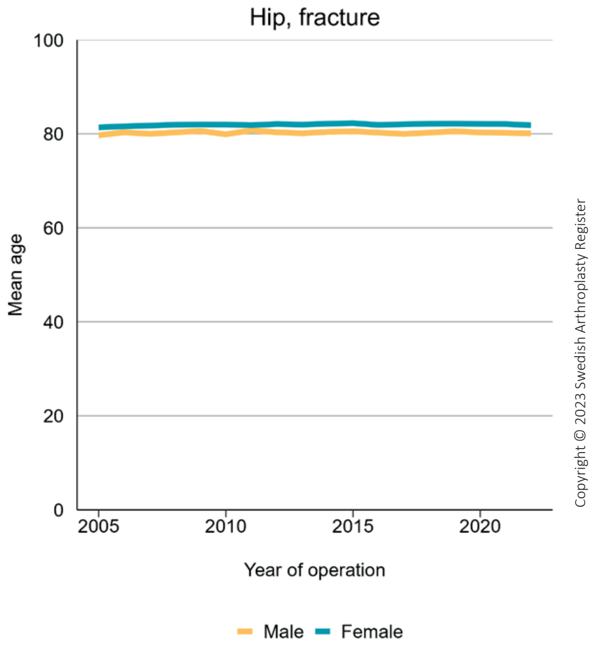


Figure 3.4. Mean age in primary hip replacement due to fracture 2005–2022.

Osteoarthritis as reason for primary hip replacement decreases with increasing age from 55–64 years. The highest proportion is in the age group 55–64 years (86.8 %) and lowest in the age group ≥85 years (17.8 %). Sequelae after childhood disease is most common in the lowest age groups, <55 years. In acute hip fracture, the relation is the opposite with higher proportion with increasing age, the lowest proportion in the age group <45 years (1.5 %) and the highest proportion in the age group ≥85 years (76.7 %) (table 3.4).

In primary knee replacement the proportion of osteoarthritis as reason for surgery increases with increasing age while the proportion of inflammatory joint disease and sequelae after fracture/trauma decreases with increasing age. Acute trauma as reason for primary knee replacement is unusual, 90 operations (0.1%) reported the past five years (table 3.5).

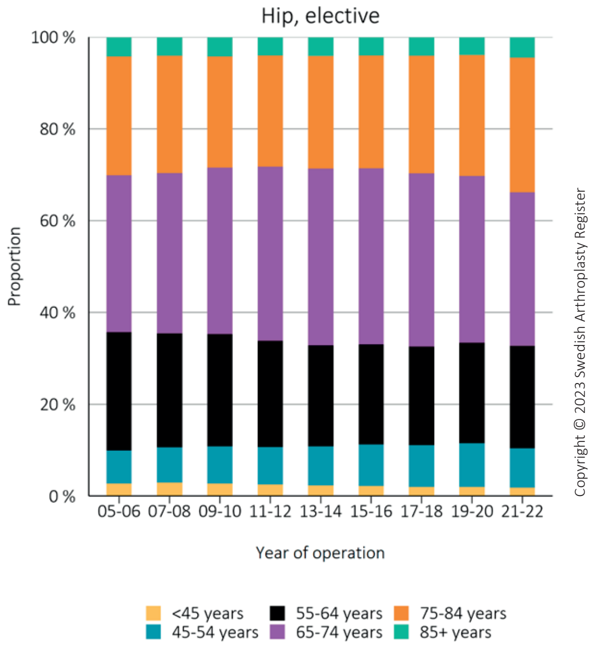


Figure 3.5 a. Distribution of age groups in elective primary hip replacement 2005–2022.

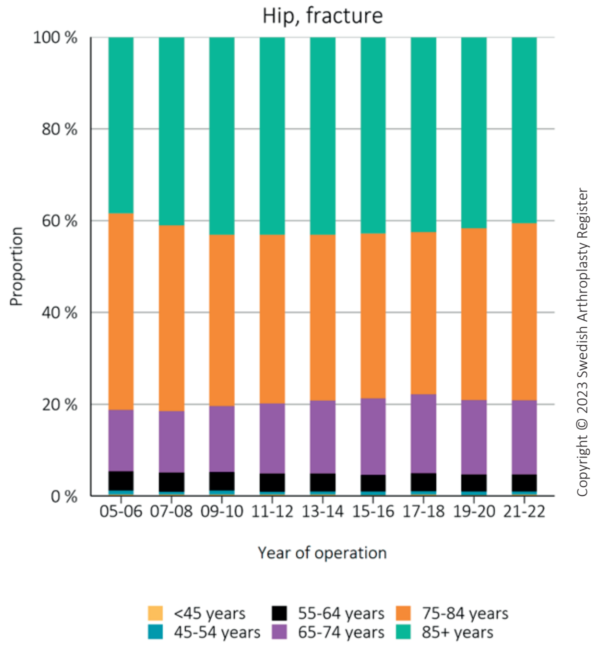


Figure 3.5 b. Distribution of age groups in primary hip replacement due to fracture 2005–2022.

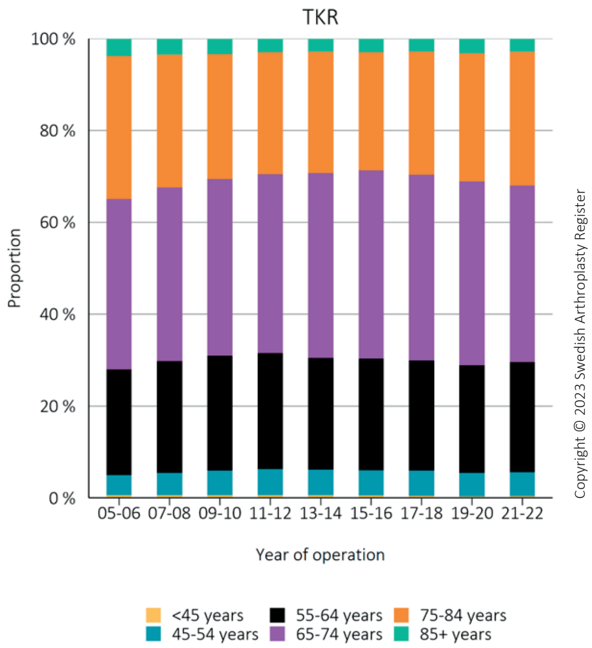


Figure 3.5 c. Distribution of age groups in primary TKR 2005–2022.

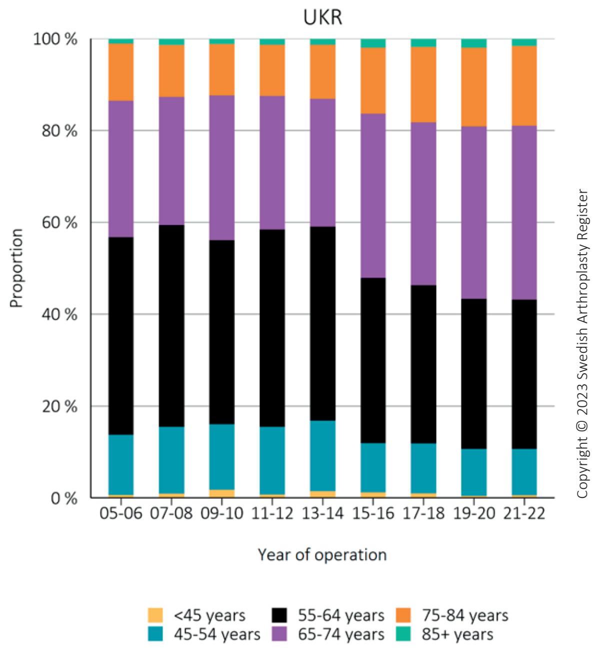


Figure 3.5 d. Distribution of age groups in primary UKR 2005–2022.

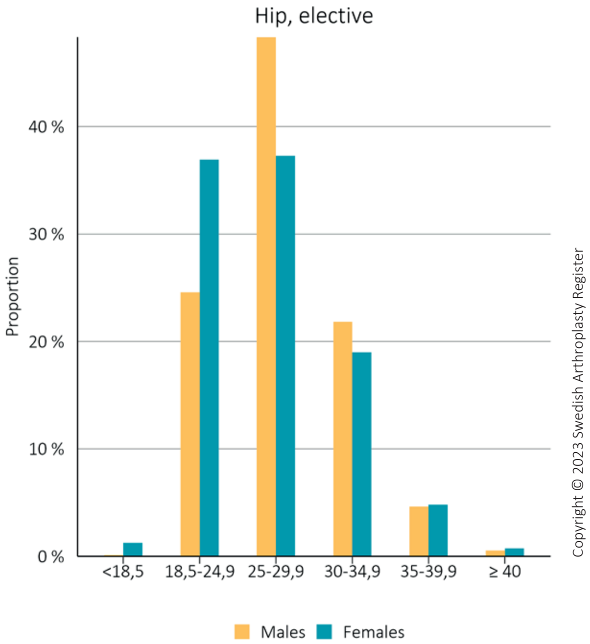


Figure 3.6 a. Distribution of BMI class and sex in elective primary hip replacement 2005–2022.

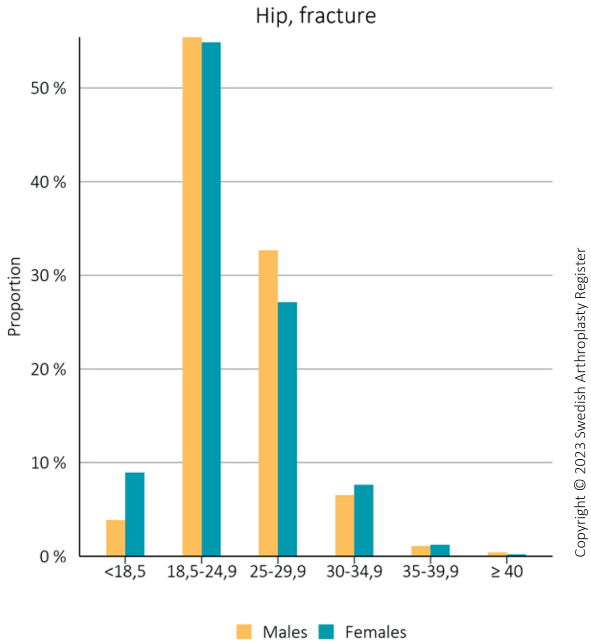


Figure 3.6b. Distribution of BMI class and sex in primary hip replacement due to fracture 2005–2022.

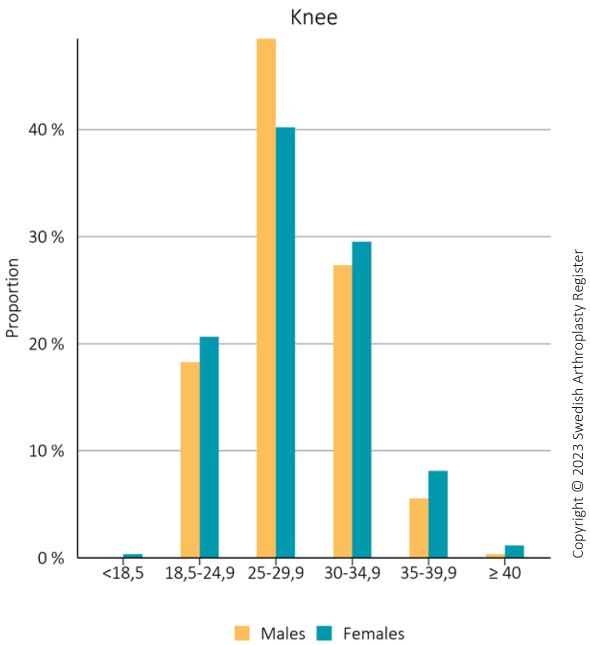


Figure 3.6c. Distribution of BMI class and sex in primary knee replacement 2005–2022.

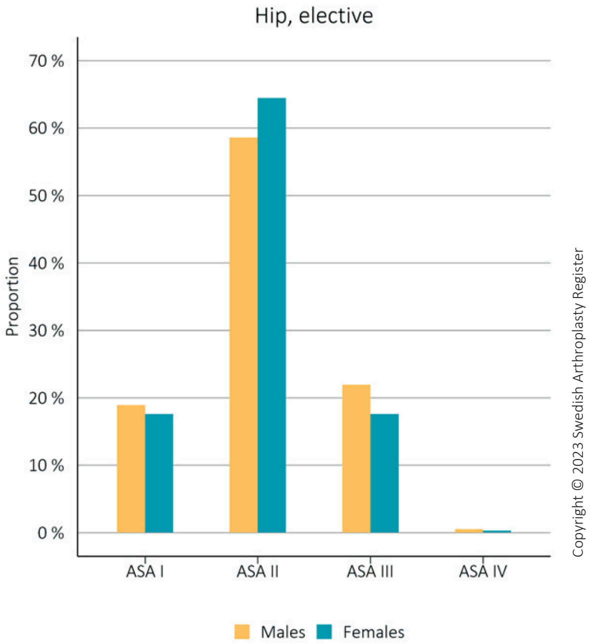


Figure 3.7a. Distribution of ASA class and sex in elective primary hip replacement 2005–2022.

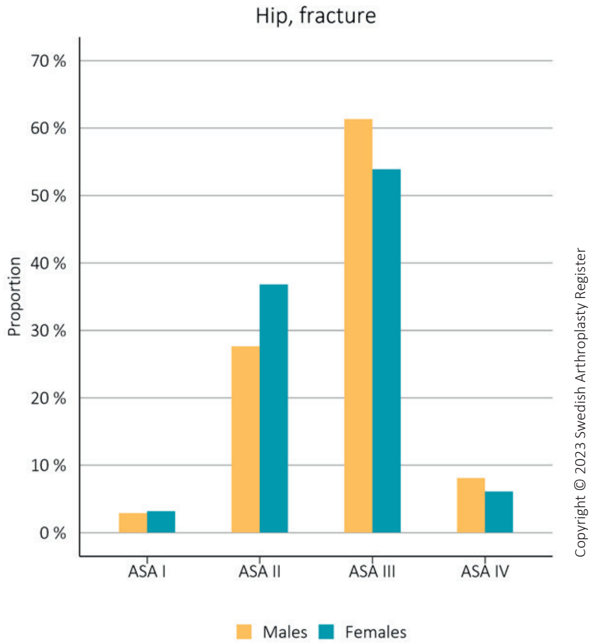


Figure 3.7b. Distribution of ASA class and sex in primary hip replacement due to fracture 2005–2022.

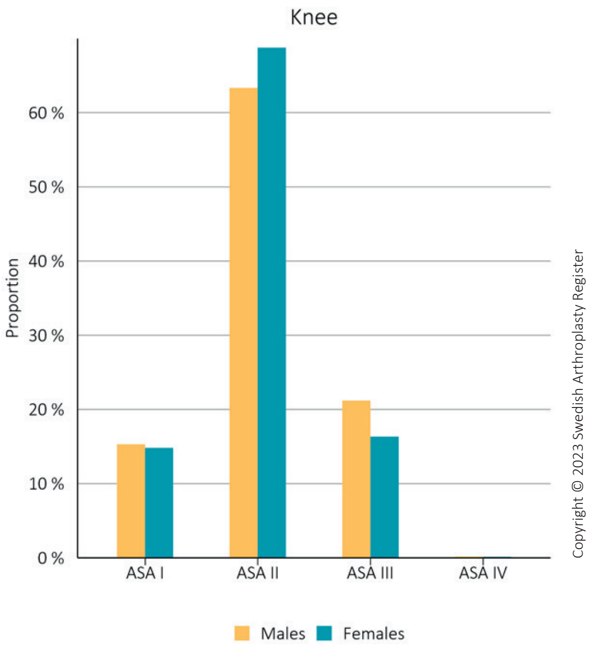


Figure 3.7c. Distribution of ASA class and sex in primary knee replacement 2005–2022.

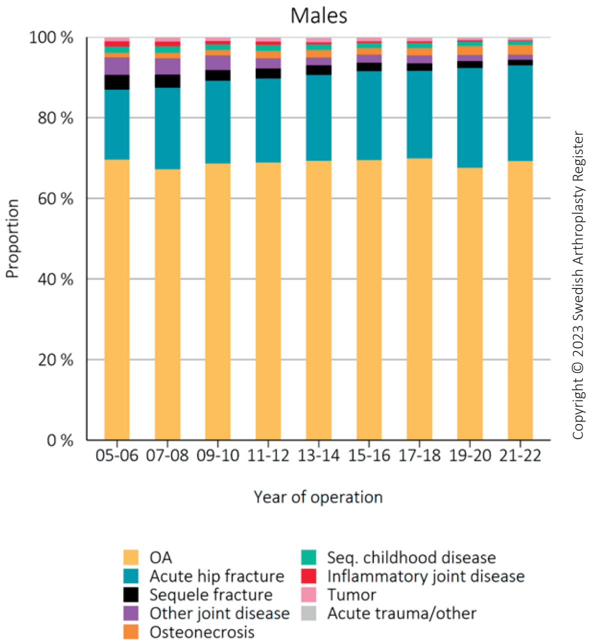


Figure 3.8a. Distribution of diagnoses in elective primary hip replacement 2005–2022 – males.

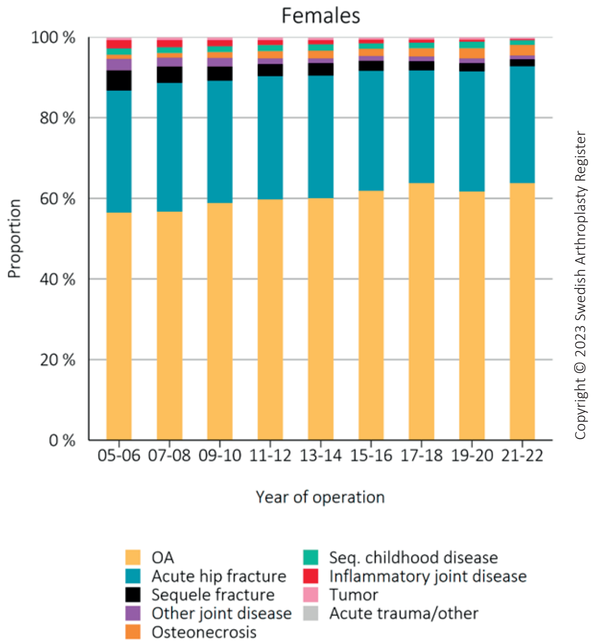


Figure 3.8b. Distribution of diagnoses in elective primary hip replacement 2005–2022 – females.

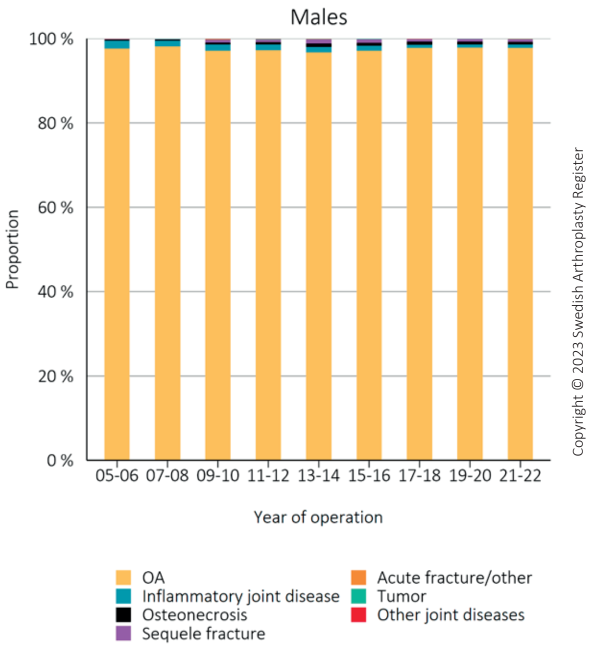


Figure 3.9a. Distribution of diagnoses in primary knee replacement 2005–2022 – males.

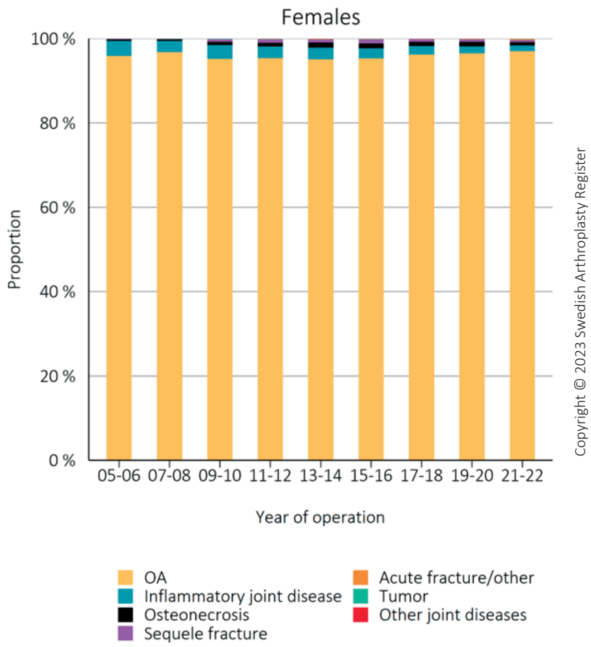


Figure 3.9b. Distribution of diagnoses in primary knee replacement 2005–2022 – females.

Diagnosis in primary hip replacement

	2018	2019	2020	2021	2022	Total
Number	**22,931**	**24,188**	**19,724**	**21,915**	**25,41**	**114,168**
Diagnosis n (%)						
Osteoarthritis	15,106 (65.9)	16,089 (66.5)	12,055 (61.1)	14,128 (64.5)	17,092 (67.3)	74,470 (65.2)
Acute hip fracture	5,953 (26.0)	6,071 (25.1)	6,102 (30.9)	6,101 (27.8)	6,627 (26.1)	30,854 (27.0)
Sequele fracture/trauma	442 (1.9)	460 (1.9)	374 (1.9)	376 (1.7)	359 (1.4)	2,011 (1.8)
Osteonecrosis	450 (2.0)	539 (2.2)	487 (2.5)	589 (2.7)	611 (2.4)	2,676 (2.3)
Sequele childhood hip disease	328 (1.4)	376 (1.6)	256 (1.3)	234 (1.1)	276 (1.1)	1,470 (1.3)
Inflamatory joint disease	119 (0.5)	111 (0.5)	73 (0.4)	66 (0.3)	43 (0.2)	412 (0.4)
Tumor	146 (0.6)	130 (0.5)	104 (0.5)	104 (0.5)	71 (0.3)	555 (0.5)
Acute trauma/Other	54 (0.2)	50 (0.2)	37 (0.2)	63 (0.3)	57 (0.2)	261 (0.2)
Other joint diseases	332 (1.4)	360 (1.5)	234 (1.2)	252 (1.2)	273 (1.1)	1,451 (1.3)

Table 3.2. Diagnosis in elective primary hip replacement 2018–2022.

Diagnosis in primary knee replacement

	2018	2019	2020	2021	2022	Total
Number	**15,504**	**16,983**	**11,815**	**12,806**	**16,999**	**74,107**
Diagnosis n (%)						
Osteoarthritis	14,998 (96.8)	16,492 (97.1)	11,461 (97.0)	12,414 (97.1)	16,551 (97.6)	71,916 (97.1)
Sequele fracture/trauma	106 (0.7)	107 (0.6)	62 (0.5)	78 (0.6)	89 (0.5)	442 (0.6)
Osteonecrosis	136 (0.9)	148 (0.9)	110 (0.9)	97 (0.8)	109 (0.6)	600 (0.8)
Inflammatory joint disease	242 (1.6)	211 (1.2)	154 (1.3)	163 (1.3)	174 (1.0)	944 (1.3)
Tumor	5 (0.0)	4 (0.0)	8 (0.1)	9 (0.1)	9 (0.1)	35 (0.0)
Acute trauma/Other	10 (0.1)	12 (0.1)	15 (0.1)	26 (0.2)	27 (0.2)	90 (0.1)
Other joint diseases	3 (0.0)	3 (0.0)	2 (0.0)	4 (0.0)	7 (0.0)	19 (0.0)

Table 3.3. Diagnosis in primary knee replacement 2018–2022.

Diagnosis in age groups in primary hip replacement

	< 45 years	45–54 years	55–64 years	65–74 years	75–84 years	≥ 85 years
Number	**1,633**	**7,598**	**19,071**	**34,18**	**34,594**	**17,092**
Diagnosis n (%)						
Osteoarthritis	750 (46.0)	6,308 (83.0)	16,555 (86.8)	27,001 (79.0)	20,810 (60.2)	3,046 (17.8)
Acute hip fracture	25 (1.5)	145 (1.9)	956 (5.0)	4,980 (14.6)	11,632 (33.6)	13,116 (76.7)
Sequele fracture/trauma	54 (3.3)	93 (1.2)	259 (1.4)	450 (1.3)	666 (1.9)	489 (2.9)
Osteonecrosis	165 (10.1)	234 (3.1)	458 (2.4)	789 (2.3)	800 (2.3)	230 (1.3)
Sequele childhood hip disease	310 (19.0)	479 (6.3)	373 (2.0)	210 (0.6)	84 (0.2)	14 (0.1)
Inflamatory joint disease	54 (3.3)	54 (0.7)	90 (0.5)	143 (0.4)	63 (0.2)	8 (0.0)
Tumor	30 (1.8)	40 (0.5)	80 (0.4)	199 (0.6)	149 (0.4)	57 (0.3)
Acute trauma/Other	3 (0.2)	7 (0.1)	32 (0.2)	51 (0.1)	107 (0.3)	61 (0.4)
Other joint diseases	240 (14.7)	238 (3.1)	266 (1.4)	353 (1.0)	283 (0.8)	71 (0.4)

Table 3.4. Distribution of diagnosis by age group in primary hip replacement 2018–2022.

Diagnosis in age groups in primary knee replacement

	< 45 years	45–54 years	55–64 years	65–74 years	75–84 years	≥ 85 years
Number	**331**	**4,400**	**18,340**	**28,972**	**19,950**	**2,114**
Diagnosis n (%)						
Osteoarthritis	244 (76.5)	4,195 (95.8)	17,800 (97.1)	28,195 (97.4)	19,438 (97.5)	2,042 (96.6)
Sequele fracture/trauma	13 (4.1)	51 (1.2)	148 (0.8)	147 (0.5)	66 (0.3)	17 (0.8)
Osteonecrosis	11 (3.4)	31 (0.7)	144 (0.8)	228 (0.8)	157 (0.8)	29 (1.4)
Inflamatory joint disease	30 (9.4)	86 (2.0)	218 (1.2)	346 (1.2)	249 (1.2)	15 (0.7)
Tumor	16 (5.0)	7 (0.2)	1 (0.0)	4 (0.0)	7 (0.0)	0 (0.0)
Acute trauma/Other	1 (0.3)	5 (0.1)	17 (0.1)	34 (0.1)	23 (0.1)	10 (0.5)
Other joint diseases	4 (1.3)	3 (0.1)	1 (0.0)	6 (0.0)	5 (0.0)	0 (0.0)

Table 3.5. Distribution of diagnosis by age group in primary knee replacement 2018–2022.

In the Swedish population, 3.3% have undergone at least one hip or knee replacement surgery.

4. Epidemiology

Authors: Annette W-Dahl and Ola Rolfson

Hip and knee replacement in Sweden

Prevalence

Prevalence refers to the ratio of individuals who have undergone hip or knee replacement procedures to the total population of the country. In other words, it quantifies the presence of individuals with hip or knee replacements within the country's overall population. Individuals who have undergone hip replacement procedures since 1991 are included in the dataset because the registry began recording individual-level hip replacements in 1992. For knee replacements, which have been tracked on an individual level since 1975, all such cases are included. Table 4.1 displays the number of individuals in different age groups, separated by sex, who have undergone either unilateral or bilateral hip or knee replacements. Table 4.2 provides similar data, but specifically for individuals with bilateral hip and knee replacements. Additionally, both tables show the prevalence per 100,000 inhabitants at the end of 2012 and 2022. At the end of 2022, 347,711 individuals had a hip or knee replacement, 217,583 had a hip replacement and 155,917 had a knee replacement. This means that 3.3 % of the population have at least one hip or knee replacement, 2.1 % have at least one hip replacement and 1.5 % at least one knee replacement. 8.9 % of the individuals with hip and knee replacement were bilaterally operated, 27 % of individuals with hip replacement were bilaterally operated and 33.5 % of those with knee replacement.

The prevalence is the highest in the ages 65–84 years for both hip and knee replacement and the prevalence is higher in females than males.

The prevalence per 100,000 inhabitants having a hip or knee replacement has increased from 2.5 % in 2011 to 3.3 % in 2022 and the increase is approximately the same for both females and males from 3.1 % in 2011 to 3.9 % 2022 in females and from 2 % to 2.7 % in males (figure 4.1 a). Just over 20 % (21.7 %) in all 85-year-old in Sweden have a hip or knee replacement and 85-year-old females have a higher prevalence (24.1 %) than 85-year-old males (18.6 %) (figure 4.1 b).

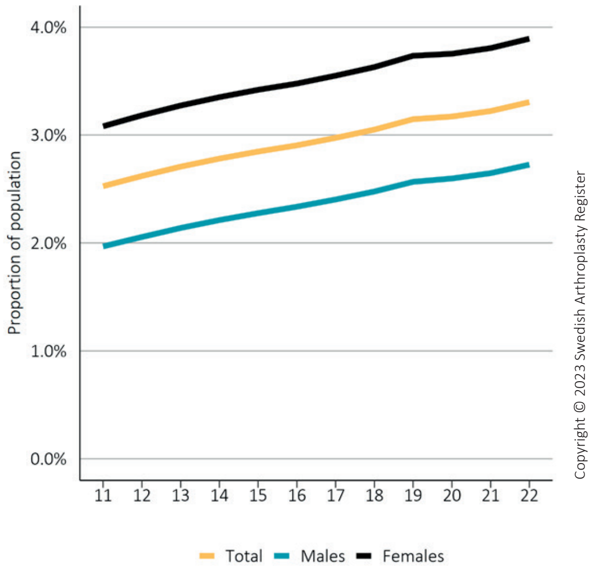


Figure 4.1 a. Prevalence of at least one hip or knee replacement in the population 2011–2022.

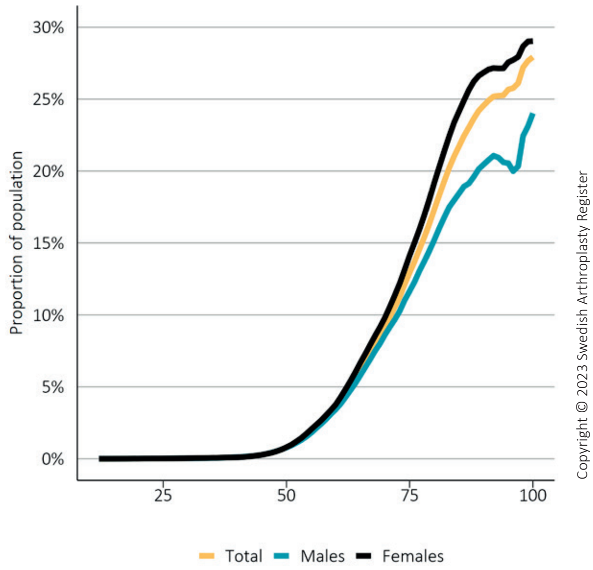


Figure 4.1 b. Prevalence of at least one hip or knee replacement in the population on 31 December 2022 divided by age.

The prevalence per 100,000 inhabitants having at least one hip replacement has increased from 1.7 % to 2.1% in the population 2011–2022 and the increase has been slightly greater in knee replacement, from 1% to 1.5 %. Females have had a slightly greater increase than males in both hip and knee replacement (figures 4.2 a and 4.3 a). 14.6 % of all 85-year-olds had at least one hip replacement and 9.4 % at least one knee replacement in 2022. Females had both a higher proportion of hip replacements and knee replacements than males (16.7 % and 11.9 %, and 10.2 % and 8.3 % respectively) (figures 4.2 b and 4.3 b).

Incidence

Incidence refers to the ratio of primary replacements performed in a given year to the total number of inhabitants in the country. It quantifies the occurrence of the procedure within the country's population. Observe that the incidence of hip and knee replacement is computed based on the number of replacements while the prevalence is about the number of individuals. In 2022, 25,410 primary hip replacements were registered, of which 20,568 were primary total hip replacements and 17,002 primary knee replacements which gives the incidence 242 for hip replacements, 195 for total hip replacements and 162 for knee replacements. Compared to 2019, the incidence is largely the same in 2022 in both hip and knee replacements after the reduction during the pandemic years 2020 and 2021.

The incidence has increased over the years for both hip and knee replacements. The substantial increase of knee replacements in the end of the 1980s has slowed down somewhat after 2009. For hip replacements the increase has also slowed down, and the incidence has remained largely unchanged. Since hip and knee replacements are mainly used for the elderly a smaller proportion of the increase depends on the aging population.

Since the incidence is age-dependent and the age structure in different regions or countries may vary it is hard to make comparisons without some form of age-standardisation. The so called "European Standard population" has been used in order to make comparisons possible. This standardisation describes what the incidence would have been for a certain region/country if all regions/countries would have had the same age distribution.

In an international comparison Sweden has a higher incidence of hip replacements than the US, Australia and the UK, but lower than Denmark, Norway, Finland and Germany. For knee replacements Sweden has a higher incidence than Norway but lower than Denmark, Finland, the US, Australia, the UK and Germany (OECD Health Statistics 2019).

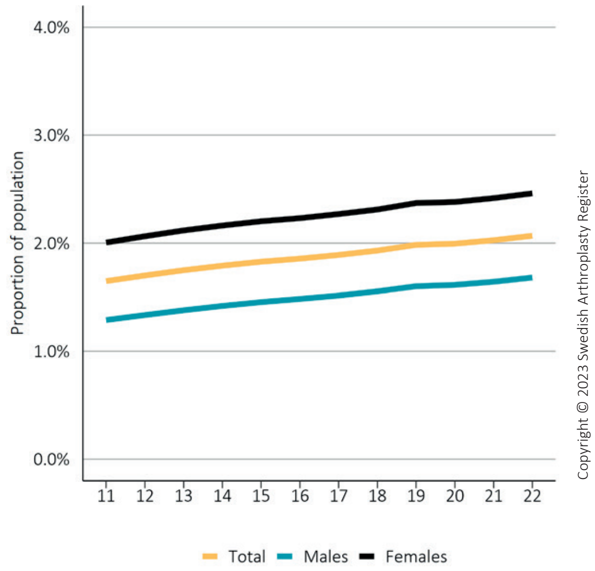


Figure 4.2a. Prevalence of at least one hip replacement in the population 2011–2022.

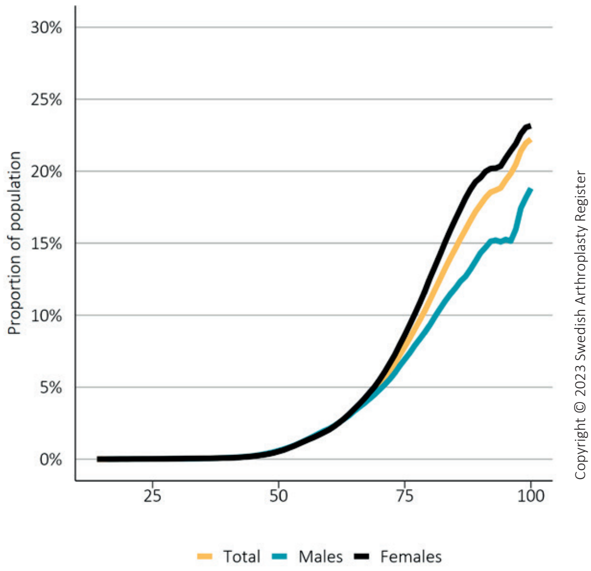


Figure 4.2b. Prevalence of at least one hip replacement in the population on 31 December 2022 divided by age.

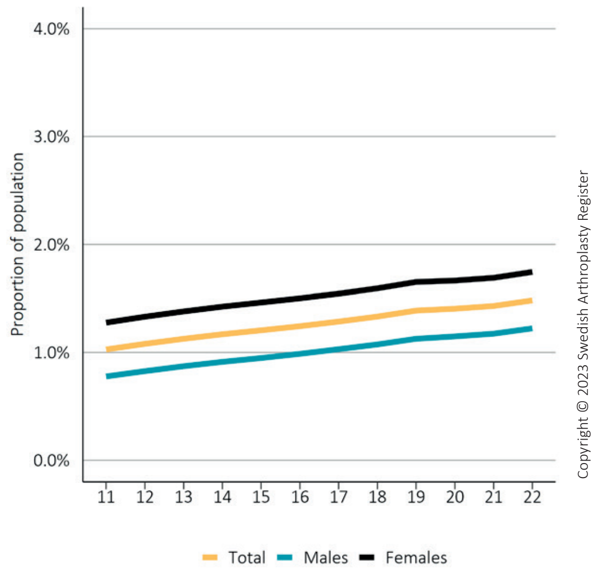


Figure 4.3a. Prevalence of at least one knee replacement in the population 2011–2022.

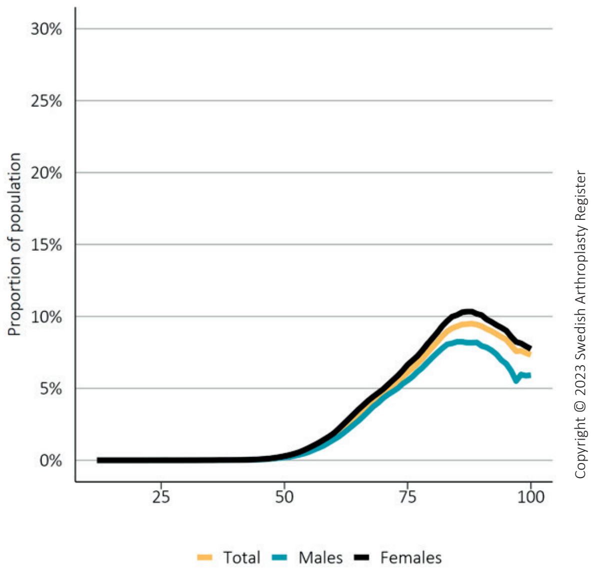


Figure 4.3b. Prevalence of at least one knee replacement in the population on 31 December 2022 divided by age.

Regional differences

According to the Health Care Act (SFS 2017:30) the aim of the healthcare is "… is good health and equal care for the entire population. Healthcare shall be provided with respect for the equal value of all individuals and for the dignity of each individual. Priority in healthcare shall be given to those with the greatest need for healthcare."

An important aspect of equality is geographical differences in how healthcare is conducted and provided within the country. Equality may in a broad sense of word be related to where in the country patients' lives. The 21 regions have independent government over their healthcare but have to follow the Health Care Act.

Production and consumption

Production and consumption are based on data from the Swedish Arthroplasty Register, the population statistics of Statistics Sweden and the address register of the Swedish Tax Agency. Production refers to the number of hip replacements, total hip replacements and knee replacements regardless of where the individual having surgery lives, that is the region's production and is presented per 100,000 inhabitants. Consumption refers to the number of hip replacements, total hip and knee replacements irrespectively of where the surgery is performed and is presented per 100,000 inhabitants. Consumption thus entails that the inhabitants in the region have access to hip and knee arthroplasty irrespective if the procedure is performed in the home region or somewhere else in the country. The calculations for consumption are based on data from the Swedish Tax Agency on region's affiliation at the time of surgery.

The Sweden maps show the distribution of production and consumption respectively for hip replacement (4.4 a and 4.5 a) and knee replacement (4.4 b and 4.5 b) per 100,000 inhabitants in the 21 regions. In tables 4.3 and 4.4 production and consumption, respectively, are shown with incidence and age-standardised incidence (European Standard population) for hip replacement, total hip replacement and knee replacement in the regions.

Regarding production, the age-standardised incidence varies from 170 to 281 for hip replacement, 130 to 247 for total hip replacements, and from 67 to 224 for knee replacement. Kalmar has the highest production incidence for both hip and knee replacements while Västmanland has the lowest for hip and Jämtland for knee replacement. The production is one and a half as high in Kalmar than in Västmanland regarding hip replacement and three times as high in Kalmar compared to Jämtland for knee replacement.

The differences in age-standardised incidence in consumption varies from 170 to 264 for hip replacements, 138 to 241 for total hip replacement, and from 93 to 207 for knee replacement. For hip replacement, Skåne has the lowest consumption, roughly 50 % of the incidence compared with Dalarna that has the highest consumption. For knee replacement Dalarna has the highest consumption, with the highest incidence, one and a half times as high consumption as Örebro which is the region that has the lowest.

The differences in consumption are considerable giving the goal of healthcare and a promise of equal care. The age-standardised consumption has however varied relatively widely between regions and within the regions between different years.

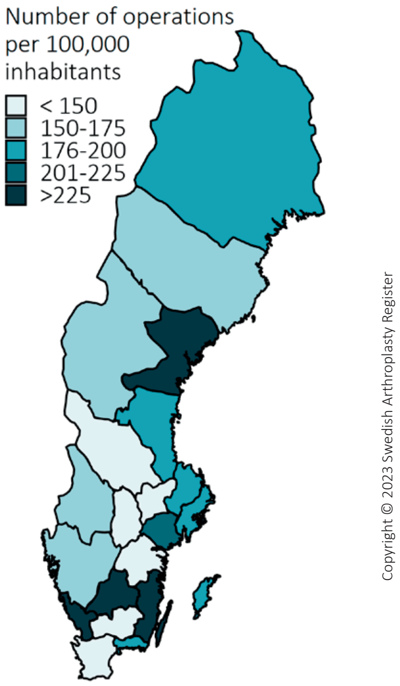


Figure 4.4 a. Production elective hip replacement.

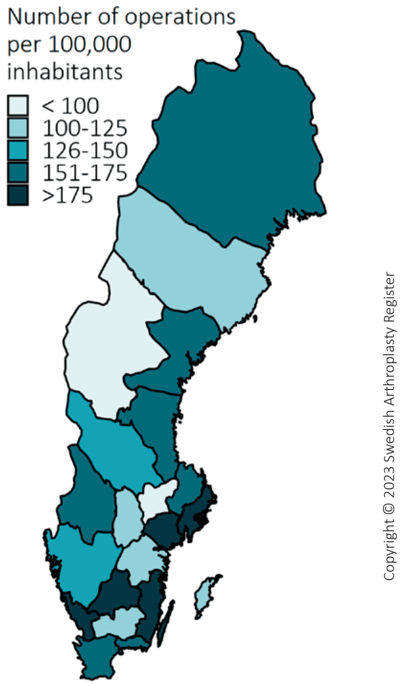


Figure 4.4 b. Production knee replacement.

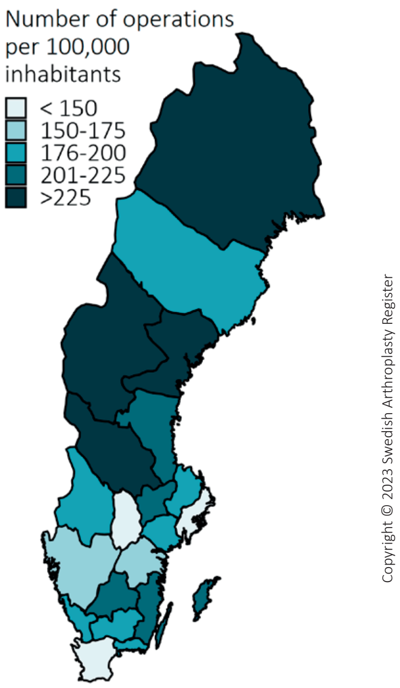


Figure 4.5 a. Consumption elective hip replacement.

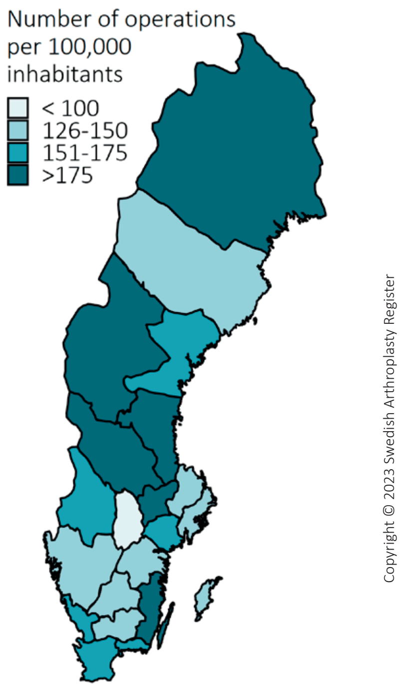


Figure 4.5 b. Consumption knee replacement.

Number of individuals with at least one hip or knee replacement

	Hip or knee		Hip		Knee	
Number per age group	**2012**	**2022**	**2012**	**2022**	**2012**	**2022**
< 45 years	2,257	2,141	1,932	1,843	373	331
45–54 years	8,714	10,382	6,000	7,348	2,912	3,237
55–64 years	33,419	43,302	19,453	25,188	15,095	19,713
65–74 years	75,830	95,690	46,832	54,047	33,142	47,657
75–84 years	82,397	130,939	53,677	82,851	35,006	59,692
≥ 85 years	47,734	65,257	34,550	46,306	16,621	25,287
Total	250,351	347,711	162,444	217,583	103,149	155,917
Prevalence per 100,000	2,620	3,305	1,700	2,068	1,079	1,482
Males						
< 45 years	1,112	1,090	956	937	156	153
45–54 years	4,332	5,190	3,232	3,849	1,100	1,341
55–64 years	15,755	21,304	9,409	12,862	6,346	8,442
65–74 years	35,050	45,902	20,702	24,604	14,348	21,298
75–84 years	32,966	58,708	20,013	33,263	12,953	25,445
≥ 85 years	13,784	21,652	9,297	13,540	4,487	8,112
Total	102,999	153,846	63,609	89,055	39,390	64,791
Prevalence per 100,000	2,161	2,904	1,335	1,681	826	1,223
Females						
< 45 years	1,193	1,084	976	906	217	178
45–54 years	4,580	5,395	2,768	3,499	1,812	1,896
55–64 years	18,793	23,597	10,044	12,326	8,749	11,271
65–74 years	44,924	55,802	26,130	29,443	18,794	26,359
75–84 years	55,717	83,835	33,664	49,588	22,053	34,247
≥ 85 years	37,387	49,941	25,253	32,766	12,134	17,175
Total	162,594	219,654	98,835	128,528	63,759	91,126
Prevalence per 100,000	3,394	4,205	2,063	2,461	1,331	1,745

Table 4.1. Number of individuals in each age group and males and females in each age group with hip replacement or knee replacement, unilaterally or bilaterally operated.

Number of individuals with hip or knee replacement, bilaterally operated

	Hip and knee		Hip		Knee	
Number per age group	**2012**	**2022**	**2012**	**2022**	**2012**	**2022**
< 45 years	17	11	394	340	53	48
45–54 years	42	37	1,242	1,625	574	624
55–64 years	175	180	4,431	6,428	3,832	5,318
65–74 years	474	743	11,829	14,828	9,758	15,943
75–84 years	566	1,421	12,559	23,731	11,178	21,210
≥ 85 years	255	718	6,076	11,860	5,161	9,083
Total	1,529	3,110	36,531	58,812	30,556	52,226
Prevalence per 100,000	16	30	382	559	320	496

Table 4.2. Number of individuals in each age group and males and females in each age group with hip replacement or knee replacement, bilaterally operated.

Production in the regions

	Hip				Knee	
Region	Incidence	Age standardized incidence	Incidence total hip	Age standard-ized incidence total hip	Incidence	Age standardized incidence
Blekinge	285	233	209	176	151	126
Dalarna	235	186	173	139	148	122
Gotland	266	203	208	161	124	95
Gävleborg	258	211	206	170	168	140
Halland	303	272	246	225	222	206
Jämtland	222	186	181	152	78	67
Jönköping	296	281	256	247	207	200
Kalmar	331	266	269	222	223	180
Kronoberg	212	196	166	158	114	108
Norrbotten	289	236	228	189	159	132
Skåne	206	204	152	153	159	162
Stockholm	245	281	212	242	195	224
Sörmland	289	254	244	217	206	183
Uppsala	247	260	206	217	174	184
Värmland	245	200	193	162	164	139
Västerbotten	234	218	175	166	112	106
Västernorrland	313	255	250	207	152	125
Västmanland	190	170	184	165	88	80
Västra Götaland	229	226	182	181	136	138
Örebro	191	175	140	130	107	100
Östergötland	204	194	157	153	123	120
Country	**242**	**234**	**195**	**191**	**162**	**160**

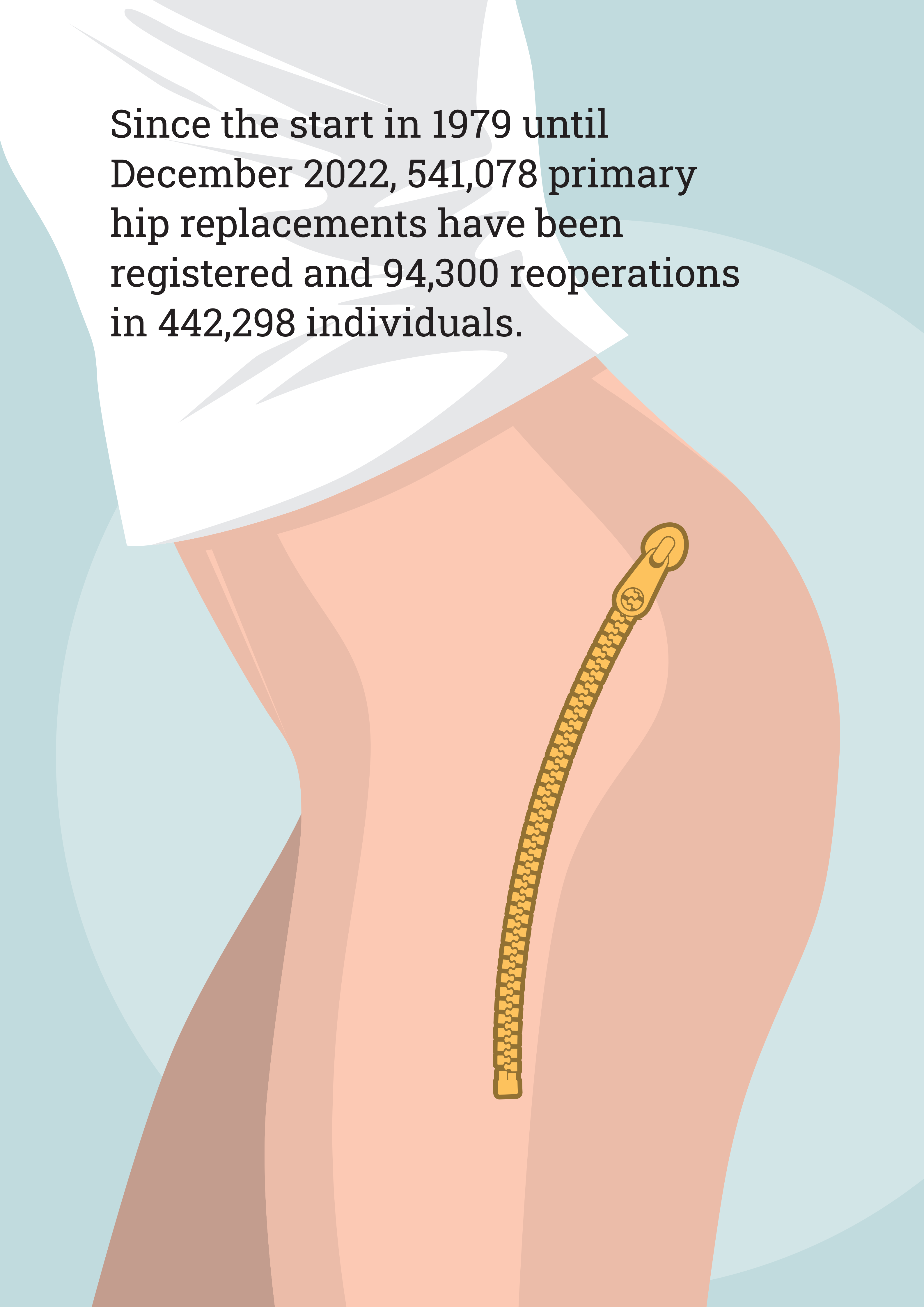
Table 4.3. Production with incidence and age-standardized incidence (European Standard Population) for hip replacements, total hip replacements and knee replacements in the regions.

Consumption in the regions

	Hip				Knee	
Region	Incidence	Age standardized incidens	Incidence total hip	Age standard-ized incidence total hip	Incidence	Age standardized incidens
Blekinge	246	205	209	177	152	127
Dalarna	316	261	288	240	248	207
Gotland	244	192	221	175	136	106
Gävleborg	265	220	232	195	196	166
Halland	212	191	184	168	170	157
Jämtland	305	264	277	241	221	193
Jönköping	244	233	215	208	143	138
Kalmar	247	203	229	190	203	164
Kronoberg	261	244	217	207	142	137
Norrbotten	293	244	258	219	200	169
Skåne	171	170	148	149	161	164
Stockholm	178	204	159	181	131	151
Sörmland	231	205	207	185	164	148
Uppsala	222	236	203	215	148	157
Värmland	235	198	209	179	162	138
Västerbotten	213	201	187	179	135	128
Västernorrland	294	243	254	213	154	128
Västmanland	248	228	245	225	176	164
Västra Götaland	208	206	182	182	140	141
Örebro	185	170	148	138	99	93
Östergötland	199	191	174	169	147	145
Country	**212**	**206**	**188**	**183**	**152**	**150**

Table 4.4. Consumption with incidence and age-standardized incidence (European Standard Population) for hip replacements, total hip replacements and knee replacements in the regions.

Since the start in 1979 until December 2022, 541,078 primary hip replacements have been registered and 94,300 reoperations in 442,298 individuals.



5. Hip replacement

5.1. Primary total hip replacement

Author: Maziar Mohaddes

In 2022, a total of 20,568 primary total hip replacements were reported. Among these, 2,188 were performed in patients who had experienced a hip fracture or its sequelae, and 41 total hip replacements were performed due to tumor-related conditions (as shown in figure 5.1.1). It's important to note that this chapter excludes data related to total hip replacements performed as a result of fractures, sequelae following fractures, or tumors.

A total of 18,339 primary elective total hip replacements were reported in 2022, where the primary reason for the surgery was osteoarthritis or other diagnoses. Notably, there was a 20 % increase in the number of reported hip replacements in 2022 compared to the previous year. This increase can be partially attributed to the fact that several hospitals were able to resume planned operations after experiencing reduced activity levels during the COVID-19 pandemic. Both private and public healthcare providers increased their production, and the distribution between them remained largely unchanged from the previous year. In 2022, private healthcare providers accounted for 39 % of all elective primary total hip replacement surgeries, compared to 41% in 2021. For context, the corresponding proportion from 2001 to 2018 was 14 %.

In the past four years, the mean age has remained relatively constant, with a slight dip in 2019 and a slight rise in 2022, as shown in table 5.1.2. Additionally, in these four years, the percentage of patients in different BMI categories has remained relatively stable, as indicated in table 5.1.2.

The notable change observed during the pandemic years, where there was an increase in the proportion of healthy patients (ASA class I), has now decreased. In 2022, most patients who underwent surgery belonged to ASA class II (62 %), as outlined in table 5.1.2.

For a more detailed breakdown of the units' case-mix, including available demographic data for each unit, please refer to table 5.1.3. It's worth noting that the proportion of patients with a BMI ≥ 35 ranges from 0 % to 19 % among the units (units with fewer than 20 reported operations are not shown). Similarly, the proportion of patients with ASA class III and IV varies from 0 % to 73 %. It's essential to be cautious about interpreting percentages for units with limited data, as they may be misleading.

Summary

The decline in the number of reported total hip replacements during the pandemic years has now been reversed. In 2022, a total of 18,339 primary elective total hip replacements were reported. Notably, a continuing high proportion of these procedures continued to be performed by private healthcare providers. Specifically, in 2022, 39 % of the reported operations were performed by private actors.

Selection groups in hip replacements 2022

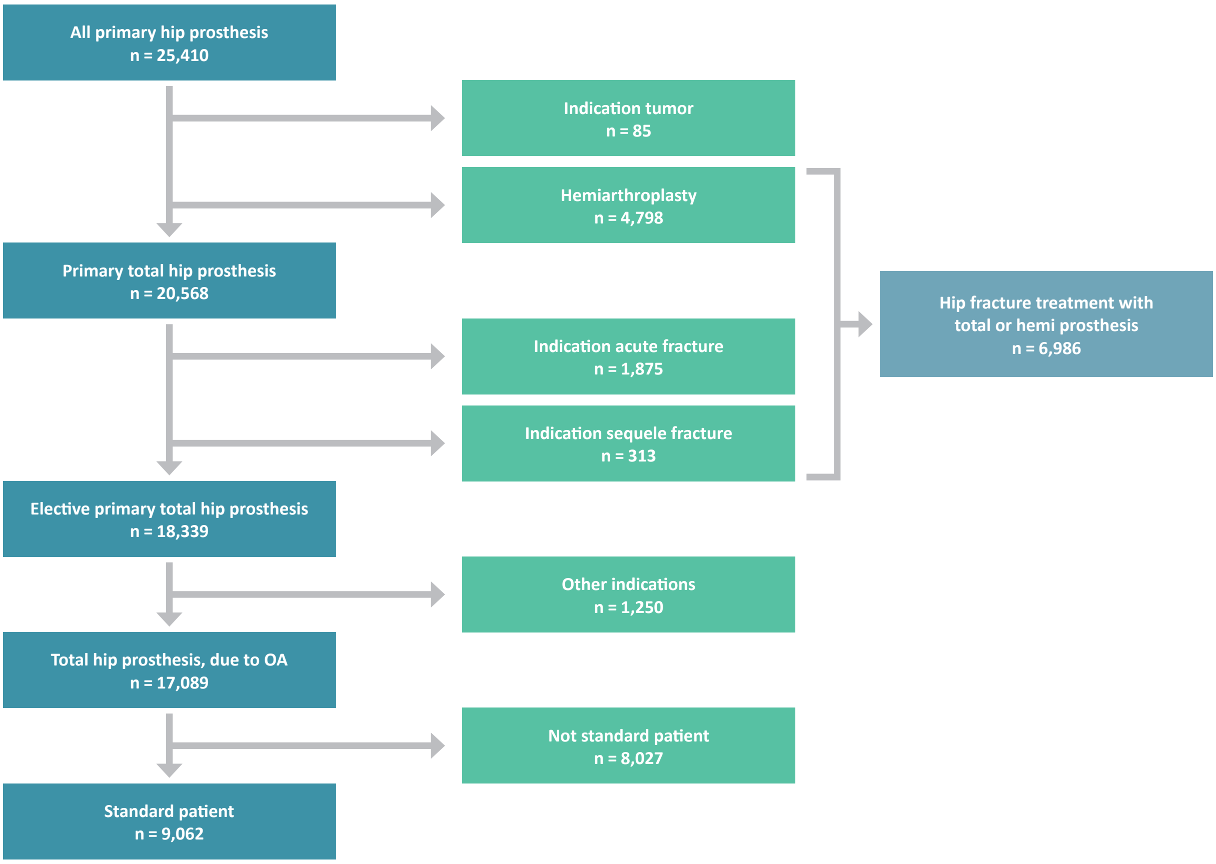


Figure 5.1.1. Flow-chart, based on diagnostic indication and type of prosthesis, shows the different selections groups in primary hip replacements used in the annual report. Current example shows the numbers of operations performed in 2022.

Surgical approach

Since 2003, posterior and direct lateral approaches in dorsal or lateral position has been completely dominant in Sweden. In 2022, either of these two approaches constituted together 99 % of all procedures. Notably, the posterior approach remained the most prevalent, accounting for 63 % of cases. The direct lateral approach in the lateral position was utilized in 30 % of operations, while the direct lateral approach in the supine position was employed in 6 %. Less common methods, such as the mini-approach, Watson-Jones approach, and the direct lateral/posterior approach combined with trochanteric osteotomy, were sporadically employed, as illustrated in figure 5.1.3.

It's worth highlighting that the distribution among the three most commonly used approaches do not show any major differences between the sex, as (figure 5.1.2). Additionally, there appears to be a recent, albeit slight, increase in the utilization of posterior approaches in recent years, as indicated in figure 5.1.3.

Fixation

Cemented fixation is more frequently reported in females, whereas uncemented fixation is more commonly reported in males, as illustrated in figure 5.1.4. It's important to consider that various factors, such as a patient's age and bone quality, likely influenced the choice of fixation method.

The increased use of cemented fixation can be traced back to the 1990s when poor outcomes with uncemented fixation prompted a surge in cemented procedures, peaking at 93 % around the turn of the millennium. However, since then, the proportion of patients undergoing cemented fixation has steadily declined each year until 2020, as shown in figure 5.1.5 a. In 2022, cemented replacements represented 52 % of all cases.

In contrast, uncemented fixation has been on the rise in the past two decades. In 2003, uncemented replacements constituted only 5 % of all reported operations, but in 2022, this figure exceeded 33 %, as seen in figure 5.1.5 a. This shift towards uncemented fixation has primarily been observed in age groups younger than 65 years and in the 65–74 year age group, with limited changes in the two oldest age groups (figure 5.1.5 b-g). Since 2012, the proportion of reversed hybrids (cemented cup, uncemented stem) has decreased.

Hybrid replacements (uncemented cup, cemented stem) were relatively uncommon in the past decade, accounting for 1.5 % of cases between 2007 and 2010, but this proportion increased to just under 9 % in 2022, as shown in figure 5.1.5 a.

In figure 5.1.6, you can observe the distribution of cemented and uncemented procedures across regions in 2022. Differences in the choice of fixation method were noted among regions. Skåne reported the lowest proportion of cemented fixation (34 %), while Värmland reported the highest proportion (80 %). These variations may be attributed to demographic disparities among the patients operated on, as well as local preferences at the respective surgical units.

Summary

Cemented fixation remains the predominant method in hip replacements. Notably, since 2020, there has been a modest increase in the proportion of patients receiving cemented fixation. Based on the available evidence, the register intends to endorse the ongoing use of cemented fixation, especially in patients aged 70 years and older.

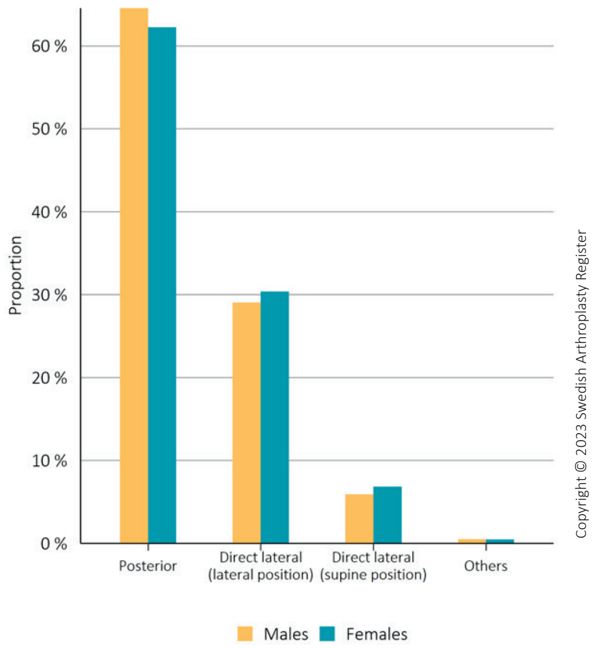


Figure 5.1.2. Distribution of surgical approach, sex.

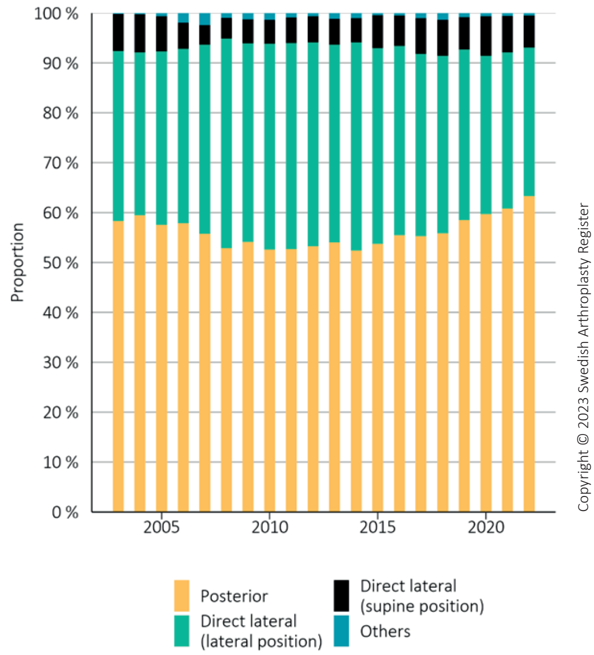


Figure 5.1.3. Time trend for surgical approach.

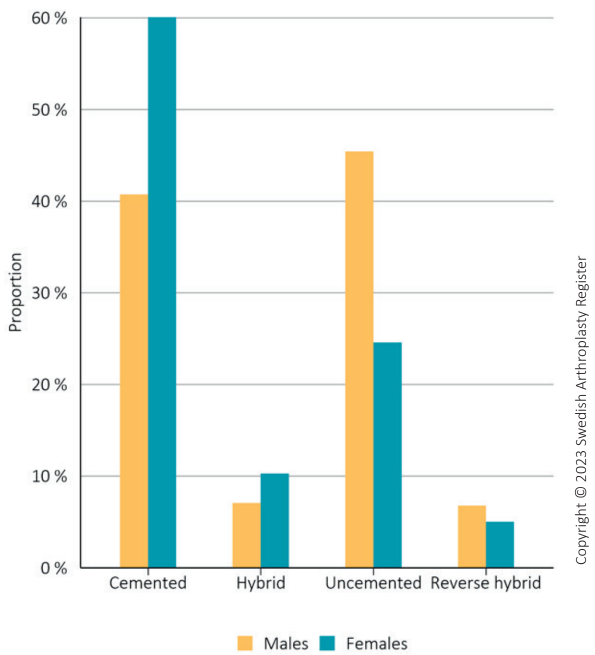


Figure 5.1.4. Distribution of fixation, sex.

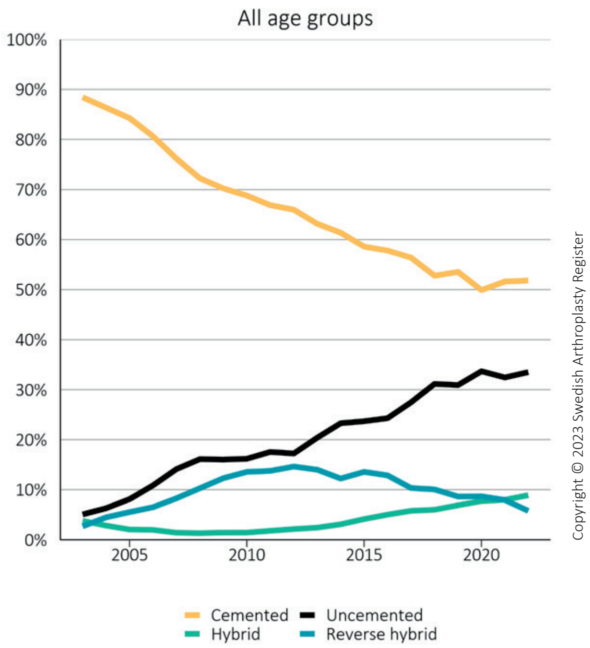


Figure 5.1.5a. Time trend for fixation method 2003–2022.

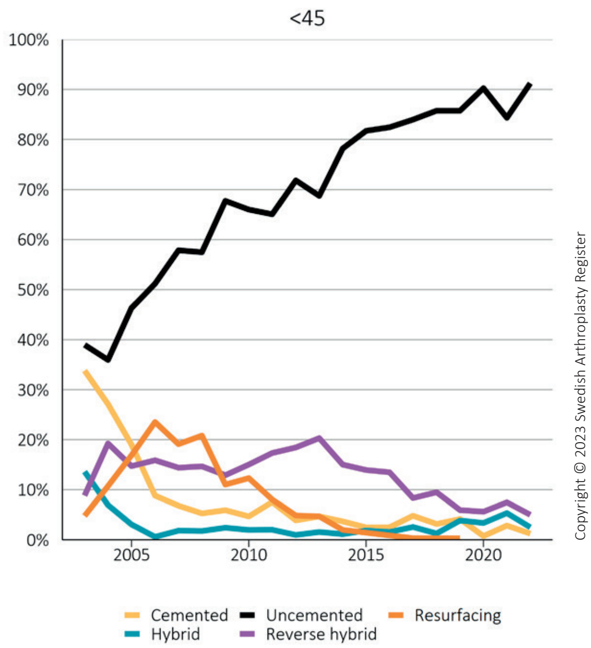


Figure 5.1.5b. Time trend for fixation method, < 45 years.

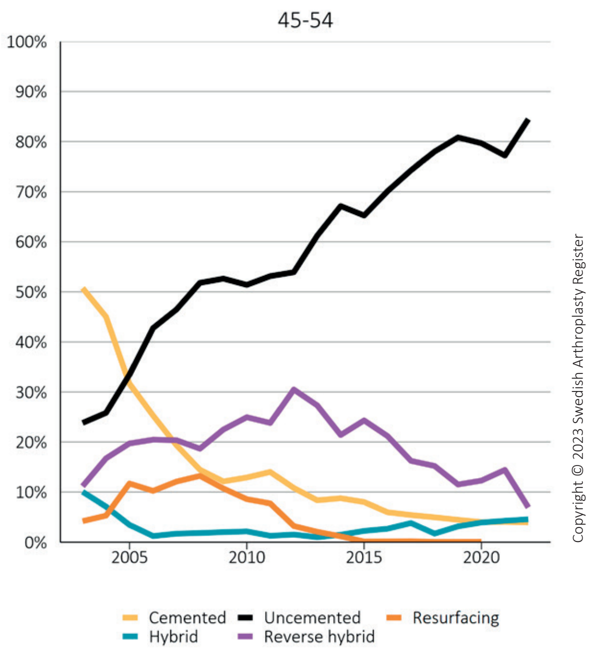


Figure 5.1.5c. Time trend for fixation method, 45–54 years.

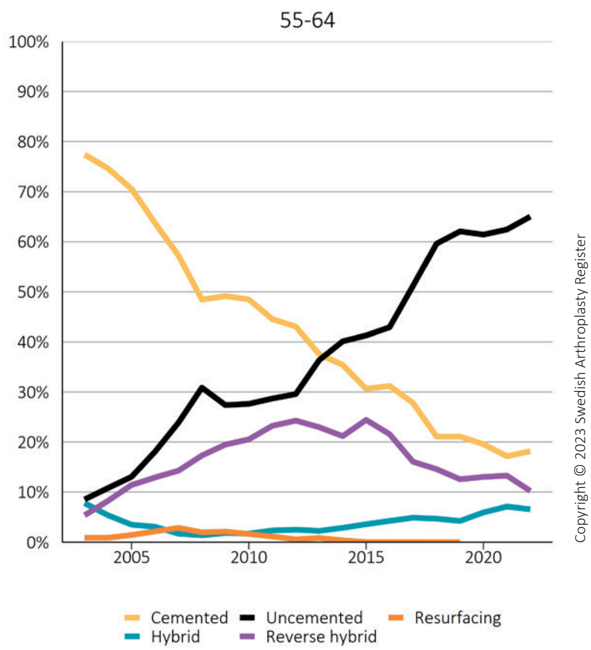


Figure 5.1.5d. Time trend for fixation method, 55–64 years.

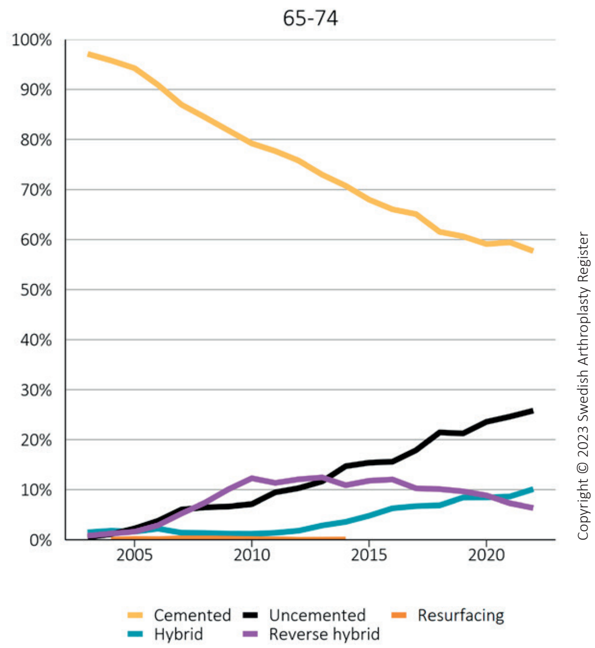


Figure 5.1.5e. Time trend for fixation method, 65–74 years.

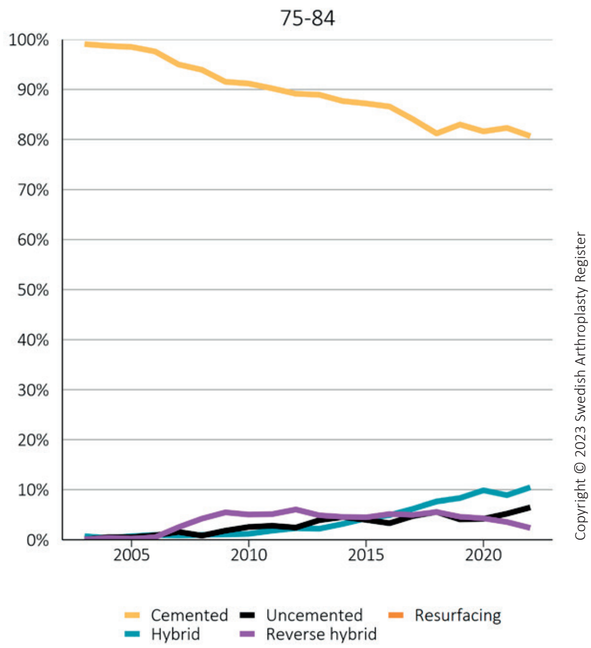


Figure 5.1.5f. Time trend for fixation method, 75–84 years.

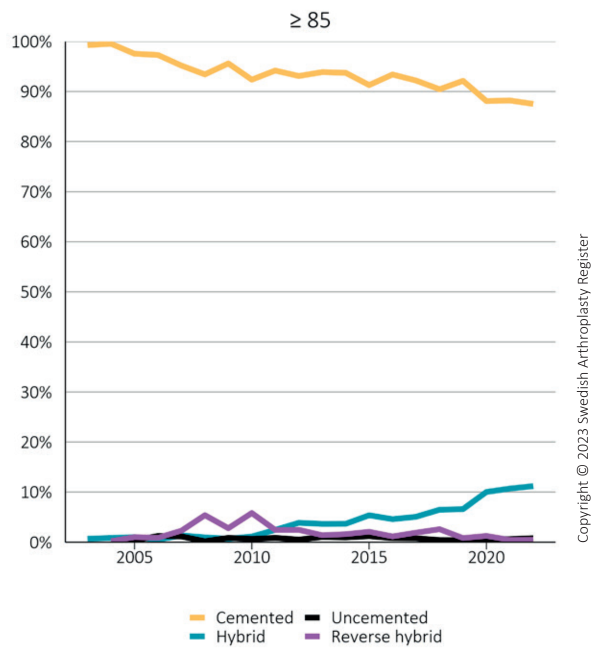


Figure 5.1.5g. Time trend for fixation method, ≥ 85 years.

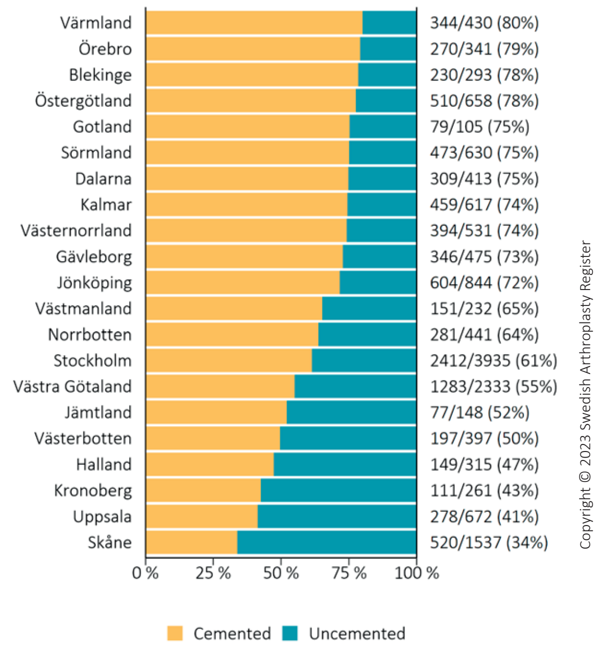


Figure 5.1.6. Use of fixation method per region. To the right, the number and percentage of cemented elective primary total hip replacements.

Implants

In 2022, the five most commonly used cemented cups comprised 91.8 % of the total number of cups of its kind. On the stem side, Lubinus SP II, Exeter, and MS30 are the dominant choices, encompassing 98.8 % of all cemented stems. When it comes to uncemented cups, the diversity of options is larger, with the five most used cups accounting for 78.9 % of the total. Regarding uncemented stems, the diversification is less pronounced compared to the cups. Since 2009, the Corail stem has held the top position as the most common uncemented stem, representing 31.1% of all uncemented stems reported to the register in 2022.

Uncemented cups are predominantly used with plastic inserts made of highly cross-linked polyethylene (96.3 % of all inserts in 2022). Similarly, when cemented cups are used, this type of polyethylene is employed in 88.8 % of cases in 2022. The trend shows a consistent increase in the use of highly cross-linked polyethylene (figure 5.1.7). In 2022, highly cross-linked polyethylene was utilized in 92 % of all hip replacements. Additionally, the combination of ceramic-polyethylene articulation has seen a slight decrease, decreasing from 27.2 % in 2021 to 26.9 % in 2022. Furthermore, femoral heads with a diameter of 36 mm are increasingly preferred, with a proportion of 12.5 % using femoral heads with a diameter of 36 mm in 2022. Trends regarding the choice of articulation and femoral head size are visualized in figures 5.1.7 and 5.1.8. Data on implant choice are summarized in tables 5.1.4-5.1.10

On group level, cemented fixation of the stem in patients aged 75 years and older has demonstrated better safety outcomes, with a lower risk of complications, particularly fractures around the prosthesis stem, compared to uncemented fixation. Therefore, cemented fixation is recommended in this age group, although individual cases may warrant deviations from this recommendation. Figure 5.1.9 illustrates the proportion of cemented and uncemented stems per unit in the age group of 75 years and older, with just over 80 % of units cementing the stem in over 95 % of cases in this age group.

Since 2018, the register has been recording the article numbers of cement types and cement mixing systems used in hip replacements. Predominantly, prefilled systems like Optipac Refobacin Bone Cement R and Palacos R + G Pro have been the choices in most cemented hip replacements reported to the register in the past three years. In 2022, one of these two systems had been used in 80 % of the reported cases. More detailed information on cement types is available in tables 5.1.11 a-c.

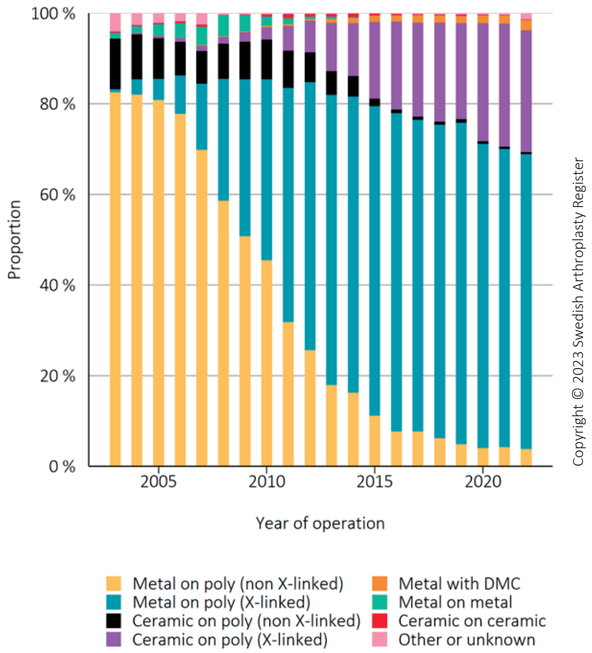


Figure 5.1.7. Time trend for articulation, 2003–2022.

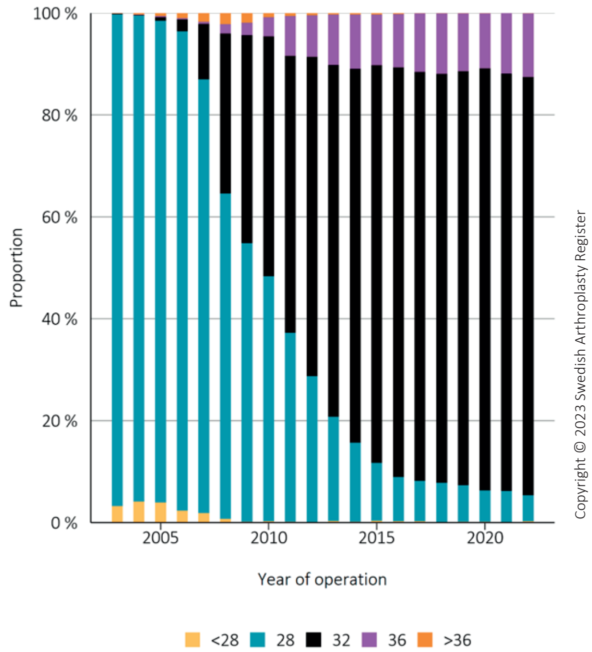


Figure 5.1.8. Time trend for head size, 2003–2022.

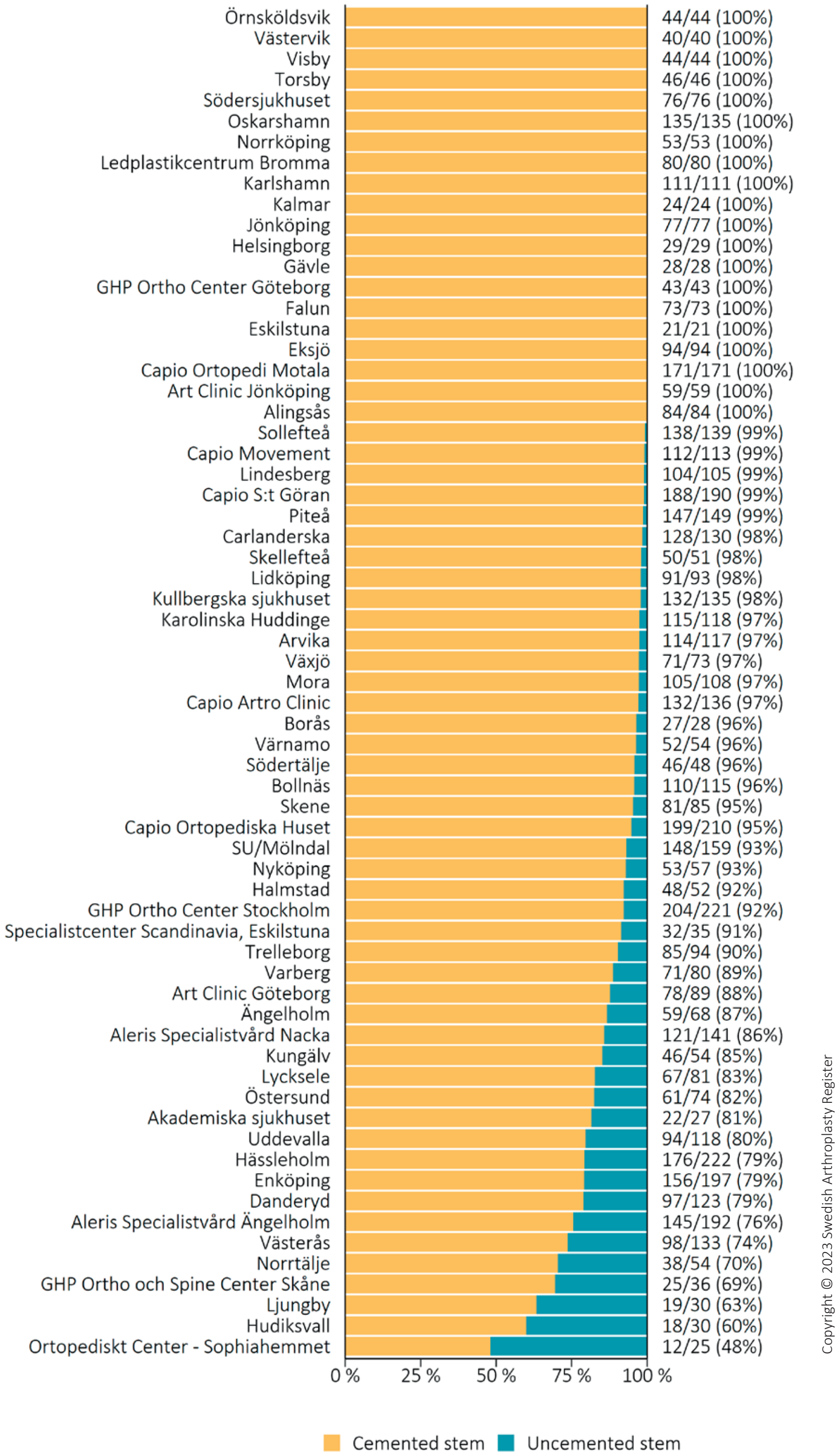


Figure 5.1.9. Proportion of total hip replacement with cemented stem in patients ≥ 75 years per unit in 2022.

All primary replacements per unit and year

Unit	2001–2018	2019	2020	2021	2022
Akademiska sjukhuset	3,125	100	71	151	187
Aleris Malmö Arena	0				31
Aleris Specialistvård Bollnäs	2,017	270			
Aleris Specialistvård Motala	4,654	105			
Aleris Specialistvård Nacka	1,773	262	303	393	536
Aleris Specialistvård Ängelholm	445	231	327	449	516
Alingsås	3,274	186	126	114	190
Art Clinic Göteborg	254	94	212	317	276
Art Clinic Jönköping	293	190	172	297	264
Arvika	2,486	231	132	287	305
Bollnäs	2,697	57	242	362	349
Borås	2,322	127	42	38	69
Capio Artro Clinic	615	395	517	641	713
Capio Movement	3,067	325	428	478	473
Capio Ortopedi Motala	<20	353	295	356	453
Capio Ortopediska Huset	6,762	687	609	776	802
Capio S:t Göran	7,355	568	313	343	354
Carlanderska	195	392	497	557	359
Carlanderska-SportsMed	0				218
Danderyd	5,009	182	105	121	216
Eksjö	339	231	154	250	307
Enköping	4,579	424	409	463	532
Eskilstuna	113	51	62	71	59
Falköping	2,364	107	42		
Falun	4,759	131	57	99	169
Frölundaortopeden	25	<20	<20	<20	<20
GHP Ortho Center Göteborg	1,564	306	295	318	309
GHP Ortho Center Stockholm	6,511	793	731	816	859
GHP Ortho och Spine Center Skåne	0				206
Gällivare	1,494	91	72	46	41
Gävle	2,425	131	118	63	96
Halmstad	3,195	203	151	116	121
Helsingborg	1,266	24	47	55	56
Hermelinen	80	26	21	30	38
Hudiksvall	1,887	86	50	54	69

The table continues on the next page.

All primary replacements per unit and year, cont.

Unit	2001–2018	2019	2020	2021	2022
Hässleholm	12,599	854	608	641	633
Jönköping	2,958	154	49	57	150
Kalmar	2,621	144	74	59	89
Karlshamn	3,617	308	209	176	283
Karlskrona	217	<20	<20	<20	<20
Karlstad	3,012	106	49	44	40
Karolinska Huddinge	3,413	189	148	194	300
Karolinska Solna	2,853	45	30	36	39
Kristianstad	28		<20		<20
Kullbergska sjukhuset	39	327	225	318	357
Kungälv	2,977	194	68	57	105
Ledplastikcentrum Bromma	0				260
Lidköping	3,012	231	163	108	215
Lindesberg	4,068	573	343	410	357
Linköping	1,153	89	76	92	85
Ljungby	2,335	164	93	103	105
Lycksele	4,744	238	287	233	230
Mora	3,231	231	206	207	254
Norrköping	3,047	193	132	132	143
Norrtälje	1,848	177	107	125	150
Nyköping	2,199	132	86	109	128
NÄL	<20	<20	<20	<20	<20
Ortopediskt Center – Sophiahemmet	0				292
Oskarshamn	3,789	395	281	303	422
Piteå	5,241	526	322	344	396
Skellefteå	1,847	109	99	96	136
Skene	19	184	120	125	224
Skövde	2,157	24	<20	26	47
Sollefteå	2,609	308	203	379	379
Sophiahemmet	3,846	265	214	257	
Specialistcenter Scandinavia Malmö	0				51
Specialistcenter Scandinavia, Eskilstuna	0	<20	<20	99	124
SU/Mölndal	4,749	494	238	230	436
Sunderby sjukhus	656	<20	<20	<20	
Sundsvall	2,297	32	<20	<20	<20

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All primary replacements per unit and year, cont.

Unit	2001–2018	2019	2020	2021	2022
SUS/Lund	131	43	44	45	30
SUS/Malmö	765	<20	<20		
Södersjukhuset	4,562	224	95	64	142
Södertälje	1,962	137	97	105	103
Torsby	1,613	111	74	168	125
Trelleborg	9,201	672	286	376	276
Uddevalla	5,089	371	197	244	320
Umeå	990	82	37	38	47
Varberg	3,622	222	175	155	189
Visby	1,793	136	112	127	110
Värnamo	2,181	138	103	174	156
Västervik	1,846	139	89	132	116
Västerås	4,112	420	212	268	348
Växjö	1,892	151	114	84	187
Ystad	411			1	
Ängelholm	1,746	198	134	118	186
Örebro	2,111	<20	<20	<20	<20
Örnsköldsvik	2,566	136	89	83	159
Östersund	3,645	249	175	79	195
Country	211,416	17,519	13,134	15,323	18,339

Table 5.1.1. Number of primary operations per unit and year. Units with fewer than 20 primary replacements are excluded.

Demography 2019–2022

	2019	2020	2021	2022
Number	17,519	13,134	15,323	18,339
Mean age (SD)	68.5 (10.7)	67.8 (10.8)	68.5 (10.8)	69.0 (10.8)
Age group n (%)				
< 45 years	338 (1.9)	267 (2.0)	281 (1.8)	322 (1.8)
45–54 years	1,608 (9.2)	1,318 (10.0)	1,402 (9.1)	1,487 (8.1)
55–64 years	3,625 (20.7)	3,089 (23.5)	3,408 (22.2)	4,123 (22.5)
65–74 years	6,513 (37.2)	4,621 (35.2)	5,254 (34.3)	6,013 (32.8)
75–84 years	4,709 (26.9)	3,357 (25.6)	4,331 (28.3)	5,532 (30.2)
≥ 85 years	726 (4.1)	482 (3.7)	647 (4.2)	862 (4.7)
Females n (%)	10,089 (57.6)	7,479 (56.9)	8,846 (57.7)	10,490 (57.2)
BMI n (%)				
< 18.5	128 (0.7)	90 (0.7)	118 (0.8)	140 (0.8)
18.5–24.9	5,385 (31.0)	4,081 (31.4)	4,806 (31.6)	5,732 (31.6)
25–29.9	7,309 (42.0)	5,486 (42.3)	6,351 (41.8)	7,611 (42.0)
30–34.5	3,606 (20.7)	2,605 (20.1)	3,088 (20.3)	3,661 (20.2)
35–39.9	845 (4.9)	629 (4.8)	727 (4.8)	855 (4.7)
≥ 40	124 (0.7)	89 (0.7)	96 (0.6)	120 (0.7)
ASA-class n (%)				
ASA I	3,475 (19.9)	2,896 (22.3)	3,053 (20.0)	3,317 (18.2)
ASA II	10,734 (61.6)	7,975 (61.3)	9,507 (62.3)	11,303 (61.9)
ASA III	3,164 (18.1)	2,103 (16.2)	2,648 (17.4)	3,555 (19.5)
ASA IV	64 (0.4)	34 (0.3)	48 (0.3)	76 (0.4)

Table 5.1.2. Demography, 2022.

Case-mix per unit 2022

Unit	Number	Females %	<55 years %	Charnley C %	BMI ≥ 35 %	ASA class ≥III	Standard patient %
Akademiska sjukhuset	187	51.9	26.7	26.2	5.3	26.8	30.1
Aleris Malmö Arena	31	58.1	6.5	0	0	0	84.6
Aleris Specialistvård Nacka	536	46.1	10.8	35.3	1.5	3.2	64.2
Aleris Specialistvård Ängelholm	516	41.5	8.5	28.5	3.5	9.1	56.8
Alingsås	190	40.5	5.8	39.5	3.7	26.3	51.1
Art Clinic Göteborg	276	38.8	9.1	26.1	0.7	0.7	69.1
Art Clinic Jönköping	264	45.5	11.4	32.2	2.7	4.5	61.7
Arvika	305	43.9	8.5	28.2	3.7	13.3	56.3
Bollnäs	349	42.7	7.2	31.2	2.6	14.6	53.6
Borås	69	39.1	8.7	17.4	17.4	58	18.8
Capio Artro Clinic	713	41.1	17.7	26.9	2.3	0.8	63.1
Capio Movement	473	39.7	9.7	19.5	3.6	20.1	54.8
Capio Ortopedi Motala	453	43.9	6.4	28.9	1.8	20.7	58.4
Capio Ortopediska Huset	802	39.8	8.4	27.2	1.8	0.4	70.7
Capio S:t Göran	354	37.6	3.4	31.4	6	55.1	32.1
Carlanderska	359	40.4	6.7	10.9	2.3	3.6	64.3
Carlanderska-SportsMed	218	66.1	19.7	5	5.8	6.6	57.4
Danderyd	216	44.4	6.5	16.2	6.5	54.6	24.7
Eksjö	307	41.4	6.2	28.7	3.9	15.4	60.5
Enköping	532	42.1	4.7	22.6	4.3	18	56.1
Eskilstuna	59	39	11.9	28.8	10.2	33.9	37.3
Falun	169	32.5	8.3	33.1	15.2	32.1	33.3
GHP Ortho Center Göteborg	309	45	17.2	15.5	1.6	5.8	57.5
GHP Ortho Center Stockholm	859	43.3	12.7	28.3	3.5	9.4	57.6
GHP Ortho och Spine Center Skåne	206	47.6	18.4	22.3	1.5	5.4	55.2
Gällivare	41	51.2	4.9	26.8	4.9	36.6	46.3
Gävle	96	49	6.2	40.6	18.8	44.8	18.8
Halmstad	121	40.5	10.7	28.1	8.3	13.2	47.9
Helsingborg	56	44.6	3.6	33.9	12.5	73.2	12.5
Hermelinen	38	55.3	31.6	18.4	0	8.1	48.6
Hudiksvall	69	52.2	1.4	39.1	5.9	40.6	35.3
Hässleholm	633	42.3	10.4	33.6	4.9	19.9	47.2
Jönköping	150	41.3	10	30.7	6.3	37.3	38.7
Kalmar	89	39.3	4.5	32.6	1.1	23.6	49.4
Karlshamn	283	41	10.2	29.7	8.9	7.8	57.1
Karlstad	40	40	10	27.5	15	32.5	22.5
Karolinska Huddinge	300	45	10	32.3	10.7	46.3	26.7
Karolinska Solna	39	48.7	20.5	7.7	6.7	50	6.7
Kullbergska sjukhuset	357	36.4	7.8	33.6	5	11.2	58.5

The table continues on the next page.

Case-mix per unit 2022, cont.

Unit	Number	Females %	<55 years %	Charnley C %	BMI ≥ 35 %	ASA class ≥III	Standard patient %
Kungälv	105	45.7	9.5	22.9	12.5	42.9	21.2
Ledplastikcentrum Bromma	260	43.8	6.2	11.9	2	7.3	64
Lidköping	215	43.3	7	36.3	10.8	29.8	42
Lindesberg	357	43.4	6.2	16.2	8.7	25.8	47.1
Linköping	85	40	47.1	17.6	10.7	19.3	24.4
Ljungby	105	47.6	11.4	30.5	9.5	22.9	34.3
Lycksele	230	43	5.7	42.2	10.9	21.4	53.1
Mora	254	42.1	5.1	31.5	10.2	24.4	50.4
Norrköping	143	44.1	7.7	30.1	14	35.5	32.6
Norrtälje	150	38	7.3	33.3	6	33.3	44
Nyköping	128	47.7	9.4	37.5	7.1	28.9	45.7
Ortopediskt Center – Sophiahemmet	292	59.6	20.5	18.8	3.8	10	54.7
Oskarshamn	422	44.1	6.2	33.6	4.5	8.1	62.3
Piteå	396	43.9	8.6	36.1	12.7	25.4	44.5
Skellefteå	136	29.4	4.4	17.6	2.2	25.7	50.7
Skene	224	42.9	12.5	17	4.9	12.5	52.5
Skövde	47	44.7	8.5	40.4	2.2	14.9	63
Sollefteå	379	43.5	4.2	30.1	1.9	27.2	48.6
Specialistcenter Scandinavia Malmö	51	54.9	7.8	19.6	2	8	69.4
Specialistcenter Scandinavia Eskilstuna	124	49.2	12.9	25.8	2.4	2.5	58.3
SU/Mölndal	436	43.3	11.9	35.3	5.4	33.2	35
SUS/Lund	30	33.3	13.3	50	23.3	53.3	3.3
Södersjukhuset	142	43	5.6	31	10.6	70.4	12.8
Södertälje	103	40.8	11.7	34	7.8	35	41.7
Torsby	125	41.6	7.2	31.2	1.6	25.6	41.5
Trelleborg	276	35.9	14.9	37.7	8.7	34.8	29.7
Uddevalla	320	38.4	10.3	36.6	9.1	33.8	37.2
Umeå	47	46.8	25.5	8.5	0	8.9	46.2
Varberg	189	39.7	6.3	28.6	6.5	25.4	48.1
Visby	110	40.9	5.5	36.4	8.3	14.7	52.8
Värnamo	156	32.1	6.4	34.6	4.5	32.1	42.9
Västervik	116	45.7	16.4	36.2	8.9	10.3	49.1
Västerås	348	42.2	6.6	30.2	6.3	35.2	35.4
Växjö	187	38.5	9.6	14.4	6.4	27.8	46
Ängelholm	186	37.6	17.7	33.9	7	28.6	38.4
Örnsköldsvik	159	44	7.5	35.2	10.7	32.7	43.4
Östersund	195	48.7	5.1	32.3	8.6	40.8	36.2
Country	**18,339**	**42.8**	**9.9**	**28.2**	**5.4**	**19.9**	**50.1**

Table 5.1.3. Case-mix per unit 2022. Units with fewer than 20 primary replacements are excluded. Note that percentages for units with few operations may be misleading.

Most common implants

	All	2011–2020	2021	2022
Number	**183,81**	**150,148**	**15,323**	**18,339**
Implant, n (%)				
Lubinus x-link (SPII standard)	37,707 (20.5)	29,802 (19.8)	3,673 (24.0)	4,232 (23.1)
Exeter Rim-fit (Exeter standard)	15,145 (8.2)	12,308 (8.2)	1,209 (7.9)	1,628 (8.9)
Pinnacle W/Cripton 100 (Corail standard)	7,374 (4.0)	5,449 (3.6)	891 (5.8)	1,034 (5.6)
Lubinus (SPII standard)	17,457 (9.5)	16,192 (10.8)	588 (3.8)	677 (3.7)
Trident hemi (Accolade II)	2,494 (1.4)	1,484 (1.0)	440 (2.9)	570 (3.1)
Pinnacle 100 (Corail standard)	2,785 (1.5)	2,114 (1.4)	286 (1.9)	385 (2.1)
Lubinus x-link (Corail standard)	2,296 (1.2)	1,576 (1.0)	360 (2.3)	360 (2.0)
Pinnacle W/Cripton 100 (Corail high offset)	2,828 (1.5)	2,202 (1.5)	268 (1.7)	358 (2.0)
Marathon (Exeter standard)	8,712 (4.7)	8,036 (5.4)	347 (2.3)	329 (1.8)
Trident hemi (Exeter standard)	3,659 (2.0)	3,008 (2.0)	356 (2.3)	295 (1.6)
Exeter Rim-fit (MS-30 polished)	4,873 (2.7)	3,767 (2.5)	872 (5.7)	234 (1.3)
ZCA XLPE (MS-30 polished)	5,886 (3.2)	5,546 (3.7)	203 (1.3)	137 (0.7)
Trilogy (CLS)	3,439 (1.9)	2,930 (2.0)	448 (2.9)	61 (0.3)
Exeter Rim-fit (Corail standard)	2,351 (1.3)	2,319 (1.5)	19 (0.1)	13 (0.1)
Contemporary Hoded Duration (Exeter standard)	2,009 (1.1)	2,009 (1.3)	0 (0.0)	0 (0.0)
Other	64,795 (35.3)	51,406 (34.2)	5,363 (35.0)	8,026 (43.8)

Table 5.1.4. Most common implants, 2011–2022.

Most common cemented implants

	All	2011–2020	2021	2022
Number	**104,757**	**87,382**	**7,898**	**9,477**
Implant, n (%)				
Lubinus x-link (SPII standard)	37,652 (35.9)	29,752 (34.0)	3,670 (46.5)	4,230 (44.6)
Exeter Rim-fit (Exeter standard)	15,126 (14 .4)	12,293 (14.1)	1,209 (15.3)	1,624 (17.1)
Lubinus x-link (MS-30 c)	902 (0.9)	0 (0.0)	37 (0.5)	865 (9.1)
Lubinus (SPII standard)	17,452 (16.7)	16,188 (18.5)	588 (7.4)	676 (7.1)
Exceed ABT E-poly without flange (cem) (MS-30 polished)	1,417 (1.4)	704 (0.8)	349 (4.4)	364 (3.8)
Marathon (Exeter standard)	8,663 (8.3)	7,992 (9.1)	342 (4.3)	329 (3.5)
IP Link (SPII standard)	1,941 (1.9)	1,521 (1.7)	151 (1.9)	269 (2.8)
Exeter Rim-fit (MS-30 polished)	4,871 (4.6)	3,766 (4.3)	872 (11.0)	233 (2.5)
ZCA XLPE (MS-30 polished)	5,883 (5.6)	5,546 (6.3)	202 (2.6)	135 (1.4)
Marathon (SPII standard)	1,110 (1.1)	881 (1.0)	76 (1.0)	153 (1.6)
Avantage (SPII standard)	1,145 (1.1)	907 (1.0)	114 (1.4)	124 (1.3)
ZCA (MS-30 polished)	868 (0.8)	784 (0.9)	51 (0.6)	33 (0.3)
Contemporary Hoded Duration (Exeter standard)	2,008 (1.9)	2,008 (2.3)	0 (0.0)	0 (0.0)
ZCA XLPE (SPII standard)	958 (0.9)	958 (1.1)	0 (0.0)	0 (0.0)
ZCA XLPE (Exeter standard)	627 (0.6)	627 (0.7)	0 (0.0)	0 (0.0)
Other	4,134 (3.9)	3,455 (4.0)	237 (3.0)	442 (4.7)

Table 5.1.5. Most common cemented implants, 2011–2022.

Most common uncemented implants

	All	2011–2020	2021	2022
Number	**48,685**	**37,588**	**4,966**	**6,131**
Implant, n (%)				
Pinnacle W/Cripton 100 (Corail standard)	7,368 (15.1)	5,448 (14.5)	891 (17.9)	1,029 (16.8)
Trident hemi (Accolade II)	2,492 (5.1)	1,484 (3.9)	439 (8.8)	569 (9.3)
Pinnacle W/Cripton 100 (Corail coxa vara)	1,967 (4.0)	1,232 (3.3)	325 (6.5)	410 (6.7)
Pinnacle 100 (Corail standard)	2,782 (5.7)	2,111 (5.6)	286 (5.8)	385 (6.3)
Pinnacle W/Cripton 100 (M/L Taper)	909 (1.9)	198 (0.5)	343 (6.9)	368 (6.0)
Pinnacle W/Cripton 100 (Corail high offset)	2,827 (5.8)	2,202 (5.9)	268 (5.4)	357 (5.8)
G7 PPS (Echo Bi-Metric (FPP))	1,259 (2.6)	667 (1.8)	239 (4.8)	353 (5.8)
Pinnacle 100 (Corail coxa vara)	1,340 (2.8)	772 (2.1)	249 (5.0)	319 (5.2)
Pinnacle W/Gription Sector (Corail standard)	1,019 (2.1)	733 (2.0)	110 (2.2)	176 (2.9)
Continuum (M/L Taper)	1,064 (2.2)	862 (2.3)	114 (2.3)	88 (1.4)
Trilogy (CLS)	3,437 (7.1)	2,929 (7.8)	447 (9.0)	61 (1.0)
Continuum (Wagner Cone)	872 (1.8)	808 (2.1)	30 (0.6)	34 0.6)
Continuum (CLS)	1,734 (3.6)	1,700 (4.5)	12 (0.2)	22 (0.4)
Exceed ABT Ringlock (Bi-Metric X por HA NC)	1,480 (3.0)	1,480 (3.9)	0 (0.0)	0 (0.0)
Trilogy IT (Bi-Metric X por HA NC)	926 (1.9)	926 (2.5)	0 (0.0)	0 (0.0)
Other	17,209 (35.3)	14,036 (37.3)	1,213 (24.4)	1,960 (32.0)

Table 5.1.6. Most common uncemented implants, 2011–2022.

Most common hybrid implants

	All	2011–2020	2021	2022
Number	**9,691**	**6,84**	**1,224**	**1,627**
Implant, n (%)				
Pinnacle W/Cripton 100 (MS-30 polished)	1,018 (10.5)	295 (4.3)	336 (27.5)	387 (23.8)
Trident hemi (Exeter standard)	3,658 (37.7)	3,008 (44.0)	356 (29.1)	294 (18.1)
Pinnacle W/Gription Sector (SPII standard)	146 (1.5)	31 (0.5)	9 (0.7)	106 (6.5)
Pinnacle W/Gription Sector (MS-30 polished)	311 (3.2)	168 (2.5)	59 (4.8)	84 (5.2)
Pinnacle sector (SPII standard)	379 (3.9)	274 (4.0)	29 (2.4)	76 (4.7)
Trident II (Exeter standard)	172 (1.8)	68 (1.0)	35 (2.9)	69 (4.2)
Pinnacle W/Cripton 100 (SPII standard)	220 (2.3)	118 (1.7)	41 (3.3)	61 (3.7)
Trident AD LW (Exeter standard)	307 (3.2)	221 (3.2)	26 (2.1)	60 (3.7)
Pinnacle W/Gription Sector (Exeter standard)	242 (2.5)	188 (2.7)	18 (1.5)	36 (2.2)
Continuum (SPII standard)	166 (1.7)	124 (1.8)	12 (1.0)	30 (1.8)
Pinnacle 100 (SPII standard)	137 (1.4)	94 (1.4)	14 (1.1)	29 (1.8)
Tritanium (Exeter standard)	335 (3.5)	295 (4.3)	15 (1.2)	25 (1.5)
Trilogy (SPII standard)	305 (3.1)	305 (4.5)	0 (0.0)	0 (0.0)
Continuum (MS-30 polished)	144 (1.5)	144 (2.1)	0 (0.0)	0 0.0)
Other	1,930 (19.9)	1,333 (19.5)	247 (20.2)	350 (21.5)

Table 5.1.7. Most common hybrid implants, 2011–2022.

Most common reverse hybrid implants

	All	2011–2020	2021	2022
Number	**19,892**	**17,621**	**1,215**	**1,056**
Implant, n (%)				
Lubinus x-link (Corail standard)	2,295 (11.5)	1,576 (8.9)	360 (29.6)	359 (34.0)
Lubinus x-link (M/L Taper)	656 (3.3)	331 (1.9)	15 (1.2)	310 (29.4)
Lubinus x-link (Corail coxa vara)	759 (3.8)	599 (3.4)	82 (6.7)	78 (7.4)
Lubinus (Corail standard)	1,419 (7.1)	1,330 (7.5)	46 (3.8)	43 (4.1)
Marathon (Corail standard)	1,848 (9.3)	1,802 (10.2)	25 (2.1)	21 (2.0)
Exeter Rim-fit (M/L Taper)	859 (4.3)	437 (2.5)	404 (33.3)	18 (1.7)
Marathon (Corail high offset)	907 (4.6)	884 (5.0)	6 (0.5)	17 (1.6)
Exeter Rim-fit (Corail standard)	2,329 (11.7)	2,297 (13.0)	19 (1.6)	13 (1.2)
Lubinus (Corail coxa vara)	421 (2.1)	406 (2.3)	6 (0.5)	9 (0.9)
Exeter Rim-fit (Corail high offset)	726 (3.6)	717 (4.1)	5 (0.4)	4 (0.4)
Marathon (ABG II HA)	925 (4.7)	925 (5.2)	0 (0.0)	0 (0.0)
Marathon (Bi-Metric X por HA NC)	734 (3.7)	734 (4.2)	0 (0.0)	0 (0.0)
Lubinus x-link (Bi-Metric X por HA NC)	553 (2.8)	553 (3.1)	0 (0.0)	0 (0.0)
ZCA XLPE (Corail standard)	376 (1.9)	376 (2.1)	0 (0.0)	0 (0.0)
Contemporary Hoded Duration (Corail standard)	374 (1.9)	374 (2.1)	0 (0.0)	0 (0.0)
Other	4,711 (23.7)	4,280 (24.3)	247 (20.3)	184 (17.4)

Table 5.1.8. Most common reverse hybrid implants, 2011–2022.

Most common cup components

	All	2011–2020	2021	2022
Number	**183,810**	**150,148**	**15,323**	**18,339**
Implant, n (%)				
Lubinus x-link	44,557 (24.3)	34,240 (22.8)	4,327 (28.3)	5,990 (32.8)
Pinnacle W/Cripton 100	14,572 (7.9)	9,681 (6.4)	2,241 (14.7)	2,650 (14.5)
Exeter Rim-fit	24,654 (13.4)	20,146 (13.4)	2,539 (16.6)	1,969 (10.8)
Trident hemi	7,826 (4.3)	5,812 (3.9)	947 (6.2)	1,067 (5.9)
G7 PPS	2,423 (1.3)	1,008 (0.7)	426 (2.8)	989 (5.4)
Pinnacle 100	5,204 (2.8)	3,661 (2.4)	663 (4.3)	880 (4.8)
Lubinus	20,287 (11.0)	18,873 (12.6)	664 (4.3)	750 4.1)
Marathon	15,276 (8.3)	14,245 (9.5)	497 (3.2)	534 (2.9)
Pinnacle W/Gription Sector	2,387 (1.3)	1,556 (1.0)	297 (1.9)	534 2.9)
IP Link	2,164 (1.2)	1,662 (1.1)	157 (1.0)	345 (1.9)
Continuum	5,702 (3.1)	5,289 (3.5)	198 (1.3)	215 (1.2)
Trilogy IT	2,309 (1.3)	1,921 (1.3)	239 (1.6)	149 (0.8)
ZCA XLPE	8,338 (4.5)	7,998 (5.3)	203 1.3)	137 (0.8)
Trilogy	5,215 (2.8)	4,641 (3.1)	493 (3.2)	81 (0.4)
Contemporary Hoded Duration	2,620 (1.4)	2,620 (1.7)	0 0.0)	0 (0.0)
Other	20,124 (11.0)	16,772 (11.2)	1,404 (9.2)	1,948 (10.7)

Table 5.1.9. Most common cup components, 2011–2022.

Most common stem components

	All	2011–2020	2021	2022
Number	**183,810**	**150,148**	**15,323**	**18,339**
Implant, n (%)				
SPII standard	64,235 (35.0)	53,247 (35.5)	4,884 (31.9)	6,104 (33.3)
Exeter standard	33,029 (18.0)	28,230 (18.8)	2,174 (14.2)	2,625 (14.3)
MS-30 polished	16,154 (8.8)	11,913 (7.9)	1,983 (12.9)	2,258 (12.3)
Corail standard	23,270 (12.7)	19,170 (12.8)	1,860 (12.1)	2,240 (12.2)
Accolade II	5,322 (2.9)	3,384 (2.3)	791 (5.2)	1,147 (6.3)
M/L Taper	4,309 (2.3)	2,310 (1.5)	954 (6.2)	1,045 (5.7)
Corail coxa vara	6,744 (3.7)	4,922 (3.3)	790 (5.2)	1,032 (5.6)
Corail high offset	7,116 (3.9)	5,967 (4.0)	506 (3.3)	643 (3.5)
Echo Bi-Metric (FPP)	1,968 (1.1)	1,021 (0.7)	469 (3.1)	478 (2.6)
CLS	8,080 (4.4)	7,029 (4.7)	580 (3.8)	471 (2.6)
Wagner Cone	1,592 (0.9)	1,440 (1.0)	74 (0.5)	78 (0.4)
CPT	563 (0.3)	442 (0.3)	47 (0.3)	74 (0.4)
Bi-Metric X por HA NC	5,498 (3.0)	5,498 (3.7)	0 (0.0)	0 (0.0)
ABG II HA	1,535 (0.8)	1,535 (1.0)	0 (0.0)	0 (0.0)
Accolade straight	883 (0.5)	883 (0.6)	0 (0.0)	0 (0.0)
Other	3,454 (1.9)	3,112 (2.1)	206 (1.3)	136 (0.7)

Table 5.1.10. Most common stem components, 2011–2022.

Number and proportion of replacements per type of stem cement

	All	2020	2021	2022
Number	**27,772**	**7,562**	**9,122**	**11,088**
Stem cement, n (%)				
Optipac Refobacin (pre-filled)	15,383 (55.4)	3,560 (47.1)	4,946 (54.2)	6,877 (62.0)
Palacos R+G Pro (pre-filled)	7,112 (25.6)	2,406 (31.8)	2,311 (25.3)	2,395 (21.6)
Palacos R+G (genta)	2,384 (8.6)	663 (8.8)	796 (8.7)	925 (8.3)
CMW	1,927 (6.9)	394 (5.2)	762 (8.4)	771 (7.0)
Copal (genta + clinda)	163 (0.6)	61 (0.8)	35 (0.4)	67 (0.6)
Copal (genta + vanco)	73 (0.3)	15 (0.2)	25 (0.3)	33 (0.3)
Smartset GHV (genta)	14 (0.1)	0 (0.0)	5 (0.1)	9 (0.1)
Refobacin Bone Cement (genta)	592 (2.1)	379 (5.0)	208 (2.3)	5 (0.0)
Refobacin Revision Cement (genta + clinda)	24 (0.1)	8 (0.1)	11 (0.1)	5 (0.0)
Other	100 (0.4)	76 (1.0)	23 (0.3)	1 (0.0)

Table 5.1.11a. Number and proportion of replacements per type of stem cement and year, 2020–2022.

Number and proportion of replacements per typ of cup cement

	All	2020	2021	2022
Number	**27,309**	**7,683**	**9,111**	**10,515**
Cup cement, n (%)				
Optipac Refobacin (pre-filled)	14,090 (51.6)	3,304 (43.0)	4,762 (52.3)	6,024 (57.3)
Palacos R+G Pro (pre-filled)	6,764 (24.8)	2,502 (32.6)	2,024 (22.2)	2,238 (21.3)
CMW	3,439 (12.6)	855 (11.1)	1,357 (14.9)	1,227 (11.7)
Palacos R+G (genta)	2,132 (7.8)	542 (7.1)	671 (7.4)	919 (8.7)
Copal (genta + clinda)	163 (0.6)	62 (0.8)	36 (0.4)	65 (0.6)
Copal (genta + vanco)	56 (0.2)	14 (0.2)	21 (0.2)	21 (0.2)
Refobacin Revision Cement (genta + clinda)	25 (0.1)	8 (0.1)	9 (0.1)	8 (0.1)
Smartset GHV (genta)	14 (0.1)	4 (0.1)	2 (0.0)	8 (0.1)
Refobacin Bone Cement (genta)	626 (2.3)	392 (5.1)	229 (2.5)	5 (0.0)

Table 5.1.11b. Number and proportion of replacements per type of cup cement and year, 2020–2022.

Number and proportion of replacements per type of the combination of stem and cup cement

	All	2020	2021	2022
Number	**31,193**	**8,700**	**10,337**	**12,156**
Combination of stem and cup, n (%)				
Optipac Refobacin (pre-filled)	16,470 (52.8)	3,768 (43.3)	5,421 (52.4)	7,281 (59.9)
Palacos R+G Pro (pre-filled)	7,627 (24.5)	2,802 (32.2)	2,398 (23.2)	2,427 (20.0)
CMW	2,925 (9.4)	678 (7.8)	1,199 (11.6)	1,048 (8.6)
Palacos R+G (genta)	2,383 (7.6)	589 (6.8)	756 (7.3)	1,038 (8.5)
Olika cement cup/stam	816 (2.6)	332 (3.8)	249 (2.4)	235 (1.9)
Copal (genta + clinda)	167 (0.5)	64 (0.7)	35 (0.3)	68 (0.6)
Copal (genta + vanco)	81 (0.3)	19 (0.2)	26 (0.3)	36 (0.3)
Smartset GHV (genta)	10 (0.0)	2 (0.0)	1 (0.0)	7 (0.1)
Refobacin Revision Cement (genta + clinda)	22 (0.1)	8 (0.1)	10 (0.1)	4 (0.0)
Refobacin Bone Cement (genta)	584 (1.9)	362 (4.2)	219 (2.1)	3 (0.0)
Other	100 (0.3)	76 (0.9)	23 (0.2)	1 (0.0)

Table 5.1.11c. Number and proportion of replacements per type of the combination of stem and cup cement and year, 2020–2022.

Number and proportion of replacements per type of the combination of stem and cup and type of fixation

		2020			2021			2022		
	All	Cemented 2020	Hybrid 2020	Reverse hybrid 2020	Cemented 2021	Hybrid 2021	Reverse hybrid 2021	Cemented 2022	Hybrid 2022	Reverse hybrid 2022
Number	**31,193**	**6,547**	**1,015**	**1,138**	**7,898**	**1,224**	**1,215**	**9,477**	**1,627**	**1,052**
Combination of stem and cup, n (%)										
Optipac Refobacin (pre-filled)	16,470 (52.8)	2,966 (45.3)	517 (50.9)	285 (25.0)	4,218 (53.4)	681 (55.6)	522 (43.0)	5,450 (57.6)	1,270 (78.1)	561 (53.1)
Palacos R+G Pro (pre-filled)	7,627 (24.5)	2,004 (30.6)	318 (31.3)	480 (42.2)	1,819 (23.0)	404 (33.0)	175 (14.4)	2,148 (22.7)	202 (12.4)	77 (7.3)
Palacos R+G (genta)	2,383 (7.6)	506 (7.7)	49 (4.8)	34 (3.0)	621 (7.9)	89 (7.3)	46 (3.8)	784 (8.3)	125 (7.7)	129 (12.2)
CMW	2,925 (9.4)	380 (5.8)	4 (0.4)	294 (25.8)	751 (9.5)	6 (0.5)	442 (36.4)	762 (8.0)	9 (0.6)	277 (26.2)
Different cement cup/stem	816 (2.6)	332 (5.1)	0 (0.0)	0 (0.0)	249 (3.2)	0 (0.0)	0 (0.0)	235 (2.5)	0 (0.0)	0 (0.0)
Copal (genta + clinda)	167 (0.5)	56 (0.9)	5 (0.5)	3 (0.3)	33 (0.4)	1 (0.1)	1 (0.1)	62 (0.7)	3 (0.2)	3 (0.3)
Copal (genta + vanco)	81 (0.3)	10 (0.2)	5 (0.5)	4 (0.4)	17 (0.2)	6 (0.5)	3 (0.2)	18 (0.2)	15 (0.9)	3 (0.3)
Smartset GHV (genta)	10 (0.0)	0 (0.0)	0 (0.0)	2 (0.2)	0 (0.0)	0 (0.0)	1 (0.1)	7 (0.1)	0 (0.0)	0 (0.0)
Refobacin Bone Cement (genta)	584 (1.9)	289 (4.4)	37 (3.6)	36 (3.2)	184 (2.3)	10 (0.8)	25 (2.1)	2 (0.0)	1 (0.1)	0 (0.0)
Refobacin Revision Cement (genta + clinda)	22 (0.1)	4 (0.1)	4 (0.4)	0 (0.0)	6 (0.1)	4 (0.3)	0 (0.0)	1 (0.0)	1 (0.1)	2 (0.2)
Other	100 (0.3)	0 (0.0)	76 (7.5)	0 (0.0)	0 (0.0)	23 (1.9)	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)

Table 5.1.11d. Number and proportion of replacements per type of the combination of stem and cup cement and type of fixation, 2020–2022.

5.2. Reoperation hip replacement

Author: Johan Kärrholm

Reoperation comprises all types of surgical procedures that can be directly related to an earlier inserted hip prosthesis, regardless of the prosthesis or some of its parts are exchanged, extracted or left untouched. This section embraces all types of reoperations after inserted primary total hip replacement. Between 2002 and 2006 the number of reoperations was around 2,100, then increasing to between 2,300 and 2,500 and then gradually decreasing to between 1,832 and 2,090 in the last three years (2020 to 2022, figure 5.2.1). Between the periods 1995–1997 and 2020–2022, the percentage of reoperations related to the total production of hip related operations (primary replacements and reoperations) decreased from 13.3 % to 9.8 % (figure 5.2.2). The observed reduction between the first and last three-year period is mainly due to a relatively larger increase in primary operations. Between the periods 1995–1997 and 2020–2022 the reoperations increased with 19.7 % and the primary operations with 61.8 %. This relative reduction in the proportion of reoperations occurred at the same time as the proportion of reoperations due to loosening has reduced from 9.3 % to 3.3 % of all total hip replacements between the first and last observation period. Also, the proportion reoperated due to dislocation, pain only and implant fracture has decreased marginally from 0.3 % for dislocation and 0.1% for implant fracture. On the other hand, infection and fracture causes have increased by 0.8 % and 0.5 % respectively, perhaps partly due to improved registration.

The relative decrease of reoperations is probably real, but varying degrees of underreporting especially of reoperations without exchange or extraction of at least one prosthesis component may also have influenced the result. Such procedures among other things comprise irrigation and synovectomy or plate fixation due to periprosthetic fracture. However, we believe that the reporting of these operations has improved, not least since several studies have focused on the problem. Direct reporting of periprosthetic fractures from the Swedish Fracture Register in recent years, mainly to improve the completeness of this complication, especially when treated without exchange of prosthesis components, has certainly also had a positive influence.

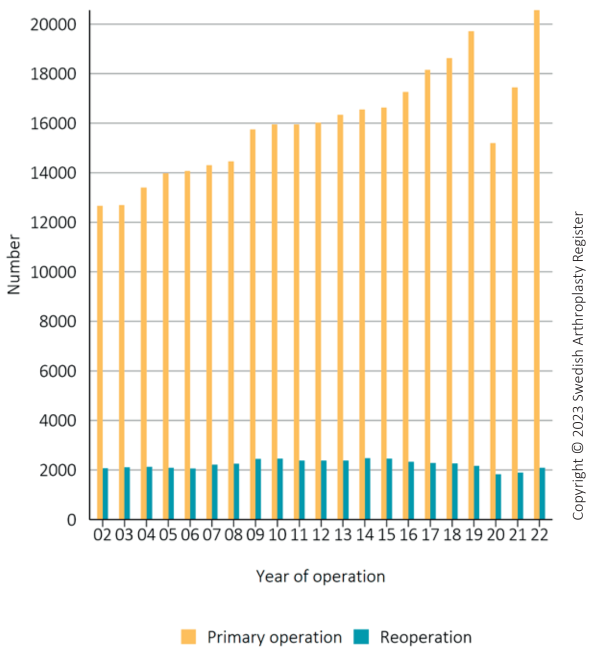

Figure 5.2.1. Number of primary and reoperations per year in 2002–2022.

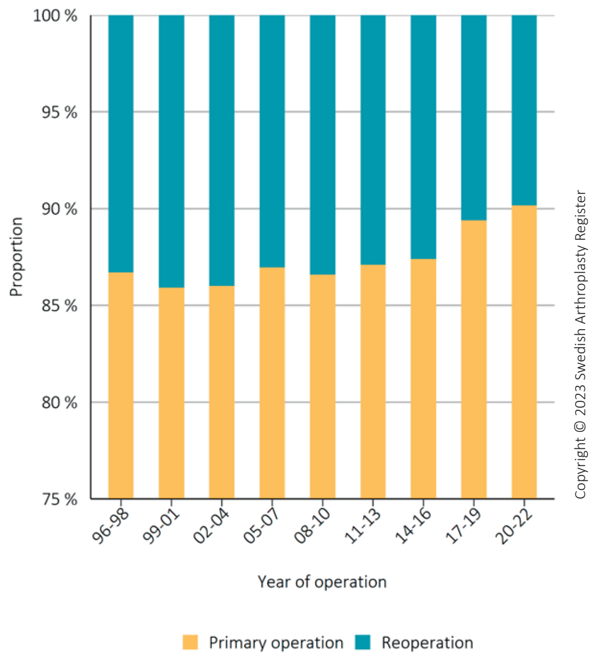

Figure 5.2.2. The distribution between reoperations (revisions and other reoperations) and primary hip replacements in 1996–2022 divided in three-years periods. The y-axis scale is adjusted and starts at 75%.

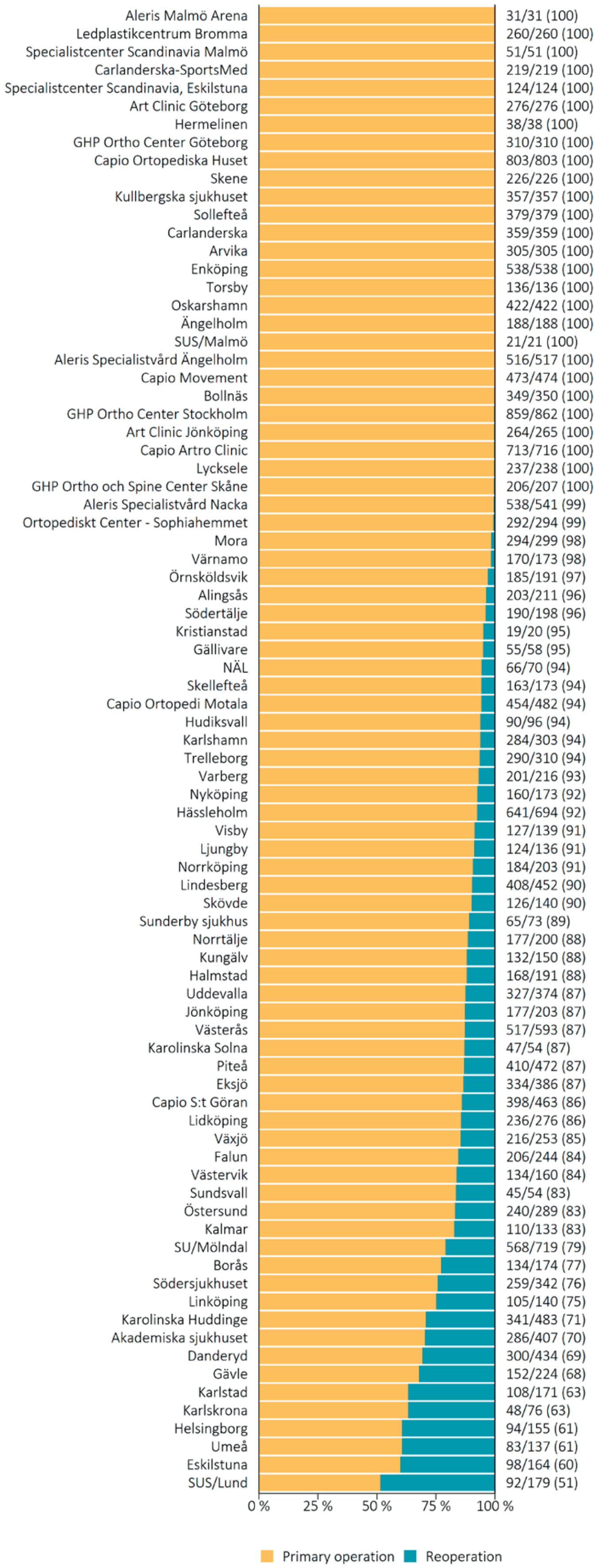

Figure 5.2.3. The distribution of primary replacements and reoperations per operating unit in Sweden 2022. The column to the right presents the number (%) of primary replacements.

Demography for all types of reoperations

	Reoperation 2010–2012	Reoperation 2014–2016	Reoperation 2020–2022	Primary operation 2020–2022
Number	**7,222**	**7,270**	**5,807**	**53,206**
Mean age (SD)	**71.6 (11.8)**	**71.8 (11.2)**	**72.3 (11.3)**	**69.2 (10.8)**
Age group n (%)				
< 55 years	598 (8.3)	572 (7.9)	439 (7.6)	5,271 (9.9)
55–64 years	1,093 (15.1)	1,084 (14.9)	926 (15.9)	11,247 (21.1)
65–74 years	2,306 (31.9)	2,501 (34.4)	1,662 (28.6)	18,064 (34.0)
75–84 years	2,354 (32.6)	2,257 (31.0)	2,052 (35.3)	15,859 (29.8)
≥ 85 years	871 (12.1)	856 (11.8)	728 (12.5)	2,765 (5.2)
Females n (%)	3,767 (52.3)	3,716 (51.2)	2,823 (48.6)	30,790 (57.9)
BMI n (%)				
< 18,5	98 (1.7)	114 (1.8)	79 (1.4)	653 (1.3)
18,5–24,9	1,872 (32.8)	2,205 (33.9)	1,737 (31.8)	17,480 (33.6)
25–29,9	2,333 (40.9)	2,573 (39.6)	2,152 (39.4)	21,277 (41.0)
30–34,9	1,032 (18.1)	1,158 (17.8)	1,066 (19.5)	9,898 (19.1)
35–39,9	276 (4.8)	344 (5.3)	333 (6.1)	2,313 (4.5)
≥ 40	98 (1.7)	109 (1.7)	90 (1.6)	328 (0.6)
ASA-class n (%)				
ASA I	801 (12.4)	659 (9.6)	389 (6.8)	9,727 (18.4)
ASA II	3,292 (51.2)	3,470 (50.5)	2,793 (49.1)	31,845 (60.3)
ASA III	2,213 (34.4)	2,585 (37.6)	2,357 (41.5)	10,912 (20.7)
ASA IV	129 (2.0)	162 (2.4)	147 (2.6)	314 (0.6)

Table 5.2.1. Demography for all types of reoperation in three selected periods 2010–2022. Data for primary replacements 2020–2022 are shown for comparison.

The relation between reoperations and primary operations gives some idea of the extent to which reoperations burden the healthcare resources for hip replacement surgery in a country or within a region. However, it is not a suitable measure for other purposes due to its sensitivity to fluctuations in the number of primary operations performed. The quota is also affected by many other factors such as patient flows between healthcare regions, the attitude of the medical profession towards performing reoperations and by the time period that hip replacement surgery has been practised within a healthcare region. As noted above, the reporting of reoperations is not as complete as reporting of primary operations. This applies especially to reoperations where the implant is left untouched. The reason may be that this type of operation is not rarely performed by orthopaedic surgeons without a special profiling against replacement surgery. Lack of knowledge that reoperations also must be reported to the register, even though the prosthesis itself has not been exchanged or extracted, is another reason. A deficient penetration of information left by the register management may also have contributed. We hope, however, that awareness within the profession regarding the importance of reporting even these procedures gradually increases. Linkage with the National Patient Register is a possibility to nevertheless catch these cases but is aggravated by the fact that used measure codes sometimes are too unspecific. We would like to highlight this problem to stress the importance of using the correct code both for diagnosis and surgical procedure.

The distribution of reoperations between units

In 2022, the proportion of reoperations performed at university units and at privately driven units decreased. In 2022, (data for 2021 in parenthesis) 28.6 % of the reoperations of total hip replacements were performed at university units, 66.3 % (57.5 %) at other public units and 5.1% (5.8 %) at private units. The number of units that performed ten or fewer reoperations in 2022 increased somewhat (n = 25) compared with the year before (n = 23). Even those who performed between 11 and 25 reoperations increased marginally (2022: n = 25; 2021: n = 23, figure 5.2.3). The number of units that perform ten or less reoperations per year is conspicuously high (see also chapter 5.3 for a more detailed analysis based on performed revisions).

Demography

In this year's report, reoperations performed in the three periods, 2010–2012, 2014–2016 and 2020–2022, are compared. In addition, demographic data for primary replacements performed in the last three-year period are shown. Table 5.2.1 shows that the mean age at reoperation in the most recent period continues to increase and was in the last three-year period about three years higher than for patients operated with a primary replacement. The proportion of females who undergo reoperation tends to decrease and was in the last period about 10 % lower than the corresponding proportion in primary surgery. This is expected since males are more frequently affected by complications that result in a reoperation.

Patients reoperated between 2020 and 2022 had slightly higher mean BMI than those having a primary replacement (data not shown). From the first period to the most recent, the proportion of reoperated patients with ASA class III–IV has increased from 36.4 % to 44.1%. In case of primary surgery this proportion was less than half as large, 21.3 %.

In summary, males are reoperated to a larger extent than expected based on the sex distribution in primary surgery. Patients who undergo reoperation also tend to be slightly older, have slightly higher BMI and higher degree of comorbidity compared with the situation in primary surgery. In addition, the degree of comorbidity and to a lesser extent, BMI and age tend to have gradually increased in patients who undergo reoperation.

Reason for reoperation

Since 2016 the Swedish Arthroplasty Register registers the reason or reasons for a reoperation with two variables, which means that two different reasons can be registered. For total hip replacements there are 35 different predefined reasons, often condensed into main groups when presented. As an example, it can be mentioned that three different reasons, loosening, osteolysis and wear often are presented under the main heading loosening.

In table 5.2.2 reason for reoperation is presented for the last two ten-year periods in detail separated into first time reoperations and reoperations that have been preceded with at least one previous reoperation. Since the database until 2015 had considerably more reasons, this data has been reclassified as far as possible according to the new classification. Also, in table 5.2.2 there has been a certain simplification. For example, the reason osteolysis is presented as one group regardless of its localisation.

Among the reasons that are usually not presented other than as part of a main group, it can be noted that the number of reoperations due to wear and osteolysis has decreased, probably as an effect of increasing use of highly cross-linked polyethylene. Furthermore, an increase in reoperations due to unclear pain and trochanteric problems is noted in the last ten-year period, an increase that is not entirely justified. The background is that the number of procedures performed was relatively high in the beginning of the period to be greatly reduced in its latter half, possibly because a few years ago we started to pay attention to the poor results after reoperation for these reasons.

A high number of reoperations due to pseudo tumour (ALVAL, Aseptic Lymphocyte-dominated Vasculitis Associated Lesions or ALTR, Adverse Local Tissue Reaction) is noted especially in the beginning of the second period, to become substantially reduced during its latter half. In 2022, this reason was the main one for reoperation in only ten cases (figure 5.2.4).

Detailed main reason for reoperation in the two last ten-year periods

	2003–2012				2013–2022			
	First reoperation		At least one previous reoperation		First reoperation		At least one previous reoperation	
Reason	Number	Propor-tion %	Number	Propor-tion %	Number	Propor-tion %	Number	Propor-tion %
Total	**14,825**	**100.0**	**6,620**	**100.0**	**14,592**	**100.0**	**6,377**	**100.0**
Loosening (regardless of time after op)	7,198	48.6	1,914	28.9	6,074	41.6	1,385	21.7
Fracture femur	2,273	15.3	740	11.2	2,296	15.7	602	9.4
Dislocation, instability, subdislocation	1,807	12.2	1,064	16.1	1,781	12.2	813	12.7
Infection	1,718	11.6	2,237	33.8	3,038	20.8	3,112	48.8
Osteolysis acetabulum and/or femur	742	5	111	1.7	255	1.7	27	0.4
Cup or liner wear	413	2.8	50	0.8	256	1.8	31	0.5
Implant breakage (including plate)	186	1.3	96	1.5	128	0.9	76	1.2
Unclear pain	126	0.8	70	1.1	158	1.1	64	1
Trocanteric problems, limp, gluteus medius rupture	56	0.4	21	0.3	99	0.7	11	0.2
Incorrectly inserted implant (eg.penetration)	44	0.3	14	0.2	40	0.3	8	0.1
Heterotopic bone formation	34	0.2	15	0.2	43	0.3	17	0.3
Other reason (including technical)	25	0.2	8	0.1	46	0.3	16	0.3
ALVAL/pseudotumor	24	0.2	5	0.1	111	0.8	20	0.3
Bleeding, hematoma	24	0.2	38	0.6	39	0.3	43	0.7
Loose implant part	24	0.2	13	0.2	8	0.1	6	0.1
Other left material	23	0.2	51	0.8	7	0	10	0.2
Difference in leg length	20	0.1	5	0.1	16	0.1	7	0.1
Cement problem (loose piece of cement, inadequate cementation etc.)	20	0.1	8	0.1	29	0.2	6	0.1
Wound complication (wound rupture, wound granuloma)	20	0.1	17	0.3	20	0.1	16	0.3
Delayed fracture healing	12	0.1	94	1.4	6	0	37	0.6
Elevated metal ions/corrosion	11	0.1	1	0	61	0.4	8	0.1
Fracture under resurfacing prosthesis	10	0.1	2	0	19	0.1	0	0
Malignant or benign tumor	6	0	1	0	9	0.1	5	0.1
Cyst/bursa	5	0	1	0	10	0.1	2	0
Fracture acetabulum	3	0	1	0	26	0.2	15	0.2
Not availiable	1	0	1	0	0	0	0	0
Allergy (suspected or known)	0	0	1	0	2	0	2	0
Dislocation/fracture spacer	0	0	40	0.6	4	0	33	0.5
Nerve or vascular injury	0	0	1	0	3	0	0	0
Per operative fracture (previous op)	0	0	0	0	8	0.1	5	0.1

Table 5.2.2. The distribution of reasons for reoperation at detailed level in the last 20 years divided in ten-year periods for the first reoperation and for hips reoperated at least once before.

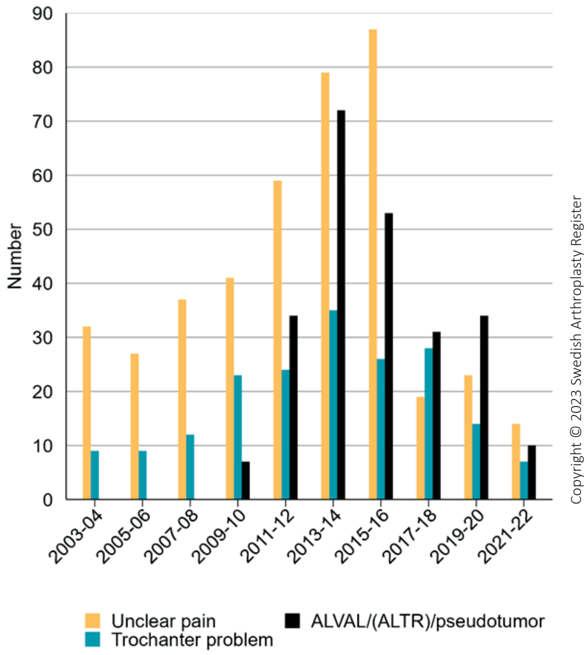

Figure 5.2.4. Number of reoperations due to unclear pain, trochanter problem and ALVAL/ (ALTR)/pseudotumor 2003–2022 divided into two-year periods.

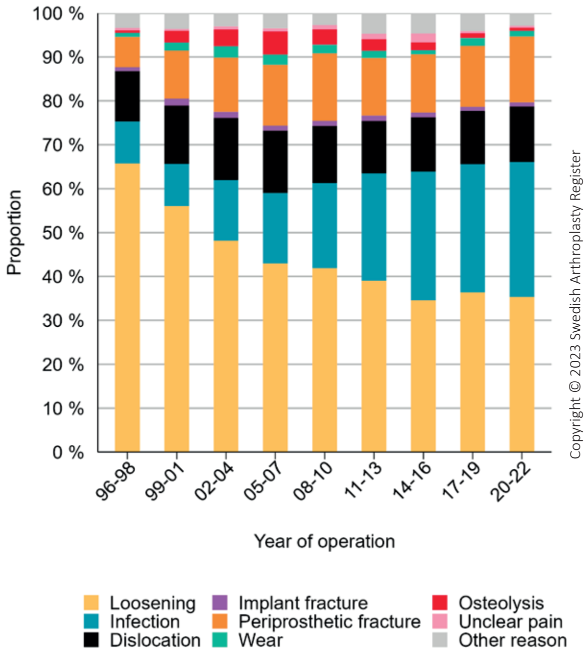

Figure 5.2.5. Reason for reoperation 1996–2022 divided in three-year periods.

Figure 5.2.5 presents the most common causes of reoperation. Since the period 1996–1998, the proportion of reoperations due to loosening has gradually decreased and the proportion of reoperations due to infection has increased. The proportion of dislocation increased in the late 1990s and early 2000s until the period 2005 to 2007. Since then, it has been around 12–13 %. The rate of periprosthetic fractures also increased gradually until the period 2008 to 2010 when it reached 15.3 %. Since then, it has been 1–2 % lower in the following three periods, rising again to 15.3 % in the last one.

The causal distribution of reoperation gives an idea of the distribution of the prosthesis-related problems that lead to surgical intervention. However, it gives a very limited idea of how the quality of the primary prostheses that are performed may change over time, measured as the proportion that ends with a reoperation. To illustrate this better, figure 5.2.6 shows the proportion of reoperated within ten years for primary prostheses inserted over three-year periods from 1996 to 2013, so that all primary surgery included in the group has been observed for ten years. In addition, information on causal distribution is available in main groups. Although mortality is likely to decrease over time, we believe that this will only have a marginal impact on the outcome. We find that the proportion of reoperated within ten years decreased from 7.8 % in the first period to 4.5 % in the last period. The reduction of 3.3 % between the first and last period corresponds to a reduction of approximately 340 fewer reoperations per year between the periods 1996 to 1998 and 2011 to 2013.

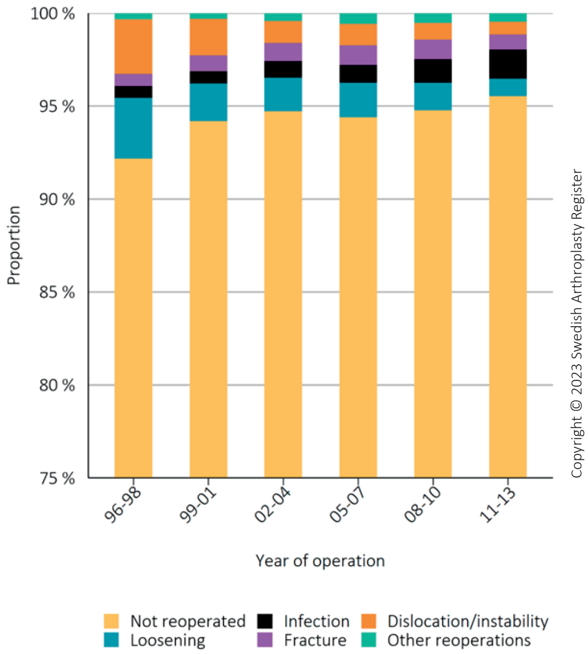

Figure 5.2.6. Six groups of primary hip replacements operated on during subsequent three-year intervals 1996–2013 where all observations have the same follow-up period (10 years). The figure illustrates how the proportion that is reoperated within a ten-year period has gradually decreased. In addition to the proportion of reoperations, the reason for reoperation is also stated.

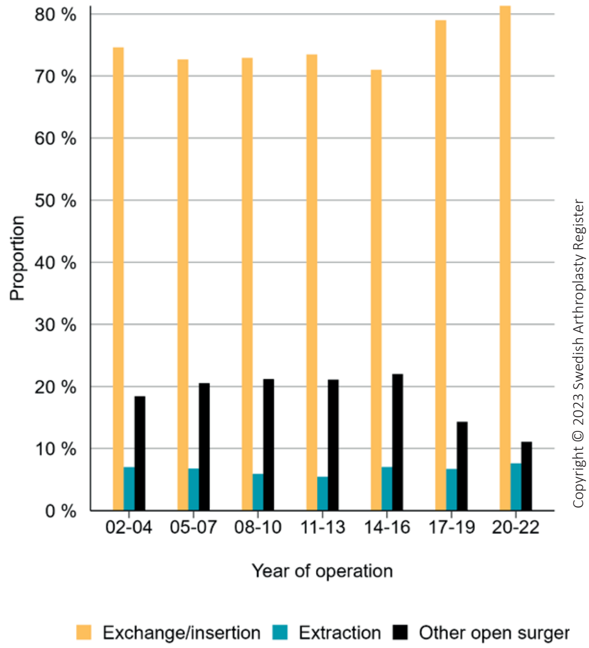

Figure 5.2.7. The distribution of the main procedures exchange/insertion, extraction and other open procedures without implant exchange or extraction in three-year periods 2002–2022.

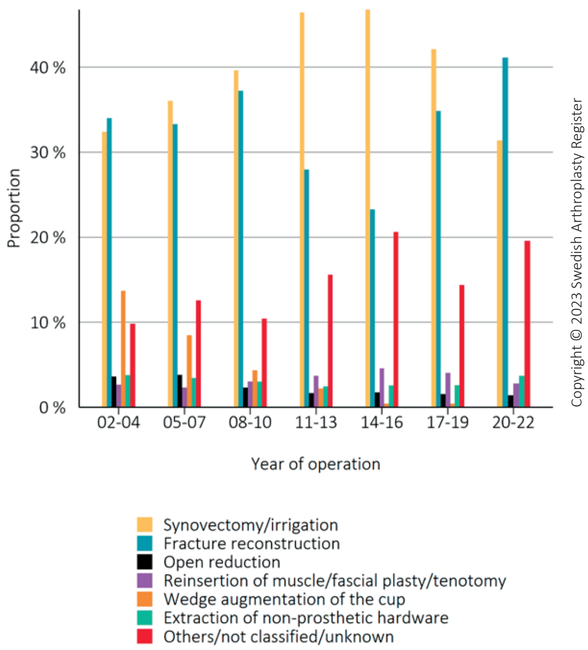

Figure 5.2.8. The most common reasons for reoperation in three-year periods 2002–2022.

Reoperation without exchange/extraction of implants

Reoperations without exchange or extraction of implant components are usually performed due to infection or fracture. In the early 2000s, dislocation was also one of the dominant reasons, but has decreased in frequency, probably because open reduction has increasingly been substituted with some kind of component change including more extensive procedures such as cup and/or stem revision. Furthermore, operation with acetabular wedge augment has almost disappeared.

The proportion of reoperations without implant exchange or extraction (other open procedures in figure 5.2.7) increased until the period 2014 to 2016 due to an increased number of operations of the type synovectomy/irrigation in case of infection and to a lesser extent, fracture reconstruction. Hereafter the number of reoperations due to infection and without implant exchange has decreased, a positive development especially since these procedures seem to have been replaced with procedures including exchange of the femoral head and liner (if present), procedures shown to have an improved probability to eradicate the infection. Figure 5.2.8 a shows that the proportion of synovectomy/irrigation procedures have decreased. Between 2014 to 2016 and the most recent period, the visualized decrease in percentage of the total number of synovectomy/irrigation meant a reduction in number per year from 250–300 to below 70 per year. The figure also shows a relative increase in the proportion of fracture reconstructions without implant exchange. This increase does not correspond to an increasing number of surgeries but is due to that these procedures constitute an increasing proportion of a type of reoperation that tends to become less common. Examples of type of surgery that have shown a clear reduction in recent years are in addition to synovectomy/irrigation, insertion of acetabular wedge augment to counteract dislocation, open reposition of dislocated joint, extraction of foreign material (cement, osteosynthesis, etc.) and secondary suture. The number of procedures that have not been possible to classify also belong to this group. The largest number was noted in 2014–2016 (n = 174), in the most recent period there were only six cases, maybe an effect of a new and hopefully better classification system being introduced.

Summary

The proportion of reoperations seen in relation to the total number of hip related surgeries has over the last two decades decreased from 13.3 % to 9.8 % in the period 2020–2022, mainly because of an increase in the proportion of primary operations.

Reoperation due to infection has increased in absolute numbers at the same time as the number of reoperations due to loosening has decreased. It is unclear if the increased number of reoperations due to infection depends on a more active attitude towards surgical treatment or a real increase in the number of infections, but probably both these factors have contributed.

Males are affected by reoperation to a larger extent than expected based on the sex distribution in primary surgery. Patients undergoing reoperation are older and have a higher degree of comorbidity than the patients who undergo primary surgery.

In the last decade, the degree of comorbidity and to some extent BMI and age have increased among patients who undergo reoperation.

Be sure to report all reoperations, even those where no prosthesis component is exchanged. The frequency of reoperations is one of our most important quality parameters.

5.3 Reoperation within two years

Author: Johan Kärrholm

Reoperations that occur in the first two years after a primary operation are used as a quality indicator. The motive is that the most common reasons for early reoperation; infection, dislocation, fracture and early loosening, are possible to influence. To a certain extent they reflect existing routines, how they are adhered to, surgical technique and the unit's case-mix.

Reoperation within two years comprises all forms of additional surgery with direct relation to an earlier operation with total hip replacement. This outcome reflects mainly early and serious complications. The indicator is therefore quickly available and easier to use in clinical improvement work compared to cumulative risk of revision at ten years. This parameter is also an important measure of the quality of the operation and reflects to a higher degree than early reoperation factors such as choice of components and how their positioning affects the risk of late complications. Patient selection, healthcare process and choice of implant have not infrequently undergone more or less extensive changes over a ten-year period. This means that the outcome can become difficult to interpret from an improvement perspective based on current situation.

Reoperation within two years is selected by the Swedish Association of Local Authorities and Regions and the National Board of Health and Welfare as a national quality indicator. The indicator may be considered as one of the most important and most influenceable measure of outcome that the Swedish Arthroplasty Register reports. The proportion of reoperations in the third year is not part of this quality indicator but is shown anyway for increased transparency.

This year's report provides data for 2022 based on reoperations of all elective total hip replacements. This means that acute hip fractures, sequelae after earlier trauma and tumour diagnosis has been excluded. As can be seen from figures 5.3.1 a-c, the proportion of osteoarthritis (previous named: primary osteoarthritis) varies between the different units. Overall, 21.7 % of patients who are operated on at university hospitals received a diagnosis other than osteoarthritis. The corresponding proportion that is operated on in public care, outside university hospitals, is lower (other units: 8.5 %). In private driven units the same proportion to only 2.1 %.

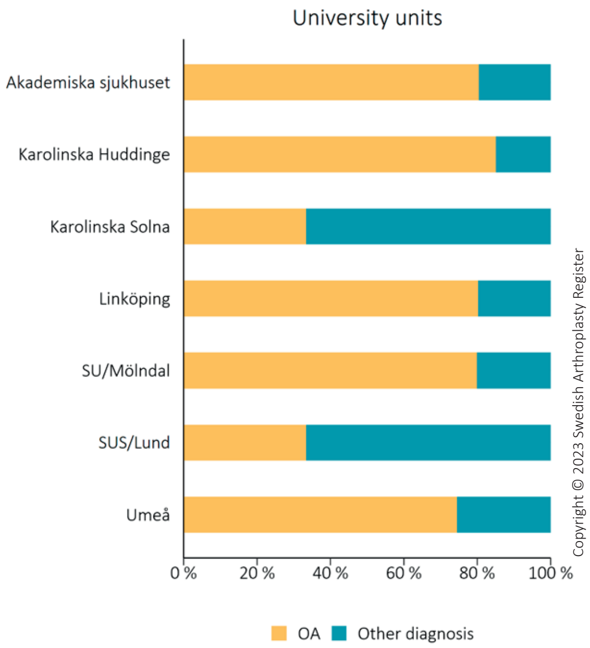

Figure 5.3.1a. The distribution of primary hip replacements performed due to OA and performed due to other reasons. The diagnosis acute hip fracture, sequel fracture or trauma or tumour diagnosis are excluded. University units are shown.

Over the past four periods the proportion of reoperations within two years has varied between 2.2 and 2.3 % for the country overall (tables 5.3.1 and 5.3.2). For the units that performed at least 100 operations in the most recent period the variation in the proportion reoperated within two years has been large, between 0.4 and 5.5 %. Since 2005–2006 there has been a clear redistribution regarding reason for early reoperation. The relative proportion of reoperation due to infection has doubled mainly at the expense of the reason groups dislocation and periprosthetic fracture whose proportions have been reduced from 27.2 % to around 14 % and from 19.4 % to 10.2 % (figure 5.3.2) Also, the proportions in the reason groups loosening and other reasons has been reduced, albeit to a somewhat lesser extent (4.5 % and 5.1% respectively). The increase in the proportion of infections depends certainly on several factors. Most likely a more active attitude towards surgical treatment when suspecting infection is reflected. The observed increase may also depend on a real increase with selection of more antibiotic resistant stems over time and/or an increased awareness that reoperations without implant exchange also should be registered. Probably all these factors contribute to varying degrees.

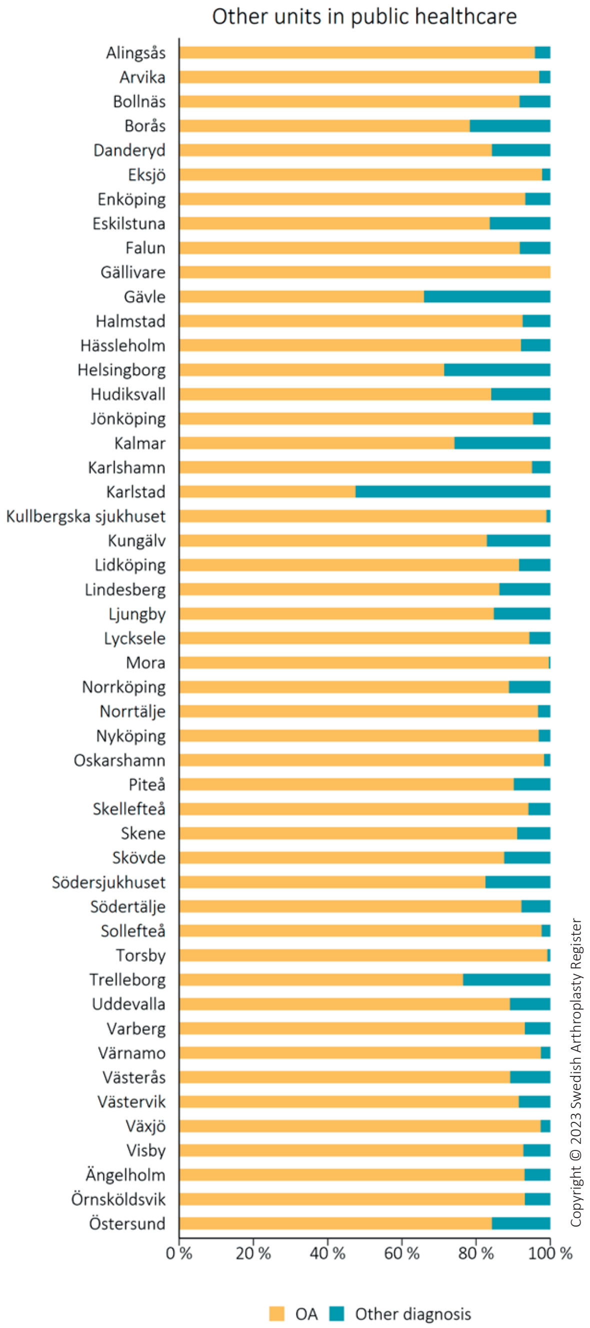

Figure 5.3.1b. The distribution of primary hip replacements performed due to OA and performed due to other reasons. The diagnosis acute hip fracture, sequel fracture or trauma or tumour diagnosis are excluded. All units in public healthcare except university units are shown.

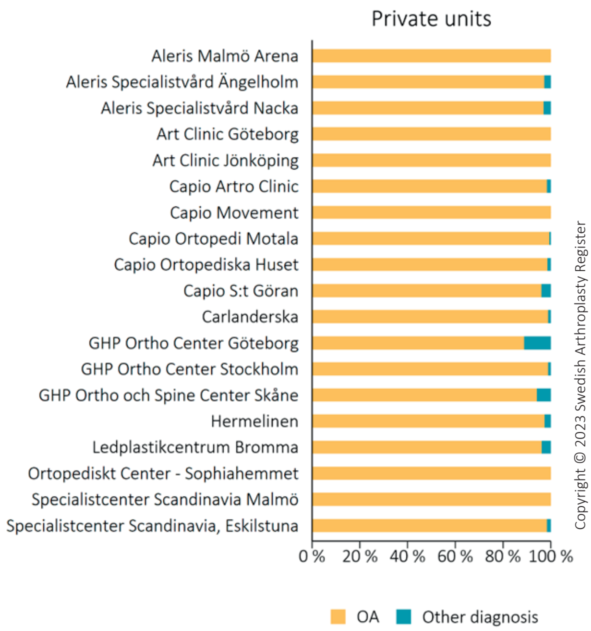

Figure 5.3.1 c. The distribution of primary hip replacements performed due to OA and performed due to other reasons. The diagnosis acute hip fracture, sequel fracture or trauma or tumour diagnosis are excluded. Private units are shown.

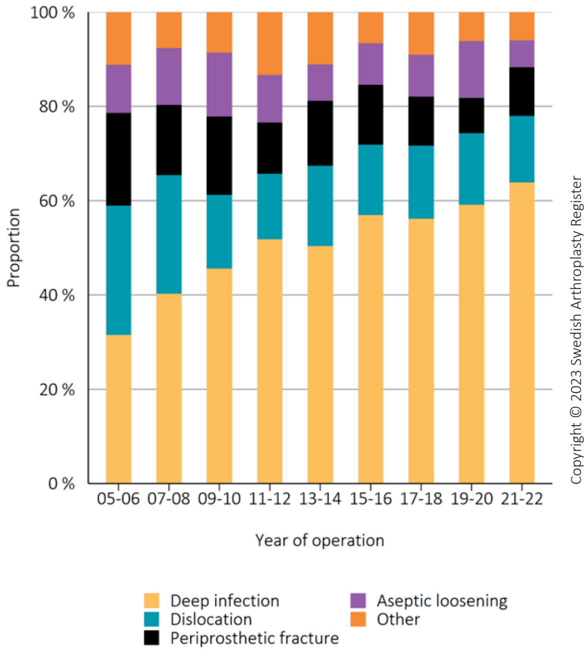

Figure 5.3.2. The distribution of reoperations within two years after the primary operation divided in nine time periods between 2005 and 2022.

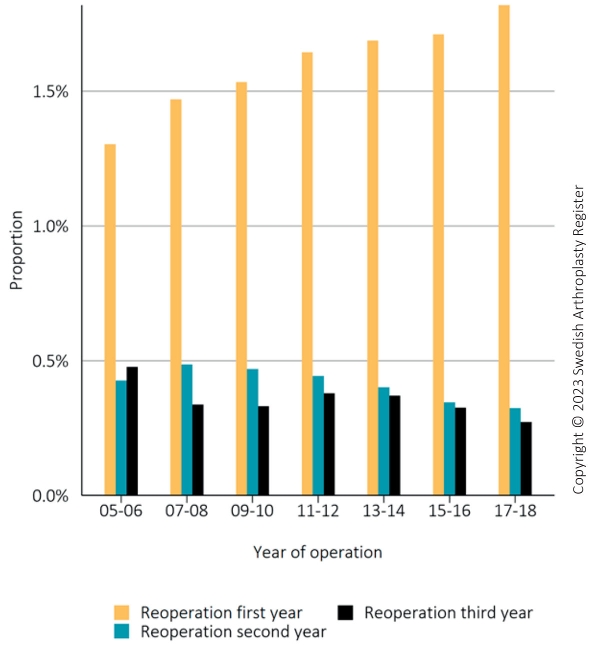

Figure 5.3.3. The proportion of reoperations in the first, second and third year respectively after the primary operation related to time period for prosthesis insertion.

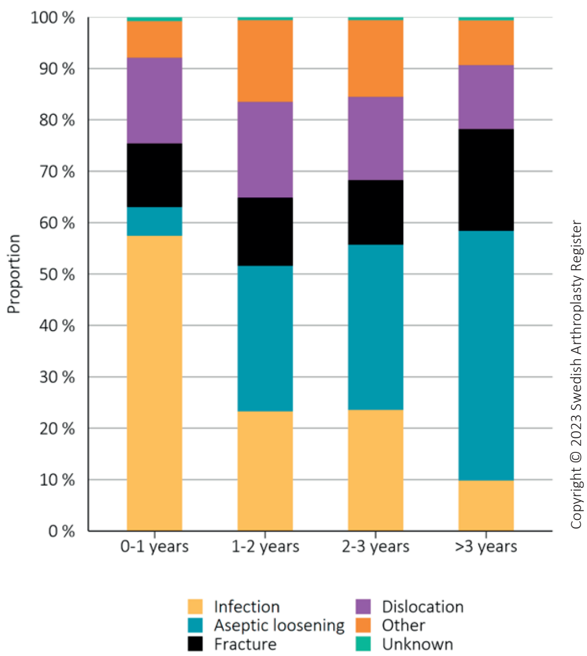

Figure 5.3.4. Most common reasons for reoperation per year up to three years after primary surgery and the distribution of the same main reasons for reoperations performed after three years.

The probability that one is affected by reoperation in the three first years after primary surgery is the largest in the first year (figure 5.3.3). If we look at the distribution of reasons from 2005 and forwards it becomes apparent that infection is by far the most common reason for reoperation in the first year after surgery (figure 5.3.4). In the following years, loosening dominates the proportion of which will gradually increases over time. Dislocation is the reason for reoperation in between 16.2 and 18.7 % of the cases in the first three years, to after that drop slightly to 12.4 %. In the same way the proportion of reoperated due to periprosthetic fracture is relatively constant (between 12.3 and 13.3 %) in the first three years but in contrast to the case with dislocation, an increase is seen here after three years to 19.8 %. The distribution of reasons over time partly reflects choice of implant, cement and surgical technique. Probably, for example, the risk of periprosthetic fracture, and maybe also for infection, would have been somewhat differently if we in Sweden used even more uncemented implants. Finally, the distribution is affected by the length of the time window especially regarding the proportion that is reoperated after three years. One must also not ignore that this section does not comprise trauma and tumour diagnoses.

Summary

Reoperation within two years is an important quality indicator because it partly reflects existing routines, how they are followed and surgical technique. Given data can however be misleading if you do not consider how complications may vary depending on the unit's case-mix.

In recent years, the proportion of reoperations within two years has varied between 2.2 and 2.3 % for the country overall. For the units that have performed at least 100 operations, the proportion of reoperations within two years has varied between 0.4 and 5.5 %.

Since 2005 to 2006, the relative proportion of reoperation due to infection has doubled, mainly at the expense of the reason groups dislocation and periprosthetic fracture.

Infection is by far the most common reason for reoperation in the first year after elective total hip replacement. In the following years, loosening dominates whose proportion gradually increases over time. Reoperation due to dislocation drops after three years, while the proportion who are reoperated due to periprosthetic fracture increases. The distribution of reasons over time reflects to a certain extent choice of implant and surgical technique in the period being evaluated.

Reoperations within two years per unit, primary replacements due to OA

	Primary operation	Reoperation		Whereof revision	Deep infection		Luxation		Fracture		Other	
Unit	Number	Number	Proportion	Number	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion
University units												
Akademiska sjukhuset	509	13	2.7	12	11	2.3	2	0.4	0	0	0	0
Karolinska Huddinge	831	14	1.8	11	10	1.2	2	0.2	2	0.4	0	0
Karolinska Solna	150	6	5	6	3	2	0	0	0	0	2	2.3
Linköping	342	12	4.5	12	7	2.4	4	1.5	1	0.6	0	0
SU/Mölndal	1,398	53	4.3	46	30	2.3	9	0.7	4	0.3	9	0.9
SUS/Lund	162	5	4	5	2	1.7	2	1.7	1	0.6	0	0
Umeå	204	4	2	3	3	1.5	0	0	0	0	1	0.5
Örebro	38	1	1	2.6	0	0	1	2.6	0	0	0	0
Private units												
Aleris Malmö Arena	31	0	0	0	0	0	0	0	0	0	0	0
Aleris Specialistvård Bollnäs	270	1	0.4	1	0	0	1	0.4	0	0	0	0
Aleris Specialistvård Motala	105	1	1	1	1	1	0	0	0	0	0	0
Aleris Specialistvård Nacka	1,494	20	1.7	18	9	0.6	7	0.7	0	0	4	0.4
Aleris Specialistvård Ängelholm	1,523	36	3	36	17	1.1	7	0.6	3	0.2	9	1.1
Art Clinic Göteborg	899	8	0.9	8	3	0.3	2	0.2	2	0.2	1	0.1
Art Clinic Jönköping	923	4	0.5	3	4	0.5	0	0	0	0	0	0
Capio Artro Clinic	2,266	55	2.8	49	30	1.5	5	0.3	6	0.3	13	0.7
Capio Movement	1,704	22	1.6	22	5	0.4	5	0.3	8	0.6	4	0.3
Capio Ortopedi Motala	1,457	27	2	27	21	1.5	0	0	1	0.1	5	0.4
Capio Ortopediska Huset	2,874	53	2.2	48	28	1	2	0.1	10	0.4	13	0.7
Capio S:t Göran	1,578	26	1.8	22	12	0.8	5	0.3	0	0	8	0.6
Carlanderska	1,805	21	1.3	21	15	0.9	0	0	2	0.1	3	0.2
Carlanderska-SportsMed	218	3	1.5	3	3	1.5	0	0	0	0	0	0
Frölundaortopeden	51	0	0	0	0	0	0	0	0	0	0	0
GHP Ortho Center Göteborg	1,228	32	2.9	32	27	2.5	2	0.2	3	0.3	0	0
GHP Ortho Center Stockholm	3,199	47	1.7	45	24	0.9	8	0.3	5	0.2	10	0.4
GHP Ortho och Spine Center Skåne	206	1	0.6	1	1	0.6	0	0	0	0	0	0
Hermelinen	115	1	0.9	1	1	0.9	0	0	0	0	0	0
Ledplastikcentrum Bromma	260	9	4.5	8	7	3.5	1	0.6	0	0	1	0.4
Ortopediskt Center – Sophiahemmet	292	4	1.5	3	1	0.4	0	0	1	0.4	2	0.7
Sophiahemmet	736	13	1.8	12	7	1	1	0.1	1	0.1	3	0.4
Specialistcenter Scandinavia Malmö	51	0	0	0	0	0	0	0	0	0	0	0
Specialistcenter Scandinavia Eskilstuna	238	2	2.9	1	0	0	1	2.4	1	0.6	0	0

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Reoperations within two years per unit, primary replacements due to OA, cont.

	Primary operation	Reoperation		Whereof revision	Deep infection		Luxation		Fracture		Other	
Unit	Number	Number	Propor-tion	Number	Number	Propor-tion	Number	Propor-tion	Number	Propor-tion	Number	Propor-tion
Other units												
Alingsås	616	17	3.3	15	13	2.3	3	0.7	0	0	1	0.3
Arvika	955	17	2.2	15	12	1.3	0	0	2	0.4	3	0.5
Bollnäs	1,010	13	1.9	12	8	1	1	0.1	1	0.1	3	0.6
Borås	276	3	1.3	2	3	1.3	0	0	0	0	0	0
Danderyd	624	18	3.6	17	11	2.1	5	1.2	0	0	1	0.2
Eksjö	942	19	2.2	18	16	1.9	2	0.2	1	0.1	0	0
Enköping	1,828	41	2.6	36	19	1.1	11	0.6	4	0.2	7	0.6
Eskilstuna	243	9	3.9	9	7	3	1	0.5	1	0.4	0	0
Falköping	149	3	2	3	3	2	0	0	0	0	0	0
Falun	456	7	2	5	3	0.7	2	0.7	0	0	2	0.6
Gällivare	250	0	0	0	0	0	0	0	0	0	0	0
Gävle	408	6	1.6	6	3	0.8	0	0	0	0	3	0.8
Halmstad	591	8	1.4	8	6	1	0	0	0	0	2	0.4
Helsingborg	182	6	4.2	6	2	1.1	2	1.1	0	0	2	2
Hudiksvall	259	3	1.5	3	2	0.8	1	0.7	0	0	0	0
Hässleholm	2,736	32	1.3	27	24	0.9	3	0.1	3	0.1	2	0.1
Jönköping	410	5	1.4	4	2	0.5	2	0.5	0	0	1	0.4
Kalmar	366	3	0.8	3	3	0.8	0	0	0	0	0	0
Karlshamn	976	19	2.2	18	9	1	4	0.5	4	0.5	2	0.2
Karlskrona	51	1	2.8	1	1	2.8	0	0	0	0	0	0
Karlstad	239	7	3.1	7	5	2.2	1	0.4	1	0.4	0	0
Kullbergska sjukhuset	1,227	30	2.6	29	23	1.9	3	0.3	0	0	4	0.4
Kungälv	424	19	4.6	19	16	3.9	1	0.2	0	0	2	0.5
Lidköping	717	10	1.4	10	5	0.7	2	0.3	2	0.3	1	0.1
Lindesberg	1,683	15	0.9	11	8	0.5	1	0.1	2	0.1	3	0.2
Ljungby	465	7	1.5	7	4	0.9	2	0.4	0	0	1	0.2
Lycksele	988	12	1.3	11	6	0.6	0	0	1	0.1	5	0.6
Mora	898	7	1	5	6	0.8	0	0	0	0	1	0.2
Norrköping	600	5	0.9	5	4	0.7	0	0	0	0	1	0.2
Norrtälje	559	21	4.3	21	12	2.3	4	0.7	1	0.2	4	1.1
Nyköping	455	12	2.8	12	10	2.2	1	0.3	0	0	1	0.2
Oskarshamn	1,401	27	2.3	27	23	1.9	2	0.2	1	0.1	1	0.1

The table continues on the next page.

Reoperations within two years per unit, primary replacements due to OA, cont.

	Primary operation	Reoperation		Whereof revision	Deep infection		Luxation		Fracture		Other	
Unit	Number	Number	Propor-tion	Number	Number	Propor-tion	Number	Propor-tion	Number	Propor-tion	Number	Propor-tion
Piteå	1,588	19	1.5	17	4	0.3	8	0.6	1	0.1	5	0.4
Skellefteå	440	3	0.7	3	1	0.2	0	0	0	0	2	0.5
Skene	653	11	2.2	9	8	1.4	0	0	0	0	3	0.8
Skövde	110	6	5.9	5	5	5	0	0	1	0.9	0	0
Sollefteå	1,269	11	0.9	11	9	0.7	1	0.1	1	0.1	0	0
Sundsvall	60	2	3.4	2	2	3.4	0	0	0	0	0	0
Södersjukhuset	525	14	3.3	12	9	2.1	2	0.4	3	0.8	0	0
Södertälje	442	3	0.7	3	0	0	0	0	2	0.5	1	0.3
Torsby	478	13	3.2	12	6	1.4	3	0.9	4	0.9	0	0
Trelleborg	1,610	19	1.2	19	10	0.6	7	0.5	2	0.1	0	0
Uddevalla	1,132	21	2	19	16	1.5	0	0	3	0.3	2	0.2
Varberg	741	9	1.3	8	5	0.8	1	0.1	2	0.3	1	0.1
Visby	485	9	2.1	7	4	0.9	0	0	2	0.5	3	0.8
Värnamo	571	20	3.9	18	15	2.8	1	0.2	0	0	3	0.7
Västervik	476	17	3.7	16	11	2.3	2	0.4	1	0.2	3	0.7
Västerås	1,248	48	4.4	48	28	2.5	10	0.9	2	0.2	7	0.6
Växjö	536	17	3.3	17	13	2.5	4	0.8	0	0	0	0
Ängelholm	636	10	1.8	10	4	0.7	4	0.8	1	0.2	1	0.2
Örnsköldsvik	467	5	1.3	5	3	0.7	0	0	0	0	2	0.6
Östersund	698	22	3.5	22	10	1.6	7	1.1	2	0.3	3	0.5
Country	64,315	1,175	2.1	1,093	714	1.2	171	0.3	102	0.2	177	0.4

Table 5.3.1. Reoperations within two years per unit based on primary total hip replacements due to OA 2019–2022. Units with fewer than 20 primary replacements in the current period are excluded. Total number of reoperations and revisions may differ from the sum of specified complications since there might be more than one type of complication. All proportions are calculated using competing risk analysis.

Reoperations within two years per unit, primary replacement due to OA, trend 2016–2022

Unit	2016–2019 Proportion	2017–2020 Proportion	2018–2021 Proportion	2019–2022 Proportion
University units				
Akademiska sjukhuset	3.2	2.7	2.7	2.4
Karolinska Huddinge	2.8	3.3	2.8	2.3
Karolinska Solna	6	7.6	7.1	5.8
Linköping	5.2	4.1	4.2	4.3
SU/Mölndal	3	3.1	3.9	4
SU/Sahlgrenska	*	*	*	*
SUS/Lund	2.3	2.6	3.4	4.2
SUS/Malmö	2	2.1	0	0
Umeå	2.8	3.1	4.3	3.2
Örebro	3.6	2.8	4.5	4.7
Private units				
Aleris Specialistvård Bollnäs	1	1.1	1	0.4
Aleris Specialistvård Motala	1.7	1.5	1.4	0.9
Aleris Specialistvård Nacka	1.6	1.4	1.5	1.7
Aleris Specialistvård Ängelholm	2.2	2.9	2.8	3
Art Clinic Göteborg	0.9	0.8	0.8	0.9
Art Clinic Jönköping	0.5	0.4	0.5	0.5
Capio Artro Clinic	2.7	2.6	2.8	2.8
Capio Movement	2.1	1.9	1.8	1.6
Capio Ortopedi Motala	3.1	2.3	2.2	2.1
Capio Ortopediska Huset	1.3	1.5	1.8	2.2
Capio S:t Göran	2.1	2	1.8	1.8
Carlanderska	1.2	1.2	1.1	1.3
Carlanderska-SportsMed				1.5
Frölundaortopeden	2.7	2.3	2	0
GHP Ortho Center Göteborg	1.4	2	2.2	2.9
GHP Ortho Center Stockholm	1.6	1.7	1.8	1.7
GHP Ortho och Spine Center Skåne				0.6
Hermelinen	0	0	1	0.9
Ledplastikcentrum Bromma				4.5
Ortopediskt Center – Sophiahemmet				1.5
Sophiahemmet	2.1	1.7	1.6	1.8
Specialistcenter Scandinavia Eskilstuna	*	*	2.4	2.9

The table continues on the next page.

Reoperations within two years per unit, primary replacement due to OA, trend 2016–2022, cont.

Unit	2016–2019 Proportion	2017–2020 Proportion	2018–2021 Proportion	2019–2022 Proportion
Other units				
Alingsås	2.2	2.6	3.1	3.1
Arvika	4.6	4.7	3.4	2.2
Bollnäs	3.5	2.3	2.1	1.9
Borås	2	1.9	2.3	2.4
Danderyd	3.9	3.9	4.1	4.2
Eksjö	4.1	4	3.4	2.5
Enköping	2	2.2	2.5	2.5
Eskilstuna	3	3	3	3.8
Falköping	1.9	2	2	2
Falun	3.9	3.8	2.9	1.6
Gällivare	0.7	0.2	0.3	0.6
Gävle	1.6	2	1.8	2
Halmstad	3	3	2.6	1.8
Helsingborg	4.5	6.8	6	4.1
Hudiksvall	1.7	1.5	1.6	1.8
Hässleholm	1.5	1.5	1.2	1.3
Jönköping	2.8	2.2	2.2	1.8
Kalmar	1.1	0.8	1.1	0.9
Karlshamn	2.7	2.3	2.3	2.2
Karlskoga	3.9	1.9	0	1.8
Karlskrona	2.6	3.1	3.7	3.8
Karlstad	4.8	4.3	3.8	2.5
Kristianstad	0.6	0.7	0	1.6
Kullbergska sjukhuset	4	3.3	2.8	2.6
Kungälv	3.7	4	5.1	5.1
Lidköping	2.4	2.1	1.7	1.5
Lindesberg	1.6	1.3	1.3	0.9
Ljungby	2.1	1.9	2	2.3
Lycksele	2.1	1.5	1.5	1.4
Mora	1.3	1.3	1.1	1
Norrköping	1.2	0.8	1.1	1.2
Norrtälje	2.7	3	3.2	4.1
Nyköping	3.2	3.4	3.1	2.8

The table continues on the next page.

Reoperations within two years per unit, primary replacement due to OA, trend 2016–2022, cont.

Unit	2016–2019 Proportion	2017–2020 Proportion	2018–2021 Proportion	2019–2022 Proportion
NÄL	1.8	1.7	1.6	0.9
Oskarshamn	1.3	1.5	1.9	2.2
Piteå	1.1	1.1	1.3	1.5
Skellefteå	1.8	2	1.6	1.4
Skene	1.6	2.2	2.6	2.2
Skövde	5.2	5	4.8	4.5
Sollefteå	1.6	1.1	1.1	0.9
Sunderby sjukhus	1.3	0.5	0	0
Sundsvall	2.7	1.8	0.6	2
Södersjukhuset	2.8	2.6	2.2	2.5
Södertälje	2.9	1.8	1.3	0.8
Torsby	3.6	4	3.7	3.2
Trelleborg	1.6	1.4	1.5	1.3
Uddevalla	2.1	2	2	2.2
Varberg	1.2	1	1.1	1.3
Visby	2.2	2.2	2.6	2.3
Värnamo	1.8	2.7	3.3	4
Västervik	2.1	2.2	2.6	3.9
Västerås	3.6	4.1	4.3	4
Växjö	4.4	3.8	4.9	3.6
Ystad	*	22.2	17.9	8
Ängelholm	1.7	1.8	2.1	2.3
Örnsköldsvik	1.3	1.2	1.1	1.4
Östersund	3.4	3.3	3	3.4
Country	**2.3**	**2.2**	**2.2**	**2.2**

Table 5.3.2. Reoperations within two years per unit based on primary elective total hip replacements (diagnoses other than OA included but patients operated on due to acute fracture, sequele fracture/trauma or with a tumor diagnosis have been excluded) 2016–2022. All proportions are calculated using competing risk analysis at two-years follow-up.

–) No primary replacements reported.

**) Fewer than 20 primary replacements in the period.*

5.4. Revision hip replacement

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This section comprises revision of total hip replacements regardless of primary diagnosis. In revision of a hip replacement parts of or the whole of the prosthesis are exchanged or extracted due to a complication. If the prosthesis or some of its parts are first extracted and later are inserted again for example awaiting the remediation of an infection (two stage or two step procedure) these two revisions are registered as one if not otherwise stated. If for example a primary hip replacement is revised in two stages, the extraction date will become time for revision of the primary hip replacement, while the insertion time will become starting point for continued observation of a first-time revision. If the prosthesis is extracted for good (no prosthesis insertion is registered at last time of observation, corresponding to 2022-12-31 in this year's report) the extraction is classified as permanent. The lack of reported prosthesis insertion after previous extraction is thus decisive if the extraction should be treated as permanent or not. Some extractions in the latter part of 2022 where insertion is planned in 2023 may then have been erroneously classified as permanent.

Since 1979 revisions (and other reoperations) have been reported on individual level, which means that more extensive data can be collected more than 40 years back in time. On the other hand, primary hip replacements have been classified on aggregated unit level until 1991 and only in 1992 an individually based registration was started based on personal identification numbers. In 1999 a more detailed registration of used components was added both in primary hip replacements and in revisions. BMI and ASA class were added in 2008, also in revisions.

Many patients wonder for how long their prosthesis will last. One way of describing this is to report the proportion of patients that have been able to keep their prosthesis to the end of their lives or who are alive and still retain the prosthesis based on operating year. Over time an increasing proportion of the primary hip replacements that have been performed a certain year will be revised and the proportion of patients alive is decreasing. Most of the patients will not be revised in their remaining lifetime. In figure 5.4.1 it is shown that of the patients that had their primary replacement in 1994, 78.9 % retained their prosthesis to the end of their lives, 6.6 % still alive with their primary prosthesis and 14.5 % had been revised at least once of which 5.6 % are still alive. The closer one moves to the present in the diagram the more patients are alive and retain their primary prosthesis. For those patients that were operated in 2013, that is ten years ago, the corresponding distribution is 24.3 % deceased without revised primary prosthesis, 72.2 % alive with primary prosthesis, 0.9 % are deceased after at least one revision and 2.6 % are alive after at least one revision.

The proportion of revisions of the total production of total hip replacements has decreased in the last two decades. Between the periods 2002–2004 and 2017–2019 the number of primary operations increased from on average 12,920 to 18,829 per year to decrease to 17,735 per year in the period 2020–2022 (figures 5.4.2 and 5.4.3). The number of revisions were 1,622 per year in the first three-year period and then constituted 11.2 % of all total hip replacements in the period. In 2017–2019 more revision in absolute numbers were reported (n=1,809 per year) but constituted just 8 % of the total number. In the last period, the number of revisions decreased to 1,630 per year corresponding to 8.4 % of the total number of total hip related surgeries in the period.

The number of performed revisions has from 2009 until 2019 remained relatively constant between 1,755 and 1,848 per year. In 2020 and 2021 the numbers were slightly lower (1,489 and 1,579 respectively), which likely is an effect of the pandemic as the number increased by 1,822 in 2022.

In the light of the proportion of elderly and the number of individuals with a hip replacement increases in the population, it would be expected that the number of hip replacements that are revised multiple times also increases. Such an increase was also noted until 1994 when multiple revisions constituted 20.6 % of all revisions. Hereafter, the proportion has varied between 19 and 24 %. In the period 1994 to 2022 they have averaged 22.3 % and in 2022 they constituted 21.2 %. In absolute numbers, multiple revisions increased more or less for three decades to 440 which was reported in 2010. Hereafter they have varied between 345 to 428 corresponding to an average number of 392 per year. In 2022, 387 were reported.

Thus, we cannot demonstrate an ongoing increase in the number of multiple patients that undergo revision differ (as do they who undergo reoperation) demographically from patients that are operated on with primary prosthesis. This can be seen as a natural effect of that patients with risk factors for revision progressively selected to the revision groups as they are subject to further revisions. In general, they are older, more often males, and have a higher degree of comorbidity (table 5.4.1). The diagnosis primary osteoarthritis is less common in the revision group and especially in multiple revision. The relative proportion of hips with acute hip fracture is also lower in the revision group compared with the primary group and it decreases further in multiple revision. High comorbidity and mortality in this group are contributing factors. The patients that have at least one revision behind them and undergoes another revision generally has as well higher degree of comorbidity, here measured as ASA class and an even greater proportion of them were initially operated on due to secondary osteoarthritis. The mean BMI is relatively similar between the groups, however with a tendency to a higher proportion of patients with BMI 30 or higher at the revision.

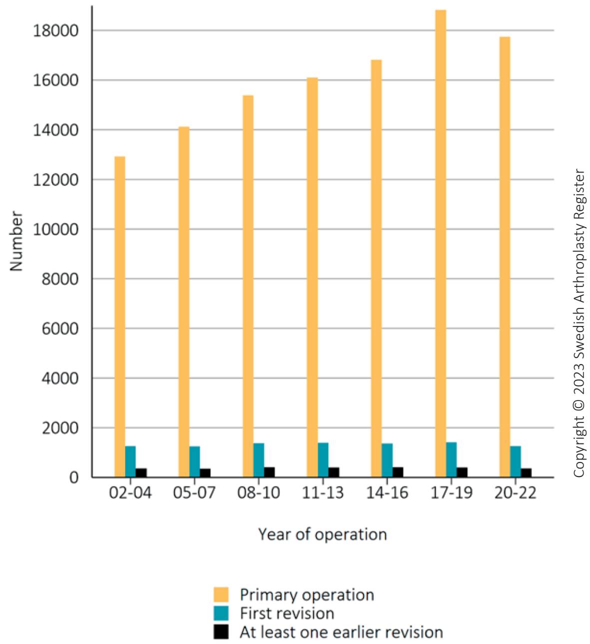

Figure 5.4.2 Number of primary hip replacements, first and multiple-time revisions respectively in 2002–2022. The figure shows the number of replacements as mean per year calculated in three-year periods. Over the entire interval 2002–2022, with the exception of the most recent period, the number of primary replacements has increased, while the number of revisions has been relatively constant. The mean per three-year period, varied between 1,622 and 1,809 per year.

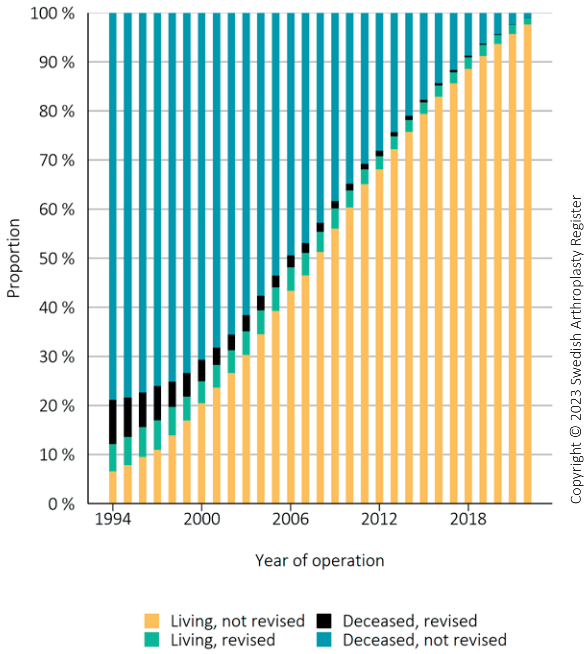

Figure 5.4.1. Distribution of patients with primary hip replacement and revision having surgery 1994–2022 divided into those who were alive and those who had died 31st of December 2022.

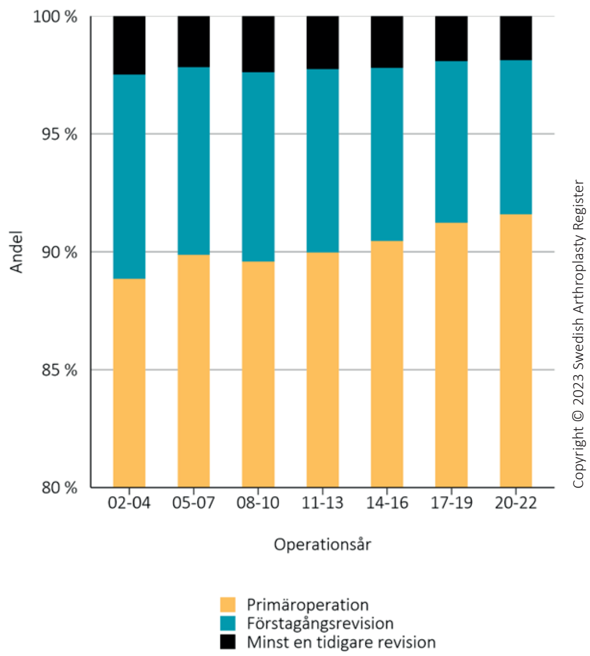

Figure 5.4.3. Proportion of primary hip replacements, first and multiple-time revisions in 2001–2022. The proportion of revisions decreased from 11.2% in the period 2002–2004 to 8.4% in the period 2020–2022.

Demography in first, second and multiple-time revision and primary hip replacement 2013–2022

	Primary replacement 2013–2022	Previous revisions, none 2013–2022	Previous revisions, one 2013–2022	Previous revisions, ≥ 2 2013–2022
Number	176,473	13,525	2,762	1,121
Mean age (SD)	69.00 (10.76)	72.07 (10.97)	72.27 (10.52)	71.59 (10.89)
Age group n (%)				
< 45	3,352 (1.9)	209 (1.5)	32 (1.2)	12 (1.1)
45–54	14,438 (8.2)	749 (5.5)	135 (4.9)	82 (7.3)
55–64	36,256 (20.5)	2,029 (15.0)	399 (14.4)	166 (14.8)
65–74	64,572 (36.6)	4,455 (32.9)	942 (34.1)	378 (33.7)
75–84	48,736 (27.6)	4,597 (34.0)	960 (34.8)	364 (32.5)
≥ 85	9,119 (5.2)	1,486 (11.0)	294 (10.6)	119 (10.6)
Females n (%)	102,300 (58.0)	6,897 (51.0)	1,330 (48.2)	538 (48.3)
BMI n (%)				
< 18.5	2,075 (1.2)	161 (1.3)	31 (1.2)	23 (2.2)
18.5–24.9	57,013 (33.4)	4,120 (32.3)	860 (33.0)	335 (32.1)
25–29.9	70,602 (41.3)	5,172 (40.6)	1,036 (39.8)	398 (38.2)
30–34.9	31,970 (18.7)	2,391 (18.8)	467 (17.9)	188 (18.0)
35–39.9	7,811 (4.6)	712 (5.6)	150 (5.8)	80 (7.7)
≥ 40	1,305 (0.8)	185 (1.5)	61 (2.3)	19 (1.8)
ASA class n (%)				
ASA I	34,905 (20.0)	1,238 (9.4)	176 (6.5)	48 (4.4)
ASA II	103,417 (59.3)	6,970 (52.8)	1,311 (48.7)	460 (42.5)
ASA III	34,899 (20.0)	4,753 (36.0)	1,128 (41.9)	549 (50.7)
ASA IV	1,125 (0.6)	252 (1.9)	79 (2.9)	26 (2.4)
Diagnosis n (%)				
Osteoarthritis	143,090 (81.1)	10,455 (78.3)	1,985 (73.6)	705 (64.8)
Acute hip fracture	16,433 (9.3)	697 (5.2)	123 (4.6)	57 (5.2)
Sequele fracture/trauma	3,908 (2.2)	423 (3.2)	110 (4.1)	65 (6.0)
Osteonecrosis	4,617 (2.6)	334 (2.5)	60 (2.2)	28 (2.6)
Sequele childhood hip disease	2,946 (1.7)	414 (3.1)	130 (4.8)	70 (6.4)
Inflamatory joint disease	1,154 (0.7)	465 (3.5)	183 (6.8)	103 (9.5)
Tumor	786 (0.4)	43 (0.3)	10 (0.4)	7 (0.6)
Acute trauma other	430 (0.2)	56 (0.4)	14 (0.5)	8 (0.7)
Other joint diseases	3,032 (1.7)	461 (3.5)	82 (3.0)	45 (4.1)

Table 5.4.1. Demography in first, second and multiple-time revisions from 2012. Corresponding variables are shown for primary hip replacements for comparison.

Revision volume per unit

For several years, we have followed the distribution of surgical volumes and noted that some units only perform few cases per year. This year's analysis comprises only total hip replacements. In 2022 these surgeries were performed in 86 units in Sweden of which 63 reported at least one revision. 24 of the units performed between one and ten revisions per year, 16 between 11 and 25, eleven between 26 and 50, eight between 54 and 84 and four (Akademiska Sjukhuset, Danderyd, Karolinska Huddinge, SU Mölndal) between 114 and 129 revisions. The year before (2021) the number of units in the group with the lowest volume (up to 10 per year) was slightly higher (n = 28) and in the group with second lowest volume (11–25 revisions per year) slightly lower (n = 10). 14 units performed 26–50, six 50–100, and three units (Akademiska Sjukhuset, Danderyd, SU Mölndal) performed between 104 and 129 revisions. Figures 5.4.4 and 5.4.5 shows the distribution of primary and revision surgeries per unit in the group total hip replacements in 2021 and 2022. The total number of these operations is also specified to be able to assess the relevance of the percentage distribution.

Some of the units reporting 10 or fewer revisions per year may have problems with poor reporting, but in most cases the reported number should be correct. In total these hospitals have together performed 79 first-time and 13 multiple revisions in 2022. The most common reason was loosening (n = 29), followed by infection (n = 25), dislocation (n = 15) and periprosthetic fracture (n = 8). Most common procedures were exchange of cup and/or liner (n = 23), exchange of femoral head (n = 21), exchange of cup/liner and stem (n = 19), exchange of stem (n = 14) and exchange of femoral head and liner. In the other cases, exchange of stem and liner or prosthesis extraction were performed. In one case information on procedure was lacking.

In summary, the number of units with low revision volumes per year has been relatively constant. We think that it is an advantage to maintain a certain volume of revisions not least as decision about performing a revision or not and choice of technique may be difficult and as the occurrence of perioperative complications and unexpected findings and events in revision surgery are not uncommon. In these cases, an experienced and for the purpose trained personnel, access to special instruments, bone bank and a sufficiently large assortment of implants should be available.

Risk of revision related to operating unit

The outcome for the individual unit regarding the risk of revision after primary surgery is influenced by many factors such as indication, case-mix, degree of preoperative optimisation, choice of implants and operating environment as well as other more or less known factors. Furthermore, there is a random variation. Not the less it is of interest to look at and visualize differences since it has been shown to be an excellent basis for possible deeper analysis and need for improvement work. As in previous years all elective primary hip replacements with the exclusion of trauma diagnoses (acute or sequelae) and tumour are included. The cumulated risk for revision at 10 years has been adjusted for differences in the distribution of diagnoses, age, sex and surgical year (figure 5.4.6). Since the window for analysis only is shift forward one year for each annual report, one can hardly expect any more dramatic changes compared to the previous year. We can however state that the number of units that are over the expected level has been reduced from four to three compared with the previous year. If one compares with the period 2010 to 2020 the corresponding number has decreased from six to three.

By analogy with the reporting of results in units that perform knee replacements we introduce this year a corresponding comparison of units that perform primary hip replacements. The relative risk of revision with 95 % confidence interval per unit is shown for a five-year period (operated 2017–2022, table 5.4.2) and for a ten-year period (2013–2022, table 5.4.3). The analysis concerns all diagnoses except acute trauma, sequelae after trauma or tumour diagnoses. This estimate the unit's effect on the revision risk relative to the national average and has been calculated with the use of a "shared gamma frailty model". Compared with a standard model of survival analysis a random effect is added to be able to handle the occurrence of correlation between the studied revision risks. The observed rank of the unit is shown with a 95 % confidence interval for the rank. The calculation has been performed using the Monte Carlo-method (stochastic simulation). The model is adjusted for differences in age and sex between the units. Only units with at least 50 observations are included. Units that are significantly better or worse than the national average have been marked in green and red respectively.

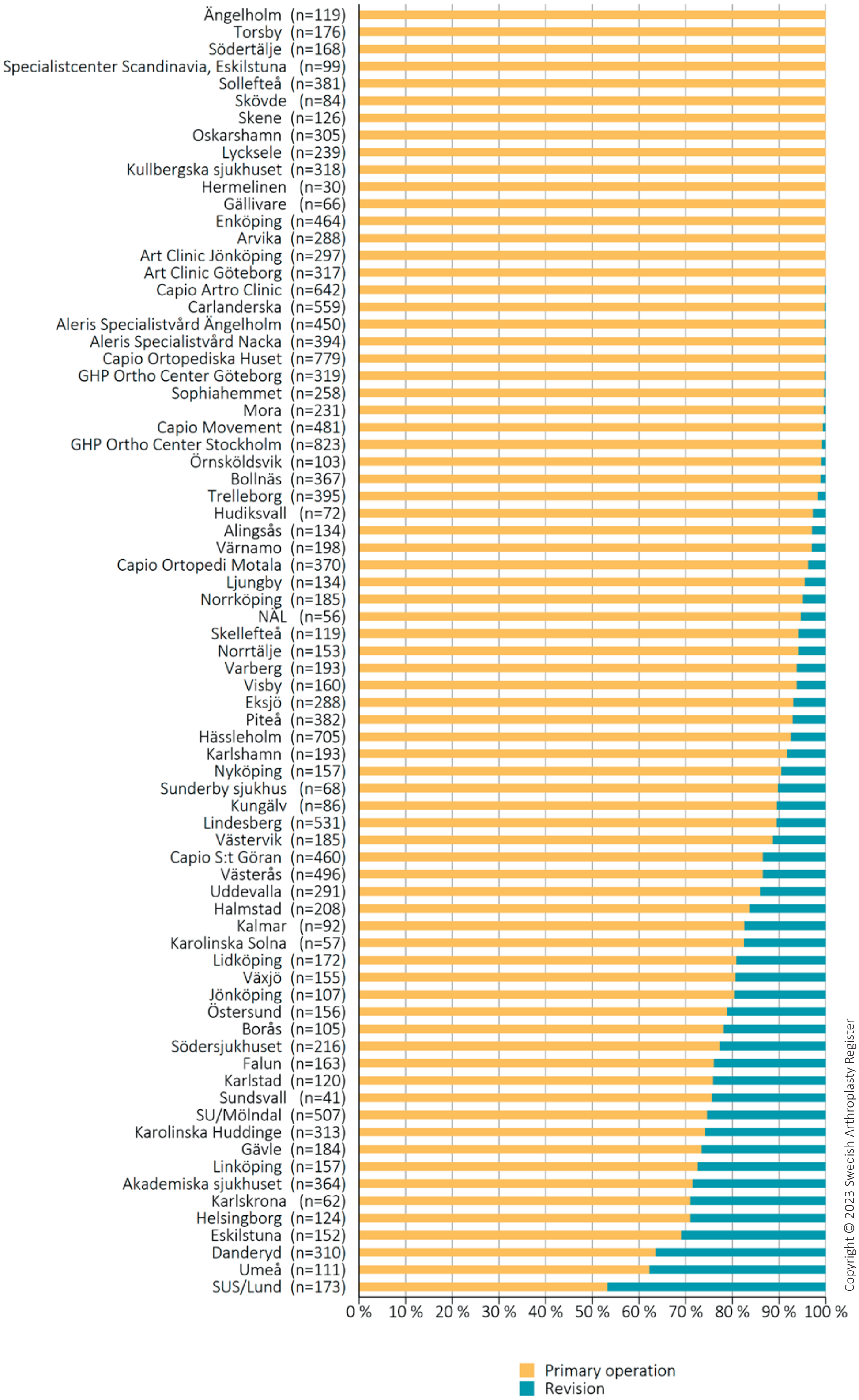

Figure 5.4.4. Distribution of primary total hip replacements and revisions of total hip replacements per unit in 2021. Total number of primaries are shown to the left.

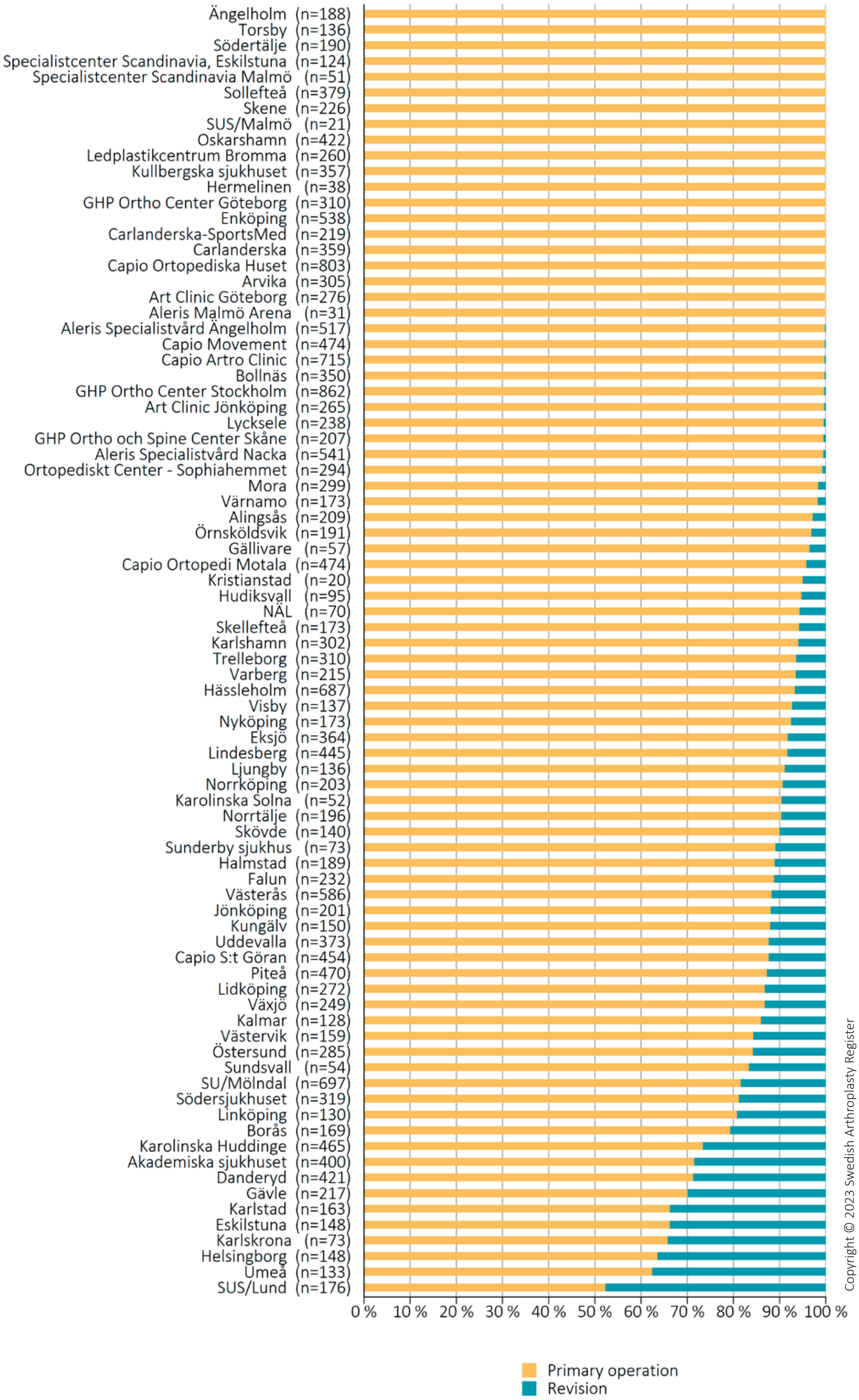

Figure 5.4.5. Distribution of primary total hip replacements and revisions of total hip replacements per unit in 2022. Total number of primaries and revisions are shown to the left. The number of units performing few revisions have been relatively constant over time. In 2022, 63 units reported that they performed at least one revision. 24 between one and ten audits and 16 between 11 and 25. At the top (bottom of diagram) were four units who reported between 114 and 129 revisions during the year.

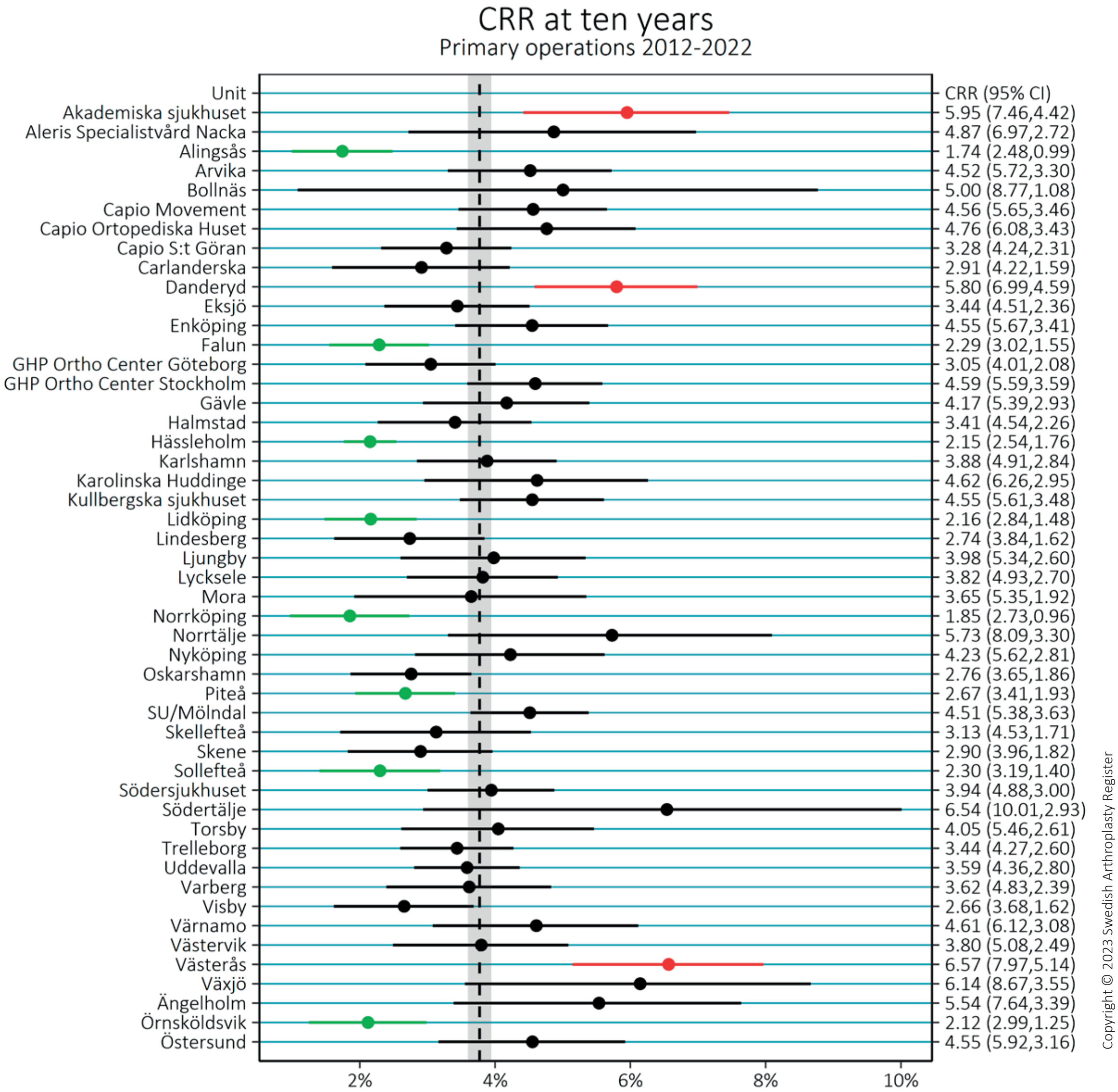

Figure 5.4.6. Cumulative revision risk per unit based on replacements performed 2012–2022. Patients with a diagnosis of trauma (acute or sequele) and tumor have been excluded. The cu-mulative risk of revision at 10 years has been adjusted for differences in distribution of diagno-sis, age, gender and year of surgery.

Relative risk of revision per unit, five years

Unit	Number	Revised	RR	RR 95 % CI	Rang	Rang 95 % CI
Gällivare	**426**	**1**	**0.41**	**0.19; 0.90**	**1**	**1-40**
Norrköping	**1,001**	**7**	**0.43**	**0.25; 0.75**	**2**	**1-27**
Art Clinic Jönköping	**1,13**	**9**	**0.49**	**0.29; 0.82**	**3**	**1-33**
Lindesberg	**2,933**	**36**	**0.55**	**0.40; 0.74**	**4**	**2-26**
Carlanderska	**2,276**	**26**	**0.55**	**0.39; 0.78**	**5**	**2-29**
Mora	**1,368**	**15**	**0.57**	**0.37; 0.89**	**6**	**2-39**
Kalmar	671	7	0.59	0.34; 1.03	7	1-48
Varberg	**1,223**	**14**	**0.59**	**0.38; 0.92**	**8**	**2-41**
Hässleholm	**4,232**	**57**	**0.62**	**0.48; 0.80**	**9**	**4-31**
Skene	**979**	**17**	**0.65**	**0.45; 0.93**	**10**	**3-42**
Skövde	**274**	**11**	**0.65**	**0.45; 0.94**	**11**	**3-43**
Capio Ortopediska Huset	**4,118**	**58**	**0.66**	**0.51; 0.84**	**12**	**6-35**
Hermelinen	157	1	0.68	0.31; 1.48	13	1-70
Aleris Specialistvård Nacka	**1,969**	**26**	**0.68**	**0.48; 0.96**	**14**	**4-44**
Aleris Specialistvård Bollnäs	886	15	0.68	0.44; 1.06	15	3-50
Piteå	**2,414**	**36**	**0.69**	**0.51; 0.94**	**16**	**6-43**
Sophiahemmet	1,267	23	0.7	0.32; 1.53	17	1-72
Lycksele	1,614	25	0.71	0.50; 1.01	18	5-48
Hudiksvall	406	5	0.72	0.39; 1.32	19	2-64
Aleris Specialistvård Motala	1,322	26	0.72	0.50; 1.02	20	6-48
Örnsköldsvik	726	10	0.72	0.44; 1.19	21	3-58
Trelleborg	**2,958**	**51**	**0.73**	**0.56; 0.96**	**22**	**9-44**
Capio Movement	2,397	38	0.75	0.55; 1.01	23	8-48
SU/Mölndal	2,331	72	0.76	0.46; 1.26	24	4-61
Ortopediskt Center – Sophiahemmet	292	2	0.78	0.38; 1.61	25	2-74
Oskarshamn	1,976	33	0.78	0.57; 1.08	26	10-52
Ljungby	802	14	0.8	0.51; 1.25	27	6-61
Södertälje	725	12	0.8	0.50; 1.28	28	6-63
GHP Ortho och Spine Center Skåne	206	1	0.81	0.37; 1.76	29	2-78
Bollnäs	1,01	13	0.82	0.52; 1.29	30	6-63
Karolinska Huddinge	1,129	18	0.82	0.54; 1.23	31	8-60
Eksjö	1,35	23	0.82	0.57; 1.19	32	9-58
GHP Ortho Center Stockholm	4,55	83	0.82	0.67; 1.02	33	17-48
Alingsås	992	17	0.83	0.54; 1.25	34	8-61
SUS/Lund	279	10	0.83	0.55; 1.26	35	8-62

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Relative risk of revision per unit, five years, cont.

Unit	Number	Revised	RR	RR 95 % CI	Rang	Rang 95 % CI
Borås	476	8	0.84	0.49; 1.44	36	5-69
Carlanderska-SportsMed	218	2	0.86	0.41; 1.77	37	3-78
Visby	715	13	0.86	0.54; 1.36	38	8-66
Art Clinic Göteborg	1,083	17	0.86	0.57; 1.30	39	9-64
Capio S:t Göran	2,634	49	0.87	0.66; 1.14	40	17-55
Frölundaortopeden	72	1	0.87	0.40; 1.90	41	2-80
Ängelholm	958	18	0.88	0.59; 1.32	42	11-65
Sollefteå	1,908	24	0.89	0.38; 2.07	43	2-82
Jönköping	786	15	0.9	0.58; 1.39	44	11-67
Lidköping	1,166	23	0.91	0.63; 1.32	45	14-65
Falun	839	17	0.93	0.61; 1.41	46	13-68
Falköping	149	3	0.94	0.47; 1.85	47	5-79
Karlshamn	1,485	31	0.96	0.69; 1.33	48	20-65
Halmstad	926	22	1.02	0.70; 1.49	49	21-71
Södersjukhuset	968	23	1.05	0.73; 1.52	50	24-72
Specialistcenter Scandinavia Eskilstuna	238	1	1.05	0.51; 2.17	51	6-82
GHP Ortho Center Göteborg	1,640	42	1.06	0.79; 1.41	52	30-68
Örebro	57	2	1.07	0.52; 2.20	53	7-82
Capio Ortopedi Motala	1,457	28	1.07	0.76; 1.50	54	27-72
Umeå	277	8	1.13	0.66; 1.93	55	17-80
Uddevalla	1,865	47	1.13	0.86; 1.49	56	36-71
Kullbergska sjukhuset	1,733	42	1.14	0.86; 1.53	57	35-72
Eskilstuna	408	11	1.15	0.70; 1.86	58	22-80
Gävle	635	17	1.16	0.76; 1.75	59	27-78
Värnamo	826	21	1.16	0.79; 1.70	60	30-77
Enköping	2,678	66	1.16	0.92; 1.47	61	40-71
Capio Artro Clinic	2,881	74	1.23	0.98; 1.53	62	44-73
Karlskrona	69	3	1.27	0.64; 2.50	63	16-83
Nyköping	718	22	1.31	0.90; 1.91	64	39-80
Sundsvall	72	2	1.32	0.80; 2.19	65	31-82
Specialistcenter Scandinavia Malmö	**51**	**0**	**1.33**	**1.06; 1.67**	**66**	**50-76**
Akademiska sjukhuset	780	25	1.33	0.93; 1.90	67	42-80
Västervik	739	25	1.39	0.97; 1.99	68	44-81
Östersund	**1,196**	**40**	**1.4**	**1.05; 1.88**	**69**	**49-80**
Torsby	711	23	1.4	0.97; 2.03	70	44-82

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Relative risk of revision per unit, five years, cont.

Unit	Number	Revised	RR	RR 95 % CI	Rang	Rang 95 % CI
Skellefteå	689	10	1.42	0.87; 2.31	71	37-83
Aleris Specialistvård Ängelholm	**1,649**	**46**	**1.44**	**1.09; 1.90**	**72**	**52-80**
Arvika	**1,378**	**43**	**1.45**	**1.09; 1.93**	**73**	**52-81**
Danderyd	**1,073**	**36**	**1.45**	**1.07; 1.98**	**74**	**51-81**
Karolinska Solna	313	15	1.48	0.95; 2.28	75	43-83
Linköping	**440**	**20**	**1.59**	**1.07; 2.35**	**76**	**51-83**
Ledplastikcentrum Bromma	260	7	1.61	0.92; 2.82	77	41-83
Karlstad	**467**	**21**	**1.65**	**1.12; 2.42**	**78**	**54-83**
Växjö	**726**	**29**	**1.7**	**1.21; 2.38**	**79**	**59-83**
Västerås	**1,933**	**76**	**1.72**	**1.38; 2.15**	**80**	**67-83**
Kungälv	**759**	**34**	**1.75**	**1.28; 2.39**	**81**	**62-83**
Helsingborg	**250**	**13**	**1.83**	**1.15; 2.89**	**82**	**56-83**
Norrtälje	**839**	**37**	**1.83**	**1.35; 2.48**	**83**	**65-83**

Table 5.4.2. Relative risk of revision per unit, five years. Units that are significantly better or worse than the national average have been highlighted with green and red respectively.

Relativ risk of revision per unit, ten years

Unit	Number	Revised	RR	RR 95 % CI	Rang	Rang 95 % CI
Kalmar	**1,327**	**15**	**0.51**	**0.33; 0.78**	**1**	**1-26**
Art Clinic Jönköping	**1,216**	**9**	**0.51**	**0.31; 0.84**	**2**	**1-32**
Norrköping	**1,982**	**26**	**0.53**	**0.38; 0.76**	**3**	**1-24**
Alingsås	**1,993**	**27**	**0.57**	**0.41; 0.80**	**4**	**1-28**
Lindesberg	**4,152**	**57**	**0.59**	**0.46; 0.76**	**5**	**2-24**
Aleris Specialistvård Sabbatsberg	500	9	0.61	0.37; 1.01	6	1-48
Hermelinen	195	1	0.65	0.32; 1.34	7	1-73
Falun	**2,333**	**42**	**0.66**	**0.49; 0.87**	**8**	**3-36**
Carlanderska	**2,979**	**45**	**0.66**	**0.50; 0.87**	**9**	**3-36**
Karlskoga	788	15	0.67	0.44; 1.03	10	2-49
Hässleholm	**7,908**	**136**	**0.67**	**0.57; 0.80**	**11**	**6-28**
Mora	**2,425**	**39**	**0.67**	**0.50; 0.90**	**12**	**3-39**
Örnsköldsvik	**1,486**	**24**	**0.68**	**0.48; 0.97**	**13**	**3-45**
Lidköping	**2,381**	**41**	**0.69**	**0.52; 0.91**	**14**	**4-40**
Gällivare	829	14	0.7	0.45; 1.08	15	2-54
Eksjö	**2,376**	**40**	**0.7**	**0.53; 0.94**	**16**	**4-42**
Piteå	**4,189**	**74**	**0.71**	**0.57; 0.88**	**17**	**6-37**
Skövde	**1,021**	**39**	**0.71**	**0.54; 0.92**	**18**	**5-40**
Oskarshamn	**3,286**	**58**	**0.73**	**0.57; 0.93**	**19**	**6-42**
Skene	1,613	34	0.75	0.56; 1.01	20	6-48
Trelleborg	**6,151**	**130**	**0.77**	**0.65; 0.92**	**21**	**12-40**
Sophiahemmet	2,315	51	0.78	0.38; 1.60	22	1-82
Örebro	437	10	0.78	0.48; 1.26	23	3-68
Visby	1,275	25	0.81	0.57; 1.15	24	7-60
Capio Ortopediska Huset	**6,138**	**122**	**0.82**	**0.69; 0.98**	**25**	**16-46**
Karolinska Huddinge	2,108	45	0.83	0.63; 1.09	26	10-55
Hudiksvall	900	19	0.84	0.57; 1.24	27	6-66
Aleris Specialistvård Motala	3,898	98	0.84	0.69; 1.02	28	16-49
Capio S:t Göran	4,792	98	0.84	0.69; 1.02	29	16-49
Borås	1,067	22	0.84	0.58; 1.21	30	7-65
Spenshult	651	33	0.84	0.55; 1.27	31	6-69
Aleris Specialistvård Elisabethsjukhuset	113	3	0.84	0.45; 1.60	32	2-83
Ortopediskt Center – Sophiahemmet	292	2	0.86	0.44; 1.68	33	2-85
GHP Ortho Center Göteborg	2,318	52	0.86	0.66; 1.11	34	14-57
SUS/Lund	827	28	0.86	0.63; 1.17	35	11-62

The table continues on the next page.

Relativ risk of revision per unit, ten years, cont.

Unit	Number	Revised	RR	RR 95 % CI	Rang	Rang 95 % CI
GHP Ortho och Spine Center Skåne	206	1	0.87	0.42; 1.79	36	2-86
Varberg	2,241	50	0.9	0.69; 1.17	37	16-62
Jönköping	1,498	34	0.9	0.66; 1.22	38	13-65
Frölunda Specialistsjukhus	342	10	0.9	0.55; 1.46	39	6-78
SU/Mölndal	4,404	145	0.9	0.64; 1.27	40	12-69
Lycksele	3,114	73	0.9	0.72; 1.12	41	19-58
Aleris Specialistvård Nacka	2795	56	0.9	0.70; 1.16	42	18-61
Frölundaortopeden	76	1	0.91	0.44; 1.86	43	2-87
Sollefteå	2,551	40	0.92	0.42; 1.99	44	2-88
Art Clinic Göteborg	1,153	18	0.92	0.62; 1.37	45	10-74
Carlanderska-SportsMed	218	2	0.92	0.47; 1.82	46	3-87
Halmstad	1,893	47	0.93	0.71; 1.22	47	19-66
Bollnäs	1,100	17	0.94	0.63; 1.41	48	11-76
Aleris Specialistvård Bollnäs	2,287	65	0.95	0.75; 1.20	49	23-64
Falköping	149	3	0.99	0.52; 1.87	50	4-87
Södersjukhuset	2,502	71	1.04	0.83; 1.31	51	31-71
Uddevalla	3,556	95	1.05	0.86; 1.28	52	34-69
Ljungby	1,508	43	1.06	0.80; 1.40	53	28-76
GHP Ortho Center Stockholm	6,846	178	1.08	0.93; 1.25	54	40-68
Karolinska Solna	1,000	35	1.09	0.80; 1.48	55	28-79
Karlshamn	2,650	73	1.09	0.87; 1.36	56	35-74
Enköping	4,366	115	1.12	0.93; 1.34	57	41-73
Ängelholm	1,455	40	1.12	0.84; 1.49	58	32-79
Värnamo	1,489	43	1.13	0.85; 1.50	59	33-80
Gävle	1,421	45	1.14	0.87; 1.51	60	35-80
Eskilstuna	722	21	1.14	0.79; 1.67	61	27-84
Västervik	1,255	37	1.15	0.85; 1.54	62	33-81
Östersund	2,44	77	1.17	0.94; 1.45	63	42-78
Kullbergska sjukhuset	2,853	82	1.18	0.95; 1.45	64	43-78
Södertälje	1,206	36	1.18	0.87; 1.60	65	35-83
Capio Movement	3,568	101	1.18	0.98; 1.43	66	45-77
Capio Ortopedi Motala	1,457	28	1.2	0.85; 1.67	67	34-85
Sundsvall	612	16	1.2	0.86; 1.68	68	34-85
Nyköping	1,242	39	1.23	0.92; 1.64	69	39-84
Skellefteå	1,203	26	1.25	0.93; 1.67	70	41-84

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Relativ risk of revision per unit, ten years, cont.

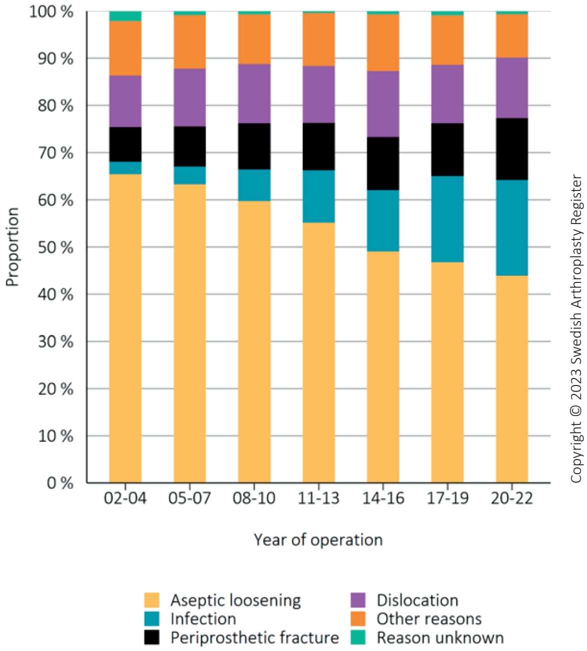
Unit	Number	Revised	RR	RR 95 % CI	Rang	Rang 95 % CI
Helsingborg	660	22	1.25	0.87; 1.81	71	35-87
Specialistcenter Scandinavia Malmö	51	0	1.26	0.92; 1.73	72	40-85
Torsby	1,216	39	1.27	0.95; 1.70	73	42-85
Specialistcenter Scandinavia Eskilstuna	**238**	**1**	**1.28**	**1.09; 1.50**	**74**	**54-80**
Växjö	**1,283**	**45**	**1.35**	**1.02; 1.77**	**75**	**49-86**
Aleris Specialistvård Ängelholm	**1,965**	**52**	**1.38**	**1.06; 1.78**	**76**	**53-86**
Capio Artro Clinic	**2,881**	**74**	**1.4**	**1.12; 1.74**	**77**	**57-86**
Linköping	**679**	**28**	**1.41**	**1.01; 1.97**	**78**	**48-88**
Akademiska sjukhuset	**1,616**	**67**	**1.42**	**1.12; 1.78**	**79**	**58-87**
Arvika	**2,298**	**80**	**1.44**	**1.16; 1.78**	**80**	**61-87**
Umeå	**510**	**23**	**1.49**	**1.04; 2.15**	**81**	**51-88**
Karlskrona	103	6	1.5	0.86; 2.62	82	35-88
Norrtälje	**1,383**	**52**	**1.51**	**1.16; 1.95**	**83**	**61-88**
Ledplastikcentrum Bromma	260	7	1.6	0.94; 2.73	84	42-88
Danderyd	2,378	103	1.61	1.33; 1.95	85	72-88
Kungälv	1,56	69	1.62	1.29; 2.04	86	70-88
Västerås	3,425	144	1.63	1.39; 1.92	87	75-88
Karlstad	1,294	64	1.65	1.30; 2.08	88	70-88

Table 5.4.3. Relative risk of revision per unit, ten years. Units that are significantly better or worse than the national average have been highlighted with green and red respectively.

Reason for revision

Between 2002 and 2022 aseptic loosening (51.5 %), infection (18.1 %), dislocation (13.9 %) and periprosthetic fracture (9.6 %) have been the most common reasons for revision regardless of presence of previous revision or not. Over time has however the distribution of reasons changed (figures 5.4.7 a and b). In first-time revision 65.4 % of the operations performed in 2002–2004 were caused by loosening, osteolysis and/or wear. The two latter reasons are also part of this group. Dislocation was the second (10.9 %) followed by periprosthetic fracture (7.2 %) and infection (2.6 %). In multiple revision in the same period the proportion of revisions due to infection and dislocation was higher at the expense of a decreasing proportion of revisions due to loosening (loosening: 53.1 %, dislocation 18.3 %, periprosthetic fracture: 6.5 %, infection: 5.5 %).

Until the period 2020–2022 this distribution changed successively in both groups. In first-time revision loosening still dominates, but has been reduced to 43.8 %, followed by infection (20.3 %), periprosthetic fracture (13.1 %) and dislocation (12.8 %). In the same period infection was the most common reason in multiple revision (34.3 %) followed by loosening (26.7 %), dislocation (17.3 %) and periprosthetic fracture (6.2 %). The total number of revisions regardless of if it is a first-time or multiple revision has regarding the reason loosening decreased from 1,017 per year in the period 2002–2004 to 653 per year 2020 to 2022. Between the corresponding periods a very noticeable increase of revisions due to infection can be seen from 147 per year in the first period to 479 per year in the last period. For the reason dislocation, the change was marginal from 204 per year in 2002–2004 to 225 per year in 2020–2022.



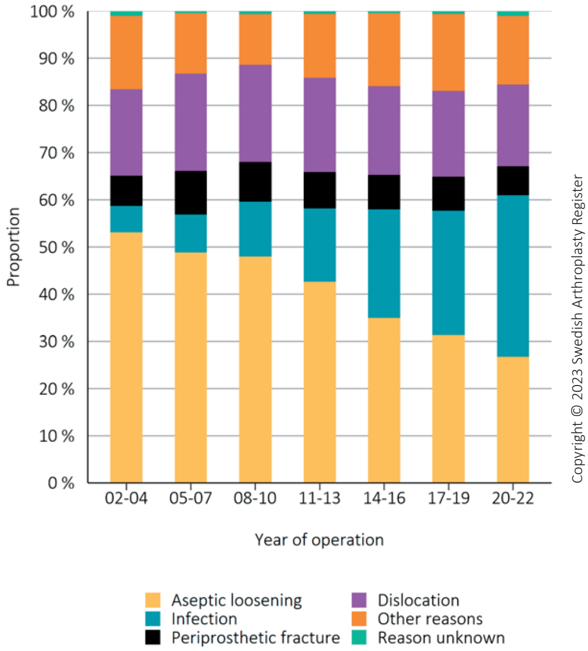


Figure 5.4.7. Distribution of reasons in first time (a) and multiple-time revisions (b) in three-year periods between 2002 and 2022 regardless of sex.

Regarding periprosthetic fractures treated with revision the relative change is larger from 115 to 183 per year. In this group, almost a doubling was noted between 2002 and 2010 (from 96 to 182). Hereafter the number varied between 168 and 189 in the following years until 2022 when as many as 214 revisions due to periprosthetic fracture were reported.

The reason for revision differs between the sexes. In the last ten years, revision due to loosening has been the most common reason for revision for both males and females (54.9 % / 55.1%). Infection has been considerably more common in males (16.0 % / 10.9 %) and dislocation more common among females (12.2 % / 17.4 %). Revision due to periprosthetic fracture was somewhat more common in males (10.9 % / 9.6 %). All percentages refer to the period 2002 to 2022 and include first-time and multiple revisions. Over the last three-year period these relations have partly changed. Revision due to loosening and dislocation especially is still more common in females (41.8 % / 44.1%) and 11.3 % / 18.2 % respectively), infection is now considerably more common among males (30.4 % / 19.9 %), while the proportion of periprosthetic fracture is relatively similar (12.5 % / 12.3 %).

Reason for re-revision related to previous reason for revision

The reason why a patient is revised the first time affects the cause profile in case of a second time revision (table 5.4.4). Whether or not the patient has been revised for the first or second time and must be revised once more, there is a high probability that the next revision is performed due to the same reason as the previous one. This is especially obvious regarding loosening/osteolysis, infection or dislocation. Regarding the reason groups infection and dislocation, 9.3 % and 6.7 % respectively of the first-time revisions were revised a second time due to the same reason in the period 2004 to 2022. If also the patients who were operated with permanent extraction are added, these proportions increase to 16.7 % and 9.5 % respectively in first-time revisions and to 21.1% and 13.1% respectively in second time revisions.

The exception to the rule that specific reason for revision often remains the same if the patient is revised multiple times constitutes the patient group revised due to periprosthetic fracture. In these cases, the most common reason for a possible subsequent revision is dislocation followed by loosening and infection, both after first and second time revision.

Reason for re-revision grouped by reason why the previous audit was performed

	Loosening	Infection	Periprosthetic fracture	Dislocation	Other/missing
Primary replacement 2004–2022 n = 31,0349					
First revision, %	1.4	1.1	0.5	0.7	0.3
No revision, %	96.0				
First revision 2004–2022 n = 25,237					
No reported incision, %	1.2	7.4	1.5	2.8	2.4
Loosening, %	**5.2**	1.1	2.8	1.6	3.4
Infection, %	1.2	**9.3**	2.2	3.5	3.5
Periprosthetic fracture, %	1.1	0.4	0.7	0.9	1.2
Dislocation, %	2.2	1.1	**3.4**	**6.7**	3.5
Other/missing, %	0.7	0.5	0.7	0.6	1.3
No re-revision, %	88.3	80.1	88.7	83.8	84.8
Second revision 2004–2022 n = 5,288					
No reported incision, %	1.8	11.5	1.8	4.1	4
Loosening, %	**6.5**	0.8	4.5	2.8	3.8
Infection, %	1.9	**9.6**	2.5	3.2	5.3
Periprosthetic fracture, %	1.2	0.3	0.7	1.5	0.5
Dislocation, %	3.4	1.6	**6.8**	**9.0**	5.6
Other/missing, %	0.7	0.8	0.7	0.9	1.2
No re-revision, %	84.5	75.4	83.0	78.5	79.5

Table 5.4.4. Distribution of reason for second and third revision respectively in percent, related to the reason for any preceding revision. Primary replacements and revisions between 2004–2022 are included. The group loosening includes osteolysis and wear. For two-staged revisions, the reason that were relevant for the first stage (extraction) is stated. Prosthesis extraction that is not followed by insertion is presented in a separate group. For a smaller proportion of these, insertion of a prosthesis may be planned in 2022. Percentage indicating the most common reason for re-revision in bold.

Regardless of the reason for the revision the risk of being revised due to infection is increased compared with the situation after primary operation. The difference in risk is the lowest when compared between primary operation (1.2 % revised due to infection) and first-time revision due to loosening (1.3 % re-revised due to infection, difference = 0.1%). As indicated above, the corresponding difference is the greatest after revision due to infection where it increases from 1.1% to over 9 % in both first and second time revision. Hereafter follows first-time revision due to "other" reasons (difference = 3.2 %) where the difference increases to 5% after a second time revision.

Prosthesis extraction without subsequent insertion of new prosthesis

As previously pointed out, it is not possible based on register data to definitively determined whether an extraction is permanent or not. In particular, it can be assumed that the majority of the patients that underwent extraction in the latter part of 2022 will be operated with a prosthesis in 2023. Furthermore, a few patients that have undergone prosthesis extraction earlier also become subjects to prosthesis insertion. It is estimated that there may be around 40 cases based on the additional number of cases reported between July and December (n = 33) in 2022 compared with the average for the same period previous years. Because of the uncertainty in this estimation, we have not considered these cases in the report below.

In the entire period 2002 and 2022, the proportion of revisions that meant a definitive total or partial prosthesis extraction constituted 1.9 % (average: 26 per year) in first-time revision and 5.1% (24 per year) in multiple revision. The number has varied between 131 and 168 in a three-year period (figure 5.4.8). The most common reasons were deep infection (62.4 %) followed by dislocation (19.8 %), loosening (10.5 %) and periprosthetic fracture (5.8 %). In the period there was a gradual increase of definitive extractions due to infection at the same time as the proportions of other reason groups decreased. Between 2020 and 2022, 79.1 % of the extractions were performed due to infection, 10.5 % due to dislocation, 6.4% due to loosening and 3.5 % due to periprosthetic fracture.

Patients who undergo permanent prosthesis extraction are slightly older than those revised in other ways (mean age permanent extraction/other procedures: 75.9/71.3 years), they have more often another diagnosis than osteoarthritis (39.4 % and 26.2 % respectively) and a higher degree of comorbidity. In the group that had undergone permanent extraction 71.7 % had ASA class III or higher and in the group that was revised in other ways this proportion was 36.8 %. Here however, 37.5 % and 29.6 % respectively of the observations are missing since ASA class was not reported in the beginning of the period. The mortality of these patients is high, especially initially (figure 5.4.9). In the observation period, 74.1 % of the patients who had undergone permanent extraction died. The corresponding proportion among those that were revised in other ways was 42.3 %.

Revision procedure

Exchange of cup and/or liner and stem has been the most common procedure in both first-time and multiple revision since 2002 (figures 5.4.10 a and b, 5.4.11 a and b). Simultaneous exchange of both cup/liner and stem has however decreased in both absolute and relative numbers both in first-time and multiple revision. Instead exchange of femoral head and/or liner has increased since the DAIR-procedures have become ever more common (DAIR, Debridement Antibiotics Implant Retention).

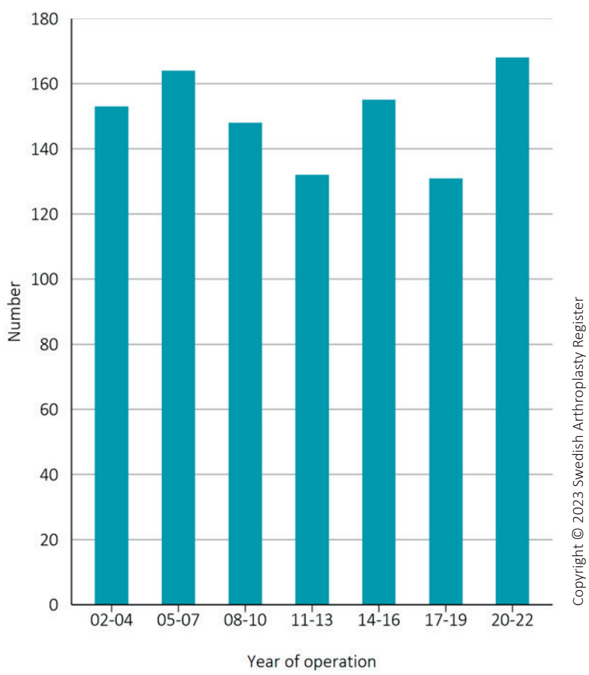


Figure 5.4.8. Number of total and partial extractions per three-year period where there is no report on a subsequent insertion of a new prosthesis or prosthesis component(s).

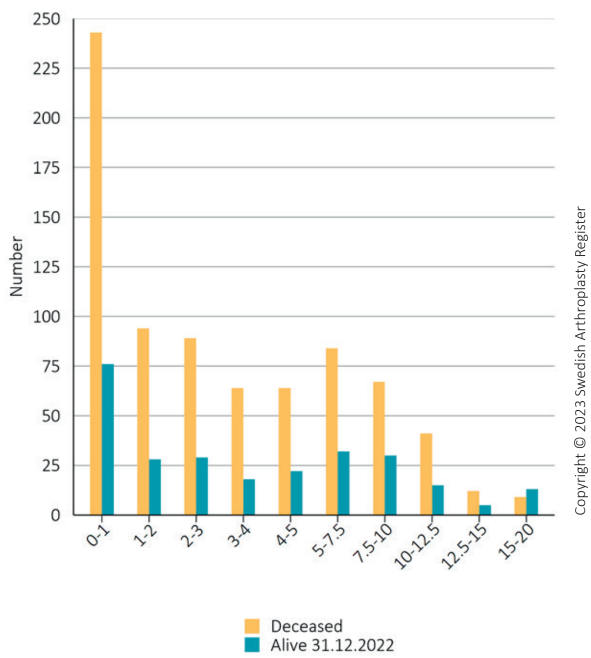


Figure 5.4.9. Year until death or last day of observation for patients (n=1,035, of which 16 with bilateral extraction) who underwent permanent prosthesis extraction divided into those who deceased and those alive at the last day of observation.

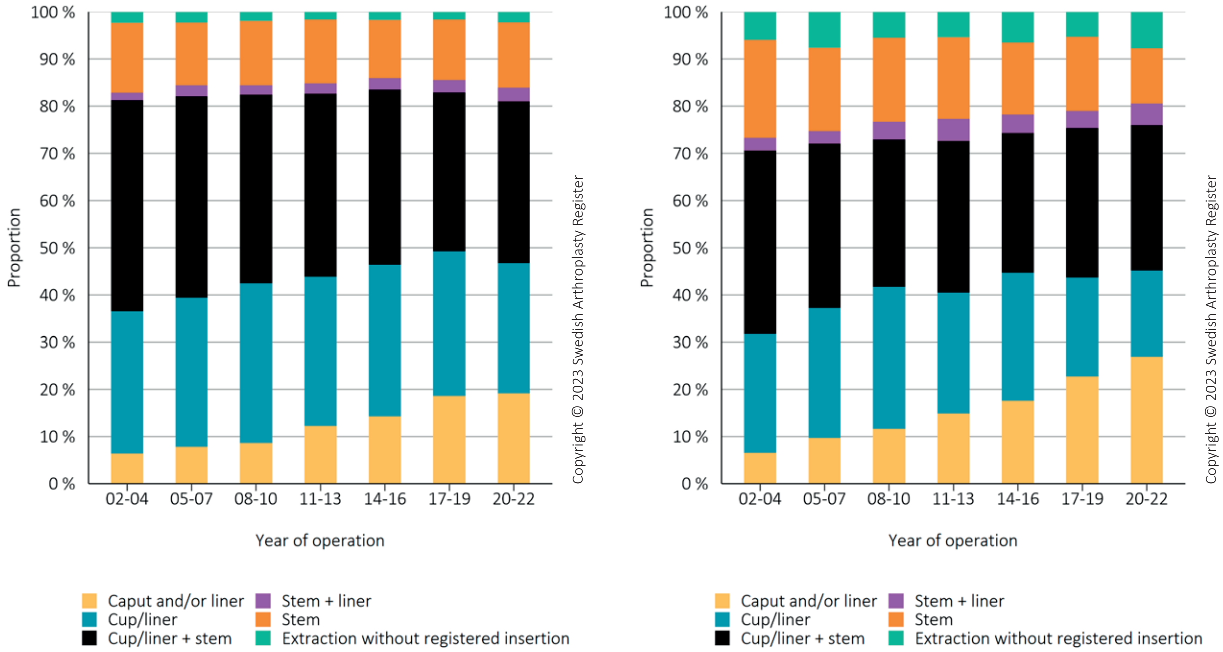


Figure 5.4.10. Relative distribution of procedure at first (a) and multiple revisions (b) in three-year periods from 2002 to 2022.

It is not unexpected that the proportion of extraction without registered insertion constitutes a considerably larger proportion of multiple revisions than of first-time revisions. In the most recent period, the number of permanent prosthesis extraction procedures in absolute numbers has been just over 80 for both first-time and multiple revision.

Choice of procedure related to reason for revision

The type of procedure varies depending of the reason for revision. Here, as well as elsewhere in this section, the headline exchange/insertion means that the patient may have undergone a two staged surgery. Extractions that are followed by a registered prosthesis insertion have been excluded. Figures 5.4.12 a and b show the relative distribution of procedures related to reason for revision in first-time and multiple revisions performed from 2017 until 2022. In aseptic loosening and first-time revision cup/liner exchange with or without stem exchange dominates. In multiple revision it becomes relatively more common that only the stem is revised with or without change of liner. In deep infection, femoral head and/or liner exchanges dominates in both first-time and multiple revision, and as expected, the relative proportion of definitive extractions increases considerably if the hip prosthesis has been revised at least once before. Most of the periprosthetic fractures are as expected revised by stem exchange. A concurrent exchange of cup is performed in 27.2 % of the first-time revisions and in 25 % of the multiple revisions. The most common procedure in first-time revision due to dislocation is cup exchange with or without exchange of stem (74.8 % in first-time, and 57.9 % in multiple revisions). Only exchange of femoral head/liner was performed in 18.4 % and 31.6 % of cases respectively. In these cases, the cup was converted to becoming dual articulating with exchange to metal insert in 7.6 % (n = 8) of the cases in first-time revision and in 21.4 % (n = 15) in multiple revision.

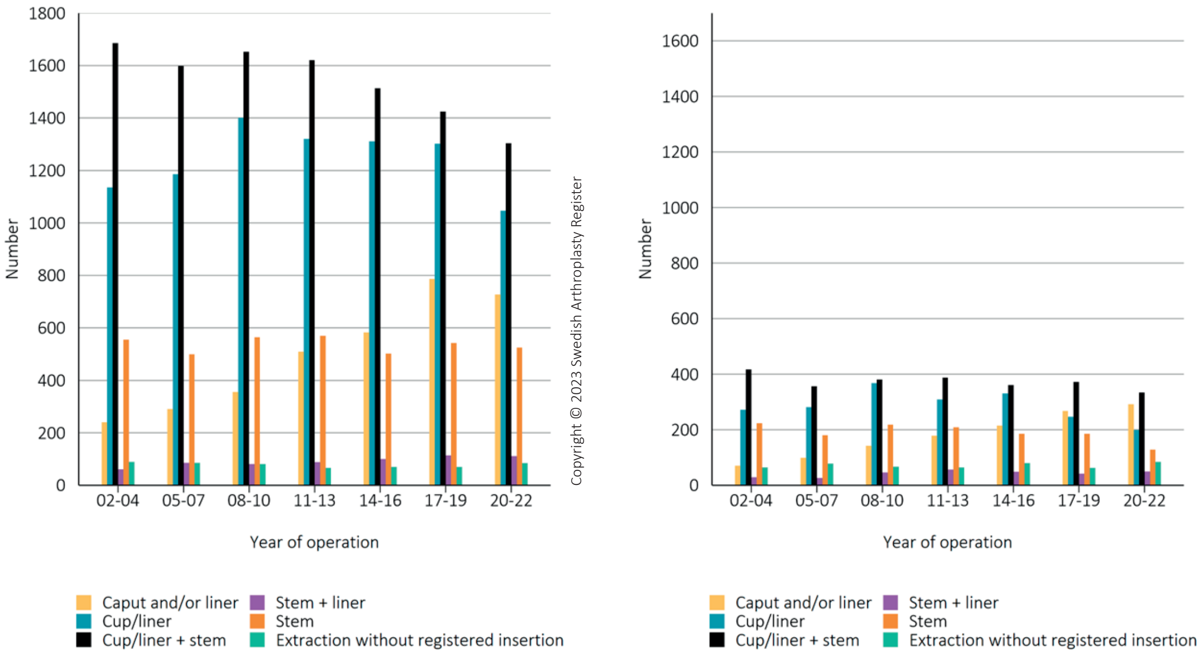


Figure 5.4.11. Procedure (number) at first (a) and multiple revisions (b) in three-year periods 2002–2022.

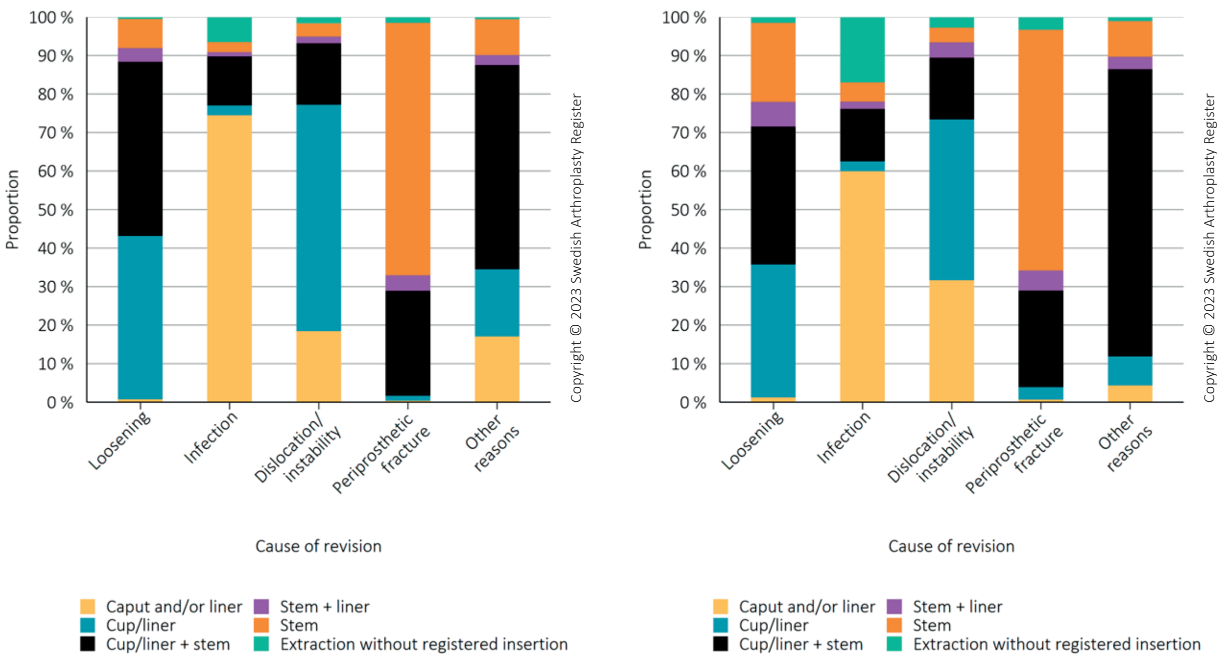


Figure 5.4.12. Distribution of procedure related to the reason for the revision in the case of first (a) and multiple revisions (b) in the period 2017 to 2022.

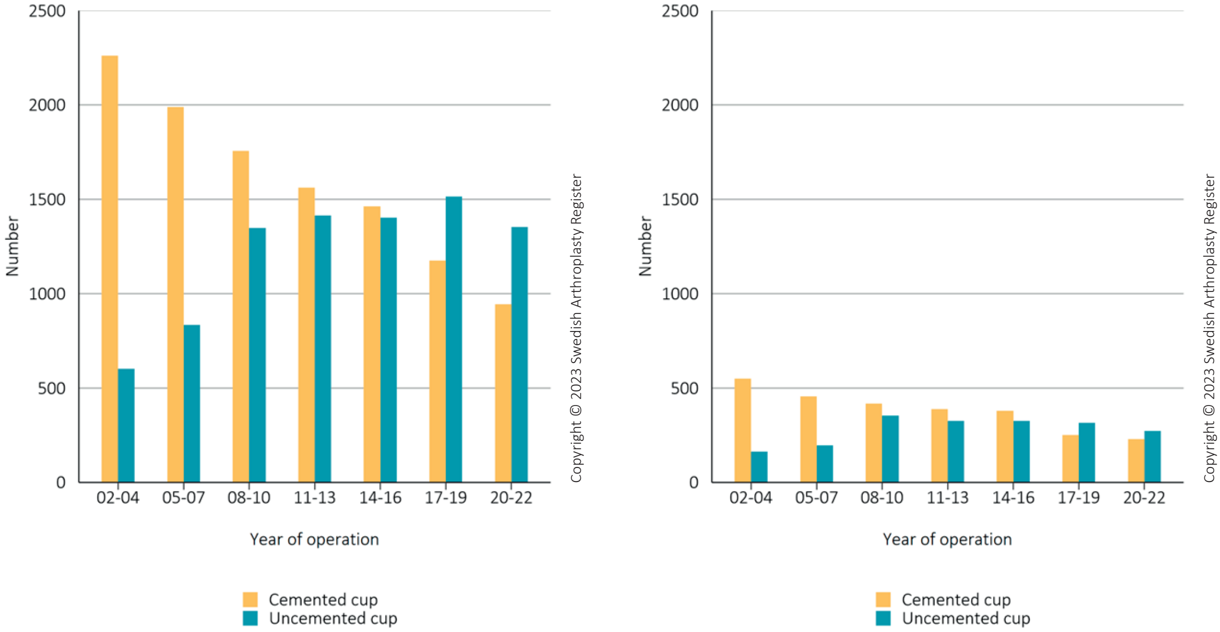


Figure 5.4.13 Number of reported operations with cemented or uncemented cup at first (a) and multiple revisions (b) in three-year periods from 2002 to 2022.

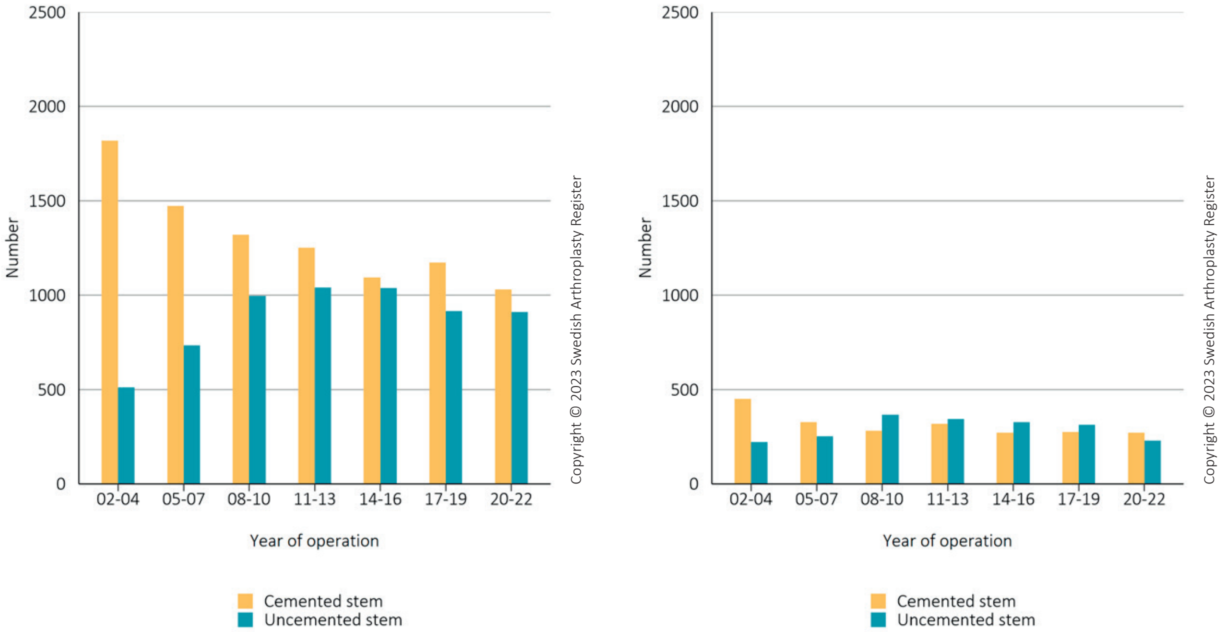


Figure 5.4.14 Number of reported operations with cemented or uncemented stem at first (a) and multiple revisions (b) in three-year periods from 2002 to 2022.

Choice of fixation

An increased use of uncemented fixation occurred somewhat earlier in revision compared with primary surgery. On the acetabulum side, an increase in number of first-time revision occurred until the period 2017–2019 and regarding multiple revision until the period 2008–2010 (figures 5.4.13 a and b). The total number of cup revisions has also decreased, which means that their relative proportion has continued to increase. In the period 2020 to 2022 uncemented cup was used in 58.9 % of the cases in first-time revision and in 54.4 % of the cases in multiple revision. A similar pattern can be seen on the stem side. The most uncemented stems were used in the periods 2011–2013 and 2014–2016 when approximately 1,040 were reported in first-time revision. In multiple revision, the corresponding peak can be seen in 2008–2010 (n = 366, figures 5.4.14 a and b). Relatively seen, the use of uncemented stems in first-time revision has decreased slightly since 2014 until 2016 from 54.6 % to 45.7 % in the most recent period. In multiple revision it has varied between 43.0 % to 48.7 % since the period 2008–2010. In the last period the proportion was 46.9 %.

Bone graft is more often used in cup than in stem revision and especially with cemented fixation. Some kind of bone graft from the bone bank was used in first-time revision in 47.4 % of the cases with cemented fixation and in 35.3 % of the cases when inserting an uncemented cup. In multiple revision the proportions were slightly smaller, 44.9 % and 30.9 % respectively. In first-time stem revision bone from the bone bank was used in 27.3 % of the cases when cemented and in 4.1% of the cases when inserting an uncemented stem. The corresponding proportions in multiple revision were 31.7 % and 5.7 % respectively. The use of bone graft when inserting a cemented or uncemented revision cup has been relatively constant, why the mean values over the entire period also reflect the situation until the last reported period. Bone transplantation when inserting a cemented stem however shows a downward trend. In the period 2002 until 2004 bone graft was used in 34.9 % of all cemented first-time stem revisions and in 35.6 % in multiple revision. In the period 2020 until 2022 these proportions had decreased to 15.5 % and 19.6 % respectively.

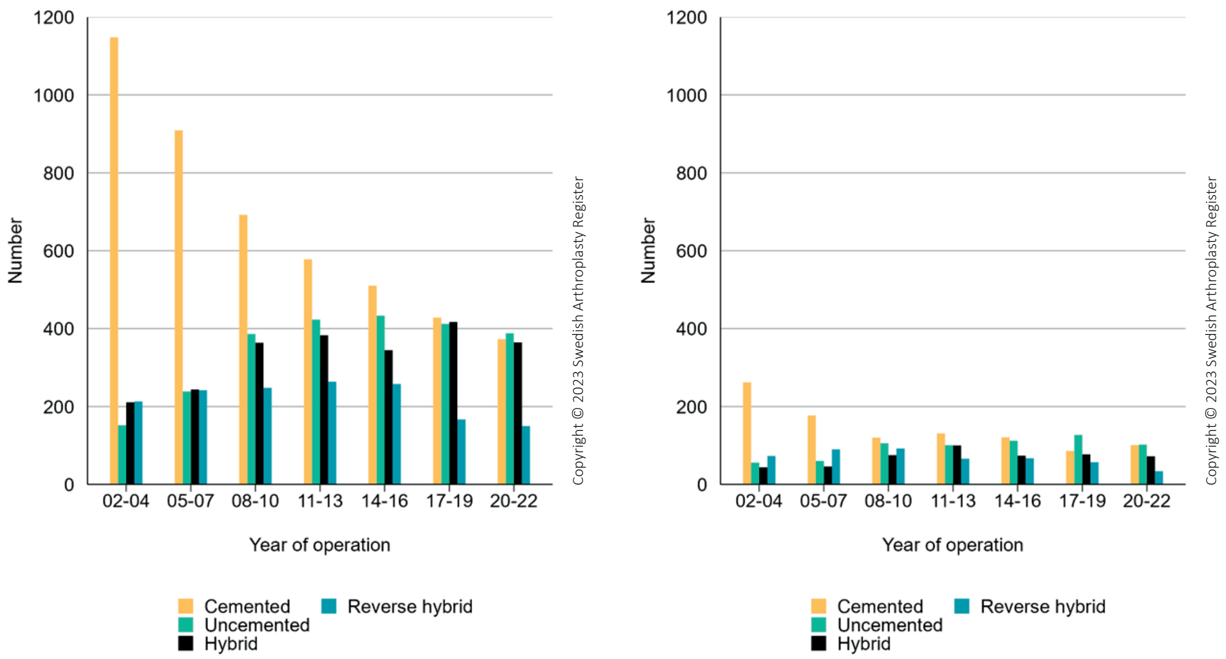
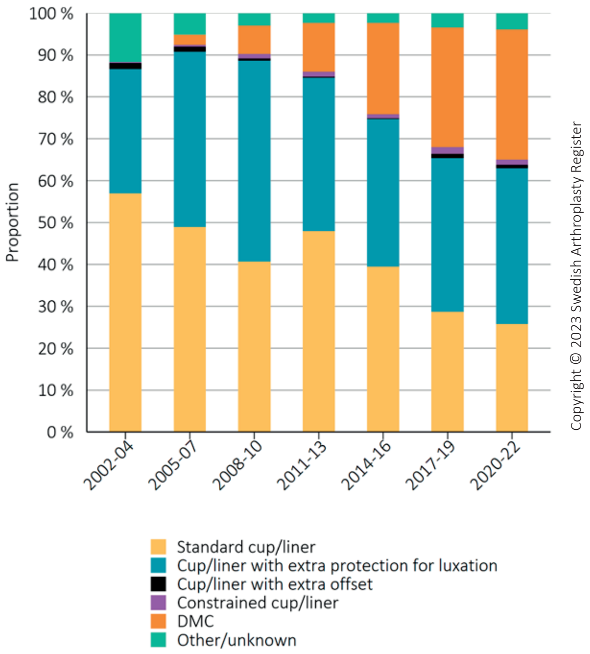


Figure 5.4.15 Number of reported operations with cemented, uncemented hybrid or reverse hybrid fixation at exchange or insertion of both cup and stem at first (a) and multiple revisions (b) in three-year periods from 2002 to 2022.



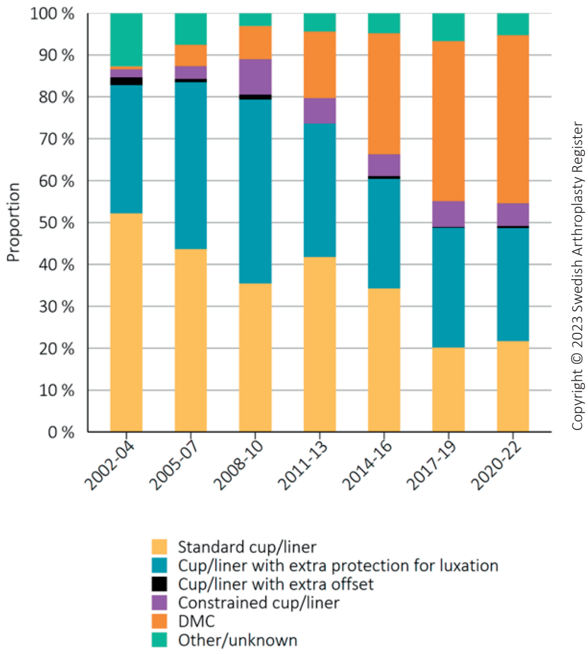


Figure 5.4.16 Distribution of cup or liner variations used with intention to reduce risk of dislocation at first (a) and multiple revisions (b) in three-year periods 2002 to 2022. The figures include 21,210 first-time and 5,396 multiple revisions operated with exchange or insertion of cemented or uncemented cup/liner from 2002 to 2022. Patients with a tumor diagnosis have been excluded.

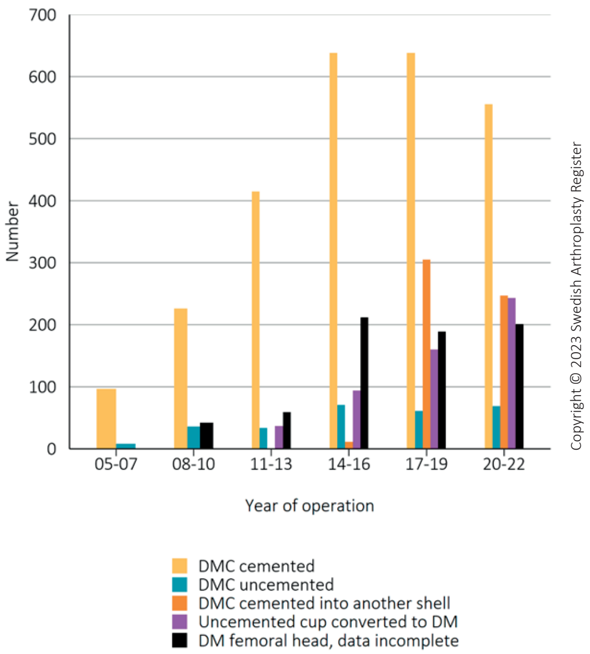


Figure 5.4.17. Use of Dual Mobility Cup in the period 2005 to 2022 related to fixation and type of construction. Both first-time and multiple-time revisions have been included.

In revision surgery the concepts completely cemented, completely uncemented, hybrid and reversed hybrid can become hard to interpret depending on if the whole or parts of the prosthesis are exchanged. Here we have chosen to only reflect the first option, that is those cases where all prosthesis parts are exchanged regardless of if this is performed in one or two stages.

From 2002 until 2022 both the number and the proportion of complete exchanges/insertions of both cup and stem have decreased. Between 2002 and 2004 until 2020 and 2022 there has been a reduction of 465 surgeries (155 per year). Cemented fixation was the most common option in the beginning of the 2000s in first-time revision (figure 5.4.15 a). Hereafter, uncemented and hybrid fixation have increased gradually and completely cemented fixation has decreased. Since the period 2017–2019 the number of replacements with cemented, uncemented and hybrid fixation has been relatively similar. Reverse hybrid fixation has throughout the period 2002 until 2022 been the least used. This method of fixation increased relatively modestly until 2011–2013 to thereafter decrease. In the most recent period they constituted just under 12% at the same time as the other three methods

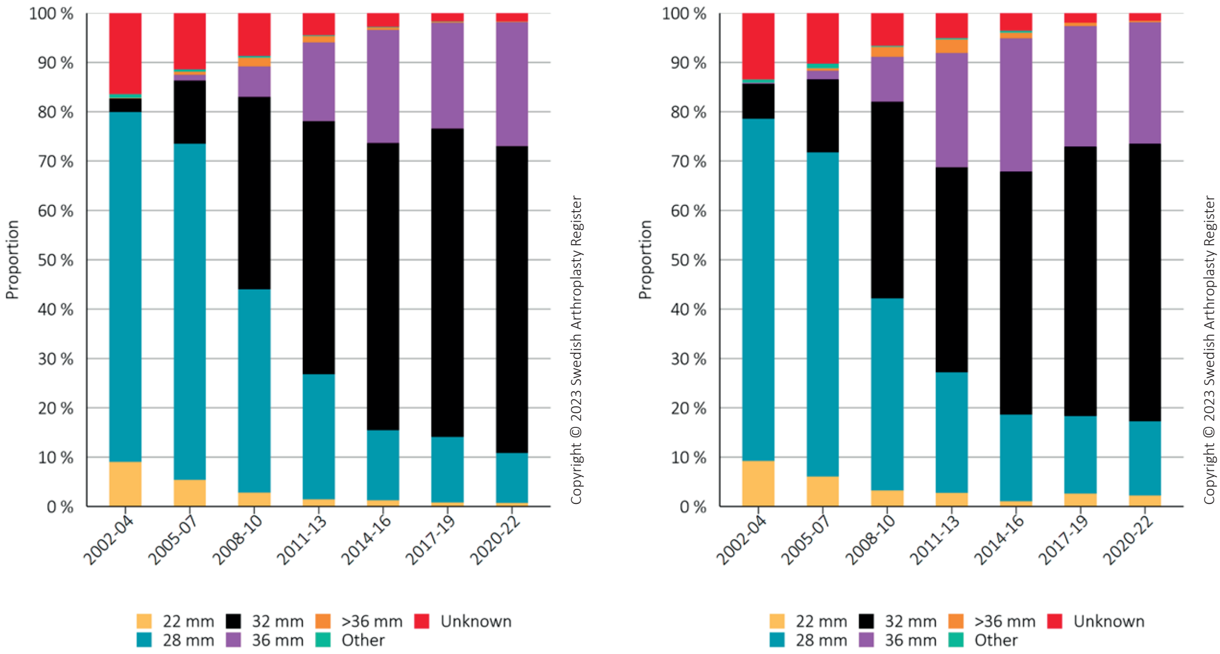


Figure 5.4.18. Choice of caput size in first- (a) and multiple revisions (b) from 2002 to 2022. 24,005 first-time revisions and 6,181 multiple revisions is included. In these cases, the specified procedure indicates that the joint head was replaced without using Dual Mobility Cup. In a smaller number of cases, the procedure may have included replacement of the caput without this being explicitly stated. These cases are reported as "unknown".

constituted 29–30 % each. In multiple revision a similar pattern can be seen regarding cemented and uncemented fixation while the proportion of hybrid fixation tends to be slightly more uncommon (figure 5.4.15 b).

Choice of liner and dual articulation

In the last two decades, the use of cup or liner constructs that intend to reduce the risk of dislocation has become increasingly common (figures 5.4.16 a and b). Liner constructs with an acetabular wedge augment, a heightened rim, increased inclination or similar were introduced already in the 1980s. At this time some cemented cups were available with so called "snap-fit" which meant that the cup opening had a somewhat smaller diameter than the femoral head and when repositioning you had to push the caput into the cup with some force. A later and more effective way of locking the femoral head in the cup is the use of "constrained liner". The snap-fit cup stopped being used as it was considered to increase the risk of loosening. Different variants of constrained liner are still being used, however to a limited extent, probably because they are prone to the same problems as the snap-fit cup even if the results in the literature have not been completely conclusive. Dual Mobility Cup (DMC) was reported for the first time in 2002 (a revision case) and have since then been used in increasing numbers until 2017–2019 (451 revisions per year) to hereafter vary relatively marginally. As in primary surgery the cemented DMC has been the most used. It has however become increasingly common that a DMC is cemented into an existing shell or that the cup is converted to DM-function using a metal insert (figure 5.4.17).

Choice of femoral head

Femoral heads are routinely being exchanged in almost all revisions. Since 2002 there is data on inserted femoral head in 85.5 % of all revisions. In other cases, the femoral head has not been exchanged or a possible exchange has not been reported. Figures 5.4.18 a and b illustrate how the choice of femoral head size has changed since the period 2002 until 2004 in first-time revision and in multiple revision. Over time there is a transition to 32 and 36 mm as an effect of the introduction of wear-resistant polyethylene with extra crosslinking and the wish of

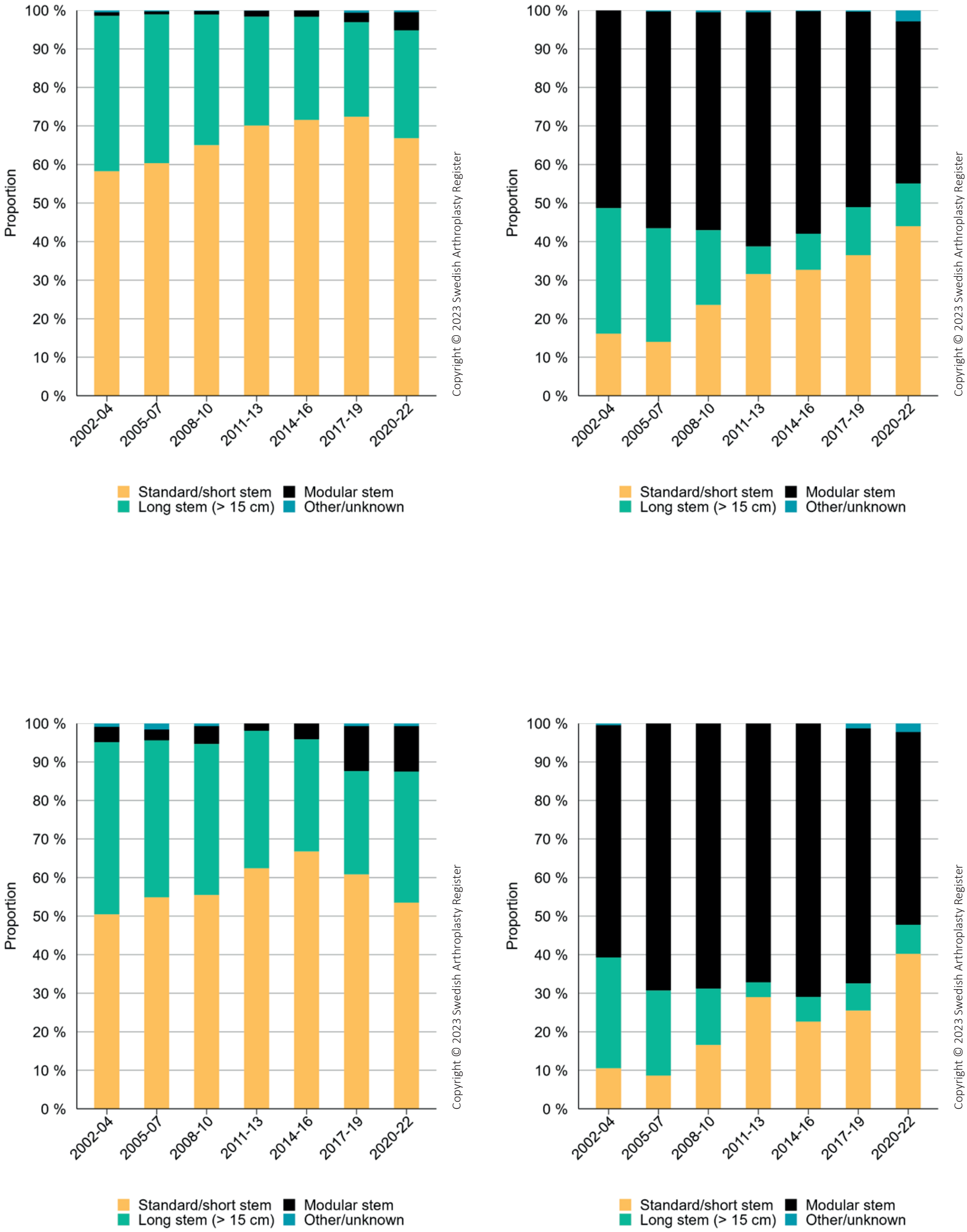


Figure 5.4.19a-d. Distribution of cemented (a) and uncemented (b) stem types at first revision and the corresponding distribution of cemented (c) and uncemented (d) stems at multiple revisions from 2002 to 2022. The stem has been classified as long if its length exceeds 150 mm.

reducing the risk of dislocation. In both first-time as well as multiple revision 32 mm femoral heads dominate and constitute 63.4 % in first-time revision and 57.6 % in multiple revision. In first-time revision the proportion of operations where a 36 mm femoral head has been inserted has greatly increased throughout the period and constituted in 2020–2022 for around one fourth (25.1%) of all operations where the femoral head has been replaced. In multiple revision a peak was reached in 2014–2016 (29.2 %) followed by a modest decrease until the latest period (all proportions are given with the exclusion of DMC).

If the use of various femoral head diameters in revision are compared to the situation in primary surgery, we find that between 2020 and 2022 32 mm femoral heads are more frequently used in primary surgery (primary hip replacement/first-time revision/multiple revision: 84 % / 63.4 % / 57.6 %) while 28 and 36 mm femoral heads are more common in revision (28 mm: 4% / 10.6 % / 13.6 %; 36 mm: 12.0 % / 25.1 % / 26.7 %). The relative high proportion of 28 mm femoral heads in revision can probably be explained by the fact that an older well fixed cup is left in certain stem revisions.

The choice of stem

Since 2002 the number of revisions where the stem is replaced has slowly decreased. Until 2012 the number of insertions varied between 906 (in 2006) and 1,065 (in 2002) per year. After 2012, there is a slow reduction to just over 850 per year in 2021 and 2022. In the period 2002–2004 uncemented stems accounted for 24.3 % of all stems to gradually increase to 49.9 %. Hereafter, there is a small reduction to 45.0 % in the most recent period corresponding to an insertion of 1,349 cemented and 1,102 uncemented implants.

In the cemented group, stems with standard length (≤15 cm) are most frequently used in both first-time and multiple revision even if their proportion was highest in first-time revision (figures 5.4.19 a and c). In 41.4 % of the first-time revisions and in 34.4 % of the multiple revisions has a cement-in-cement revision been performed. Two-part stem has been used relatively rarely however with a clear increase in the last two periods. Between 2020 and 2022 they constituted 4.7 % of the first-time revisions and 11.8 % of the multiple revisions.

Among the uncemented stems, two-part stem has dominated and especially in multiple revision (figure 19 b and d). Their proportion increases between the first period until the period 2011–2013 in first-time revision and little longer, until 2014–2016 in multiple revision to then decrease. The reduction is relatively large. In first-time revision the proportion decreases from 60.8 % to 42.0 % in the most recent period. In multiple revision the reduction is slightly greater from 70.9 % to 50.0 %. Instead, the proportion of uncemented standard stems increases and especially in multiple revision. The reason for this change cannot be determined, but this observation strongly argues against an increase of severe bone defects in the proximal femur but rather suggests the opposite.

Choice of specific implant

Table 5.4.5 shows the most used cemented and uncemented cups and stems in 2021 and 2022 as well as 2012. The schedule is rolling and updated yearly. This year we have divided the SPII-stems into standard length and long (> 15 cm) even if the information here as in regard to the Exeter stem is not entirely reliable. In previous annual reports we have indicated that the risk for stem fracture is relatively high for the short Exeter stem. However, when compared with the narrowest Exeter stems of standard length the difference is not assured (see separate in-depth analysis) which suggest that it is not the length but the diameter being the most decisive.

In cemented fixation of the cup the trend to use DM-cup remains. In the last two years this type of implant has constituted just under 50 % of all cups with cemented fixation. In 2022, BiMobile has entered the list among the five most common and accounts for 11.1% of all. The year before, the proportion was 4.4 % and in 2020 just 1.3 %. When using an uncemented cup the list is topped by several implants that have shown increased revision rate in primary surgery which does not necessarily mean that the same relationship applies to revision. Several of these uncemented shells are also used with cemented DM-cup or with metal inserts for conversion to this type of joint. In total, this is 28.5 % of the cases. In most of cases this procedure has been used when inserting TMT revision (n = 75, 61,5 % of all TMT) followed by Tritanium revision (n = 25, 18.0 %), Delta-One-TT (n = 15, 45.5 %) and G7 OsseoTi (n = 10, 18.2 %).

Most used cup and stem

2012		2021		2022	
Name	**%**	**Name**	**%**	**Name**	**%**
Cup, Cemented, n	**618**	**Cup, Cemented, n**	**367**	**Cup, Cemented, n**	**406**
Exeter Rim-fit	22.5	Avantage	32.7	Avantage	25.1
Avantage	20.9	Exeter Rim-fit	18.3	Exeter Rim-fit	23.6
Marathon	16.2	Lubinus x-link	15.5	Lubinus x-link	16.3
Lubinus	10.5	Polarcup cemented	12	BiMobile shell	11.3
Lubinus x-link	6	Marathon	10.1	Polarcup cemented	11.1
Other	23.9	Other	11.4	Other	12.6
Cup, Uncemented, n	**585**	**Cup, Uncemented, n**	**523**	**Cup, Uncemented, n**	**583**
TMT revision	23.8	Tritanium revision (trident)	22.8	Tritanium revision (trident)	23.7
Continuum	20	TMT revision	20.3	TMT revision	20.4
Trilogy	17.1	Continuum	9.4	Continuum	7
TMT modular	8.9	Pinnacle 100	6.3	Pinnacle W/Cripton 100	6.7
Mallory Head	4.1	Trilogy IT	5.2	G7 OsseoTi	6.3
Other	26.2	Other	36.1	Other	35.8
Stem, Cemented, n	**522**	**Stem, Cemented, n**	**439**	**Stem, Cemented, n**	**488**
Exeter standard	28.7	Exeter standard	35.1	Exeter standard	31.1
Exeter short revision stem	14.2	SPII long (> 15 cm)	16.9	SPII standard (≤ 15 cm)	19.7
SPII long (> 15 cm)	13.4	SPII standard (≤ 15 cm)	15.3	SPII long (> 15 cm)	15.6
SPII standard (≤ 15 cm)	13	Exeter short revision stem	7.7	Exeter long	11.7
CPT long revision	7.5	Exeter long	5.9	Exeter short revision stem	6.8
Other	23.2	Other	19.1	Other	15.1
Stem, Uncemented, n	**478**	**Stem, Uncemented, n**	**408**	**Stem, Uncemented, n**	**373**
MP	38.7	Restoration	30.4	Restoration	36.7
Restoration	24.9	MP	29.4	MP	18.8
Revitan	15.1	Arcos	11.5	Arcos	16.6
Arcos	4.2	Corail revision	7.8	Corail revision	7
Corail KAR	3.6	Revitan	6.4	Revitan	6.7
Other	13.5	Other	14.5	Other	14.2

Table 5.4.5. The five most used cemented an uncemented cup and stems in revision surgery presented as percent of the total number of reported in 2012, 2021 and 2022. Both first and multiple-time revisions are included.

In cemented fixation of the stem, Exeter standard has been the most common in all of the three years reported. in the entire period from 2012 until 2022 most cases performed where the Exeter standard stem was used either a cement-in-cement revision (49.7 % of the surgeries) or transplanted bone (28.5 %) and in just over one fifth of the cases (21.8 %) none of these procedures. Since 2012 the use of the short Exeter stem has decreased and in the last two years, the SPII-stem in different lengths in second and third place with a tendency towards increased use of stems with standard length.

Among uncemented revision stems different types of two-part stem have dominated with a trend towards increased popularity for Restoration. Only one solid long uncemented stem, Corail revision, is found among the five most used.

The size of the group "others" reflects to a certain extent how diversified the choice of implant is in Sweden. The size of the group also greatly influenced by how the implants from different manufacturers are divided and therefore should not be given too much great importance. However, we can state that the group is decreasing over time for the cemented implants while it stays relatively

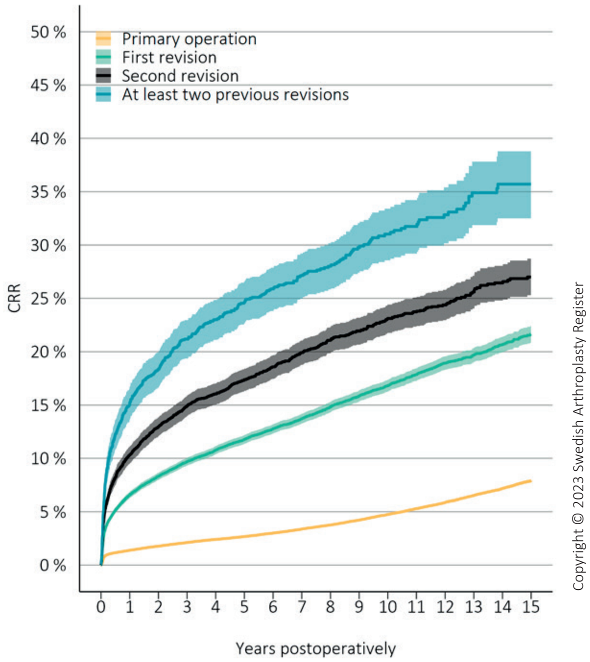
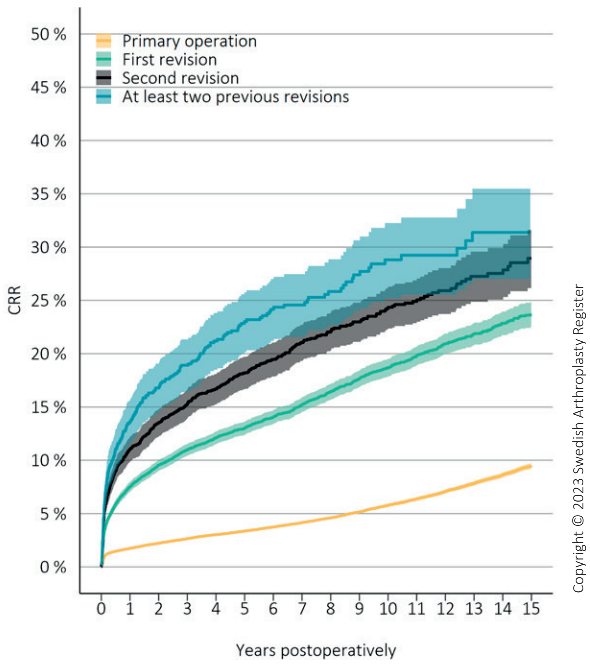


Figure 5.4.20. Cumulative risk of revision until 15 years including both sexes based on revision regardless reason or type of procedure in primary total hip replacements, first and second time revisions and in revisions of hip replacements with at least two previous revisions. Revisions from 2001 are included.



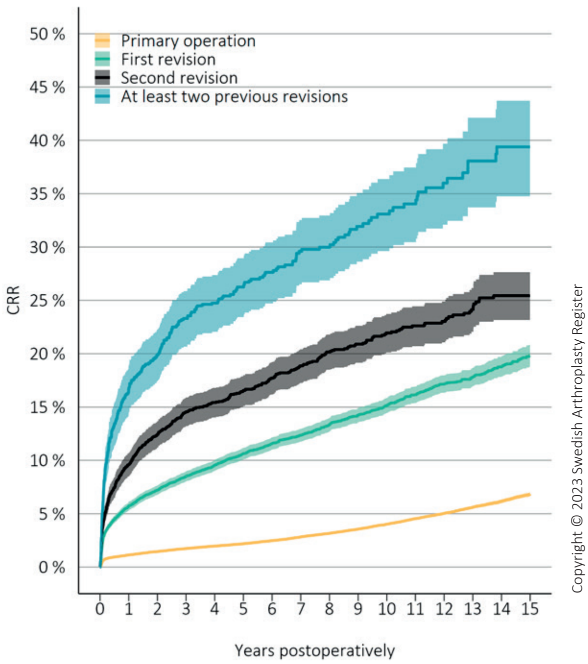


Figure 5.4.21. Cumulative risk of revision until 15 years' in males (a) and females (b) based on revision regardless reason or type of procedure in primary total hip replacements, first and second time revisions and in revisions of hip replacements with at least two previous revisions. Revisions from 2002 are included.

constant for the uncemented stems and increased between 2012 and 2021 for the uncemented cups, likely due to introduction of new cups with surface coating of trabecular metal. Between the most recent two years the groups size has been relatively unchanged, around 36 %.

Results

The risk of revision increases progressively the more times a hip replacement is revised. The cumulative risk of revision after 15 years in primary total hip replacements operated from 2002 and onwards is 8.3 ± 0.2 % (38,157 observations at 15 years), in first-time revisions, 22.9 ± 0.8 % (2,191 observations), in second time revisions 27.3 ± 1.9 % (392 observations) and for hips revised at least twice previously 36.0 ± 3.6 % (101 observations) (figure 5.4.20). Figures 5.4.21 a and b show the cumulative risk of revision in males and females with the same grouping. After 13 years however, the data becomes more uncertain since only 88 hip replacements remain in males and 108 in females why the diagram ends at this time point. The cumulative risk of revision in males is higher in three of the groupings (primary, first-time and second time revision). The prognosis measured as risk of re-revision is therefore getting worse for each performed revision. Evaluation with Cox regression analysis including all diagnoses except tumour diagnosis with adjustment for age, sex, primary diagnosis and surgical year shows that the cumulative risk of (re-)revision in the period 2002 until 2022 was 3.8 times (95 % CI: 3.6–3.9) higher after first-time revision compared with primary surgery, 5.4 (5.1–5.8) times higher if the hip was revised for the second time and 7.8 (7.1–8.6) times higher if the hip has been revised at least twice before. In general, the risk in males is approximately 37 % higher than in females (HR: 1.37, 1.33–1.41).

The reason the patient is revised affects the risk of having further revisions, which has been illustrated earlier in this section (table 5.4.4). An analysis of cumulative risk of revision divided into the four most common reasons for revision show that the risk of re-revision in the first years after the index revision is the greatest if the reason is infection or dislocation. The cumulative risk of revision increases early after the index operation, which also means that these revisions occur early (figures 5.4.22 a and b). After four to five years' parallelism of the curves between the different causes of revision disappear mainly

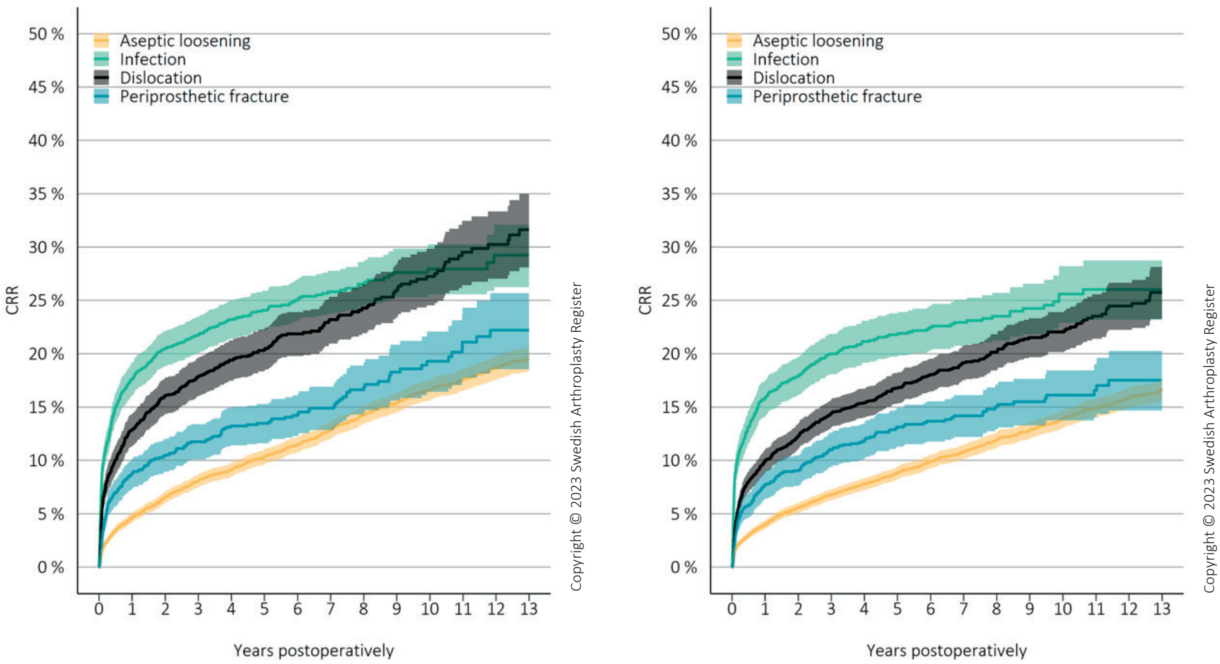


Figure 5.4.22. Cumulative risk of revision in males (a) and females (b) divided on reason for revision and based on outcome of revision regardless its reason, type of procedure performed and number of previous revisions. Revisions from 2002 are included. The curves end at 13 years as the number of observations at that time become less than 100 in some of the groups.

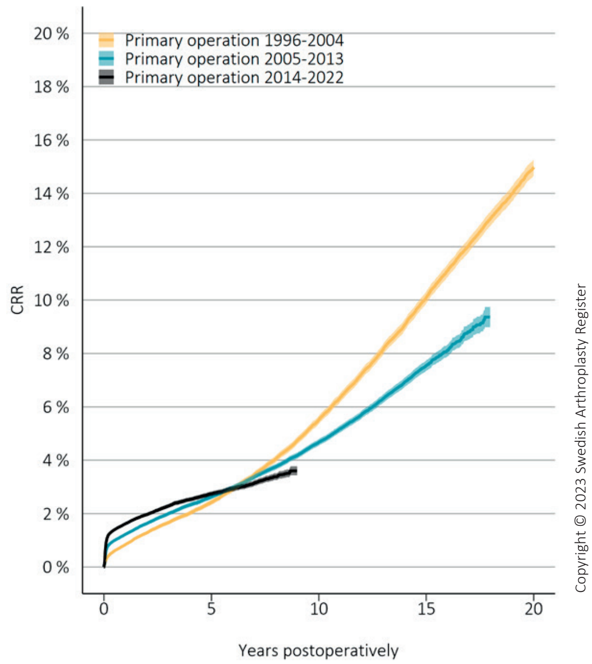


Figure 5.4.23. Comparison of cumulative risk of revision regardless cause between groups of primary total hip replacements performed in three subsequent periods in 1996 to 2022. The calculations are shown up to that year only 100 observations remain. The risk of early revision rises the closer to the present the index operation was performed. After about six to seven years, an opposite relationship occurs.

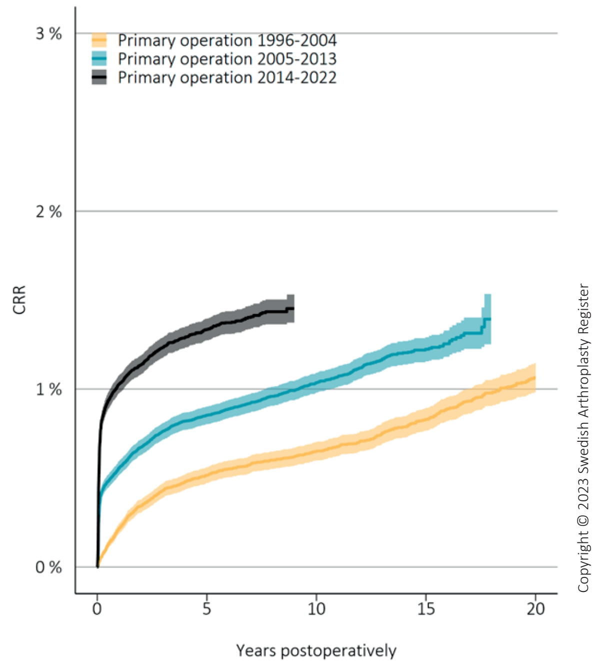


Figure 5.4.24. Comparison of cumulative risk of revision due to infection between groups of total hip replacements performed in three consecutive periods in 1996 to 2022. Data are shown up to the year when only 100 observations remain. The increasing risk of revision due to infection the closer you get to the present is an important reason, although not the only reason why the risk of early revision, regardless of the cause, has increased in recent times.

because the risk of re-revision due to infections decreases. The mortality in this group is high and also increasing number of hips revised due to infection have had surgery with extraction of the prosthesis.

In the last 25–30 years, the results after primary hip replacement measured as risk of revision has successively changed. The risk of early revision in primary total hip replacement regardless of reason has increased, but in the long run the results have improved (figure 5.4.23). The increase of the early revisions can partly be explained by an increasing number of revisions due to infection (figure 5.4.24). Increased use of uncemented stems with a heightened risk of early periprosthetic fracture may also have played a role. The reasons behind a lower risk for revision after some years when the curves in figure 5.4.23 start to converge to later cross each other and thereafter diverge are unclear. We know that the frequency of revisions due to loosening has gradually reduced in the past two decades. A conversion from older polyethylene types to more wear-resistant polyethylene with extra cross-linking has certainly contributed to this by the risk for osteolysis and loosening is reduced. An increased use of uncemented fixation with lower risk of loosening in the longer perspective may also play a role.

In first-time revision a similar pattern is seen regarding how the cumulative risk of revision has changed over time. Initially, it is elevated in the periods 2005–2013 and 2014–2022 to hereafter decrease and after six to seven years, the lines cross each other and the cumulative risk becomes lower in the group operated in 2005–2013 (figure 5.4.25). The latest revised group shows the same tendency possibly with slightly later time point for when the crossing occurs. The follow-up time until at least 100 observations remain is however relatively short. After revision for the second time (figure 5.4.26) and in those cases the hip has been revised at least twice previously (figure 5.4.27) similar pattern is seen regarding surgeries performed in the two first periods, possibly with a tendency for the lines to cross even earlier. Regarding hips operated after 2013 an existence of similar pattern is hard to assess since the follow-up time is short. To the extent the lines cross each other or will do so later, this occurs later which would mean that the results have deteriorated compared with earlier. Increasing number of revision cases due to deep infection over time and the poor results of these revisions (increased risk that they will be revised again) could possibly be responsible for this observation.

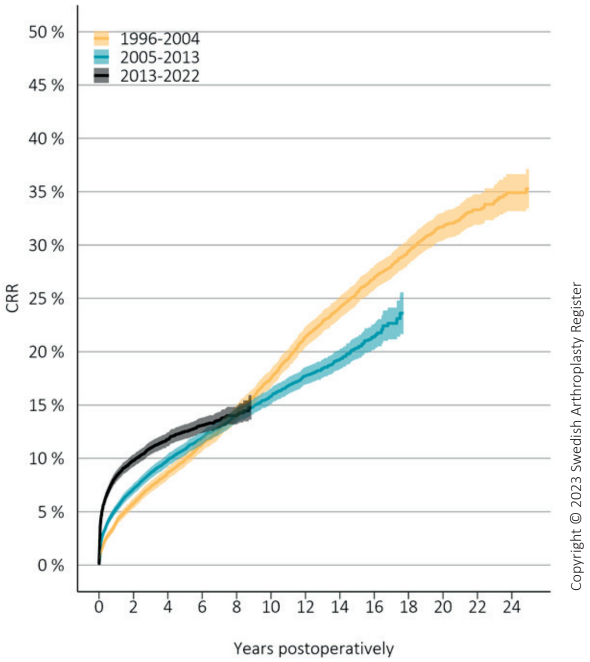


Figure 5.4.25. Comparison of cumulative risk of re-revision regardless of reason between groups of first-time revisions who had surgery in three subsequent periods 1996 to 2022. The calculations are shown up to that year only 100 observations remain. The risk of having an early revision increase the closer to the present the index operation was performed. As with primary surgery, the opposite relationship occurs after about seven years regarding the groups that had surgery in the first two periods. One can suspect that the group that was performed in the last period will show the same tendency but here is the follow-up time of a sufficiently large num-ber of cases too small to be able to be assessed.

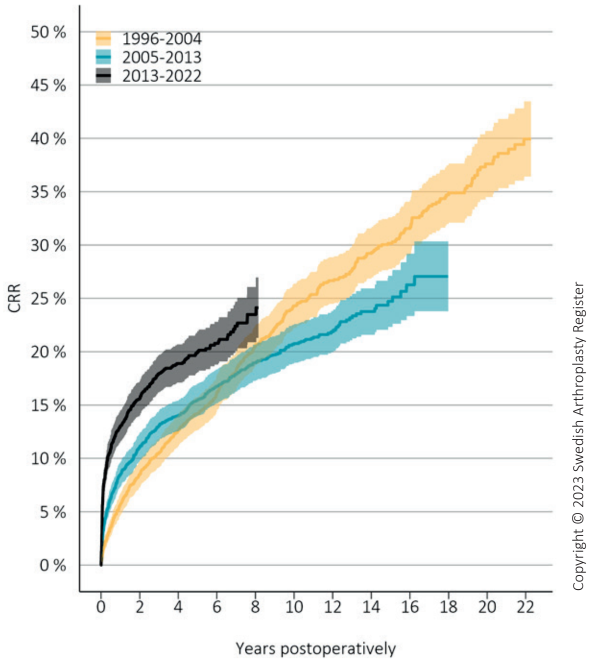


Figure 5.4.26. Comparison of cumulative risk of re-revision regardless of reason between groups of secondary revisions who had surgery in three subsequent periods 1996 to 2022. The calculations are shown up to that year only 100 observations remain. The risk of having an early revision increase the closer to the present the index operation was performed. Here, as with primary surgery and first-time revision an opposite relationship occurs after about six to seven year regarding the groups that had surgery in the two first periods.

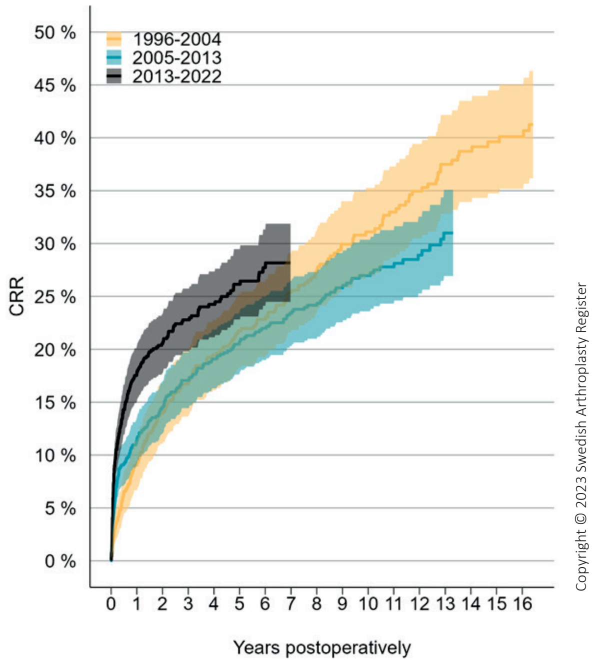


Figure 5.4.27. Comparison of cumulative risk of re-revision regardless of cause between groups of hip replacements revised at least twice before. The three groups had surgery in three subsequent periods 1996 to 2022. The calculations are shown up to the year when only 100 observations remain. The interrelationship of the curves resembles about the one shown in figures 5.4.26 and 27 except that the cross between group 1 (operated 1996–2004) and group 2 (operated 2005–2013) occurs earlier. The number of observations is relatively few and varies between 586 (group 1) and 884 (group 3) which means that the data are more uncertain and follow-up time with still 100 patients will be the shortest.

Summary

Revision of a hip replacement means that the replaced hip undergoes an additional surgery where the entire prosthesis or parts of it is replaced or extracted.

Since the period 2002 to 2004 the proportion of revisions of the total number of primary and revision surgeries has decreased from 11.2 % to 8.4 % in 2020 to 2022.

Since 2002 loosening has been the dominating reason in first-time and multiple revision but its relative proportion has successively decreased. Instead above all the proportion of revisions due to infection has increased and has become the most common reason for revision in those cases that have been revised at least once previously. Patients having a revision are in general older, more often males and have more often other diagnoses than osteoarthritis and a higher degree of comorbidity compared with those operated with a primary hip replacement. The results after both primary operation and revision measured as the risk of additional revision has in the long-term perspective improved. In the first years after the index operation the risk of re-revision has however increased due to an increased number of re-revisions due to infection.

The risk of having additional revisions increases with increasing number of already performed revisions. The prognosis is worst in revision due to infection followed by revision due to dislocation. The importance of optimising the result in the primary operation can therefore not be emphasized enough.

5.5. Evaluation of implants and implant combinations

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Legal framework for medical technical products

The EU's legal framework for among other things orthopaedic implants (Medical Device Regulation, MDR, the regulation of the European Parliament and the Council 2017/745) that must be compiled with in Sweden became effective at the end of May 2021. The framework is comprehensive and emphasises the importance of clinically demonstrable good performance related to risk, unique identification of implants and post-market surveillance. The framework comprises not only completely new implants but can also refer to a new size of an existing prosthesis. Important in the new framework is that the manufacturer has to show that the new prosthesis entails a clear benefit for the patient combined with low risk of complication. In practice this means that clinical use without limitations cannot be approved until a sufficiently large patient population has been followed-up in a sufficiently long period of time.

Furthermore, the clinical result based on patient-reported data must fulfil today's standard and at the same time the risk of complications should be low. Although the regulations most important parts have been introduced some transition provisions remain until the 31st of December 2028. The concept also comprises the construction of a databank (European Databank on Medical Devices, EUDAMED) where all information on a current prostheses is to be gathered and to which complications can be reported. The database contains a unique product identifier (unique device identifier – UDI), information on clinical trials and should among other things function as safety monitoring and market control.

This new legal framework is beneficial as the patient benefit will be large with an increasing safety level and the risk of future implant-related problems can be reduced. The framework also means that it will become more complicated, time-consuming and probably more expensive to introduce new implants and innovations. On the other hand, the need for well-designed clinical studies will increase as well. Probably, the prices will also be affected but to which extent is so far unclear.

The situation in Sweden

In Sweden, we have for a long time had a restrictive approach towards change of standard implants. This approach is probably the most important reason why Sweden has among the lowest revision rates in the world. The clinical results for most of the new implants has in most cases been equivalent with already existing ones and several of them are worse. In single cases, this cautious attitude may have involved that implants with better properties than current standard has come to be introduced late in Swedish healthcare. This drawback weighs relatively lightly against the background of the good results that have been noted for the most used prosthesis types in Sweden and the sometimes disastrous consequences that can be the result when a new and unknown implant is inserted in a large number of patients.

Today there are no preclinical tests that in a safe way can decide if a new prosthesis works better or worse than existing ones. Since the prostheses used today in Sweden in general have a very high standard it is mainly in selected patient groups that one can expect that additional implant development may make a difference. Change of standard implants also means a certain risk-taking since new routines must be learnt. Against this background it seems self-evident that change of implant should only take place in those cases where there is a clinical need, and the replacing implant has documented advantages. Service and price also play a role, even if the price often forms a small part of the total cost.

The hip and knee registries that merged in the Swedish Arthroplasty Register have a long history, the longest in the world. Continuous feedback of results has meant that mainly only well-documented implants are routinely used. Despite this there are differences in cumulative risk of revision between the implant combinations used. Differences are generally relatively small. Two years ago, the Swedish Arthroplasty Register introduced a new way to evaluate hip replacements. The method is similar to the one used for knee replacements since several years. An increased or decreased risk should be assessed against the absolute number of revisions in the reference group. If a specific reason for revision is extremely uncommon in this group, a significant difference can arise in comparison to the comparison group, despite a numerically relatively small increase or decrease in number of cases in the study group. Many factors must be considered when interpreting the results.

In previous annual reports we have briefly summarised how other arthroplasty registries evaluate implants in order to illustrate that the procedure to evaluate implants is not easy and obvious. Most registries use the outcome revision, regardless of reason and regardless of component revised. Some registries multiply the number of observed components with the number of observational years, which means that no consideration is taken to that the reason of revision vary with time as far as comparison with other prostheses are performed. The comparison group may be compared with all other implants, all other implants in the same product category, a selected reference group or a reference implant. Sometimes a fixed limit is used corresponding to for example five percent cumulative risk of revision after ten years. So far there has not been any established standard. Such standard is not entirely easy to achieve because the conditions vary between different registries with respect to the total number of observations, the number of different implants that are used within the registers coverage area, the length of the follow-up and the extent of the individual register's data capture. In addition, the limits set for acceptable risk of revision are constructed at a specific point in time. Today's acceptable standard, needs not necessarily be the same 10 to 20 years later.

Control group – choice of outcome

Until the annual report 2020 we have used a reference group consisting of implants with at least 95 percent component survival after ten years. This reference group consisted of several designs. Each of them should have at least 50 remaining observations at the ten-year follow up. The evaluation performed now, is largely copied from the former knee replacement register with some exceptions. Unlike this evaluation, the outcome varies depending on the type of component being studied. When evaluating cups, the outcome is cup revision including liner revision in uncemented modular cups. Any reasons for revision except infection have been included. For stems, the corresponding outcome is non-infectious stem revision. In both cases revisions are included where also other components have been exchanged or extracted. To be included the number of observed implants must exceed 100.

In this year's as well as in the analysis in previous years all elective hip replacements are included. The group includes all diagnoses except hip fracture, sequelae after hip fracture and tumour. Data is adjusted for age, sex, diagnoses and surgical year. In each of the four analyses (cemented cup, uncemented cup, cemented stem, uncemented stem) a comparison to a reference implant is performed.

The selection criteria for the reference implants are based on high and continuous use in the analysed period. The advantage with a reference implant is that data can be easier to interpret. A possible drawback is that the reference implant over time may be needed to be replaced if it is modified or its relative use decreases or ceases. This year, the analysis is based on components inserted in 2012–2021 with a follow-up until 31st of December 2022. When analysing cups, hip replacements with both cemented and uncemented stems are included in the analysis. In the same way, cases with both cemented and uncemented cups are included when analysing stems. This procedure is not self-evident since for example the risk of cup revision can be supposed to be affected by the choice of stem fixation. Uncemented stems are prone to suffer from early periprosthetic fracture. In revision, the cup may also be exchanged to avoid dislocation. We think however that this bias is relatively limited. It should however be noted especially if the group of implants that are in focus is relatively small.

Cemented cup

In the group cemented cups, Marathon has been used as reference. This cup was introduced in 2008. The polyethylene is radiation-treated with 5 MRad. Regarding the group elective total hip replacements, approximately 2,000 implants per year were reported in the beginning of the period (2012–2013). Hereafter the number of cases has successively been reduced and constituted just under 550 in 2022. In table 5.5.1 we find that none of the other cups used in 2012 to 2021 have a significantly lower risk of non-infectiously caused cup revision in Sweden. One of the cups, ZCA XLPE show as in previous years an increased risk of revision. The most common reasons in this case have been dislocation (0.8% of all inserted ZCA XLPE, Marathon: 0.2%) followed by loosening (ZCA/XLPE/Marathon: 0.5%/0.4%). The dislocation problem associated with the ZCA-cup we have highlighted in previous annual reports and may probably be partly explained by that the cup is relatively shallow. Furthermore, Lubinus, Contemporary Hooded Duration and ZCA show

Hazard ratio for cemented cup revision. The Marathon cup is reference.

	Number	Revisions number	Follow-up*	HR (95 % CI)	p-value
Marathon	13,346	101	10	Ref	
FAL x-link	*193*	*0*	*10*	*0*	
Polarcup cemented	283	1	8	0.68 (0.09;4.9)	0.70
Exeter Rim-fit	23,417	118	10	0.88 (0.67;1.16)	0.37
IP Link	2,14	10	8	0.92 (0.48;1.77)	0.80
Exceed ABT E-poly without flange (cem)	1,856	9	10	0.99 (0.5;1.97)	0.98
Lubinus x-link	43,866	257	10	1.08 (0.85;1.37)	0.54
Avantage	1,647	12	9	1.27 (0.69;2.33)	0.45
Lubinus	**15,893**	**182**	**10**	**1.65 (1.29;2.11)**	**<0.01**
Contemporary	120	2	10	1.71 (0.42;6.96)	0.45
Elite Ogee	143	2	10	1.79 (0.44;7.28)	0.42
Low profile cup	139	2	8	1.86 (0.46;7.55)	0.39
ZCA XLPE	**6,634**	**99**	**10**	**1.9 (1.44;2.53)**	**<0.01**
FAL	322	6	10	2.08 (0.91;4.76)	0.08
ZCA	**1,135**	**21**	**8**	**2.47 (1.54;3.96)**	**<0.01**
Contemporary Hoded Duration	**1,933**	**42**	**10**	**2.55 (1.77;3.67)**	**<0.01**
BiMobile shell	127	1	1	3.29 (0.45;23.83)	0.24
Other	253	4	9	2.45 (0.9;6.68)	0.08
OA				**0.51 (0.41;0.63)**	**<0.01**
Increasing age (per year)				**0.97 (0.97;0.98)**	**<0.01**
Female				0.92 (0.8;1.06)	0.25
Later surgical year (per year)				**1.07 (1.03;1.1)**	**<0.01**

Table 5.5.1. Hazard ratio (HR) ratio with 95% confidence interval (CI) in cemented cup revisions. The Marathon cup is the reference. To be included in the analysis at least 100 observations are needed. The hazard ratios are adjusted for diagnosis, age, sex and surgical year.

Red text indicates statistically significant increased and green text indicates statistically significant decreased risk of revision after adjustment for diagnosis, age, sex and year of operation.

**) Years until numbers at risk exceed 20 observations.*

an increased risk. All of these are manufactured by an older type of polyethylene that is radiation treated in lower doses for sterilisation. In these three cases the reason loosening dominates (Lubinus/Contemporary Hooded Duration/ZCA/Marathon: 0.7 % / 1.6 % / 1.3 %, 0.4 %), followed by dislocation (0.3 % / 0.4 % / 0.5 %, 0.2 %). The follow-up time for the cups with older polyethylene is approximately 1 to 1.5 times longer than for the Marathon cup, which may have influenced the result. Several observations indicate that the introduction of highly cross-linked polyethylene entails a lower risk for revision even in the case of cemented fixation.

Uncemented cup

The first version of the Trilogy cup is still the reference in uncemented cups. It has been used since the mid-1990s in Sweden and almost exclusively with the new type of polyethylene since 2007. In 2012, 672 cases were reported. Since then, the number decreased to 331 in 2018 to increase to 493 in 2021. In 2022, only 81 cases were reported which means that the role as reference implants may be questioned in future annual reports. Most of the uncemented cups reported in 2011 to 2021 have been inserted with highly cross-linked polyethylene (99.8 %, 0.2 % unknown or older polyethylene).

In table 5.5.2 none of the uncemented cups differ significantly from the Trilogy cup, with a lower risk of cup and/or liner revision. As in the annual report 2022, nine cup designs differ for the worse with increased risk. One of them, that in our previous report (2022) had significantly higher risk, Tritanium this year is not significantly different from Trilogy (HR = 1.85, 95 % CI 0.76-4.5). Instead, Avantage Reload turns out for the worse, however with a very limited number of observations. Pinnacle W/Gription and Pinnacle 100 was the most used and fourth most used cup respectively in the period. The first one shows a roughly doubled risk (2.07 95 % CI: 1.19-3.61) and Pinnacle 100 a tripled risk (3.16, 95 % CI 1.78-5.6). In both cases, there is an increased risk of dislocation (percentage of revised, Pinnacle W/Gription 100: 0.5 %; Pinnacle 100: 0.7 %; Trilogy: 0.2 %) followed by loosening (0.3 %, 0.4 %, 0.2 %). The difference in the risk of dislocation can possibly be explained by the fact that standard liner has been used in the surgery with the two variants of Pinnacle cup in 76.8 % and 43.7 % of cases, respectively. The corresponding proportion for Trilogy was just 1.8 %.

Between 2012 and 2022, 1,396 Trident AD LW have been reported, which corresponds to an eleventh place regarding use (Trilogy is in fifth place). In this case the proportion revised due to loosening is 0.6 % and the proportion revised due to dislocation is 0.4 %, which is 0.4 % and 0.2 % respectively higher than for Trilogy. Regarding Continuum, Trilogy-IT and TMT Revision, these cups are more often revised due to dislocation. 1.4 %, 1.6 % respectively 2.4 % of inserted cups between 2013 and 2021 have been revised due to this complication. The proportion of Continuum cups with standard liner has been relatively high (65.9 %), considerably lower in surgeries with Trilogy IT (21.9 %) and even lower with TM cup (6.2 %). The frequency of revision due to loosening was 0.4 % for the TM-cup. For the other two, it was 0.2 %, i.e. the same as for Trilogy. It should be noted that the number of revisions of the TM-cup as of aforementioned Trident AD LW is relatively low, 10 and 11 respectively. Regarding the BHR-cup, loosening dominates as cause of revision (5 out of 10 revisions). One of the revisions were performed due to pseudo tumour. Regarding Allofit Alloclastic, five of the six reported revisions were performed due to dislocation. Two of the three revisions of Avantage Reload were performed due to loosening and one due to incorrectly inserted implant. In summary, it may appear remarkable that three out of the four most used uncemented cups in 2012 to 2022 have a risk of revision higher than the reference implant.

Cemented stem

The SP-stem has been used in Sweden since the early 1980s. The original standard model was 150 mm long regardless of diameter. In the latter part of the 1980s, a modification with modular head was introduced and the stem changed name from SPI to SPII. A few replacements with stem length 130 are registered since more than 20 years ago. In 2015 the reported number was over 200 and has since varied between three and five hundred. In the period they constituted 7.1 % of all SPII stems with a length of 130 or 150 mm. Exeter stem with a length of 125 mm has been used since the beginning of 2000 (see separate in-depth analysis).

In the analysis of cemented stems, SPII 150 mm has been used as reference. It has a long documentation in Sweden and is the most used stem. In table 5.5.3 we see that all stems, except the SPII with stem length over 150 mm show significantly increased risk of being revised compared to SPII 150 mm. The reason that all of the polished

Hazard ratio for uncemented cup revision. The Trilogy cup is used as reference.

	Number	Revisions number	Follow-up*	HR (95 % CI)	p-value
Trilogy IT	4,349	24	10	Ref	
Regenerex	*683*	*0*	*10*	*0*	
TMT modular	*153*	*0*	*10*	*0*	
Tritanium revision (trident)	*113*	*0*	*5*	*0*	
R3	*107*	*0*	*8*	*0*	
Trident AD WHA	1,001	2	10	0.57 (0.13;2.46)	0.45
Allofit	782	2	10	0.76 (0.18;3.32)	0.72
Trident hemi	7,593	19	10	0.84 (0.43;1.64)	0.60
Pinnacle sector	1,642	6	10	1.13 (0.44;2.91)	0.80
Delta Motion	152	1	10	1.17 (0.15;8.84)	0.88
Exceed ABT Ringlock	1,787	11	10	1.57 (0.73;3.38)	0.25
Delta-TT	694	4	9	1.62 (0.54;4.48)	0.39
G7 PPS	2,412	8	6	1.8 (0.75;4.3)	0.19
Tritanium	1,065	7	10	1.85 (0.76;4.5)	0.18
Pinnacle W/Gription Sector	2,384	12	8	1.95 (0.91;4.18)	0.09
Pinnacle W/Cripton 100	**14,553**	**75**	**10**	**2.07 (1.19;3.61)**	**<0.01**
Delta-PF	105	1	9	2.39 (0.32;18)	0.40
Trident II	521	2	3	2.4 (0.54;10.65)	0.25
Trident AD LW	**1,396**	**11**	**10**	**2.47 (1.14;5.35)**	**0.02**
Continuum	**5,48**	**56**	**10**	**2.71 (1.56;4.73)**	**<0.01**
Pinnacle 100	**4,967**	**45**	**10**	**3.16 (1.78;5.6)**	**<0.01**
Trilogy IT	**2,3**	**30**	**10**	**3.97 (2.16;7.3)**	**<0.01**
TMT revision	**448**	**10**	**10**	**4.96 (2.23;11.05)**	**<0.01**
BHR	**190**	**10**	**10**	**11.41 (5.09;25.56)**	**<0.01**
Avantage Reload	**121**	**3**	**7**	**6.32 (1.83;21.88)**	**<0.01**
Allofit Alloclassic	**113**	**6**	**10**	**10.05 (3.91;25.82)**	**<0.01**
Other	**696**	**12**	**10**	**4.06 (1.91;8.61)**	**<0.01**
OA				**0.62 (0.46;0.83)**	**<0.01**
Increasing age (per year)				1 (0.99;1.01)	0.71
Female				1.19 (0.96;1.47)	0.12
Later surgical year (per year)				0.98 (0.94;1.03)	0.47

Table 5.5.2. Hazard ratio (HR) with 95% confidence interval (CI) in uncemented cup revisions. The Trilogy cup is the reference. To be included in the analysis at least 100 observations are needed. The hazard ratios are adjusted for diagnosis, age, sex and surgical year.

Red text indicates statistically significant increased and green text indicates statistically significant decreased risk of revision after adjustment for diagnosis, age, sex and year of operation.

**) Years until numbers at risk exceed 20 observations.*

stems having an increased risk of revision is due to the fact that they are more often revised than SPII due to periprosthetic fracture. In Exeter 150 mm, MS30 and the CPT groups, 0.4 % were revised due to this complication compared with 0.03 % in the reference group. The proportion revised due to loosening was however lower in the three groups with polished stem (Exeter 150 mm: 0.1 %, MS30: 0.1 %, CPT: 0.2 %, SPII: 0.3 %). The proportions revised due to periprosthetic fracture and loosening respectively were equally high in the group "short Exeter stem" (0.3 %). Regarding SPII 130 mm and the group others, the most common reason for revision was loosening. In the first group 0.5 % were revised due to this reason between 2012 and 2022. In the group others, this proportion was even larger, 1.1 %. Among the polished stems the proportion of revisions due to dislocation was between 0.04 % (short Exeter stem) and 0.25 % (MS30). In the reference group, the corresponding proportion was 0.05 %. To what extent the stem's positioning has been the primary reason to perform these revisions is however unknown.

Uncemented stem

The Corail stem is currently the most common uncemented stem in Sweden. Since 2012, on average 3,202 inserted prostheses per year have been reported in 2012 to 2022 in elective primary surgery (including standard, coxa vara and high-offset type). As comparison, it can be mentioned that the corresponding average for the most used cemented stem, SPII 150 mm, was 5,056 per year.

The Corail stem exists in three main varieties of which two are mainly or only used with (coxa vara) or without collar (high offset). This year, we have used the standard version of the Corail stem, with or without a collar, as a reference. This stem constitutes 62.6 % of all Corail stems with standard length, while high offset constituted 19.1 % and coxa vara 18.3 % during the entire period. Since 2019, the Corail standard has reduced its proportion of all uncemented stems from 38.8 % to 31% in 2022. Corail coxa vara has increased from 11.7 % to 14.3 % while Corail high offset has decreased from 14.4 % to 8.9 % in

Hazard ratio for cemented stem revision. The SPII standard 150 stem is used as reference.

	Number	Revisions number	Follow-up*	HR (95% CI)	p-value
SPII 150 mm	55,618	214	10	Ref	
SPII longer than 150 mm	*169*	*0*	*8*	*0*	
Exeter 150 mm	**27,415**	**179**	**10**	**1.67 (1.38;2.06)**	**<0.01**
MS-30 polished	**14,913**	**114**	**10**	**2.36 (1.88;2.97)**	**<0.01**
Exeter 125 mm*	**2,765**	**20**	**10**	**2.47 (1.55;3.92)**	**<0.01**
SPII 130 mm	**3,158**	**22**	**8**	**2.55 (1.64;3.97)**	**<0.01**
CPT 130 mm	**510**	**5**	**10**	**3.23 (1.33;7.86)**	**0.01**
Other	**559**	**11**	**10**	**3.01 (1.61;5.62)**	**<0.01**
OA				**0.54**	**<0.01**
Increasing age (per year)				0.99	0.28
Female				**0.42**	**<0.01**
Later surgical year(per year)				**1.05**	**<0.01**

Table 5.5.3. Hazard ratio (HR) with 95 % confidence interval(CI) in cemented stem revisions. The SPII stem is the reference. To be included in the analysis at least 100 observations are needed. The hazard ratios are adjusted for diagnosis, age, sex and surgical year.

Red text indicates statistically significant increased and green text indicates statistically significant decreased risk of revision after adjustment for diagnosis, age, sex and year of operation.

**) Years until numbers at risk exceed 20 observations.*

Hazard ratio for uncemented stem revision. The Corail stem is used as reference.

	Number	Revisions number	Follow-up*	HR (95% CI)	p-value
Corail standard	22,044	178	10	Ref	
Symax	*109*	*0*	*10*	*0*	
Bi-Metric por HA	225	1	5	0.54 (0.08;3.89)	0.54
Corail coxa vara	**6,429**	**32**	**10**	**0.65 (0.45;0.96)**	**0.03**
Accolade straight	635	5	10	0.68 (0.28;1.68)	0.41
Accolade II	5,301	27	10	0.75 (0.5;1.13)	0.17
Bi-metric HA FMRL	160	1	5	0.81 (0.11;5.78)	0.83
CLS	7,217	60	10	1 (0.74;1.35)	0.99
Corail high offset	**6,686**	**97**	**10**	**1.73 (1.34;2.24)**	**<0.01**
Echo Bi-Metric (FPP)	1,968	12	7	1.1 (0.6;1.99)	0.76
SP-CL	397	3	6	1.16 (0.37;3.63)	0.80
M/L Taper	4,307	33	10	1.26 (0.86;1.84)	0.23
Bi-Metric X por HA NC	**4,800**	**74**	**10**	**1.49 (1.12;1.97)**	**<0.01**
Echo Bi-Metric (RPP)	303	3	8	1.63 (0.52;5.11)	0.41
Fitmore	201	4	10	1.79 (0.66;4.86)	0.25
Wagner Cone	**1,476**	**25**	**10**	**2.07 (1.35;3.19)**	**<0.01**
ABG II HA	**1,260**	**38**	**10**	**3.01 (2.1;4.29)**	**<0.01**
CFP	**166**	**7**	**10**	**3.76 (1.75;8.05)**	**<0.01**
ANATO	**151**	**4**	**7**	**3.82 (1.41;10.31)**	**<0.01**
Other	**485**	**14**	**10**	**2.84 (1.63;4.92)**	**<0.01**
OA				0.83 (0.63;1.09)	0.19
Increasing age (per year)				**1.01 (1.01;1.02)**	**<0.01**
Female				0.86 (0.73;1.02)	0.07
Later surgical year (per year)				1 (0.97;1.03)	0.93

Table 5.5.4. Hazard ratio (HR) with 95 % confidence interval (CI) in uncemented stem revisions. The Corail stem is the reference. To be included in the analysis at least 100 observations are needed. Implants without any reported cup revision is presented in italics. The hazard ratios are adjusted for age, sex and surgical year.

Red text indicates statistically significant increased and green text indicates statistically significant decreased risk of revision after adjustment for diagnosis, age, sex and year of operation.

**) Years until numbers at risk exceed 20 observations.*

the same period. In total, the Corail stem's proportion has decreased from 64.9 % to 54.3 % between 2019 and 2022, mainly in favour of an increased proportion of M/L Taper and Accolade II.

In this year's analysis six stems show an increased risk for revision and only one stem reduced risk compared to Corail standard. In all cases, except one, with increased risk (Bi-metric X por HA NC) there is a larger proportion of stem revisions due to loosening. The proportion revised due to this reason varied between 0.8 % (Corail high offset) and 3.6 % (CFP). Corresponding proportion for Corail standard was 0.2 %, the same as for Corail coxa vara, however, with an overall significantly reduced risk. The differences between the three variations of the Corail stem is however difficult to interpret because the choice of offset and CCD-angle is controlled by the patient's anatomy, which means there is a risk of bias. Bi-metric X por HA NC showed a relatively high risk of revision due to periprosthetic fracture (1.1 %). The proportion of ABG II that was revised due to the same reason was even greater (1.6 %). In the CFP and ANATO groups non has been revised due to periprosthetic fracture and in the remaining two, Wagner Cone and Corail high offset, the proportion of revision due to periprosthetic fracture was 0.1 % and 0.4 % respectively (Corail standard: 0.3 %). Both the CFP-stem and the ANATO were revised in 0.6 % and 0.7 % of the cases respectively due to dislocation while this reason of revision varied between 0.1 % and 0.4 % among the other four with increased risk (Corail standard: 0.1 %). The number of observations in the CFP and ANATO groups is however very limited which restricts the possibilities for relevant conclusions. Furthermore, the background of a stem revision due to dislocation is difficult to interpret only based on register data.

Finally, the presence of increased or decreased risk of revision without a deeper analysis may be difficult to interpret because more detailed data is lacking regarding patient selection, hip anatomy and other environment factors related to care process and surgery, factors that may have a great influence especially if the number of observations is few. For those implants that are used in thousands during ongoing years with elevated risk of revision, it is reasonable to believe that a consistent risk increase, at least to some extent, is caused by the implant itself. Even here, there can however be bias. As for example it could be suspected that uncemented cups almost exclusively used with standard liner perform worse as regards risk of dislocation than those that mainly are used with liners that provide increased protection against this complication.

Summary

When evaluating cemented implants and uncemented cups inserted 2012 to 2021 there is no specific design that has significantly lower risk of non-infectious cup and stem revision respectively than the chosen reference implant after adjustment for age, sex, diagnosis and surgical year. When inserting an uncemented stem the same relation applies except for Corail coxa vara which had a lower risk of non-infectious revision of the stem compared with Corail standard. The variation between the three Corail stems is however difficult to interpret since choice of offset and CCD-angle is controlled by the hip's anatomy.

In general, dislocation followed by loosening is the most common reasons why cups are revised more often than the reference implant regardless of choice of fixation.

Polished cemented stems perform worse than the reference due to increased risk of revision because of periprosthetic fracture. The polished stems tend to be revised less frequently due to loosening, which does not fully compensate for their increased revision rate due to periprosthetic fracture. The shorter SPII-stem has an increased risk of being revised due to loosening.

Increased revision risk of uncemented stem was in five out of six cases mainly associated with increased risk of revision due to loosening. Choice of articulation, surgical technique and comorbidity may despite the adjustments made have influenced the outcomes and especially in those cases where the number of observations is limited. The presented results should therefore be interpreted against this background.

5.6. Hip fracture treatment with total or hemiarthroplasty

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This chapter report the results of individuals treated for a hip fracture with either hemiarthroplasty (HA) or total hip arthroplasty (THA). In 2022, the largest number ever of such surgeries was reported, 6,986. The increase is not solely due to a likely increase in the number of fractures (see below), but is largely influenced by how Swedish orthopedic surgeons choose treatment in patients with hip fractures. Femoral neck fractures are primarily treated with a hip arthroplasty. Data from the Swedish Fracture Register show that increasingly younger individuals receive total hip arthroplasty, at the expense of internal fixation.

There have been few demographic changes in the period 2018–2022. Sex distribution, proportion of underweight and overweight, and proportion with different degrees of morbidity (ASA class) are unchanged (table 5.6.1). However, a trend is seen; the proportion who are 75–84 years old at the time of the fracture is increasing. The peak year of 1945 50,000 more were born than 1933, the year with the lowest number of births, 135,000 compared to 85,000. Even in following years, until the end of the 50s, the birth cohorts were large, so there is reason to expect a continued large number of fragility fractures in the future.

Demography in hip arthroplasty as fracture treatment

	2018	2019	2020	2021	2022
Number	**6,395**	**6,531**	**6,476**	**6,477**	**6,986**
Mean age (SD)	81.47 (9.58)	81.59 (9.25)	81.42 (9.44)	81.41 (9.32)	81.20 (9.32)
Age group n (%)					
< 45	15 (0.2)	11 (0.2)	17 (0.3)	14 (0.2)	22 (0.3)
45–54	51 (0.8)	51 (0.8)	44 (0.7)	50 (0.8)	42 (0.6)
55–64	228 (3.6)	239 (3.7)	247 (3.8)	234 (3.6)	267 (3.8)
65–74	1,133 (17.7)	1,046 (16.0)	1,068 (16.5)	1,026 (15.8)	1,157 (16.6)
75–84	2,248 (35.2)	2,442 (37.4)	2,422 (37.4)	2,445 (37.7)	2,741 (39.2)
≥ 85	2,720 (42.5)	2,742 (42.0)	2,678 (41.4)	2,708 (41.8)	2,757 (39.5)
Females n (%)	4,139 (64.7)	4,215 (64.5)	4,045 (62.5)	4,180 (64.5)	4,449 (63.7)
BMI n (%)					
<18,5	317 (6.8)	364 (7.0)	341 (6.7)	410 (7.7)	422 (7.1)
18,5–25	2,653 (56.6)	2,888 (55.6)	2,917 (57.3)	2,918 (54.7)	3,282 (55.1)
25–30	1,337 (28.5)	1,516 (29.2)	1,431 (28.1)	1,529 (28.7)	1,736 (29.1)
30–35	314 (6.7)	362 (7.0)	332 (6.5)	383 (7.2)	430 (7.2)
35–40	61 (1.3)	52 (1.0)	64 (1.3)	75 (1.4)	71 (1.2)
≥ 40	9 (0.2)	14 (0.3)	9 (0.2)	19 (0.4)	17 (0.3)
ASA class n (%)					
ASA I	250 (4.1)	235 (3.7)	161 (2.6)	199 (3.1)	211 (3.1)
ASA II	2,189 (36.0)	2,257 (35.7)	2,138 (34.1)	2,170 (34.3)	2,283 (33.5)
ASA III	3,274 (53.8)	3,428 (54.2)	3,540 (56.5)	3,492 (55.2)	3,856 (56.6)
ASA IV	373 (6.1)	399 (6.3)	426 (6.8)	463 (7.3)	464 (6.8)

Table 5.6.1. Demography in fracture-related hip arthroplasty.

The most common stem components in fracture patients

	2012	2021	2022
Number	**5,941**	**6,477**	**6,986**
Implant, n (%)			
SPII standard	2,663 (44.8)	4,112 (63.7)	4,525 (65.5)
Exeter standard	1,915 (32.2)	1,633 (25.3)	1,697 (24.6)
MS-30 polished	301 (5.1)	407 (6.3)	377 (5.5)
Covision straight	331 (5.6)	165 (2.6)	145 (2.1)
CPT	412 (6.9)	4 (0.1)	9 (0.1)
Corail standard	114 (1.9)	17 (0.3)	16 (0.2)
Restoration	21 (0.4)	26 (0.4)	26 (0.4)
Exeter long	24 (0.4)	14 (0.2)	19 (0.3)
MP proximal standard	16 (0.3)	13 (0.2)	14 (0.2)
Bi-Metric X por HA NC	35 (0.6)	0 (0.0)	0 (0.0)
Corail coxa vara	11 (0.2)	3 (0.0)	11 (0.2)
Corail high offset	6 (0.1)	8 (0.1)	10 (0.1)
Wagner Cone	18 (0.3)	4 (0.1)	1 (0.0)
Spectron EF Primary	21 (0.4)	1 (0.0)	0 (0.0)
Unknown	0 (0.0)	19 (0.3)	16 (0.2)
Other	52 (0.9)	31 (0.5)	38 (0.6)

Table 5.6.2. The most common stem components in fracture patients.

When it comes to considerations about surgical technique, the number of patients who are operated on with direct lateral approach is increasing (figure 5.6.1). Both HA and THA with Dual Mobility cup (DM-cup) are increasing, while the number of conventional THAs is unchanged (figure 5.6.5). THA and DM cup should be added together to understand how the THA concept has increased in the last 16 years, from 25 % in 2006 to 31% in 2022.

Two stems continue to dominate; the Lubinus SPII-stem was used in 66 % and the Exeter-stem in 25 % of the fracture patients in 2022. If the MS-30 stem and the Covision straight stem are included, 97 % are now treated with these cemented stems (table 5.6.2). These four stems have a relatively equal incidence of revision surgery (figure 5.6.2 b-e). Now the Lubinus SPII and Exeter stems can be followed up to 15 years, with just over 6 % and just over 7 % revision rate respectively. MS-30 is at the same level at 13 years, while Covision straight has approximately 4 % at 10 years. There is some statistical uncertainty about the last two, there are fewer stems studied and they are only used in a few hospitals. This means that confounders can affect the result. The uncemented stems still constitute less than 1%. The most common uncemented stem, Corail, has a higher revision rate than the cemented stems, just over 10 % at 13 years (figure 5.6.2 a). That the direct lateral approach is most common may also be seen as an advantage compared to posterior approach, at least measured as a lower revision rate over the entire 15-year period (figure 5.6.3).

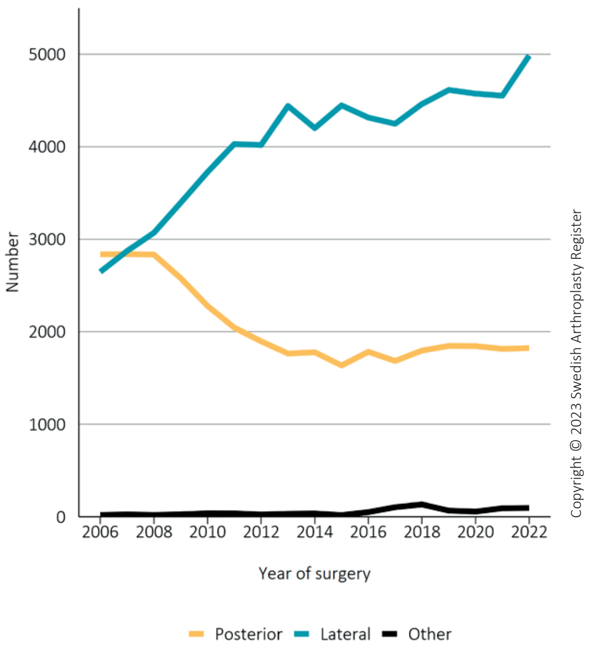


Figure 5.6.1. Choice of surgical approach in fracture-related hip arthroplasty.

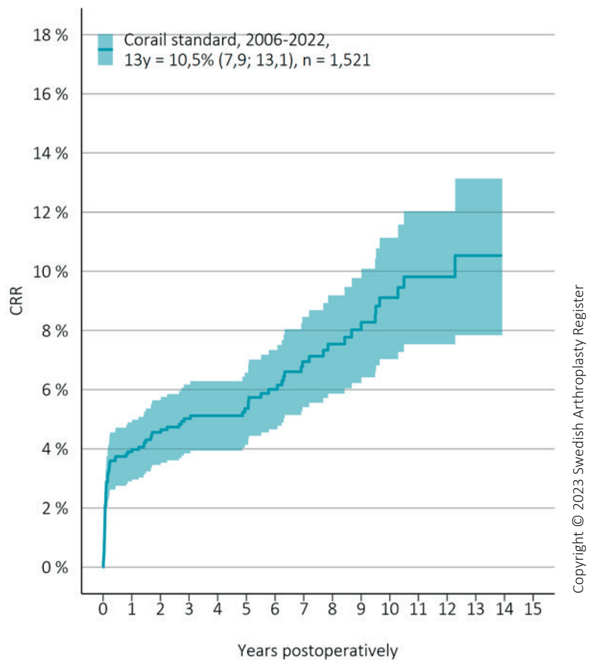


Figure 5.6.2a. Cumulative risk of revision for the uncemented Corail stem.

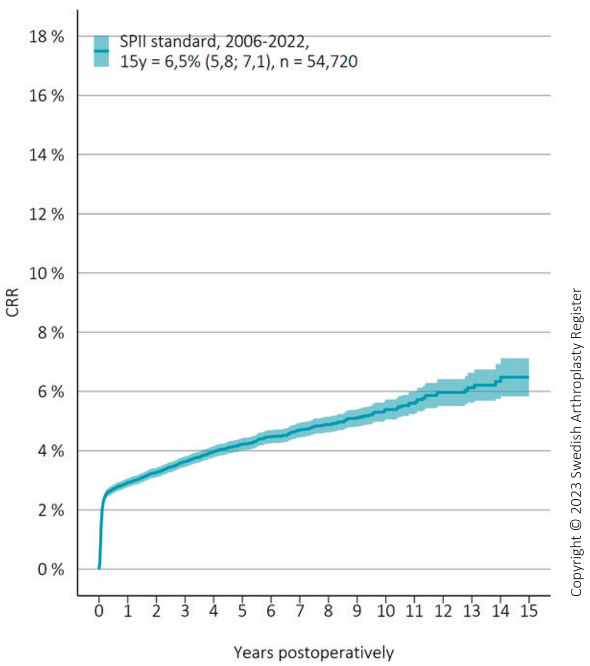


Figure 5.6.2b. Cumulative risk of revision for the cemented Lubinus II stem.

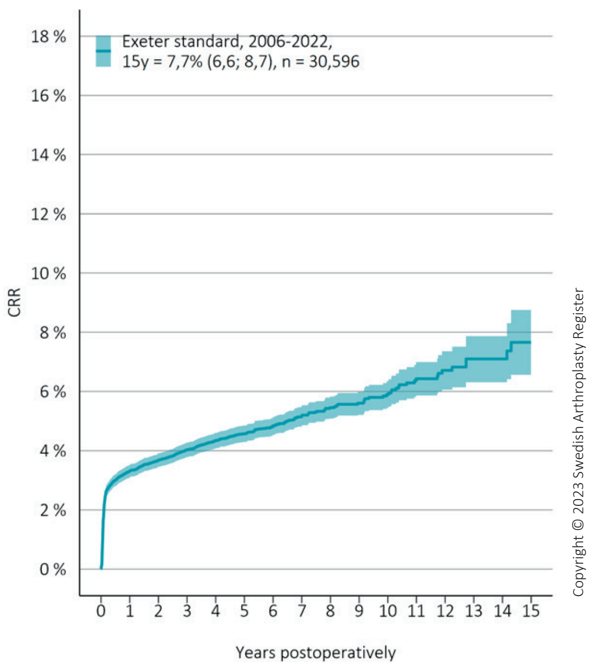


Figure 5.6.2c. Cumulative risk of revision for the cemented Exeter standard stem.

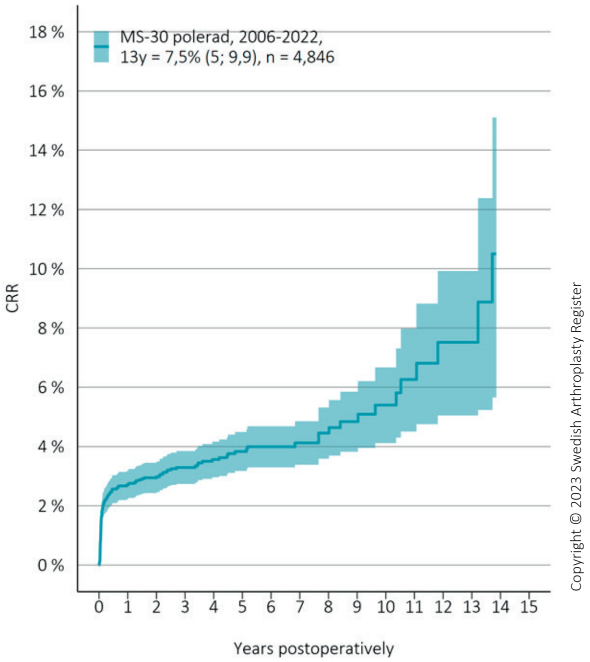


Figure 5.6.2d. Cumulative risk of revision for the cemented MS30 polished stem.

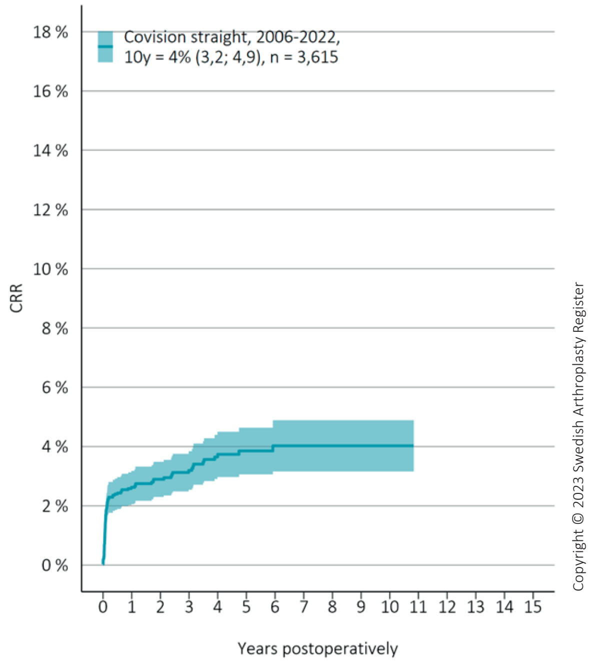


Figure 5.6.2e. Cumulative risk of revision for the cemented Covision straight stem.

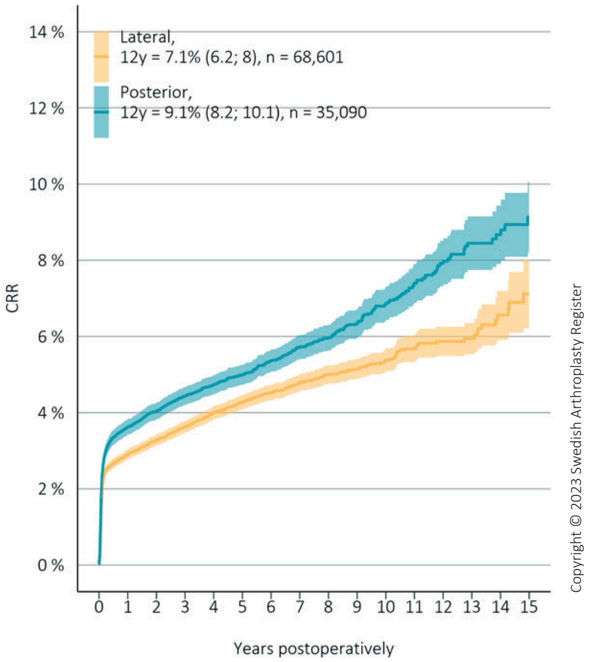


Figure 5.6.3. Cumulative risk of revision related to surgical approach.

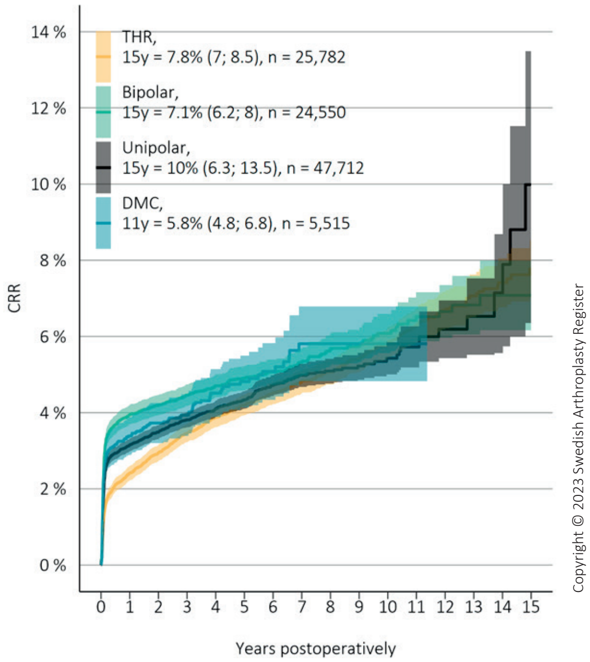


Figure 5.6.4. Cumulative risk of revision related to type of prosthesis.

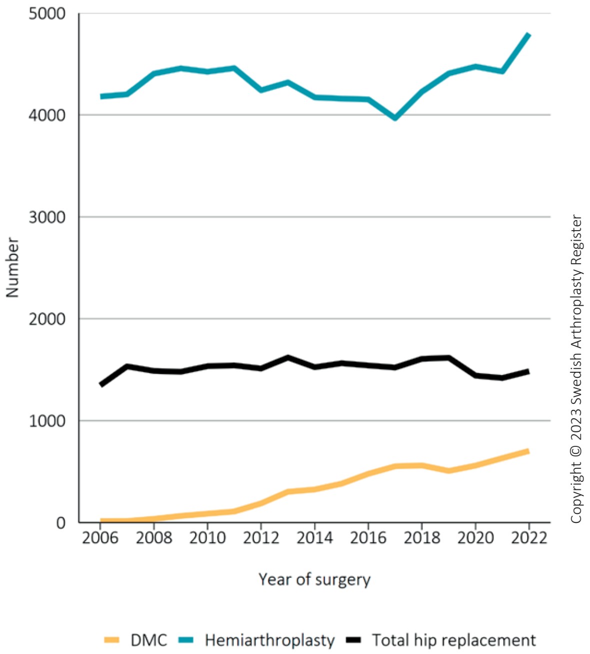


Figure 5.6.5. Choice of prosthesis in fracture-related hip arthroplasty.

The surgeon may choose a HA, or a THA with an acetabulum cup. The options contribute to more implant models regarding articulation (table 5.6.3) compared to the stem side. In 2022, the Unipolar femoral head was the most common option, followed by the relatively new Modular Trauma Head (unipolar). This prosthetic head was reviewed in an in-depth analysis last year, where a short-term follow-up regarding revision surgeries showed a similar result to Unipolar head. It would be ideal for the units that introduced the Modular Trauma Head to perform analyzes of whether this implant change led to a reduced number of dislocations, something that requires reading medical records to ensure. The modular construction of the Modular Trauma Head with a sleeve that is placed between the stem and the head provides more choices of neck length and possibly better stability, but also implies a theoretical risk of other complications. The bipolar UHR Universal Head is also being used in increasing numbers. In cases where an acetabulum cup is inserted, the Lubinus X-link is most common. DMC were also chosen in 2022 for every tenth patient with a hip fracture, among these Avantage is the most common.

The cumulative revision rate is similar for all four articulation types (figure 5.6.4). Bipolar HAs have slightly higher cumulative revision rate in the first years and THAs clearly lower, but after 3 to 5 years no difference is seen. Here it can be noted that DMC do not result in a reduction in the overall revision rate. They follow the curves of both types of HA. As always, we remind you that the revision rate is only the tip of the iceberg. A significant proportion of those who develop complications are treated either with minor interventions or non-operatively, but their suffering can nevertheless be great.

Register collaboration

As in last year's report, we remind of the linkage of data between the Arthroplasty Register and the Fracture Register. If a hip arthroplasty with a diagnosis of hip fracture is found in one of the registers, but not in the other, the data is linked to the other register. However, in the next step, register coordinators must manually complete the registration.

Early reoperations

Deep infections, dislocations and periprosthetic fractures are the most common complications in the fracture group and they occur early after surgery. They do not always lead to revision, in cases where the surgeon limits the intervention to other, minor surgery. To cover both major and minor secondary interventions, we report "Reoperations within six months" (table 5.6.4). The disadvantage is that there is under-reporting from some units, i.e. a low number here can at worst be due to suboptimal reporting routine. The country's combined results are 3 % early reoperations. Both small and large units are among the 13 units that have over 4 % reoperations. A high rate of early reoperations may be due to a proactive approach to correcting problems such as dislocation surgically. Nevertheless, high rates should perform a local review to identify factors to improve.

The most common cup components

	2012	2021	2022
Number	**5,941**	**6,477**	**6,986**
Implant, n (%)			
Unipolar femoral head	1,405 (23.6)	1,755 (27.1)	1,667 (23.9)
Modular Trauma Heads	0 (0.0)	736 (11.4)	1,180 (16.9)
UHR Universal Head	644 (10.8)	856 (13.2)	914 (13.1)
Lubinus x-link	131 (2.2)	627 (9.7)	599 (8.6)
Unitrax modular endohead	576 (9.7)	456 (7.0)	401 (5.7)
Avantage	128 (2.2)	392 (6.1)	328 (4.7)
Exeter Rim-fit	80 (1.3)	237 (3.7)	307 (4.4)
Lubinus	534 (9.0)	161 (2.5)	178 (2.5)
MultiPolar Bipolar Cup	120 (2.0)	186 (2.9)	177 (2.5)
Marathon	358 (6.0)	190 (2.9)	153 (2.2)
Covision unipolar	337 (5.7)	164 (2.5)	144 (2.1)
Polarcup cemented	50 (0.8)	121 (1.9)	142 (2.0)
Vario cup	356 (6.0)	109 (1.7)	126 (1.8)
Unipolar	86 (1.4)	128 (2.0)	119 (1.7)
V40 unipolar	285 (4.8)	0 (0.0)	0 (0.0)
Other	851 (14.3)	359 (5.5)	551 (7.9)

Table 5.6.3. The most common cup/head components in fracture patients.

Reoperations within six months per unit

Unit	Number of primary operations [1)]	Number of reoperations [2)]	Proportion (%) [3)]
University units			
Akademiska sjukhuset	756	19	2.6
Karolinska Huddinge	388	18	4.9
Karolinska Solna	44	2	4.5
Linköping	518	15	3.1
SU/Mölndal	1,154	29	2.6
SUS/Lund	607	19	3.3
SUS/Malmö	703	20	2.9
Umeå	342	11	3.4
Örebro	100	3	3.3
Other units			
Borås	406	5	1.3
Danderyd	922	32	3.6
Eksjö	187	9	5.2
Eskilstuna	333	13	4.1
Falun	420	14	3.5
Gävle	460	10	2.2
Halmstad	385	6	1.6
Helsingborg	577	27	4.8
Hässleholm	37	1	2.7
Jönköping	254	8	3.3
Kalmar	307	2	0.7
Karlskrona	442	11	2.7
Karlstad	553	23	4.3
Kristianstad	422	17	4.1
Norrköping	310	5	1.7
NÄL	786	23	3.1
Skövde	437	18	4.4
Sunderby sjukhus	507	7	1.4
Sundsvall	356	5	1.5
Södersjukhuset	1,011	23	2.4
Uddevalla	20	1	5.9
Varberg	375	10	2.8
Västerås	570	19	3.5

The table continues on the next page.

Reoperations within six months per unit, cont.

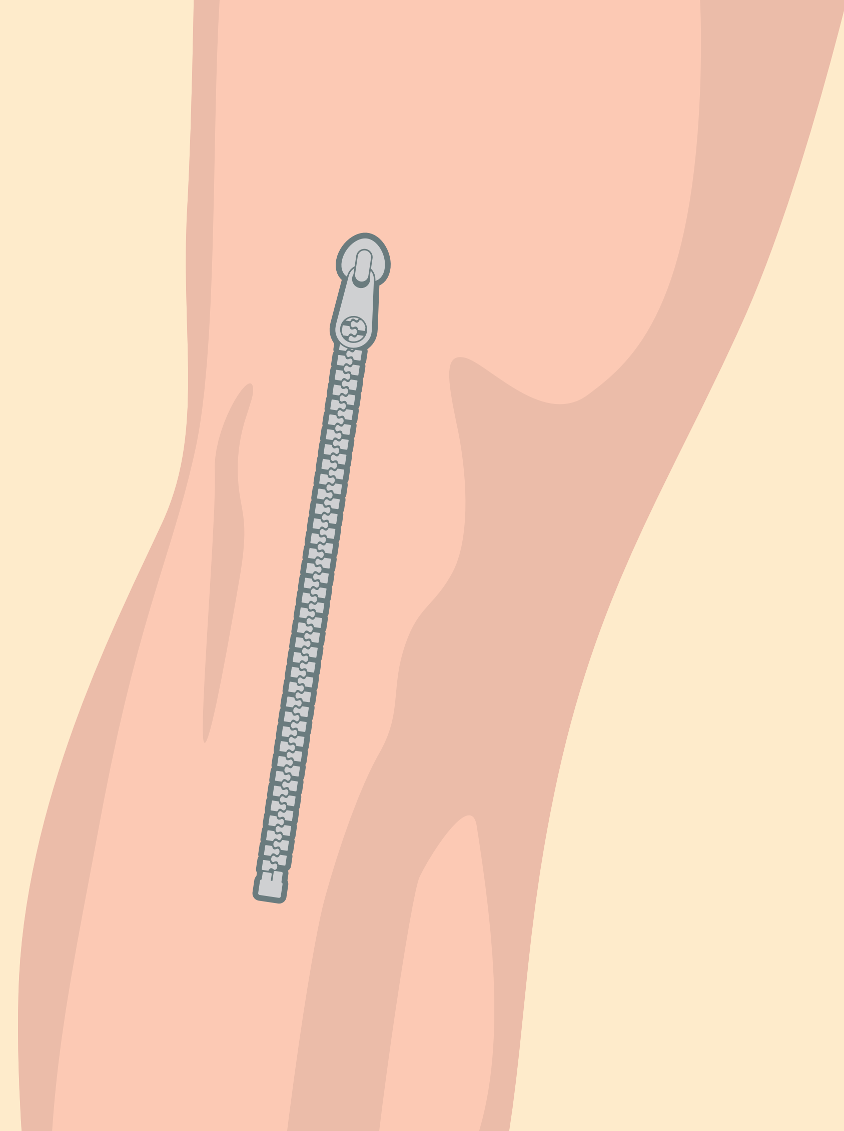
Unit	Number of primary operations 1)	Number of reoperations 2)	Proportion (%) 3)
Växjö	288	14	5.1
Ystad	292	15	5.4
Östersund	290	8	2.8
Alingsås	153	7	4.7
Gällivare	161	6	3.8
Hudiksvall	251	4	1.7
Karlskoga	311	6	2.1
Kungälv	256	11	4.4
Lidköping	173	3	1.8
Lindesberg	236	1	0.4
Ljungby	131	4	3.2
Lycksele	86	1	1.2
Mora	238	4	1.7
Norrtälje	145	5	3.5
Nyköping	218	6	2.8
Piteå	29	0	0
Skellefteå	207	7	3.6
Södertälje	239	1	0.5
Torsby	90	2	2.4
Trelleborg	37	1	2.9
Visby	158	6	3.9
Värnamo	158	5	3.2
Västervik	216	6	2.9
Örnsköldsvik	237	3	1.3
Private units			
Capio S:t Göran	602	16	2.8
Country	**19,939**	**568**	**3**

Table 5.6.4. Reoperations within six months per unit.

1) Number of primary operations for fracture patients 2020–2022. Units with less than 20 operations in the period are excluded..

2) Number of re-operations within six months.

3) Proportion of reoperations calculated using competing risk analysis at six months' follow-up.



Since the start in 1975 until December 2022, 344,549 primary knee replacements and 29,759 reoperations have been registered in 260,825 individuals.

6. Knee replacement

6.1. Primary knee replacement

Authors: Annette W-Dahl and Perna Ighani Arani

In 2022, 17,002 primary knee replacements were registered, barely 100 fewer than 2019 but 43 % more than 2020 and 33 % more than in 2021. This means that roughly 25 % fewer primary knee replacements (just over 4,000 operations) have been performed in the pandemic years if the production had been the same as in 2019 and in 2022. The standard treatment for a primary knee replacement is a total replacement (TKR), that in 2022 accounted for 87 % of the operations. The proportion of unicompartmental knee replacement (UKR) was similar as in 2021, 12.3 % whereof just under 3 % were lateral UKRs. Other forms of replacements (patellofemoral prosthesis and partial prosthesis) were reported to a limited extent (figure 6.1.1). In 2022, 76 units reported to the register which includes all units performing elective (planned) knee replacement. It should be noted that the number of knee replacements may differ somewhat in different analyses as data has been extracted at different times. Table 6.1.1 shows demography in primary knee replacements, divided into TKR, medial UKR and lateral UKR.

The mean age in primary knee replacement is six months lower in 2022 (67.2 years) compared to 2021 (68.7 years). Historically, the mean age has increased from just over 65 years in 1975 to just over 71 years in 1994. The main reason was an increase in the number of surgeries within the older age groups. A probable explanation for this is an improved anesthesiological technique with increased safety in older patients and an altered age structure in the society. After 1994 the proportion of patients below 65 years of age increased somewhat and the mean age decreased. This tendency has not continued in recent years with exception of the pandemic years 2020 and 2021 when many older patients did not received care to the same extent as before. The age group 65–74 years constitute the largest proportion with 38.8 %, followed by the age group 75–84 years (28.2 %). Almost one third (30.2 %) of the primary knee replacements in 2022 were performed in individuals under 65 years of age.

Flow-chart knee replacements 2022

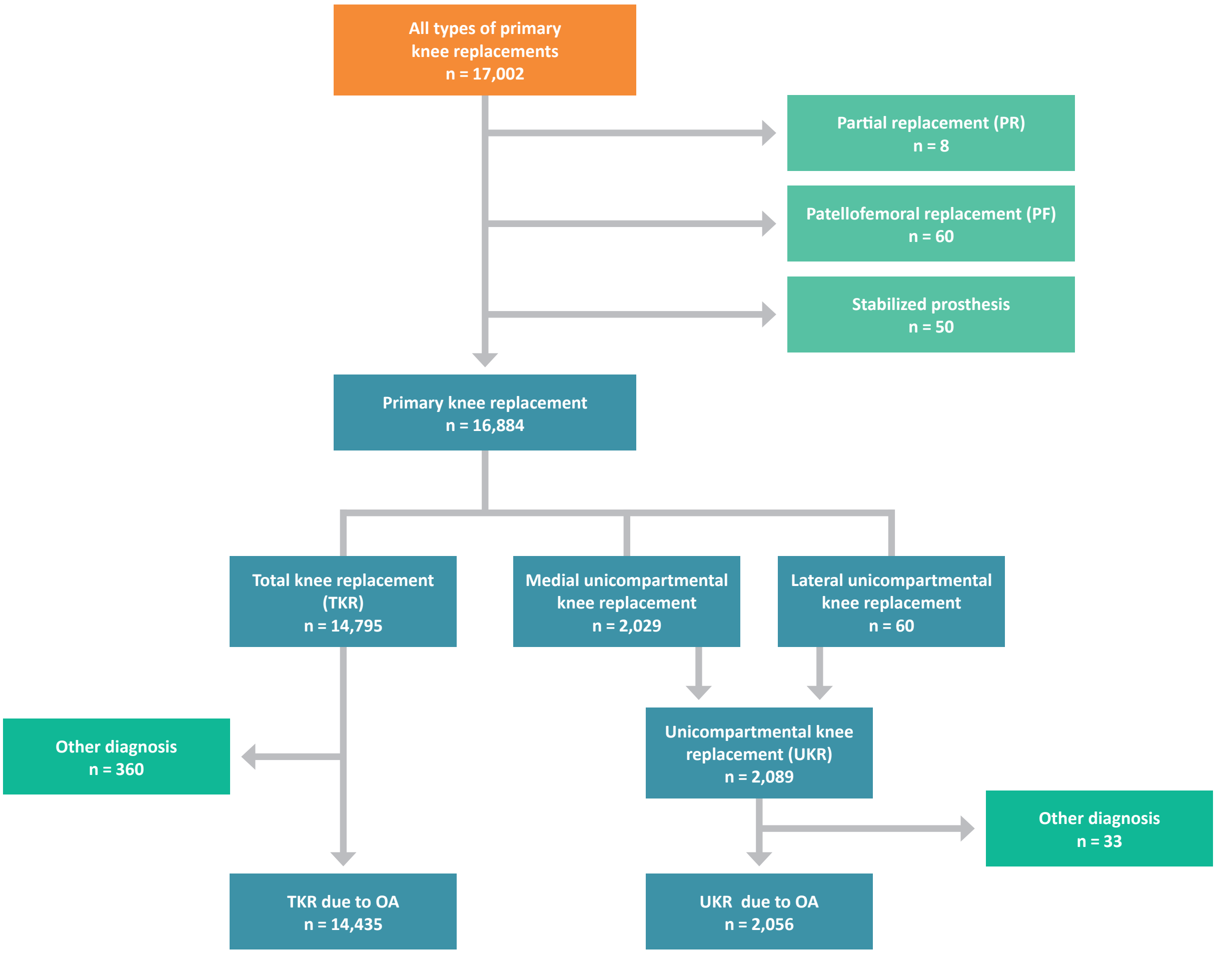


Figure 6.1.1. Flow-chart knee replacements 2022.

The mean age of those operated on with medial UKR was just over three and a half years younger than those operated with a TKR (66.1 years and 69.7 years respectively), while the mean age in those operated with a lateral UKR was just over one year older than those operated with a medial UKR (67.5 years). In 2022, more than one fourth (28.4 %) of those operated with a TKR were ≤ 65 years of age compared with 42.6 % of those operated with a UKR were ≤ 65 years of age.

Knee replacement is a more common in females than in males. In the early 1980s, 70 % of the surgeries were performed in females. Since then, the proportion of surgeries in males has increased slowly and in 2022 they constituted 44.7 %. There was a larger proportion of females having a TKR (56.1 %). In medial UKR the proportion of males was larger (51.7 %) than in TKR and lateral UKR (43.9).

The registration of BMI and ASA class in knee replacement started in 2009. The proportion of primary knee replacements in individuals with obesity (BMI ≥ 30) was somewhat larger (36.8 %) than in those having a UKR (33.6 %). Approximately one fourth of those operated on with a lateral UKR had obesity compared with one third of those operated on with a medial UKR. The corresponding proportion in those with BMI ≥ 35 were 8.2 % in TKR, 5.4 % in medial UKR and 5.1 % in lateral UKR.

Demography TKR and UKR 2020–2022

	2020			2021			2022		
	TKR	UKR lateral	UKR medial	TKR	UKR lateral	UKR medial	TKR	UKR lateral	UKR medial
Number	10,341	22	1,354	11,060	35	2	14,791	60	2,029
Mean age (SD)	67.0 (9.0)	64.4 (12.3)	65.6 (9.2)	69.1 (9.0)	66.1 (12.7)	65.9 (9.0)	69.7 (8.9)	67.5 (10.4)	66.1 (9.0)
Age group (%)									
< 45 years	39 (0.4)	0 (0.0)	8 (0.6)	40 (0.4)	1 (2.9)	9 (0.6)	44 (0.3)	2 (3.3)	10 (0.5)
45–54 years	579 (5.6)	6 (27.3)	158 (11.7)	634 (5.7)	7 (20.0)	160 (9.9)	724 (4.9)	4 (6.7)	207 (10.2)
55–64 years	2,631 (25.4)	5 (22.7)	467 (34.5)	2,769 (25.0)	8 (22.9)	537 (33.3)	3,426 (23.2)	16 (26.7)	652 (32.1)
65–74 years	4,014 (38.8)	6 (27.3)	483 (35.7)	4,201 (38.0)	7 (20.0)	604 (37.4)	5,750 (38.9)	22 (36.7)	782 (38.5)
75–84 years	2,794 (27.0)	4 (18.2)	219 (16.2)	3,094 (28.0)	11 (31.4)	283 (17.5)	4,417 (29.9)	14 (23.3)	341 (16.8)
≥ 85 years	284 (2.7)	1 (4.5)	19 (1.4)	322 (2.9)	1 (2.9)	21 (1.3)	430 (2.9)	2 (3.3)	37 (1.8)
Females (%)	5,755 (55.7)	10 (45.5)	660 (48.7)	6,231 (56.3)	22 (62.9)	771 (47.8)	8,291 (56.1)	41 (68.3)	979 (48.3)
BMI (%)									
< 18.5	17 (0.2)	0 (0.0)	0 (0.0)	19 (0.2)	0 (0.0)	2 (0.1)	28 (0.2)	1 (1.7)	1 (0.0)
18.5–24.9	1,913 (18.5)	5 (22.7)	284 (21.0)	2,091 (19.0)	9 (25.7)	296 (18.4)	2,868 (19.6)	23 (39.0)	372 (18.5)
25–29.9	4,470 (43.3)	10 (45.5)	633 (46.8)	4,800 (43.7)	12 (34.3)	790 (49.2)	6,365 (43.4)	21 (35.6)	958 (47.6)
30–34.5	3,033 (29.4)	7 (31.8)	344 (25.4)	3,144 (28.6)	11 (31.4)	436 (27.1)	4,205 (28.7)	11 (18.6)	573 (28.5)
35–39.9	783 (7.6)	0 (0.0)	84 (6.2)	843 (7.7)	3 (8.6)	77 (4.8)	1,064 (7.3)	3 (5.1)	101 (5.0)
≥ 40	113 (1.1)	0 (0.0)	8 (0.6)	88 (0.8)	0 (0.0)	5 (0.3)	126 (0.9)	0 (0.0)	8 (0.4)
ASA-class (%)									
I	1,721 (16.7)	3 (13.6)	314 (23.2)	1,688 (15.3)	7 (20.0)	389 (24.2)	2,038 (13.8)	18 (30.0)	463 (22.9)
II	6,885 (66.7)	16 (72.7)	870 (64.4)	7,477 (67.7)	26 (74.3)	1,044 (64.8)	9,843 (66.8)	37 (61.7)	1,291 (63.7)
III–V	1,724 (16.7)	3 (13.6)	167 (12.4)	1,873 (17.0)	2 (5.7)	177 (11.0)	2,854 (19.4)	5 (8.3)	272 (13.4)
Diagnosis (%)									
Osteoarthritis	10,051 (97.2)	22 (100.0)	1,317 (97.3)	10,731 (97.1)	35 (100.0)	1,579 (97.8)	14,409 (97.6)	60 (100.0)	1,996 (98.4)
Inflamatory joint disease	152 (1.5)	0 (0.0)	1 (0.1)	161 (1.5)	0 (0.0)	0 (0.0)	171 (1.2)	0 (0.0)	1 (0.0)
Osteonecrosis	69 (0.7)	0 (0.0)	36 (2.7)	62 (0.6)	0 (0.0)	30 (1.9)	78 (0.5)	0 (0.0)	28 (1.4)
Sequele fracture/ trauma	56 (0.5)	0 (0.0)	0 (0.0)	73 (0.7)	0 (0.0)	0 (0.0)	82 (0.6)	0 (0.0)	1 (0.0)
Acute trauma	10 (0.1)	0 (0.0)	0 (0.0)	21 (0.2)	0 (0.0)	3 (0.2)	21 (0.1)	0 (0.0)	1 (0.0)
Tumor	1 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.0)	0 (0.0)	0 (0.0)
Other joint diseases	2 (0.0)	0 (0.0)	0 (0.0)	2 (0.0)	0 (0.0)	2 (0.1)	6 (0.0)	0 (0.0)	1 (0.0)

Table 6.1.1. Demography in TKR and UKR 2022.

The proportion of primary operations in individuals classified as ASA class III–IV is somewhat higher in 2022 (18.6 %) compared to 2009/2010 (15.2 %). Individuals operated with TKR were classified as ASA III–IV to a larger proportion (19.4 %) than those having medial UKR (13.4 %) and lateral UKR (8.3 %). Osteoarthritis is the predominating reason for primary knee replacement in both TKR (97.6 %), medial UKR (98.4 %) and lateral UKR (100 %). The number of surgeries due to inflammatory joint disease, in particular rheumatoid arthritis, has however decreased, especially in recent years, possibly due to new medical treatment. Osteonecrosis was a more common diagnosis in medial UKR (1.4 %) than in TKR (0.5 %).

50 stabilized prostheses, 60 patellofemoral prostheses and 8 partial prostheses were reported in 2022. The mean age was 65.3 years in those having a stabilized prosthesis, 62.9 years in those with a patellofemoral prosthesis and 43.4 years in those with a partial prosthesis. More females than males were reported both in those having a stabilized prosthesis (36/14) and those having a patellofemoral prosthesis (47/13). Four males and four females each were reported having a partial knee prosthesis.

The tables 6.1.2–5 show primary knee replacements reported by the units in 2022. Topmost, the mean value for the country is shown and thereafter for each unit respectively where the units are divided into university units, privately run units or other units and then in alphabetical order. To the far left the total number of operations that have been reported is given and in the next column the proportion of the reports that were complete. The rest of the data is only based on complete reports. Please note that the percentages for the units with few operations may be misleading.

Case-mix

Table 6.1.2 show for each unit respectively the proportion of operations performed due to osteoarthritis (OA), the proportion of females, the proportion younger than 55 years of age, the proportion of BMI 35 or above and the proportion classified as ASA III or higher. Among the university units we can see that there is a higher proportion of other diagnoses than OA and ASA class ≥III compared with the national average. The university units have in general a larger proportion of patients younger than 55 years of age. The privately run units report in general a lower proportion of ASA ≥III than the rest of the country with exception for Capio Movement and S:t Görans sjukhus. The regionally run units not categorised as university units do not differ to any great extent from the country, with some exceptions. For example, the proportion with BMI ≥35 is up to three times as high in Gävle, Lidköping, Södertälje and Södersjukhuset. Södersjukhuset has three times as high a proportion of patients with ASA ≥III as the country on average while it is about one fourth in Karlshamn. The variation between the units in case-mix is large and cannot be generalised to university unit, privately run unit or other units.

That a previous operation (not replacement) is performed in the index knee (not shown in the table) was reported in 17 % of operations. Meniscal surgery is the most common (6 %), followed by arthroscopy (3.9 %), cruciate ligament surgery (2.9 %), osteosynthesis (1.3 %), osteotomy (0.7 %) and other surgery (1.4 %). In 3 % of operations more than one previous operation was reported. The previous operations reported is not comprehensive but gives a view of what is known at the time of primary replacement.

Prophylactic antibiotics

Indicators for prophylactic antibiotics (table 6.1.3) are based on the recommendations from the PRISS-project reported 2022. Due to that patients who had received clindamycin had a higher risk of revision due to infection than patients who received Cloxacillin in a Swedish study (Robertsson et al. 2017), the recommendations for penicillin allergy have been revised. The updated recommendation (April 2023) is available at www.patientforsakringen.se. The columns "% that are given Cloxacillin/Cefotaxime/Dalacin", "% that are given dose 2 g × 3/2 g × 2/600 mg × 2" and "% with AB time (45–30 min)" thus show the proportion of operations where antibiotics has been given according to the PRISS-recommendations.

The column "% with AB-time (45–15 min)" report the proportion operations where the preoperative dose was given 45–15 minutes before start of surgery, which was the previously recommended time-interval that have been reported in previous annual reports. All units report that they use Cloxacillin or corresponding as their first choice. Dalacin has decreased as prophylaxis between 2017 and 2022 from 7.5 % to 3.9 %. Cefotaxime was reported in 1.5 % of the operations. Since Cloxacillin has a short half-life, it is important that it is administered within the right time-interval. A study from the register showed inadequate routines when administering prophylactic antibiotics in knee replacements (Stefansdottir A et al. 2009). A gradual improvement since the register started to register time of the first dose in 2009. The two following years, the proportion reported to be administrated within the time-interval 45–15 min increased by 8 %. In 2013–2022 the proportion has however decreased to 80 %.

Just in 51 % of the operations in 2022 the preoperative dose was administrated 45–30 min before the start of the surgery. Only GHP Ortho Center Stockholm, Ljungby and Torsby have succeeded in implementing the latest recommendation. In these units, 90 % or more receive the preoperative dose within 45–30 min before the start of surgery.

Thrombosis prophylaxis

As there are no national or international guidelines or best practice for the start, choice of drug and treatment time of thrombosis prophylaxis the choice of what is presented in table 6.1.4 is based on what was reported as most common at the start of the registration in 2009 with the exception of the proportion of NOAC (Non-vitamin K antagonist oral anticoagulants) which has been changed from the proportion of drug for injection (Dalteparin, Tinzaparin or Enoxaparin) in last year's report. The columns show the proportion of knee replacements where thrombosis prophylaxis was planned postoperatively, the proportion where NOAC were planned and the proportion of planned treatment time of 8–14 days respectively. In the table we can see that it was most common to start the thrombosis prophylaxis postoperatively and that it was only Lycksele that reported that they start more frequently preoperatively. In 54.9 % of the operations only NOAC was planned, which was somewhat higher than in 2021 (52.1%). A combination of injection and NOAC were reported in 15.2 % which was twice as high a proportion as in 2021 (6.8 %). Overall, it was reported that 70.1 % received thrombosis prophylaxis with NOAC in 2022 compared to 58.9 % in 2021.

For how long thrombosis prophylaxis is planned has remained relatively similar in the years since the variable started to be registered in 2009 (see previous reports) and about 72–79 % of the operations have a planned prophylaxis of 8–14 days. In 2022, the corresponding proportion was 82 %. On the other hand, the proportion of operations that were reported to have a shorter prophylaxis (1–7 days) has decreased slightly from 2020 to 2022, from 16 % to 11.4 %, while the proportion that was reported not receiving any prophylaxis at all decreased slightly from 3.9 % in 2022 compared to 5.1% in 2021.

Surgical technique

As for thrombosis prophylaxis there are no guidelines what applies to choice of anaesthesia, tourniquet, drainage and LIA (local infiltration anaesthesia); information in the form which we call "surgical variables". In table 6.1.5 the proportion of operations where general anaesthesia was used, the use of a tourniquet, drainage and LIA (local infiltration anaesthesia) with or without remaining catheter are presented in percentage as well as the median surgical time for each unit. Spinal anaesthesia was the most common form of anaesthesia (58.7 %). The proportion of general anaesthesia stagnated the years prior to the pandemic to 32.4 % in 2019. In the pandemic years the proportion of general anaesthesia increased slightly (34.6 % in 2020 to 38.9 % in 2021). In 2022 general anaesthesia was reported in 33 % of the surgeries. 14 units reported that they performed more 80 % of the surgeries in general anaesthesia. The use of drainage has decreased from 26 % in 2011 to 0.2 % in 2022. In 2022 broadly the same proportion of operations were performed using tourniquet as in 2021. Thus, the proportion of operations performed using tourniquet has decreased from 90 % in 2011 to just below 28 % in 2022. LIA, with or without remaining catheter, was as previously used in most of the operations.

The median time for a primary knee replacement (without considering fixation) varied between the units from 24.5 to 120.5 minutes. In the country, the median time for TKA was 66 min, UKA 50 min, patellofemoral prostheses 58.5 min, partial prostheses 52.5 min and for hinged/stabilized prostheses 141 min. Since 2009 the median time in TKR has varied between 65 and 82 min and in UKR between 50 and 80 min. Bone grafting is uncommonly used in primary knee replacements and was then reported almost exclusively in form of auto graft. Bone grafting was reported in <1% of operations and was somewhat more common in tibia (59%) than femur (4%). Computer Assisted Surgery (CAS) was reported in 14 operations from four units (Lindesberg seven, Hässleholm three, SU/Mölndal three and Umeå one). No UKRs were reported performed with CAS.

Custom made instruments/sawing blocks were reported in 40 operations in 2022 which was more than what was reported in 2021 (18 operations). The technique was reported from 19 units whereof Kungälv reported eight and Lindesberg seven.

Case-mix per unit

Unit	Number of reports	Complete reports %	OA %	Females %	< 55 years %	BMI ≥ 35 %	ASA ≥ III %
Country	**16,989**	**99.8**	**97**	**55**	**6**	**7**	**19**
University units							
Akademiska	100	99.4	99	64	11	19	29
Karolinska Huddinge	172	99.5	90	56	5	10	59
Karolinska Solna	49	98	61	53	16	4	55
SU/Mölndal	303	100.0	93	62	8	9	32
SUS/Lund	17	100.0	53	71	12	12	53
Umeå	14	100.0	86	50	0	7	43
Privately run units							
Aleris Specialistvård Malmö Arena	35	100.0	97	54	3	3	0
Aleris Specialistvård Nacka	524	99.9	99	53	7	3	5
Aleris Specialistvård Ängelholm	613	100.0	98	57	8	6	12
Art Clinic Göteborg	353	99.5	99	58	6	2	3
Art Clinic Jönköping	248	99.8	99	56	5	4	7
Capio Artro Clinic	799	99.4	99	51	11	4	2
Capio Movement	532	100.0	99	60	7	10	26
Capio Ortopedi Motala	463	99.1	98	60	6	6	17
Capio Ortopediska Huset	842	100.0	100	56	7	3	1
Capio S:t Göran	287	99.8	95	64	3	7	59
Carlanderska	365	99.5	100	60	5	4	3
Carlanderska-SportsMed	213	99.2	100	35	13	8	3
Frölundaortopeden	27	100.0	96	15	11	0	0
GHP Ortho Center Göteborg	292	99.9	99	49	9	0	7
GHP Ortho Center Stockholm	873	99.9	98	55	6	4	7
GHP Ortho och Spine Center Skåne	182	99.6	98	50	10	3	8
Hermelinen	35	100.0	100	29	9	11	9
Ledplastikcentrum Bromma	310	99.1	97	59	8	4	8
Ortopedisk Center Sophiah.	224	99.7	99	29	13	6	10
Specialistcenter Scandinavia Eskilstuna	119	99.7	98	50	3	3	2
Specialistcenter Scandinavia Johanniskliniken	87	100.0	98	54	9	3	3
Specialistcenter Scandinavia Malmö	29	95.2	97	45	3	7	14
Other units							
Alingsås	204	100.0	99	47	3	8	21
Arvika	320	99.3	99	56	5	2	11
Bollnäs	375	99.8	97	51	4	3	14
Borås	53	100.0	94	57	0	11	66
Danderyd	192	99.8	91	53	4	13	53
Eksjö	314	98.5	98	55	3	5	19
Enköping	508	99.9	99	59	3	6	22
Eskilstuna	55	99.6	91	60	4	11	40

The table continues on the next page.

Case-mix per unit, cont.

Unit	Number of reports	Complete reports %	OA %	Females %	< 55 years %	BMI ≥ 35 %	ASA ≥ III %
Falun	195	99.8	97	62	5	18	35
Gällivare	29	100.0	100	48	7	14	31
Gävle	62	100.0	94	50	2	21	68
Halmstad	120	100.0	100	55	8	8	24
Helsingborg	261	99.9	96	54	8	10	35
Hudiksvall	39	100.0	97	65	5	13	26
Hässleholm	779	99.9	92	55	5	6	16
Kalmar	90	99.8	80	52	2	4	41
Karlshamn	239	100.0	97	57	3	5	5
Karlstad	18	100.0	89	44	11	0	28
Kullbergska sjukhuset	339	100.0	99	55	5	9	8
Kungälv	102	98.2	97	65	6	18	34
Lidköping	95	100.0	99	65	6	20	32
Lindesberg	326	99.9	99	54	4	9	19
Ljungby	112	100.0	99	48	8	4	27
Lycksele	223	100.0	94	60	5	8	21
Mora	228	99.8	99	57	7	11	21
Norrköping	117	100.0	96	62	3	7	20
Norrtälje	169	100.0	98	46	5	7	33
Nyköping	110	99.8	100	43	0	7	21
Oskarshamn	348	99.9	98	52	2	7	16
Piteå	332	99.9	94	61	5	14	25
Skellefteå	72	100.0	99	72	1	7	28
Skene	187	99.8	99	61	5	9	11
Skövde	37	100.0	92	43	3	5	16
Sollefteå	145	100.0	97	60	4	1	26
Sundsvall	19	97.9	95	74	0	0	35
Södersjukhuset	150	99.6	96	59	9	21	65
Södertälje	136	97.5	99	64	3	21	39
Torsby	128	99.8	100	50	7	8	20
Trelleborg	334	100.0	97	61	6	12	28
Uddevalla	154	100.0	96	50	3	6	38
Varberg	108	100.0	99	55	2	13	18
Visby	75	99.1	96	49	3	4	9
Värnamo	197	99.9	98	52	6	7	29
Västervik	113	99.6	100	52	2	10	14
Västerås	244	100.0	97	57	6	13	39
Växjö	120	100.0	100	57	3	6	28
Örnsköldsvik	205	99.9	99	57	4	10	41
Östersund	103	100.0	89	65	8	9	33

Table 6.1.2. Case-mix per unit.

Prophylactic antibiotics per unit

Unit	Number of reports	Complete reports %	Percent having Cloxacillin, Cefotaxim or Clindamycin %	Percent having dosage 2 g × 3, 2 g × 2 or 600 mg × 2 %	Percent AB time within (45–15 min) %	Percent AB time within (45–30 min) %
Country	**16,989**	**98.4**	**99.8**	**93.2**	**80.4**	**51.1**
University units						
Akademiska	100	99	100	94	84	39
Karolinska Huddinge	172	96	100	83	73	42
Karolinska Solna	49	96	100	86	73	53
SU/Mölndal	303	99	99	95	86	61
SUS/Lund	17	94	100	82	71	41
Umeå	14	98	100	79	71	43
Privately run units						
Aleris Specialistvård Malmö Arena	35	89	100	77	60	26
Aleris Specialistvård Nacka	524	99	100	98	62	46
Aleris Specialistvård Ängelholm	613	99	99,7	98	79	11
Art Clinic Göteborg	353	99	100	98	82	6
Art Clinic Jönköping	248	99	100	97	94	21
Capio Artro Clinic	799	99	100	99	80	71
Capio Movement	532	99	100	89	65	54
Capio Ortopedi Motala	463	99	100	99	93	70
Capio Ortopediska Huset	842	99	99,6	98	74	56
Capio S:t Göran	287	99	100	93	56	47
Carlanderska	365	98	99	92	92	31
Carlanderska-SportsMed	213	97	100	89	87	32
Frölundaortopeden	27	98	100	85	100	11
GHP Ortho Center Göteborg	292	99	100	97	86	73
GHP Ortho Center Stockholm	873	99	100	99	95	90
GHP Ortho och Spine Center Skåne	182	98	100	96	62	48
Hermelinen	35	100	100	100	86	23
Ledplastikcentrum Bromma	310	98	99	86	82	56
Ortopedisk Center Sophiah.	224	99	99	95	83	71
Specialistcenter Scandinavia Eskilstuna	119	99	99	95	81	35
Specialistcenter Scandinavia Johanniskliniken	87	91	100	81	71	23
Specialistcenter Scandinavia Malmö	29	100	100	97	86	79
Other units						
Alingsås	204	99	100	98	83	67
Arvika	320	62	100	5	61	45
Bollnäs	375	99	99	96	91	49
Borås	53	98	98	94	60	38
Danderyd	192	99	99	91	65	45
Eksjö	314	99	100	95	85	59
Enköping	508	99	100	98	94	60
Eskilstuna	55	100	100	91	75	42

The table continues on the next page.

Prophylactic antibiotics per unit, cont.

Unit	Number of reports	Complete reports %	Percent having Cloxacillin, Cefotaxim or Clindamycin %	Percent having dosage 2 g × 3, 2 g × 2 or 600 mg × 2 %	Percent AB time within (45–15 min) %	Percent AB time within (45–30 min) %
Falun	195	100	100	99	84	51
Gällivare	29	99	100	97	72	24
Gävle	62	99	98	89	82	19
Halmstad	120	97	100	85	85	50
Helsingborg	261	99	99	93	80	33
Hudiksvall	39	99	100	95	77	51
Hässleholm	779	99	99	96	75	37
Kalmar	90	98	99	94	83	41
Karlshamn	239	99	99	97	89	52
Karlstad	18	100	100	100	78	72
Kullbergska sjukhuset	339	99	100	98	90	57
Kungälv	102	99	100	90	71	51
Lidköping	95	99	100	92	81	41
Lindesberg	326	99	100	96	90	40
Ljungby	112	100	100	98	94	90
Lycksele	223	99	100	98	63	49
Mora	228	99	99	91	90	73
Norrköping	117	97	100	94	62	45
Norrtälje	169	98	99	97	79	56
Nyköping	110	98	100	93	63	45
Oskarshamn	348	99	100	99	72	62
Piteå	332	99	98	96	95	58
Skellefteå	72	96	100	99	56	44
Skene	187	98	99	94	73	49
Skövde	37	100	100	98	95	73
Sollefteå	145	99	100	95	91	43
Sundsvall	19	100	100	100	58	32
Södersjukhuset	150	98	99	50	63	24
Södertälje	136	98	100	92	83	46
Torsby	128	99	100	95	95	94
Trelleborg	334	99	100	98	82	44
Uddevalla	154	99	99	97	69	52
Varberg	108	98	100	86	92	69
Visby	75	96	99	93	84	37
Värnamo	197	99	99	96	83	58
Västervik	113	99	100	99	85	44
Västerås	244	99	100	93	79	48
Växjö	120	99	99	94	81	28
Örnsköldsvik	205	99	100	94	82	59
Östersund	103	98	100	90	79	49

Table 6.1.3. Prophylactic antibiotics per unit 2022.

Antithrombotic prophylaxis per unit

Unit	Number of reports	Complete reports %	Percent starting postop %	Percent having NOAC %	Percent treated for 8–14 days %
Country	**16,989**	**99.8**	**96.3**	**70.1**	**81.9**
University units					
Akademiska	100	100	90	100*	92
Karolinska Huddinge	172	99	99	87	83
Karolinska Solna	49	98	87	28	62
SU/Mölndal	303	100	99	94	93
SUS/Lund	17	100	100	0	53
Umeå	14		100	100	93
Privately run units					
Aleris Specialistvård Malmö Arena	35	100	100	100	97
Aleris Specialistvård Nacka	524	100	99	100	98
Aleris Specialistvård Ängelholm	613	99	99	99	98
Art Clinic Göteborg	353	100	99	99	99
Art Clinic Jönköping	248	100	99	100	99
Capio Artro Clinic	799	99	99	99	99
Capio Movement	532	99	99	4	<1
Capio Ortopedi Motala	463	100	100	1	96
Capio Ortopediska Huset	842	99	99	99*	98
Capio S:t Göran	287	100	93	78*	83
Carlanderska	365	100	99	99	97
Carlanderska-SportsMed	213	100	97	98	96
Frölundaortopeden	27	100	100	100	93
GHP Ortho Center Göteborg	292	100	100	100	99
GHP Ortho Center Stockholm	873	99	99	99	98
GHP Ortho och Spine Center Skåne	182	100	99	100	97
Hermelinen	35	100	91	100	66
Ledplastikcentrum Bromma	310	100	96	99*	80
Ortopedisk Center Sophiah.	224	100	99	65*	36
Specialistcenter Scandinavia Eskilstuna	119	100	99	100	97
Specialistcenter Scandinavia Johanniskliniken	87	100	92	100	67
Specialistcenter Scandinavia Malmö	29	100	100	100	89
Other units					
Alingsås	204	100	100	0	98
Arvika	320	97	93	93	85
Bollnäs	375	99	99	99	98
Borås	53	100	80	100	80
Danderyd	192	99	96	0	63
Eksjö	314	99	73	0	60
Enköping	508	99	99	99	96
Eskilstuna	55	100	98	100	98

The table continues on the next page.

Antithrombotic prophylaxis per unit, cont.

Unit	Number of reports	Complete reports %	Percent starting postop %	Percent having NOAC %	Percent treated for 8–14 days %
Falun	195	100	98	0	17
Gällivare	29	100	92	96	88
Gävle	62	100	94	81	89
Halmstad	120	100	96	0	0
Helsingborg	261	100	97	99	95
Hudiksvall	39	100	97	0	97
Hässleholm	779	100	96	0	28
Kalmar	90	99	95	0	93
Karlshamn	239	100	99	37	97
Karlstad	18	100	100	87	100
Kullbergska sjukhuset	339	99	98	87	99
Kungälv	102	100	90	97	97
Lidköping	95	100	93	99	94
Lindesberg	326	100	99	88	84
Ljungby	112	100	99	98	98
Lycksele	223	100	3	1	99
Mora	228	99	99	99	93
Norrköping	117	99	91	0	89
Norrtälje	169	100	100	0	95
Nyköping	110	100	98	100	97
Oskarshamn	348	100	99	0	92
Piteå	332	100	82	99*	100
Skellefteå	72	100	100	100	96
Skene	187	100	99	99	90
Skövde	37	100	100	100	97
Sollefteå	145	100	99	100	86
Sundsvall	19	100	100	94	94
Södersjukhuset	150	100	97	0	93
Södertälje	136	100	97	0	61
Torsby	128	100	99	97	92
Trelleborg	334	100	100	0	2
Uddevalla	154	100	97	90	93
Varberg	108	100	100	0	83
Visby	75	100	96	99	78
Värnamo	197	100	98	0	85
Västervik	113	100	100	0	56
Västerås	244	100	95	4	7
Växjö	120	99	90	94	93
Örnsköldsvik	205	100	96	97	95
Östersund	103	100	96	2	91

Table 6.1.4. Antithrombotic prophylaxis per unit 2022.

Surgical technique

Unit	Number of reports	Complete reports %	Percent having general anesthesia %	Percent drainage %	Percent tourniquet %	Percent LIA %	Median Op time
Country	**16,989**	**99.1**	**33.0**	**0.2**	**27.8**	**96.0**	**63**
University units							
Akademiska	100	86	60	1	3	80	71,5
Karolinska Huddinge	172	99	13	1	2	90	100
Karolinska Solna	49	99	12	6	4	90	108
SU/Mölndal	303	98	9	0	10	92	95
SUS/Lund	17	95	41	0	12	94	116
Umeå	14	99	36	7	50	93	115
Privately run units							
Aleris Specialistvård Malmö Arena	35	100	94	0	0	97	50
Aleris Specialistvård Nacka	524	99	99	1	64	95	25
Aleris Specialistvård Ängelholm	613	99	99	0	1	96	45
Art Clinic Göteborg	353	99	100	0	1	100	59
Art Clinic Jönköping	248	100	100	0	3	98	64.5
Capio Artro Clinic	799	99	9	0	4	98	51
Capio Movement	532	99	1	0	12	99	51
Capio Ortopedi Motala	463	99	1	2	14	99	64
Capio Ortopediska Huset	842	99	1	0	20	99	44
Capio S:t Göran	287	99	13	0	50	98	78
Carlanderska	365	99	5	0	8	98	44
Carlanderska-SportsMed	213	97	1	0	23	98	39
Frölundaortopeden	27	100	100	0	0	85	60
GHP Ortho Center Göteborg	292	99	28	0	4	91	80
GHP Ortho Center Stockholm	873	99	2	1	9	99	57
GHP Ortho och Spine Center Skåne	182	98	8	0	8	90	62
Hermelinen	35	100	0	0	0	100	59
Ledplastikcentrum Bromma	310	99	95	0	47	97	49
Ortopedisk Center Sophiah.	224	99	12	1	40	37	61
Specialistcenter Scandinavia Eskilstuna	119	99	5	0	8	98	50
Specialistcenter Scandinavia Johanniskliniken	87	99	87	0	95	100	24.5
Specialistcenter Scandinavia Malmö	29	99	7	0	76	100	56
Other units							
Alingsås	204	99	4	0	1	99	76
Arvika	320	90	6	0	1	90	62
Bollnäs	375	99	88	1	84	97	67
Borås	53	98	17	2	71	92	94
Danderyd	192	99	7	1	43	90	84
Eksjö	314	98	14	1	1	93	66
Enköping	508	99	90	0	55	100	69
Eskilstuna	55	99	9	0	0	100	89

The table continues on the next page.

Surgical technique, cont.

Unit	Number of reports	Complete reports %	Percent having general anesthesia %	Percent drainage %	Percent tourniquet %	Percent LIA %	Median Op time
Falun	195	99	17	1	91	99	71
Gällivare	29	100	7	0	34	97	71
Gävle	62	99	32	2	95	98	62
Halmstad	120	99	9	0	88	98	80.5
Helsingborg	261	99	49	1	0	92	67
Hudiksvall	39	100	8	0	3	97	67
Hässleholm	779	99	90	0	1	99	40
Kalmar	90	99	13	1	2	100	89.5
Karlshamn	239	99	98	1	89	98	68
Karlstad	18	99	6	0	0	94	92.5
Kullbergska sjukhuset	339	99	4	0	14	98	74
Kungälv	102	99	14	0	18	100	100
Lidköping	95	99	17	0	3	95	70
Lindesberg	326	100	100	0	0	100	78
Ljungby	112	99	89	0	25	87	57.5
Lycksele	223	99	6	0	97	99	84
Mora	228	95	5	0	97	87	54
Norrköping	117	99	14	0	9	82	98
Norrtälje	169	100	23	0	81	97	79
Nyköping	110	99	4	1	35	99	84.5
Oskarshamn	348	99	11	0	56	100	81
Piteå	332	99	2	0	98	100	65.5
Skellefteå	72	93	0	0	100	100	80
Skene	187	97	6	1	90	94	83
Skövde	37	99	3	0	0	89	71
Sollefteå	145	99	7	0	59	99	88
Sundsvall	19	99	5	0	0	100	120.5
Södersjukhuset	150	99	13	0	1	99	81.5
Södertälje	136	99	15	0	1	99	67
Torsby	128	100	14	0	7	98	72.5
Trelleborg	334	99	30	1	44	97	80
Uddevalla	154	99	5	0	1	97	101.5
Varberg	108	99	19	0	0	91	85
Visby	75	98	9	0	4	97	98
Värnamo	197	99	7	0	0	99	84
Västervik	113	99	26	0	0	99	74
Västerås	244	99	4	0	1	94	65
Växjö	120	98	64	0	5	98	53
Örnsköldsvik	205	99	6	0	95	92	79
Östersund	103	99	32	0	92	100	87

Table 6.1.5. Surgical technique per unit 2022.

Type of arthrotomy in UKR

Model	Mini incision n	Standard incision n	Unknown n
Link	32	128	0
Oxford	929	607	7
Persona-PK	9	79	0
Sigma-PKR	0	33	0
Triathlon Uni	2	133	0
ZUK	25	105	0
Total	**997**	**1,085**	**7**

Table 6.1.6. Type of arthrotomy in UKR 2022.

Arthrotomy

Since 1999 it is registered if the minimally invasive surgery (MIS) was used. We define MIS as a small arthrotomy (without a specific limit on the length) where the operation is performed without everting the patella. While the use of MIS in TKR is uncommon, the popularity of MIS in UKR increased rapidly in the end of the 1990s and reached its maximum in 2007 when 61% of all UKRs were reported to be operated with MIS. Some prosthesis models, especially Oxford, are more commonly used with MIS than others. In 2022, MIS was reported in 47.9 % of the UKRs (table 6.1.6) but just in 0.7 % of the TKRs.

Fixation

The use of cement remains by far the most common method of fixating the components to the bone. Cementless fixation, however continues to increase. In 2010, 2.4 % of all TKRs were reported to be fixated without cement and in 2022 8.9 % were reported as completely uncemented. In 2022, 0.5 % of the TKRs were hybrids (figure 6.1.2). In UKR the change has been markedly in recent years. Before 2010 almost all UKRs were cemented but since 2013 this has changed. In 2022, 69.9 % of all UKRs were without cement and 3.3 % were hybrids (figure 6.1.3). The reason behind this is mainly the popularity of Oxford's cementless variant, that was used in 97.5 % of the Oxford cases.

Figure 6.1.4 shows the proportion of type of fixation in each county respectively in TKR 2020. Skåne reports cementless fixation in almost half of all TKRs (47.7 %), Västerbotten almost one fourth (22 %) and Dalarna 15 % while most of the regions reported no or a very small proportion of cementless TKRs.

Cement

Since 2007 there is a sticker with article number for the cement in almost all operations where cement has been used, why the cement types can be reliably identified (table 6.1.7). As the type of mixing system may be likely to influence the quality of the cement, we are also interested in the article numbers of these, that is if separate mixing systems with their own article number have been used. In practically all the cement that was reported in 2022 in primary operations contained antibiotics of gentamicin type. In the section with in-depth analyses the most common cement types that are used in TKR are evaluated.

Implants

TKAR was developed in the 1970s when there already existed hinge prostheses and UKRs. When the knee arthroplasty register started registration in 1975, TKR had just been introduced in Sweden why hinged prostheses and UKRs were used for the majority of the primary knee replacements (figure 6.1.5). It was also common to combine two UKRs in the same knee (bilateral UKR) in those cases the knee disease affected more than one compartment. When the use of TKRs spread, bilateral UKR ceased being used. Nowadays hinged prostheses, linked and stabilized prostheses are mainly used for especially severe primary cases, trauma, tumours and revisions. In uncomplicated primary cases, TKR is mostly used, but also UKR in some cases with unicompartmental disease. The use of UKR decreased gradually between 1990 and 2014 but has since then increased gradually again. To use UKR on the lateral side of the knee is since the mid-1990s very uncommon. The reason why the popularity of UKR declined may be that UKR has been shown to have a considerably higher revision rate compared to TKR (see figure 6.4.4). However, it must be noted that the joint disease may progress in the parts of the knee that have not been replaced in UKR. This means that it may be tempting to offer revision of UKR to TKR in patients with pain of unclear nature. The risk of revision due to infection is however considerably lower in UKR than in TKR. This also applies to the risk that revisions may be performed with stabilized implant, arthrodesis or amputation, which of course is in favour in UKAs (see tables 6.4.2 a-b).

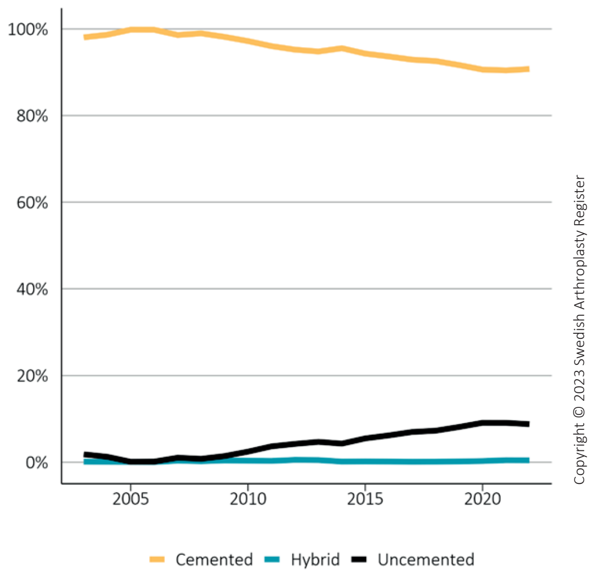


Figure 6.1.2. Time trend for fixation method, TKR/OA.

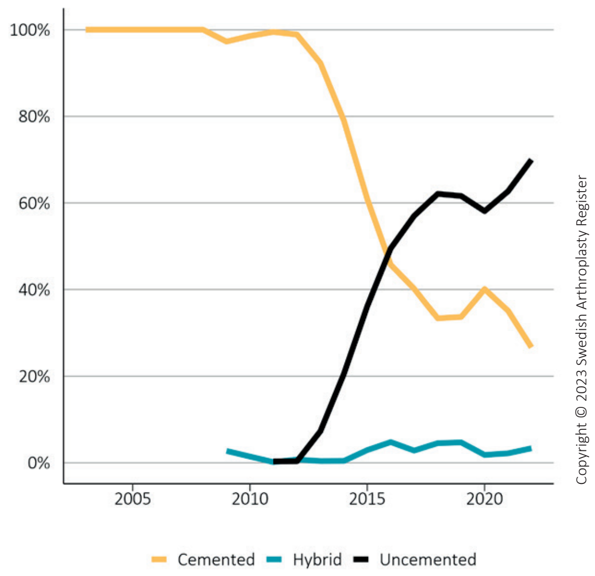


Figure 6.1.3. Time trend for fixation method, UKR/OA.

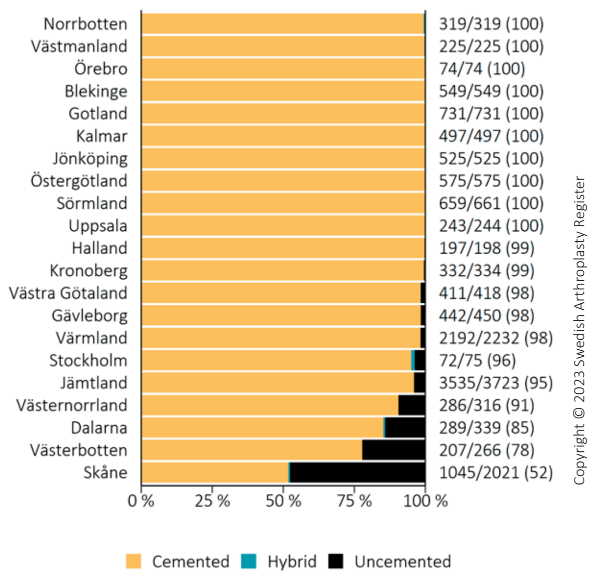


Figure 6.1.4. The relative use of fixation type in TKR/OA. The column on the right shows the number cemented/total number (%).

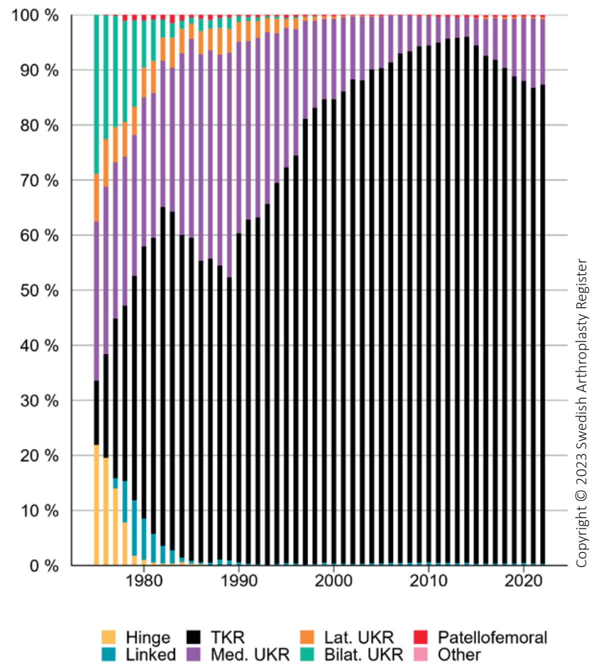


Figure 6.1.5. Distribution of type of prosthesis in primary surgery 1975–2022.

Type of cement

Cement	Number TKR	Proportion TKR %	Number UKR	Proportion UKR %
Optipac Refobacin (prefilled)	8,793	65	239	43
Palacos R+G Pro (prefilled)	3,290	24	136	25
Palacos R+G (gentamicin)	858	6	53	10
Smartset GHV (gentamicin)	314	2	114	21
Refobacin Bone Cement (genta)	153	1	1	0
Refobacin Revision Cement (genta+clinda)	12	0	0	0
Copal (genta + clinda)	10	0	0	0
Copal (genta + vanco)	7	0	0	0
Refobacin Plus Bone Cement (genta)	5	0	1	0
Optipac Refobacin Revision	3	0	0	0
Palacos R	3	0	0	0
CMW with Gentamicin	2	0	11	2
Other	2	0	0	0
Optipac Refobacin Plus	1	0	0	0
Palacos MV (Palamed)	1	0	0	0
Total	**13,454**	**98**	**555**	**101**

Table 6.1.7. Type of cement in TKR and UKR 2022.

Prosthesis model

The prosthesis model is probably the factor that generates the most interest and that is most often related to the outcome after a knee replacement. However, it is not only the model/design that determines the risk of a later reoperation, but also the so-called case-mix. The Swedish Arthroplasty Register tries in its analysis to reduce the effect of case-mix by considering factors such as the patients' disease, sex, age and the time-period in which the operation was performed.

Another important factor that the register is not able to include in the analyses is the surgical experience of the individual surgeon. It is obvious that surgeons and surgical teams can be more or less skilled at operating, which may influence the results of individual implants, especially when the use has been limited to a few surgeons and units. Therefore, it could be discussed if it is fair to report results of specific models when it can be argued that deviant results may be influenced by the skills of the surgeon and the team. To this we can only say that the risk of revision for the individual model is the result of what the users have been able to achieve with that particular model. The final result is determined by the prosthesis design, material, durability, accompanying instruments, ease of use, safety margins (how the prosthesis behaves if it is not inserted in exact position), together with the skills of the surgeon and the surgical team and the training in the use of the instruments/prosthesis and to choose appropriate patients for this particular surgery. Producers together with the distributors have the opportunity to influence most of these factors. Therefore, it cannot be considered wrong to associate the model with the results even if the results do not depend solely on design, material and durability.

Historically, the most used knee replacement models in Sweden have been among those with the lowest revision rate. This may be due to the fact that surgeons and units have been able to choose the best models, but also because when the same implants are used frequently, the surgical habits become strong.

The models that have shown a significant worse result than the others have mostly disappeared from the Swedish market. An exception was the Oxford UKR-prosthesis that initially had inferior results but after modifications and with increased surgical experience recovered.

Table 6.1.8 a show TKR (including revision models) and 6.1.8 b UKR implants used at primary surgery 2022. Table 6.1.8 a does not include 50 linked prostheses reported in primary surgery, mainly rotation models (Link Endo, MUTARS, NexGen, S-ROM Noiles, Smith & Nephew and Stryker) for the treatment of malignancies, fractures and other special cases. Just as last year, the same three models dominate. NexGen MBT from Zimmer accounts for just under half (49 %) of the implants while Triathlon MBT from Stryker accounts for 16.7 % and PFC Sigma TKA MBT from DePuy accounts for 11.5 %. When it comes to UKR, the Oxford-model dominates and was used in 73.9 % of the procedures in 2022 which is a higher proportion than in 2021.

Types of polyethylene

Figure 6.1.6 shows that the Swedish orthopaedic surgeons have started relatively late in replacing well-proven older conventional polyethylene (UHMWPE) with the newer highly cross-linked polyethylene (HXLPE). The proportion of highly cross-linked polyethylene has increased since 2006, when these began to be used in Sweden gradually until 2019 (28.3 %), to decrease slightly in the last three years to 21 %.

The majority of the implants using highly cross-linked polyethylene in Sweden until 2022 have been Triathlon (X3 polyethylene), PFC (XLK polyethylene) or Persona (Vivacit-E polyethylene). In this year's report we have performed an in-depth analysis with these three protheses models with the conventional and highly cross-linked polyethylene that shows a higher risk of revision, all causes, for the highly cross-linked polyethylene (please see the section in-depth analyses). The Australian register (AONJRR) has previously reported a lower revision rate for highly cross-linked polyethylene (Steiger et al. 2015) but that was prosthesis dependent and applied to NexGen and Natural II but not to Triathlon or Scorpio NRG. Data on PFC was not included.

It is important to remember that the methods of increasing the durability of the new polyethylene by radiation and/or addition of antioxidants are very different between the manufacturers.

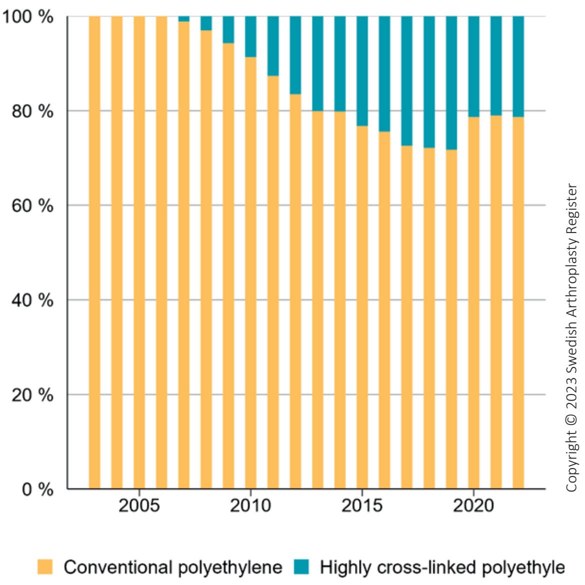


Figure 6.1.6. Distribution of UHMWPE and the highly cross-linked polyethylene.

Most common TKR implants

	2011–2020		2021		2022	
Model	**Number**	**Proportion %**	**Number**	**Proportion %**	**Number**	**Proportion %**
NexGen MBT	60,964	47.5	5,844	52.9	7,248	49.0
Triathlon MBT	15,004	11.7	1,673	15.1	2,465	16.7
PFC Sigma TKA MBT	23,957	18.7	1,816	16.4	1,701	11.5
Persona TKA	1,213	0.9	536	4.9	1,157	7.8
Attune MB TKA	139	0.1	55	0.5	812	5.5
Persona TKA Trabicular Metal	47	0.0	138	1.3	232	1.6
NexGen Trabecular Metal	2,305	1.8	139	1.3	224	1.5
Genesis II MBT	2,416	1.9	226	2.0	211	1.4
Legion/Genesis II Pri MBT	1,876	1.5	185	1.7	180	1.2
Triathlon Total Stabilizer	734	0.6	114	1.0	146	1.0
NexGen Revision	589	0.5	66	0.6	111	0.8
PFC Sigma TKA APT	8,767	6.8	166	1.5	94	0.6
PFC Sigma TC-3 (revision)	382	0.3	49	0.4	60	0.4
Journey TKA	169	0.1	18	0.2	47	0.3
Triathlon APT	97	0.1			42	0.3
PFC constrained (rev not TC3)	223	0.2	11	0.1	26	0.2
Legion / Genesis II Revision	87	0.1	11	0.1	11	0.1
Persona Revision	1	0,0	3	0.0	11	0.1
Attune RP TKA			3	0.0	3	0.0
PFC Sigma TKA Rotating platform	174	0.1	4	0.0	2	0.0
LCS (New Jersey) Rotating platform					1	0.0
Legion/Genesis II Pri APT					1	0.0
NexGen Mobile Bearing Knee					1	0.0
NexGen Unspecified	1	0,0	1	0.0	1	0.0
AGC Anatomica MBT	185	0.1				
AGC Dual Articular Knee	4	0,0				
AGC Revision	1	0,0				
AGC universal MBT	1	0,0				
Duracon Bi/Tri MBT	8	0.01				
Duracon Bi/Tri unpec.	2	0,0				
Genesis II APT	2	0,0				
Link Gemini TKA	68	0.05				
NexGen APT	887	0.69				
PFC Sigma TKA unspec	17	0.01				

The table continues on the next page.

Most common TKR implants, cont.

	2011–2020		2021		2022	
Model	**Number**	**Proportion %**	**Number**	**Proportion %**	**Number**	**Proportion %**
Profix	397	0.31				
Profix HPT	78	0.06				
Profix Oxinium	4	0.0				
Profix Revision	16	0.0				
Vanguard Finned Stem Modular	2,045	1.6				
Vanguard I-Beam Modular	5,273	4.1				
Vanguard Revision Knee	100	0.1				
Vanguard XP	26	0.0				
Vanguard unspecified	13	0.0				
Total	**128,272**	**100.0**	**11,058**	**100.0**	**14,787**	**100.0**

Table 6.1.8 a. Most common TKR implants (including revision models) in primary surgery 2022.

Most common UKR implants

	2011–2020		2021		2022	
Model	**Number**	**Proportion %**	**Number**	**Proportion %**	**Number**	**Proportion %**
Oxford	5,951	62.5	1,082	65.6	1,543	73.9
Link Endo Sled Uni	1,426	15.0	109	6.6	160	7.7
Triathlon Uni	589	6.2	196	11.9	135	6.5
ZUK Uni MBT	1,043	11.0	117	7.1	130	6.2
Persona PK	107	1.1	62	3.8	88	4.2
Sigma PKR	258	2.7	59	3.6	33	1.6
Genesis uni	77	0.8				
Ibalance UKA MBT	61	0.6	1	0.1		
Miller-Galante Uni APT	6	0.1				
Preservation Uni APT	2	0.0				
Total	**9,520**	**100.0**	**1,649**	**100.0**	**2,089**	**100.0**

Table 6.1.8 b. Most common UKR implants in primary surgery 2022.

Patella component at TKA

In the 1980s, a patella component was used in just over half of the TKR cases. Since then, the use has decreased but in 2021 it has increased somewhat from previous years (barely 3 %) to 4.6 % in 2021 and 4 % in 2022 (figure 6.1.7 and table 6.1.9).

The use has previously been strongly associated with the prosthesis model. In 2022, the patella component was used proportionally usually together with Journey, Triathlon Total Stabilizer and Attune. In Sweden females are supported somewhat more often than males in TKR. This has been explained with femoral patellar problems being more common in females. In 2022, 3.1% of the males received a patella component compared to 5.2% of the females. The relative use of patella component in the different age groups 2022 shows that the use of patella component is slightly more common in the youngest age groups but also in the oldest age group (figure 6.1.8). The proportions however, varied somewhat depending on that there are relatively few young patients and those aged 85 years and over. How the use of patella component affects the risk of revision is discussed in chapter 6.4 together with CRR-curves (figures 6.4.8 and 6.4.9) showing how the impact has changed over time.

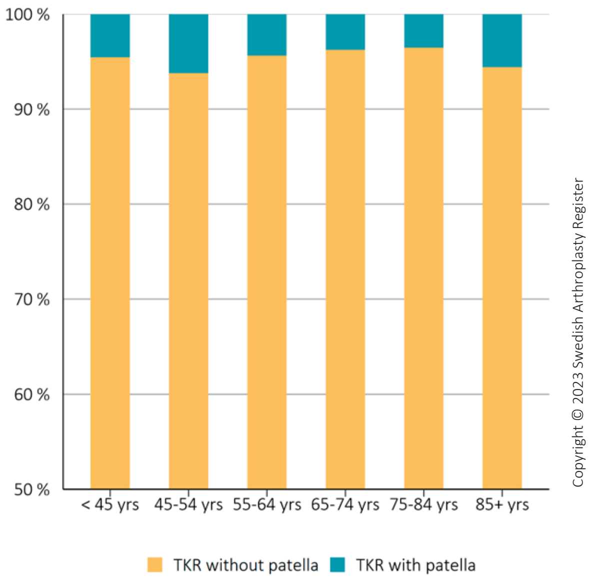


Figure 6.1.8. Distribution of the use of patella component in the different age groups 2022.

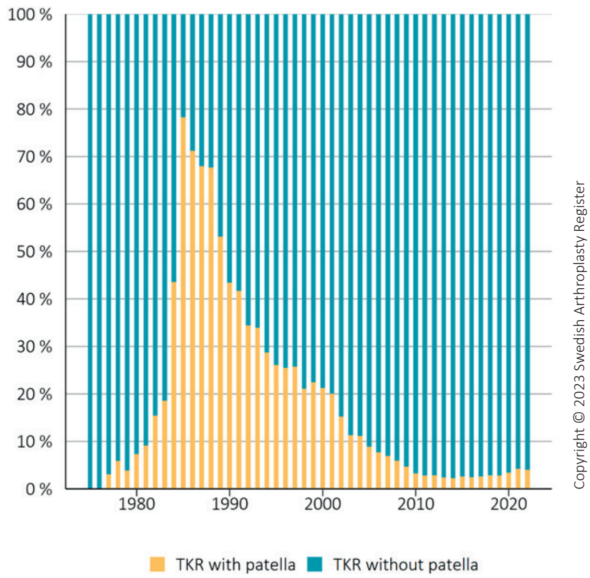


Figure 6.1.7. Distribution of TKR with or without patella component.

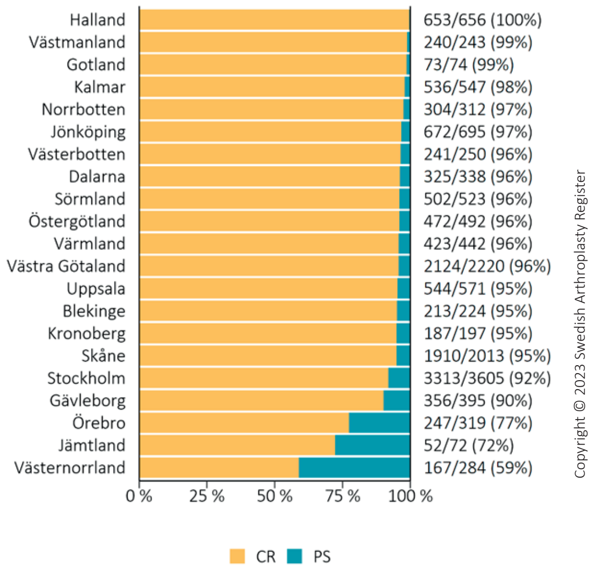


Figure 6.1.9. The relative use of CR and PS TKR respectively in the regions 2022. The column on the right shows the number of CR/total number (%).

Cruciate ligament retaining and cruciate ligament sacrificing TKR

There are cruciate ligament sacrificing types of TKRs that stabilise the knee. Most common with an eminence in the middle part of the tibia polyethylene that goes into a box in the femoral component between the medial and lateral gliding surfaces without affecting the rotation too much. The type is called "posterior stabilized" (PS) and requires resection of the posterior cruciate ligament. Those advocating the use of PS claim that it provides increased flection and more normal knee movement than the minimally stabilising, posterior cruciate retaining (CR) type. The disadvantages of PS implants are that the increased stability stresses on the polyethylene and bone surfaces and thus theoretically increase the risk of wear and loosening.

PS implants have been popular in other countries such as the US. However, they have not been used much in Sweden as CR implants has been preferred, at least in those knees that are without major malalignment and that have an intact posterior cruciate ligament.

As figure 6.1.9 shows, it differs between the regions how often PS implants are used. In 2022, the type was used relatively often in three regions; Jämtland, Västernorrland and Örebro. In 2019, 8 % of the primary TKRs were of PS type when revision models and stemmed prostheses included, however in 2021 the use of PS models was halved to 4 % to increase to 6.3 % in 2022 (figure 6.1.8). In the late 90's and early 20's the proportion of PS was slightly more than 1 % of the operations.

Use of patella component

Model	Number TKR with patella	Proportion TKR with patella %	Number TKR without patella	Proportion TKR without patella %
NexGen MBT	127	1,8	7 121	98,3
Triathlon MBT	175	7,1	2 290	92,9
PFC Sigma TKA MBT	65	3,8	1 636	96,2
Persona TKA	13	1,1	1 144	98,9
Attune MB TKA	104	12,8	708	87,2
NexGen Trabecular Metal	10	4,5	214	95,5
Persona TKA Trabicular Metal	18	7,8	214	92,2
Genesis II MBT	6	2,8	205	97,2
Legion/Genesis II Pri MBT	16	8,9	164	91,1
Triathlon Total Stabilizer	19	13,0	127	87,0
NexGen Revision	12	10,8	99	89,2
PFC Sigma TKA APT	3	3,2	91	96,8
PFC Sigma TC-3 (revision)	6	10,0	54	90,0
Triathlon APT	1	2,4	41	97,6
Journey TKA	8	17,0	39	83,0
Övriga	6	16,2	31	83,8
Persona Revision	1	9,1	10	90,9
Attune RP TKA	1	33,3	2	66,7
Legion/Genesis II Pri APT	0	0,0	1	100,0
NexGen Mobile Bearing Knee	0	0,0	1	100,0
NexGen Unspecified	0	0,0	1	100,0
Total	**591**		**14 193**	

Table 6.1.9. The use of patella component in primary TKR 2022.

6.2. Reoperation of knee replacements regardless of diagnosis, reason and earlier operations

Authors: Annette W-Dahl and Ola Rolfson

Reoperation includes all types of procedures that can be related to a previous inserted knee replacement, regardless of whether components are inserted, replaced, removed (including arthrodesis or amputation) or left untouched. The number of reoperations has increased year by year as the number of primary operations has increased and slightly more from 2013 except for the pandemic years 2020 and 2021 (figure 6.2.1). The reason for the increase in recent years is probably that prior to 2013 procedures other than those that were revision (components are replaced, added or removed) were not requested when reporting knee replacements, but have been registered if they were sent to the register. 2020 was the first year the variable reoperation was reported. It should be noted that other procedures are not well-defined as opposed to revision. It is difficult to determine to what extent these reoperations are reported and thus may affect outcome and disadvantage units that are good at reporting other interventions than revision. The relative proportion of reoperations has decreased since the early 1990s and then increased again in 2013 to 2015 (figure 6.2.2). The reason is probably the same that has been described above and that the proportion of primary operations has increased considerably.

Figure 6.2.3 shows the distribution of primary operations and reoperations reported per unit in 2022. The number and the proportion of primary operations are shown in the column to the right. Units with fewer than 20 operations have been excluded. The proportion of reoperations of the unit varies from Umeå, SUS/Lund and Karlstad where more than half of the operations are reported to be reoperations to units that have reported no reoperations at all. The variation may be due to, for example, primary operations being performed at one/several units in a region while the reoperations are concentrated to another unit in the region.

The mean age was just over one year older and the proportion of males somewhat higher in reoperation than in primary operation in 2022 (table 6.2.1). The age groups 75 years and older was slightly higher represented in reoperation compared to primary operation. Compared to primary operation, a larger proportion has BMI ≥ 35,

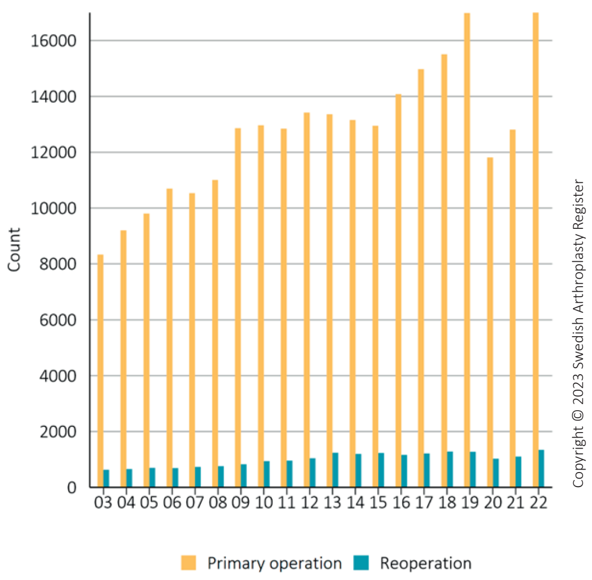


Figure 6.2.1. Number of primary and reoperations per year 2003–2022

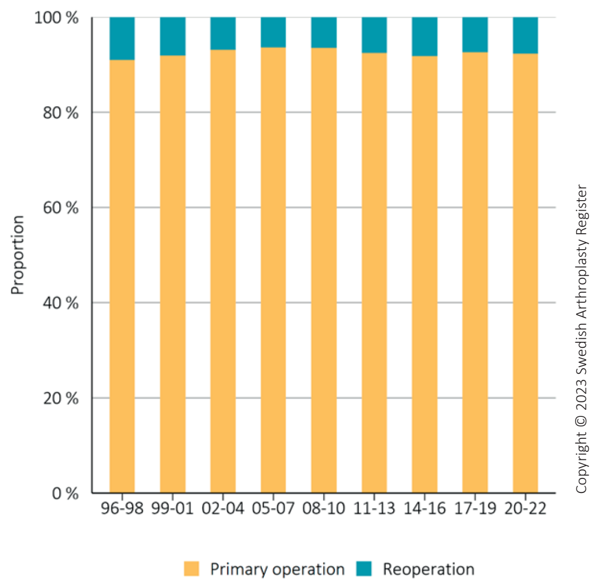


Figure 6.2.2. Distribution of primary knee replacements and reoperations (revision + other procedures) 1996–2022 divided in three-year periods.

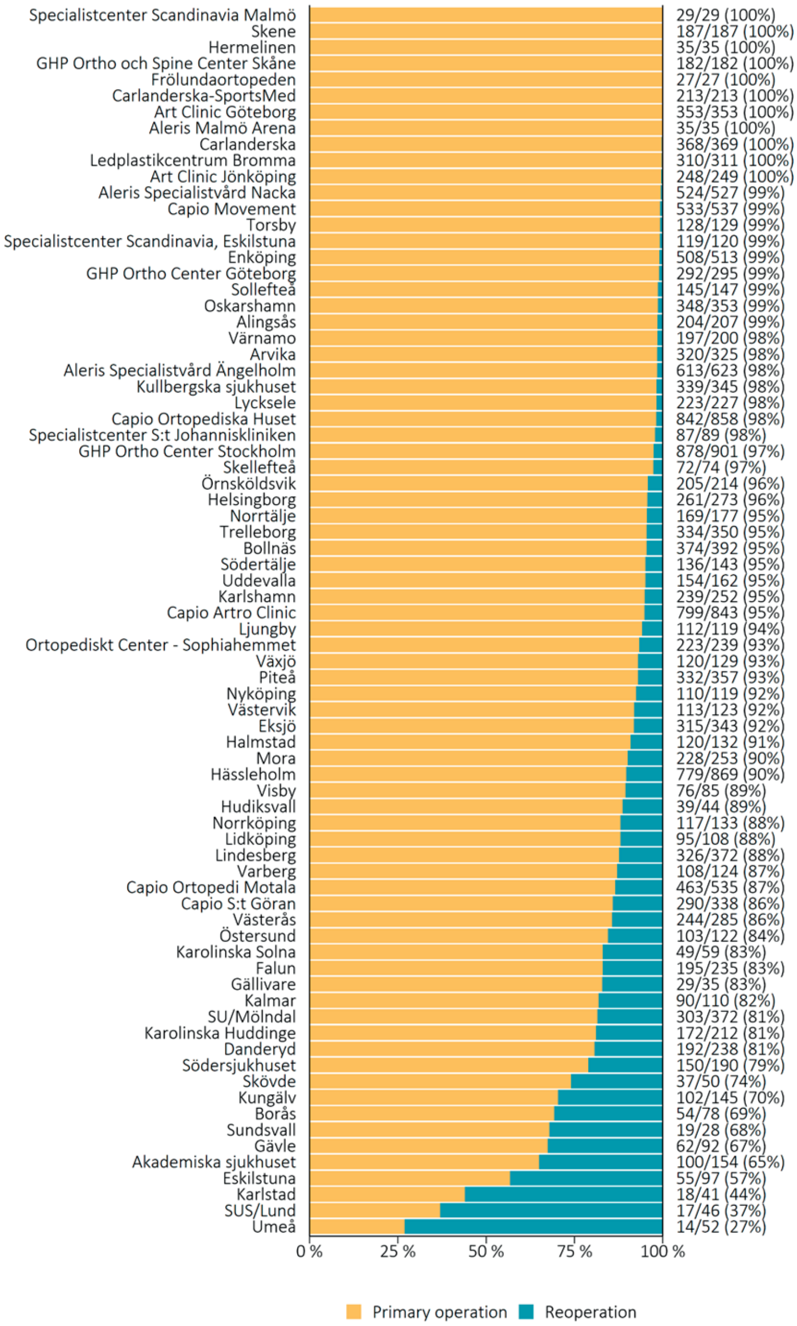


Figure 6.2.3. Distribution of primary and reoperations per unit 2022. Units with fewer than 20 operations are excluded. The column on the right shows the number of primary operations/ total number of operations (% primary operations).

ASA ≥ III and diagnoses other than osteoarthritis (diagnosis from the primary operation) in reoperations. The most common reasons for reoperation in the last 10 years for TKR/OA and UKR/OA are shown in figure 6.2.4. In TKR/OA infection is nowadays the single most common reason for reoperation (more common than loosening). The reason "progress" for reoperation in TKR refers to, in principle, to patellofemoral osteoarthritis. The reoperation reason "patella" includes all kinds of patellar problems in replacements inserted both with and without patella component (however not loosening or wear of the patella component). Note that the distribution of reasons for reoperation not necessarily reflects the risk of these complications. Since the number of primaries in TKR/OA has increased considerably over time, early reoperations are overrepresented, such as infections and joint stiffness. In UKR/osteoarthritis progression of OA is the most common reason for reoperation and the proportion of reoperations due to loosening is higher than in TKR/OA, while infection is uncommon.

Figure 6.2.5 shows the distribution of the main intervention exchange/insertion, extraction and other procedures not affected the implant in the three-year periods 2002–2022. Exchange/insertion of prosthesis components has been the predominant intervention. However, in the last three-year periods the proportion has decreased due to an increased reporting of other procedures. The most commonly reported procedures where the prosthesis is not affected are infection treatment/examination and manipulation under anaesthesia.

Demography in reoperation

	Reoperation	Primary operation
Number	1,345	17,002
Mean age (SD)	70.4 (9.9)	69.2 (9.1)
Age group (%)		
< 45 years	9 (0.7)	70 (0.4)
45–54 years	70 (5.2)	957 (5.6)
55–64 years	300 (22.3)	4 114 (24.2)
65–74 years	452 (33.6)	6 588 (38.7)
75–84 years	425 (31.6)	4 795 (28.2)
≥ 85 years	89 (6.6)	478 (2.8)
Females (%)	718 (53.4)	9 402 (55.3)
BMI (%)		
< 18.5	2 (0.2)	33 (0.2)
18.5–24.9	259 (20.4)	3 301 (19.6)
25–29.9	509 (40.0)	7 398 (43.9)
30–34.5	360 (28.3)	4 808 (28.5)
35–39.9	124 (9.8)	1 174 (7.0)
≥ 40	17 (1.3)	134 (0.8)
ASA-class (%)		
I	107 (8.2)	2 546 (15.0)
II	748 (57.5)	11 238 (66.3)
III–V	445 (34.2)	3 159 (18.6)
Diagnosis (%)		
Osteoarthritis	1,254 (94.4)	16,552 (97.6)
Inflamatory joint disease	34 (2.6)	174 (1.0)
Osteonecrosis	15 (1.1)	109 (0.6)
Sequele fracture/trauma	12 (0.9)	89 (0.5)
Acute trauma	5 (0.4)	27 (0.2)
Tumor	8 (0.6)	9 (0.1)
Other joint diseases	1 (0.1)	7 (0.0)

Table 6.2.1. Demography in reoperations (with diagnosis from primary operation). Primary operations performed in 2022 for comparison.

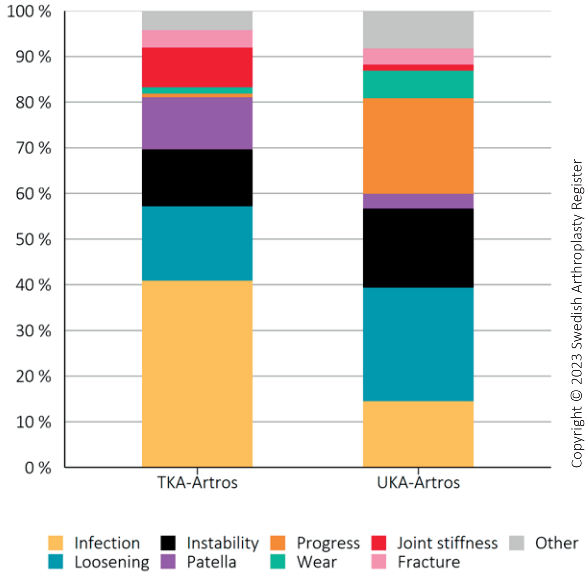


Figure 6.2.4. The most common reasons for reoperation in the last 10 years per type of operation/diagnosis.

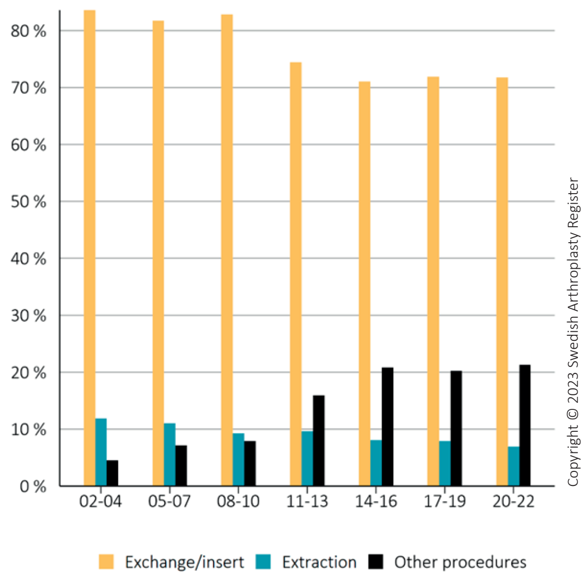


Figure 6.2.5. Distribution of the main procedures exchange/insertion, extraction and other procedures where the implant is not affected in three-year periods 2002–2022.

6.3 Reoperation within two years in TKR/OA

Authors: Annette W-Dahl and Ola Rolfson

Reoperations within two years after a primary operation has been used as a quality indicator in hip replacement surgery for several years and is selected by the Swedish Association of Local Authorities and Regions and the National Board of Health and Welfare as a national quality indicator. The variable is included in "Vården i Siffror" (www.vardenisiffror.se). Reoperation within two years include all forms of additional surgery after the primary surgery. This outcome measure is intended to reflect mainly early and serious complications. The indicator is therefore considered important, readily available and easier to use for clinical improvement work, compared to the risk for revision at 10 years.

As previously described in chapter 6.2 we began to systematically requesting other procedures than revisions from the units in 2013 for knee replacement surgery. The reason why two-year reoperations were not reported previously is partly because the reliability in the reporting of other procedures is uncertain, partly because there are few reoperations per unit per year. Therefore, several years of reporting is needed to obtain reasonable number for a meaningful analysis at unit level. In addition, it is difficult to determine to what extent other procedures are reported, and thus this may affect outcome and disadvantage units that are good at reporting other procedures than prosthesis procedures.

An indicator further assumes that the reporting is reliable, which we currently believe is not the case for the knee replacement surgery. Despite the shortcoming in the reporting, we have chosen to present the indicator "Reoperation within two years for TKR/OA" for several different reasons. It is, of course, important to be able to follow the early reoperation rate for those units that have good reporting. For those units that have not reviewed their procedures to also report reoperations that are not revisions, we want to encourage them to improve reporting. The reporting is also a part of the harmonisation of the presentation of hip and knee replacement after the merger of the registers. The corresponding analysis for hip replacements is presented in chapter 5.3.

The most common reasons for reoperation within two years were infection, patella problems and loosening until 2008 with an increasing proportion of infection 2009–2010 (figure 6.3.1). This increase coincides with the implementation of a more surgically aggressive treatment of suspected early infections. After 2013, infection remains the most common reason for reoperation within two years but the proportion of joint stiffness and fracture as reason for reoperation have increased, probably due to change in reporting routines.

In TKR for OA, reoperation within two years 2019–2022 is presented for each unit (university units, private units and other units in alphabetical order) and refers to first-time events (number and proportion) within two years from the primary operation (table 6.3.1). Due to few reoperations reported within two years only infection (suspected or verified) as a single group while other reasons for reoperation are combined into one group, "other reason". The number of revisions (and the percentage of the number of reoperations) is provided to give an idea of the reporting of other procedures than revision. The results of the compilation are currently uncertain and do not give a fair picture of the proportion of reoperations within two years at national and unit level.

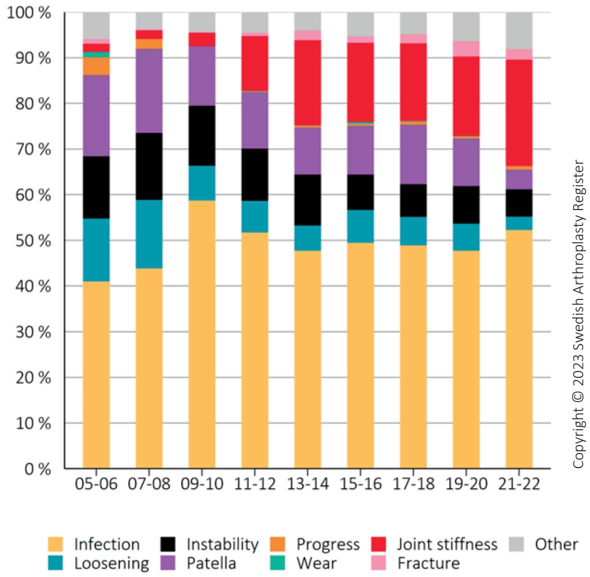


Figure 6.3.1. Distribution of reason for reoperation within two years after the primary operation in TKR/OA.

Number and proportion of reoperations within two years after the primary operation per unit 2019–2022

Unit	Number primary	Number reoperation	Whereof revisions	Revisions %	Infection number	Infection %	Other reason number	Other reason %
University units								
Akademiska sjukhuset	277	13	5	38	3	1.1	10	3.6
Karolinska Huddinge	463	6	4	67	2	0.4	4	0.9
Karolinska Solna	64	2	1	50	2	3.1	0	
SU/Mölndal	840	11	10	91	7	0.8	4	0.5
SUS/Lund	59	0	0		0		0	
Umeå	284	10	10	100	5	1.8	5	1.8
Private units								
Aleris Malmö Arena	32	0	0		0		0	
Aleris Specialistvård Bollnäs	269	2	2	100	0		2	0.7
Aleris Specialistvård Motala	114	2	2	100	0		2	1.8
Aleris Specialistvård Nacka	635	6	6	100	3	0.5	3	0.5
Aleris Specialistvård Ängelholm	1,135	20	19	95	8	0.7	12	1.1
Art Clinic Göteborg	853	6	4	67	4	0.5	2	0.2
Art Clinic Jönköping	861	6	6	100	2	0.2	4	0.5
Capio Artro Clinic	2,187	69	18	26	17	0.8	52	2.4
Capio Movement	1,814	17	13	76	10	0.6	7	0.4
Capio Ortopedi Motala	1,311	32	30	94	16	1.2	16	1.2
Capio Ortopediska Huset	2,639	87	24	28	18	0.7	69	2.6
Capio S:t Göran	863	10	8	80	5	0.6	5	0.6
Carlanderska	1,309	8	5	63	3	0.2	5	0.4
Carlanderska-SportsMed	452	4	2	50	1	0.2	3	0.7
Frölundaortopeden	87	2	2	100	0		2	2.3
GHP Ortho Center Göteborg	1,044	13	12	92	7	0.7	6	0.6
GHP Ortho Center Stockholm	2,251	58	28	48	19	0.8	39	1.7
GHP Ortho och Spine Center Skåne	164	2	2	100	2	1.2	0	
Hermelinen	100	1	1	100	1	1.0	0	
Ledplastikcentrum Bromma	204	3	2	67	3	1.5	0	
Ortopediskt Center - Sophiahemmet	340	7	6	86	6	1.8	1	0.3
Sophiahemmet	78	2	2	100	0		2	2.6
Specialistcenter Scandinavia, Eskilstuna	133	2	1	50	0		2	1.5
Other units								
Alingsås	635	11	6	55	5	0.8	6	0.9
Arvika	966	15	13	87	8	0.8	7	0.7
Bollnäs	791	13	9	69	8	1.0	5	0.6

The table continues on the next page.

Number and proportion of reoperations within two years after the primary operation per unit 2019–2022, cont.

Unit	Number primary	Number reoperation	Whereof revisions	Revisions %	Infection number	Infection %	Other reason number	Other reason %
Borås	218	4	2	50	2	0.9	2	0.9
Danderyd	272	12	10	83	9	3.3	3	1.1
Eksjö	1,089	26	23	88	10	0.9	16	1.5
Enköping	1,618	36	22	61	11	0.7	25	1.5
Eskilstuna	167	8	4	50	0		8	4.8
Falköping	63	0	0					
Falun	402	8	2	25	1	0.2	7	1.7
Gällivare	226	1	1	100	0		1	0.4
Gävle	260	7	7	100	4	1.5	3	1.2
Halmstad	445	0	0		0		0	
Helsingborg	787	11	10	91	6	0.8	5	0.6
Hudiksvall	194	1	1	100	1	0.5	0	
Hässleholm	2,808	42	39	93	17	0.6	24	0.9
Kalmar	252	1	1	100	1	0.4	0	
Karlshamn	772	5	5	100	4	0.5	1	0.1
Karlstad	186	2	2	100	1	0.5	1	0.5
Kullbergska sjukhuset	883	20	14	70	8	0.9	12	1.4
Kungälv	374	25	8	32	10	2.7	15	4.0
Lidköping	447	7	7	100	2	0.4	5	1.1
Lindesberg	1,25	21	16	76	13	1.0	8	0.6
Ljungby	305	6	4	67	3	1.0	3	1.0
Lycksele	505	15	12	80	10	2.0	5	1.0
Mora	634	25	4	16	5	0.8	20	3.2
Norrköping	374	11	11	100	5	1.3	6	1.6
Norrtälje	563	10	10	100	7	1.2	3	0.5
Nyköping	275	5	5	100	3	1.1	2	0.7
Oskarshamn	1,159	23	10	43	7	0.6	16	1.4
Piteå	909	13	9	69	9	1.0	4	0.4
Skellefteå	298	4	3	75	3	1.0	1	0.3
Skene	526	3	3	100	3	0.6	0	
Skövde	69	3	3	100	2	2.9	1	1.4
Sollefteå	605	17	14	82	14	2.3	3	0.5
Sundsvall	85	5	4	80	4	4.7	1	1.2
Södersjukhuset	455	12	3	25	10	2.2	2	0.4
Södertälje	434	6	5	83	3	0.7	3	0.7

The table continues on the next page.

Number and proportion of reoperations within two years after the primary operation per unit 2019–2022, cont.

Unit	Number primary	Number reoperation	Whereof revisions	Revisions %	Infection number	Infection %	Other reason number	Other reason %
Torsby	454	5	3	60	2	0.4	3	0.7
Trelleborg	1,742	18	17	94	11	0.6	7	0.4
Uddevalla	685	10	9	90	5	0.7	5	0.7
Varberg	452	8	7	88	5	1.1	3	0.7
Visby	353	6	4	67	2	0.6	4	1.1
Värnamo	680	9	7	78	4	0.6	5	0.7
Västervik	399	10	9	90	4	1.0	6	1.5
Västerås	844	21	21	100	13	1.5	8	0.9
Växjö	297	9	8	89	3	1.0	6	2,0
Örnsköldsvik	366	4	1	25	3	0.8	1	0.3
Östersund	337	7	6	86	6	1.8	1	0.3
Country	**49,811**	**943**	**618**	**66**	**411**	**0.8**	**531**	**1.1**

Table 6.3.1. Number and proportion of first reoperations (suspected or verified infection or other reason) within two years after primary operation 2019–2022 per unit. The number of primary and revisions (and proportion of primary operations) are given for comparison.

Units with fewer than 20 primary operations in the current period are excluded but are included in the national figures. It should be noted that it is difficult to determine to what extent other procedures than revision is reported and thus it can affect the outcome and disadvantage units that are good at reporting other procedures.

6.4 Revision knee replacement

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Revision is defined as a reoperation of a knee replacement where components are inserted (added), exchanged or extracted (including arthrodesis and amputation). This means that soft tissue procedures such as arthroscopy and "lateral release" are not registered as revisions.

The current status per surgical year in knee replacement surgery is illustrated in figure 6.4.1 (one individual may be included with both right and left knee). As seen in figure 6.4.1 almost 80 % of the patients operated in 1980 have not been revised in their lifetime. One fifth of the then operated have undergone revision and out of the few that are still alive more than half have been revised.

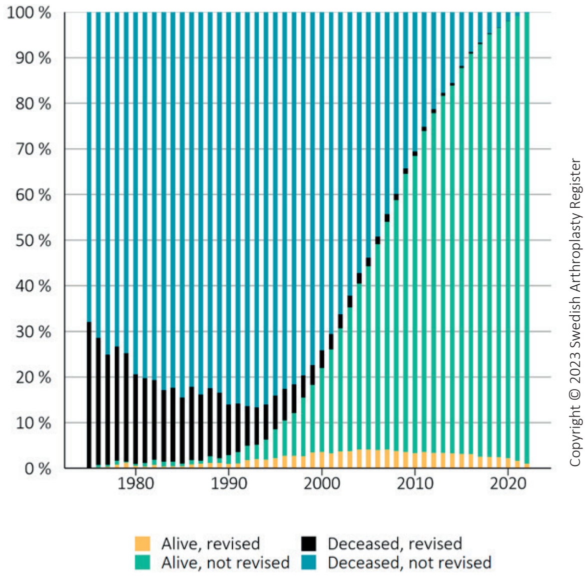

Figure 6.4.1. Current status per surgical year in patients having knee replacements.

Demography

There was almost two-year difference in mean age in first-time revision of TKR in 2022 compared with primary TKR 2022 (table 6.4.1). The mean age in first-time revision of UKR in 2022 was a more than 3 years higher compared with primary UKR in 2022. Slightly higher proportion of males were revised in the TKR-group and slightly higher proportion of females in the UKR-group in comparison with the proportions of males and females operated on with primary TKR and UKR. In revision of TKR the proportion with BMI ≥ 30 was higher than in primary surgery and in the UKR-group the proportion with BMI ≥ 35 was higher than in the primary surgery. In both revisions of TKR and URA the proportion of those classified as ASA ≥ III was higher than in primary surgery.

Figure 6.4.2 shows the distribution of primary surgery and revisions per unit in 2022. The number and the proportion of primary operations are shown in the column to the right. Units with fewer than 20 operations have been excluded. The proportion of revisions of the unit's production varies from SUS/Lund where more than 56 % of the operations were reported as revisions to units that have not reported any revisions at all. The variation may for example depend on that primary operations are performed in one or more units in a region while revisions are concentrated to other units in the region.

Reason for revision

The most common reasons for revision in the last ten years in TKR/OA and UKR/OA are shown in figure 6.4.3. In TKR/OA, infection has been the most common reason in the last few years compared to previous time when loosening dominated as reason for revision. The reason for revision "progress" in TKR includes all kinds of patellar problems in patients with replacements both with and without a patella component (but not loosening or wear of the patella component).

Note that the distribution of reasons for revision not necessarily reflects the risk of having these complications. Since the number of primary operations in TKR/OA has increased substantially over time, early revisions are overrepresented and thereby infections. In UKR/OA progression of osteoarthritis is the most common reason for revision while the proportion of revisions due to loosening is higher and the proportion of revision due to infection is lower than in TKR/OA.

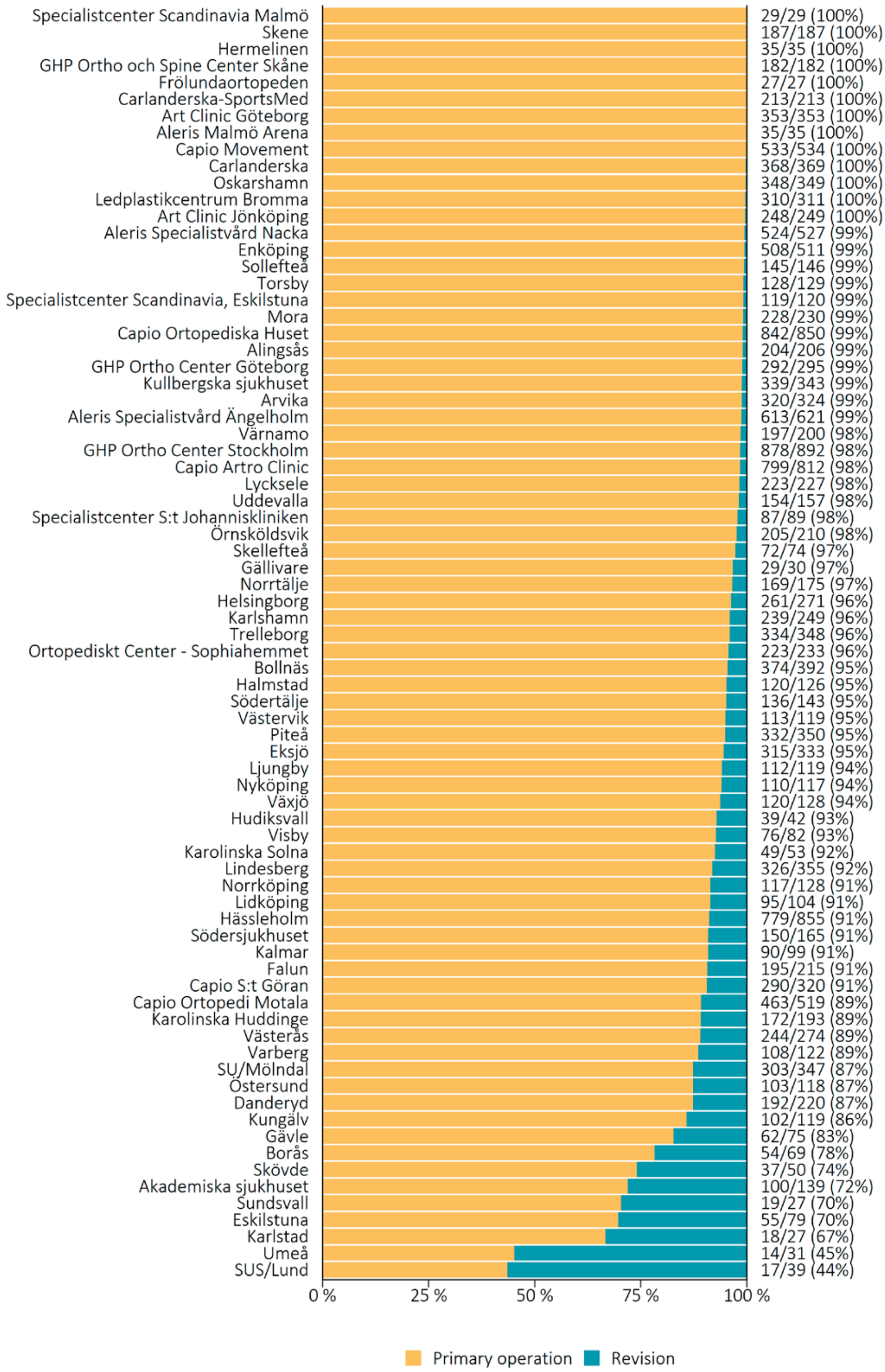

Figure 6.4.2. Revisions per unit 2022. The column on the right shows the number of primary operations/total number (% primary).

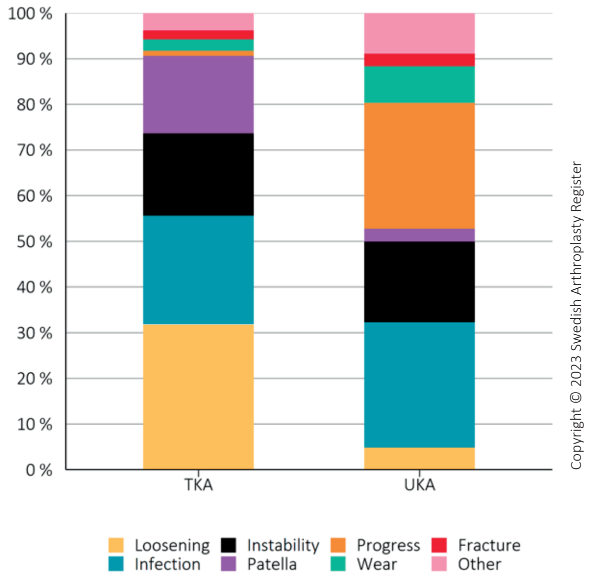

Figure 6.4.3. Distribution of reason for revision 2013–2022.

Revision procedures

Tables 6.4.2 a-b show the different types of first-time revisions that were performed in 2013–2022, divided into type of primary operation (TKR and UKR). It should be noted that the type of revision is exclusive (only one type is allowed for each revision), which means that, for example in case of patella surgery with simultaneous exchange of polyethylene only the patella procedure is presented.

For TKR/OA we see that revisions where polyethylene/meniscal bearing is exchanged has stagnated and is somewhat lower than in the period that was reported in the previous annual report. For UKA it is encouraging that no one is revised with a new UKA as this type of revision has been shown to have a high re-revision rate. For TKR we see that revisions where polyethylene is exchanged have stagnated and is slightly higher in the period that was reported in the previous annual report. For UKR, revision to TKR is the most common procedure.

Factors affecting the revision rate

How implants affect the revision rate has been given its own section (chapter 6.5 Evaluation of implants) in this year's report as a part of the harmonisation of the reporting of knee and hip replacements.

Underlying disease

Early on, it was realized that patients with different underlying disease, for example RA and OA could have different postoperative outcome with different revision rate. Therefore, it has always been reported separate curves for these diagnoses. The modern medical treatment for RA has, however, decreased the need for knee replacements in this group and it has become increasingly difficult to see statistically significant differences. We have therefore chosen not to report RA separately due to too few reported cases.

Age

The effect of age in primary surgery can be illustrated by dividing the patients into different age groups. It shown that in both TKR and UKR the risk of revision is higher in those having a knee replacement in younger age (figure 6.4.4). Possible explanations are that the younger have a higher level of physical activity, a greater demand for pain relief and function, another life situation and that they have a health status that more readily allows revision than the elderly.

Surgical year

For TKR we saw a decrease in the risk for revision in the first three decades from the start of the register, which has not been as evident for UKR (figure 6.4.5). In the period 2006–2015 the number of early revisions in TKR increased, a trend that has continued in most recent period 2016–2022. This has been mainly due to an increase in the number of early revisions due to infection (figure 6.4.6).

For UKR the improvement over the first three decades was not as marked as for TKR. But even, for UKR the early revision rate increased in the period 2006–2015 and 2016–2022. However, the explanation here is mainly that since the late 1990s the relative proportion of younger patients receiving UKR has increased, and they have a higher risk of revision. On the other hand, we can see a decrease of the revision rate in UKR in the last period compared with in 2006–2015 (figure 6.4.5).

When the Swedish Arthroplasty Register reports the risk of revision due to infection this means that the risk of being revised due to infection in the first revision and other causes of revision are censored (figure 6.4.6). This risk decreased the first decades for osteoarthritis. In the period 2006–2015 we saw a significant increase in the risk of revision due to infection compared with the past in TKR, which continues in 2016–2022 and now also in UKR. The increase is mainly due to early polyethylene exchange due to infection or suspected infection. The increase is probably due to that treatment of infection in the recent years has been more surgically aggressive in early suspected infections.

Sex

The effect of sex on risk of revision is complicated because males and females have different revision patterns. Revision for early infection is overrepresented in males while in females loosening and patella problems are those that dominate early. The difference between the sexes is even greater when the breaking point only includes revision for infection (figure 6.4.7). Why males more often get revised for infection than females is unclear.

Patella component in TKR

How the use of patella component affects the risk of revision is complicated. The use is different depending on prosthesis model, while at the same time it has decreased over the years. In the 2002 annual report we noted for the first time that TKR with patella component (inserted 1991–2000) had a lower risk of revision than those without (figure 6.4.8). In this period TKR without patella component had a significantly higher revision rate than those with patella component (HR 1.3 (CI 1.1–1.4)). An analysis of the period 2001–2010 (figure 6.4.9) demonstrates the contrary, that TKR without patella component have a significantly lower revision rate (HR 0.8 (CI 0.7–0.9)). In the current period 2013–2022, the risk is the similar (HR 1.00 (CI 0.88–1.15)).

The reason for this can only be speculated. The insertion of the patella component takes extra time at surgery and involves an extra prosthesis component to be fixed to bone, implicating an increased risk for infection, loosening and wear. Therefore, modifications in the quality of the patella components and fixation may be the reason for the change in the risk of revision over time. On the other hand, some of the TKRs that are inserted without primary patella component are secondarily operated with such a component. That the femur components have become more "patella friendly" and/or that the surgeons' enthusiasm for secondary patella resurfacing has changed, are also possible explanations for these inconstant outcomes.

It could be discussed whether the use of patella component should be considered when the risk of revision for units and implants respectively. We have chosen to present the implant's total risk of revision (both with and without patella component). This gives a comprehensive view of the situation in patient groups and implants. When we compare HR for implants (table 6.5.3 and 6.5.4) we present results separately for TKR with and without patella component and when we assess the risk of revision in different units, we take in consideration, in the regression analysis, whether a patella component has been used or not.

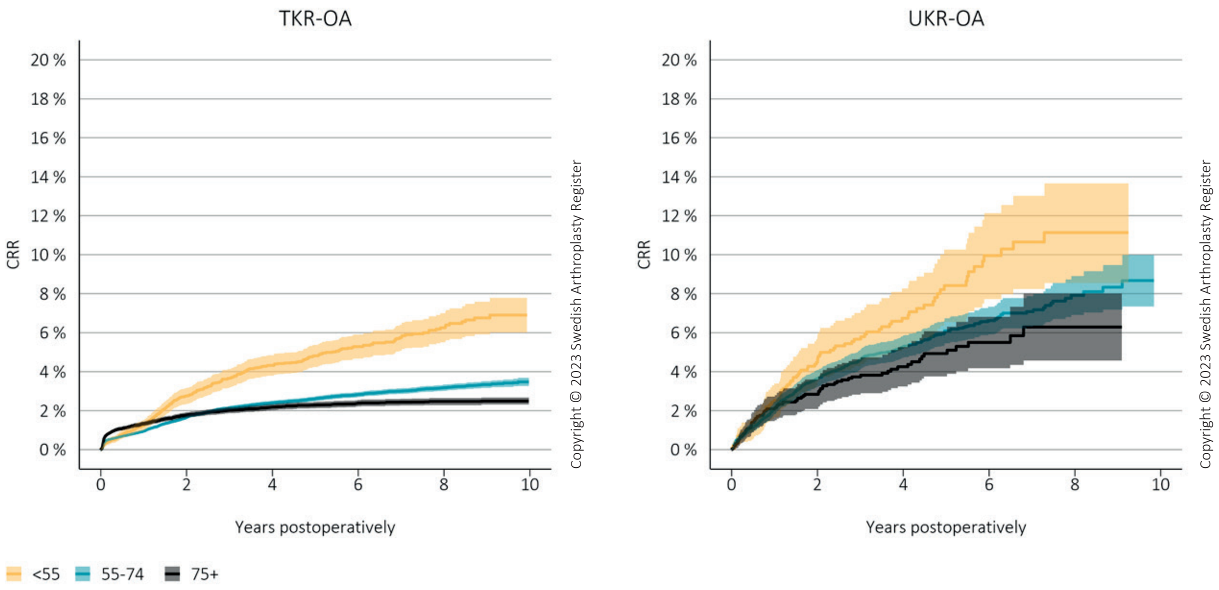

Figure 6.4.4. CRR in different age groups TKR/OA (left) and UKR/OA (right) inserted in the period 2013–2022.

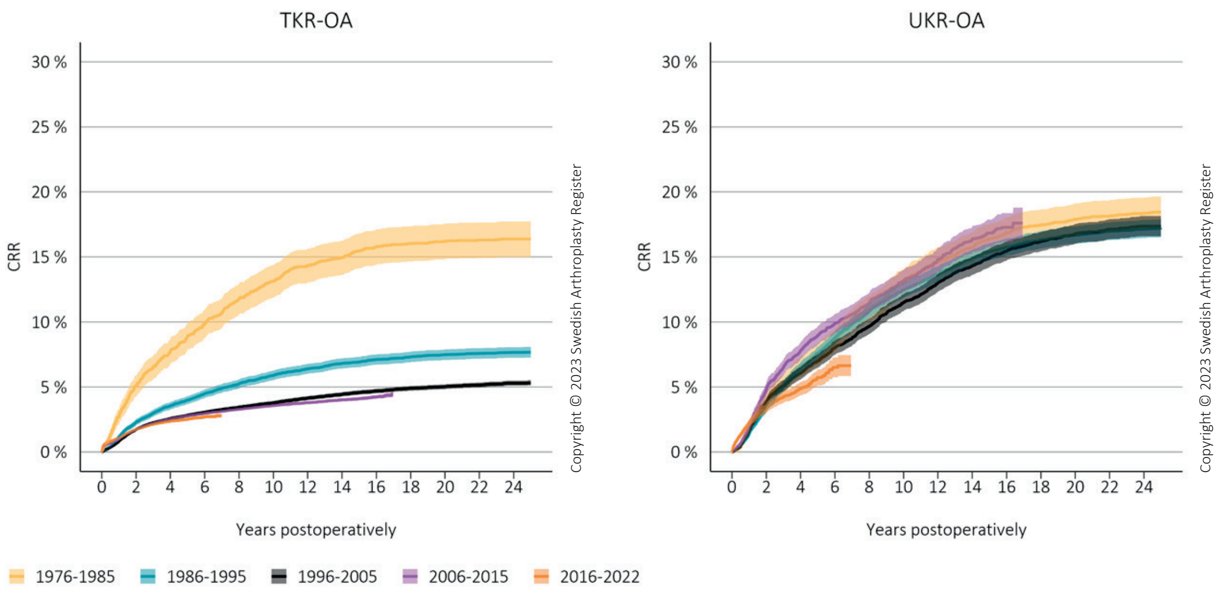

Figure 6.4.5. CRR in different periods up to 20 years in TKR/OA (left) and UKR/OA (right).

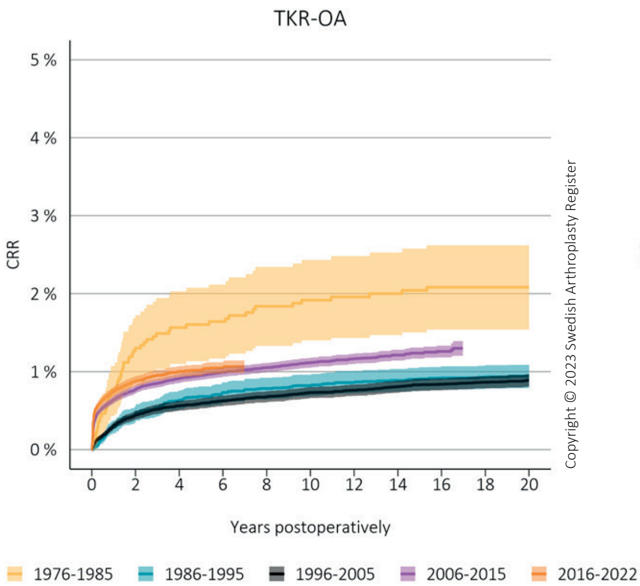

Figure 6.4.6. CRR due to infection in different periods up to 20 years in TKR/OA (left) and UKR/OA (right).

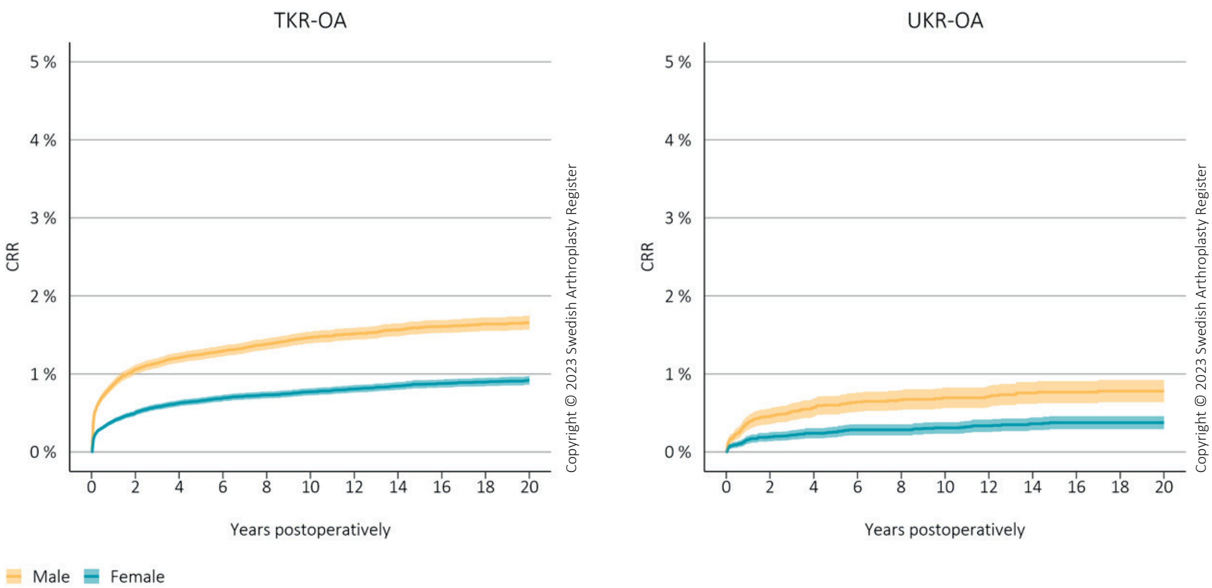

Figure 6.4.7. CRR du to infection by sex up to 20 years in TKR/OA (left) and UKR/OA (right).

Demography in first time revisions 2022

	TKR revision	UKR revision	Primary operation TKR	Primary operation UKR
Number	**618**	**197**	**14,791**	**2,089**
Mean age (SD)	**71.5 (9.0)**	**69.6 (9.5)**	**69.7 (8.9)**	**66.1 (9.1)**
Age group (%)				
< 45 years	2 (0.3)	0 (0.0)	44 (0.3)	12 (0.6)
45–54 years	25 (4.0)	14 (7.1)	724 (4.9)	211 (10.1)
55–64 years	111 (18.0)	50 (25.4)	3,426 (23.2)	668 (32.0)
65–74 years	223 (36.1)	62 (31.5)	5,750 (38.9)	804 (38.5)
75–84 years	217 (35.1)	63 (32.0)	4,417 (29.9)	355 (17.0)
≥ 85 years	40 (6.5)	8 (4.1)	430 (2.9)	39 (1.9)
Females (%)	328 (53.1)	109 (55.3)	8,291 (56.1)	1,020 (48.8)
BMI (%)				
18.5–24.9	120 (19.9)	31 (15.9)	2,868 (19.6)	395 (19.1)
25–29.9	234 (38.9)	96 (49.2)	6,365 (43.4)	979 (47.2)
30–34.5	187 (31.1)	52 (26.7)	4,205 (28.7)	584 (28.2)
35—39.9	53 (8.8)	13 (6.7)	1,064 (7.3)	104 (5.0)
≥ 40	8 (1.3)	3 (1.5)	126 (0.9)	8 (0.4)
ASA-class (%)				
ASA I	42 (6.9)	17 (8.6)	2,038 (13.8)	481 (23.1)
ASA II	357 (58.3)	142 (72.1)	9 ,843 (66.8)	1,328 (63.7)
ASA III–V	213 (34.8)	38 (19.3)	2,854 (19.4)	277 (13.3)

Table 6.4.1. Demography in first time revisions 2022 divided in TKR and UKR with primary operation TKR and UKR 2022 for comparison.

Procedure in revision of primary TKR

Procedure	Number	Proportion %
Exchange of meniscal bearing/insert	1,654	30.3
TKA utan patella	1,204	22.1
Patella addition	980	18.0
Linked (rot. Hinge) without patella	446	8.2
TKR with patella	304	5.6
Extraction (two-staged)	233	4.3
Exchange tibia	208	3.8
Extraction	131	2.4
Exchange femur	63	1.2
Linked (rot. Hinge) with patella	51	0.9
Linked (rot. Hinge) with patella	43	0.8
Extraction + prostesis spacer	19	0.4
Exchange patella	15	0.3
Arthrodesis	9	0.2
Reposition of the same insert	8	0.2
Patella extraction	5	0.1
Exchange of hinge part	3	0.1
Extraction tibia	1	0.0
Hinged without patella	1	0.0
Extraction (empty joint)	1	0.0
Addition of screw/hinge part	1	0.0
Unknown	71	1.3
Total	**5,451**	**100.0**

Table 6.4.2a. Procedure for revision in primary TKR/OA 2013–2022.

Procedure in revision of primary UKR

Procedure	Number	Proportion %
TKR without patella	1,168	76.1
Exchange of meniscal bearing/insert	173	11.3
TKR with patella	94	6.1
Linked (rot. Hinge) without patella	30	2.0
Extraction (two-staged)	15	1.0
Exchange tibia	8	0.5
UKR medial	3	0.2
Patellofemoral prosthesis	3	0.2
Exchange femur	2	0.1
Extraction	2	0.13
Linked (rot. Hinge) with patella	1	0.1
Reposition of the same insert	1	0.1
Patella addition	1	0.1
Femoral amputation	1	0.1
Unknown	32	2.1
Total	**1,534**	**100.0**

Table 6.4.2b. Procedure for revision in primary UKR/OA 2013–2022.

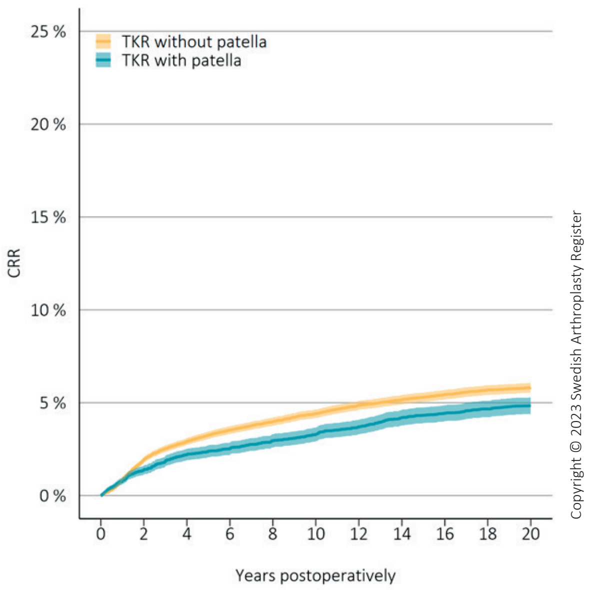

Figure 6.4.8. CRR in TKR/OA inserted in the ten-year period 1991–2000, with or without patella component respectively.

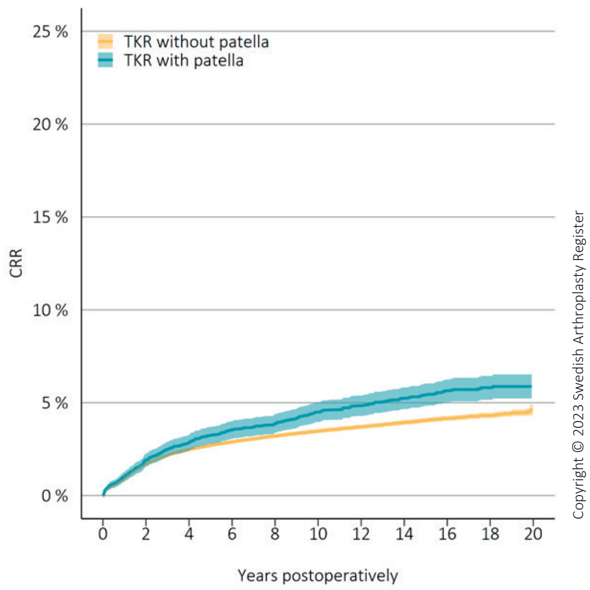

Figure 6.4.9. CRR in TKR/OA inserted in the ten-year period 2001–2010, with or without patella component respectively.

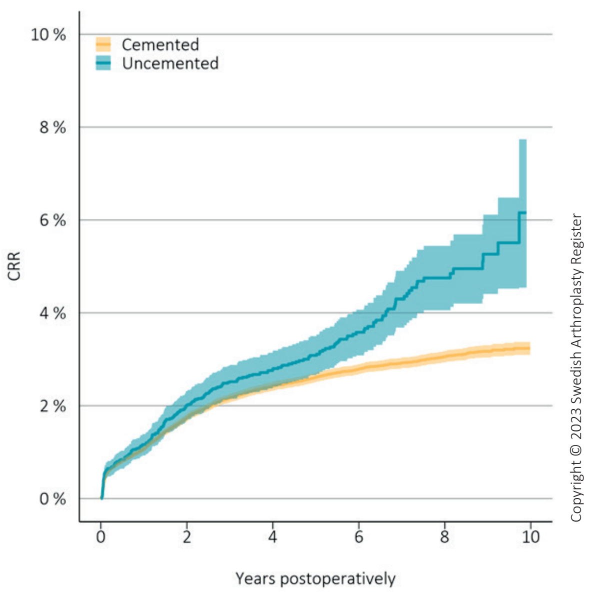

Figure 6.4.10. CRR in cemented and uncemented TKR/OA inserted in the ten-year period 2013–2022.

Use of cement

Cement has been used in the large majority of the surgeries since the mid-90s, however, with an increase in uncemented cases the recent years. We have previously shown in an analysis in TKRs inserted in the period 1985–1994, when the use of uncemented implants was slightly more common, that these had a higher risk of revision. Also, in the last ten-year period we now see a significantly higher risk of revision in uncemented implants compared to the cemented (figure 6.4.10).

Revision risk per unit

What is the true average outcome of a given treatment at a given unit can only be determined for defined groups of already treated individuals. Such outcome, however, only reflect historical conditions and cannot easily be used for comparisons of future treatment outcomes. The observed average outcome of a treatment at a unit is not constant. Different selections of patients receiving the same treatment have different average outcomes, as well as individual surgeons. This unit-specific variability must be considered in order to make comparisons between units meaningful.

The Swedish Arthroplasty Register has harmonised in selection, methods and how the results are presented in order to be equivalent for both knee and hip replacements, however it is not completely consistent yet. Traditionally, operations in a ten-year period have been included with one-year delay (for example 2011–2020) when cumulative revision rate (CRR) has been estimated. In the analyses that follow, one additional year has been included (eleven-year period), and the most recent year has been included so that the period becomes 2012–2022. The change means that operations can be followed for more than ten years instead of for more than nine years. Including the most year's revisions may result in missing revisions, as we know from experience that revisions will be reported from the previous year are added in the coming year.

Table 6.4.3 shows for each unit the number of primary surgeries (TKR) performed for osteoarthritis in the analysed five-year period (2017–2022) and how many of these that have been revised. Table 6.4.4 shows the corresponding numbers but for a ten-year period (2013–2022). This is followed by RR (relative risk of revision) with 95 % confidence interval. This estimates unit effects on the revision risk relative to the national average and has been calculated as in previous years with "shared gamma frailty model". Finally, the observed rank of the unit is shown together with a 95 % confidence interval for the rank. The calculation has been performed using the Monte Carlo-method.

Only units, where more than 50 primary operations have been performed are shown in the analysis including all TKRs performed due to osteoarthritis. The results have been adjusted for differences in sex and age distribution as well as for differences in the distribution of prostheses with and without a patella component. The units that are significantly better or worse than the national average have been marked in green and red respectively.

The figures 6.4.11 and 6.4.12 show CRR after five and ten years respectively (primary operations 2017–2022 and 2012–2022 included). presented but are included in the national data.

In this year's report we present for the first time, CRR for patellofemoral prosthesis and partial knee prosthesis.

Relative risk of revision per unit, five years

Unit	Number TKR	TKR revised	RR	RR 95 % CI	Rang	Rang 95 % CI
Halmstad	**766**	**3**	**0.39**	**0.20; 0.77**	**1**	**1-25**
Carlanderska	**1,601**	**11**	**0.46**	**0.28; 0.75**	**2**	**1-24**
Art Clinic Jönköping	**1,061**	**7**	**0.48**	**0.27; 0.84**	**3**	**1-31**
Capio Movement	**2,671**	**24**	**0.5**	**0.35; 0.72**	**4**	**1-21**
Kalmar	426	2	0.52	0.25; 1.08	5	1-48
Mora	**1,025**	**9**	**0.57**	**0.34; 0.95**	**6**	**1-40**
Gällivare	357	2	0.57	0.28; 1.18	7	1-53
Karlshamn	**1,296**	**13**	**0.59**	**0.37; 0.93**	**8**	**2-38**
Aleris Specialistvård Nacka	**1,014**	**10**	**0.6**	**0.36; 0.99**	**9**	**2-42**
Alingsås	**1,013**	**10**	**0.6**	**0.37; 1.00**	**10**	**2-43**
Aleris Specialistvård Bollnäs	881	12	0.63	0.39; 1.01	11	2-44
Carlanderska-SportsMed	692	7	0.63	0.36; 1.11	12	2-49
Skene	747	7	0.64	0.36; 1.11	13	2-50
Art Clinic Göteborg	1,076	10	0.65	0.39; 1.07	14	2-47
Piteå	1,437	18	0.69	0.46; 1.04	15	5-45
Uddevalla	1,113	14	0.69	0.44; 1.08	16	4-48
Södersjukhuset	905	12	0.7	0.44; 1.12	17	4-50
GHP Ortho Center Göteborg	1,383	18	0.71	0.47; 1.07	18	5-47
Örnsköldsvik	645	8	0.74	0.43; 1.27	19	4-58
Capio Artro Clinic	2,740	36	0.74	0.55; 1.02	20	9-44
Falun	742	10	0.75	0.46; 1.24	21	4-57
Södertälje	722	10	0.77	0.47; 1.28	22	5-58
Karolinska Solna	137	1	0.77	0.35; 1.69	23	2-71
Falköping	63		0.79	0.34; 1.86	24	2-73
Hudiksvall	307	4	0.81	0.43; 1.54	25	3-67
Lidköping	848	14	0.82	0.52; 1.28	26	8-58
Capio S:t Göran	1,661	27	0.82	0.58; 1.16	27	11-53
Trelleborg	3,307	58	0.83	0.64; 1.06	28	15-47
Karolinska Huddinge	634	9	0.83	0.50; 1.40	29	6-63
Oskarshamn	1,883	31	0.84	0.60; 1.17	30	12-53
Borås	381	6	0.85	0.47; 1.52	31	5-67
Capio Ortopediska Huset	3,982	66	0.86	0.68; 1.09	32	17-49
Aleris Specialistvård Motala	896	19	0.88	0.59; 1.31	33	11-60
Lindesberg	2,095	37	0.88	0.65; 1.19	34	15-54
Värnamo	1,07	18	0.89	0.59; 1.34	35	12-61
GHP Ortho Center Stockholm	3,261	56	0.9	0.70; 1.16	36	18-53
Varberg	767	14	0.9	0.58; 1.42	37	11-64
SU/Mölndal	1,546	29	0.92	0.65; 1.28	38	16-59
Hermelinen	136	2	0.92	0.44; 1.90	39	4-74

The table continues on the next page.

Relative risk of revision per unit, five years, cont.

Unit	Number TKR	TKR revised	RR	RR 95 % CI	Rang	Rang 95 % CI
Specialistcenter Scandinavia, Eskilstuna	133	1	0.95	0.43; 2.06	40	4-75
Bollnäs	791	11	0.97	0.59; 1.58	41	12-68
Torsby	655	12	0.97	0.60; 1.55	42	12-68
Nyköping	412	8	0.99	0.58; 1.70	43	11-71
Arvika	1,356	25	1	0.70; 1.43	44	19-64
Karlstad	429	10	1.02	0.61; 1.68	45	13-70
Ortopediskt Center - Sophiahemmet	340	6	1.06	0.59; 1.90	46	12-74
Ljungby	498	11	1.06	0.65; 1.73	47	16-71
SUS/Lund	110	3	1.08	0.55; 2.14	48	9-76
Helsingborg	1,066	22	1.09	0.75; 1.59	49	23-68
GHP Ortho och Spine Center Skåne	164	2	1.11	0.54; 2.28	50	8-76
Frölundaortopeden	107	3	1.12	0.56; 2.20	51	10-76
Skellefteå	457	11	1.12	0.69; 1.83	52	18-73
Gävle	388	10	1.13	0.68; 1.87	53	18-74
Aleris Specialistvård Ängelholm	1,445	29	1.15	0.82; 1.61	54	29-69
Enköping	2,348	52	1.15	0.89; 1.50	55	34-67
Sophiahemmet	352	12	1.16	0.72; 1.86	56	21-73
Östersund	650	17	1.17	0.77; 1.77	57	25-72
Norrtälje	858	21	1.18	0.80; 1.73	58	27-72
Eksjö	1,543	36	1.19	0.88; 1.63	59	33-70
Visby	557	15	1.23	0.79; 1.90	60	27-74
Ledplastikcentrum Bromma	204	3	1.26	0.64; 2.48	61	15-77
Hässleholm	**4,487**	**115**	**1.26**	**1.05; 1.52**	**62**	**45-67**
Akademiska sjukhuset	432	12	1.29	0.80; 2.07	63	28-75
Sundsvall	102	4	1.29	0.68; 2.45	64	18-77
Västerås	**1,254**	**36**	**1.38**	**1.02; 1.88**	**65**	**43-74**
Sollefteå	952	28	1.38	0.98; 1.95	66	41-75
Växjö	424	13	1.41	0.89; 2.24	67	35-76
Umeå	508	19	1.43	0.96; 2.14	68	40-76
Kullbergska sjukhuset	**1,254**	**36**	**1.46**	**1.08; 1.99**	**69**	**47-75**
Kungälv	**692**	**24**	**1.47**	**1.02; 2.12**	**70**	**44-76**
Danderyd	**458**	**18**	**1.68**	**1.11; 2.52**	**71**	**50-77**
Skövde	**157**	**9**	**1.72**	**1.02; 2.89**	**72**	**45-77**
Västervik	**572**	**22**	**1.73**	**1.18; 2.52**	**73**	**53-77**
Norrköping	**674**	**28**	**1.76**	**1.25; 2.48**	**74**	**57-77**
Capio Ortopedi Motala	**1,311**	**40**	**1.79**	**1.33; 2.41**	**75**	**60-77**
Eskilstuna	**306**	**16**	**1.83**	**1.19; 2.80**	**76**	**54-77**
Lycksele	**742**	**30**	**1.84**	**1.32; 2.57**	**77**	**60-77**

Table 6.4.3. Relative risk of revision per unit, five years. Units with significantly better or worse results than the national average are shown in green and red respectively.

Relative risk of revision per unit, ten years

Klinik	Antal TKA	Reviderade	RR	RR 95% KI	Rang	Rang 95% KI
Art Clinic Jönköping	1,130	7	0.44	0.25; 0.77	1	1-25
Carlanderska	1,949	17	0.47	0.31; 0.71	2	1-20
Alingsås	1,963	23	0.49	0.34; 0.71	3	1-19
Kalmar	836	8	0.49	0.29; 0.84	4	1-32
Aleris Specialistvård Nacka	1,686	20	0.52	0.35; 0.76	5	1-24
Carlanderska-SportsMed	984	12	0.54	0.34; 0.86	6	1-34
Gällivare	683	8	0.56	0.33; 0.96	7	1-43
Karlshamn	2,504	36	0.58	0.43; 0.79	8	2-27
Karolinska Huddinge	1,248	18	0.61	0.41; 0.92	9	2-40
Spenshult	732	15	0.62	0.40; 0.96	10	2-43
Capio Movement	4,123	67	0.66	0.53; 0.84	11	6-32
Halmstad	1,772	32	0.67	0.48; 0.92	12	4-40
Skene	1,279	20	0.67	0.46; 0.99	13	3-47
GHP Ortho Center Göteborg	1,909	31	0.68	0.49; 0.94	14	5-41
Art Clinic Göteborg	1,144	12	0.68	0.42; 1.09	15	3-55
Karolinska Solna	555	11	0.71	0.44; 1.15	16	3-60
Jönköping	734	16	0.72	0.47; 1.10	17	4-55
Karlskoga	635	14	0.73	0.47; 1.14	18	4-59
Capio Artro Clinic	2,740	36	0.74	0.54; 1.01	19	7-48
Hudiksvall	659	12	0.74	0.46; 1.19	20	4-62
Uddevalla	2,007	37	0.76	0.56; 1.02	21	8-50
Sabbatsberg	410	10	0.76	0.46; 1.25	22	4-66
Mora	1,906	36	0.77	0.56; 1.04	23	9-51
Trelleborg	6,954	151	0.78	0.66; 0.92	24	15-40
GHP Ortho Center Stockholm	5,299	105	0.79	0.65; 0.95	25	14-43
Falköping	63		0.8	0.34; 1.86	26	1-83
Hermelinen	163	2	0.81	0.39; 1.66	27	2-81
Värnamo	1,731	34	0.81	0.59; 1.11	28	11-57
Piteå	2,680	56	0.82	0.64; 1.05	29	13-52
Capio Ortopediska Huset	6,185	130	0.84	0.70; 0.99	30	18-47
Oskarshamn	3,213	70	0.86	0.68; 1.08	31	17-54
Borås	757	17	0.86	0.57; 1.31	32	9-69
Örebro	215	6	0.87	0.49; 1.56	33	5-78
Nyköping	814	18	0.88	0.59; 1.32	34	10-70
Torsby	1,235	28	0.9	0.64; 1.27	35	14-67

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Relative risk of revision per unit, ten years, cont.

Klinik	Antal TKA	Reviderade	RR	RR 95% KI	Rang	Rang 95% KI
Capio S:t Göran	3,390	81	0.9	0.73; 1.12	36	21-58
Båstad Active Motion	58	1	0.91	0.42; 1.97	37	3-84
Lindesberg	3,087	68	0.91	0.73; 1.15	38	20-60
Örnsköldsvik	1,182	28	0.93	0.66; 1.30	39	15-69
Varberg	1,508	38	0.93	0.69; 1.26	40	18-66
Aleris Specialistvård Motala	2,856	84	0.94	0.76; 1.16	41	23-61
Ängelholm	100	3	0.95	0.49; 1.88	42	5-83
Specialistcenter Scandinavia, Eskilstuna	133	1	0.97	0.45; 2.10	43	4-85
Frölunda Specialistsjukhus	481	16	0.97	0.63; 1.49	44	13-76
Aleris Specialistvård Bollnäs	2,347	70	0.98	0.78; 1.24	45	26-65
Arvika	2,181	50	0.98	0.76; 1.28	46	23-68
Västerås	2,358	61	0.99	0.77; 1.26	47	25-66
Växjö	898	23	0.99	0.68; 1.43	48	17-74
Skellefteå	921	25	1.01	0.70; 1.44	49	19-74
SU/Mölndal	3,083	84	1.01	0.82; 1.24	50	29-66
Södersjukhuset	2,188	65	1.02	0.81; 1.29	51	28-69
Karlstad	1,289	40	1.03	0.77; 1.38	52	24-72
Lidköping	1,833	54	1.06	0.82; 1.37	53	29-72
Ortopediskt Center - Sophiahemmet	340	6	1.06	0.59; 1.90	54	11-84
Aleris Specialistvård Ängelholm	2,193	52	1.07	0.82; 1.39	55	30-73
Sundsvall	448	15	1.08	0.70; 1.67	56	18-81
Frölundaortopeden	107	3	1.1	0.56; 2.16	57	9-85
Östersund	1,296	39	1.11	0.83; 1.49	58	30-76
Bollnäs	865	15	1.11	0.72; 1.72	59	20-82
GHP Ortho och Spine Center Skåne	164	2	1.13	0.55; 2.32	60	8-86
Enköping	4,157	117	1.13	0.94; 1.35	61	41-71
Eksjö	2,450	67	1.15	0.91; 1.45	62	38-75
Visby	925	28	1.15	0.82; 1.61	63	29-80
Elisabethsjukhuset	111	6	1.16	0.65; 2.07	64	14-85
Södertälje	1,272	39	1.17	0.87; 1.57	65	34-79
Falun	2,198	79	1.2	0.96; 1.49	66	43-76
Ljungby	1,033	34	1.21	0.88; 1.65	67	36-81
Akademiska sjukhuset	853	31	1.22	0.88; 1.70	68	36-81
Sophiahemmet	704	31	1.22	0.88; 1.70	69	36-81
Norrtälje	1,270	38	1.24	0.92; 1.67	70	39-81

The table continues on the next page.

Relative risk of revision per unit, ten years, cont.

Klinik	Antal TKA	Reviderade	RR	RR 95% KI	Rang	Rang 95% KI
Helsingborg	1,471	44	1.28	0.97; 1.69	71	44-81
Danderyd	1,066	37	1.28	0.95; 1.73	72	42-82
Ledplastikcentrum Bromma	204	3	1.29	0.66; 2.53	73	15-86
Skövde	794	33	1.31	0.95; 1.80	74	42-83
Umeå	**1,081**	**45**	**1.36**	**1.03; 1.80**	**75**	**50-83**
Sollefteå	**1,414**	**49**	**1.39**	**1.06; 1.82**	**76**	**53-83**
Kullbergska sjukhuset	**2,195**	**80**	**1.44**	**1.16; 1.78**	**77**	**60-83**
SUS/Lund	352	17	1.46	0.96; 2.21	78	44-86
Västervik	**1,057**	**41**	**1.49**	**1.11; 1.98**	**79**	**56-85**
Gävle	**968**	**44**	**1.51**	**1.14; 1.99**	**80**	**58-85**
Norrköping	**1,344**	**57**	**1.53**	**1.19; 1.96**	**81**	**62-85**
Hässleholm	**7,784**	**323**	**1.6**	**1.43; 1.80**	**82**	**73-84**
Lycksele	**1,129**	**46**	**1.64**	**1.25; 2.16**	**83**	**65-86**
Kungälv	**1,460**	**75**	**1.79**	**1.44; 2.24**	**84**	**74-86**
Capio Ortopedi Motala	**1,311**	**40**	**1.91**	**1.43; 2.57**	**85**	**74-86**
Eskilstuna	**496**	**32**	**2.1**	**1.52; 2.90**	**86**	**77-86**

Table 6.4.4. Relative risk of revision per unit, ten years. Units with significantly better or worse results than the national average are shown in green and red respectively.

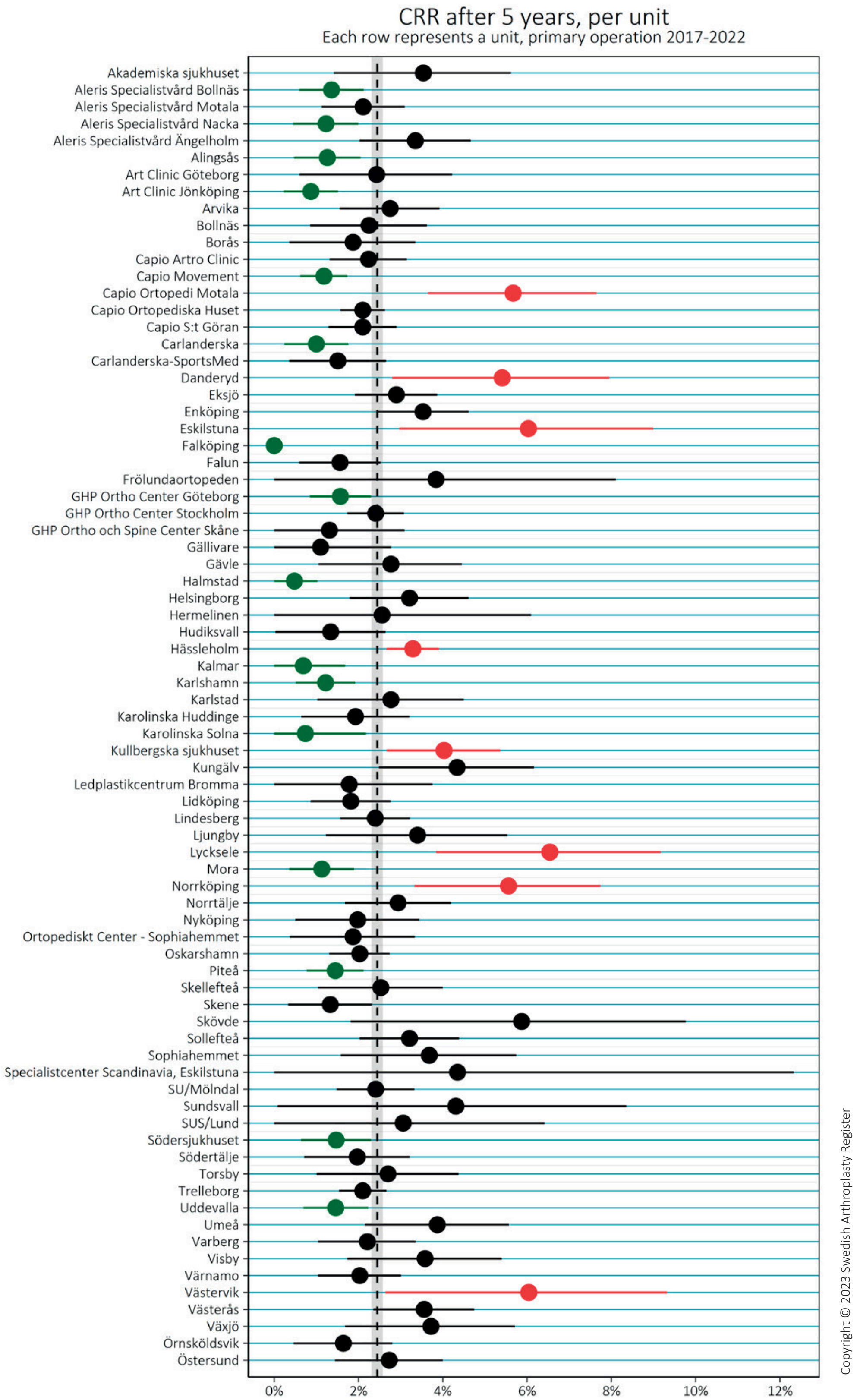

Figure 6.4.11. CRR after five years per unit (primary operation 2017–2022). Units with fewer than 50 primary operations in the last five years are not presented.

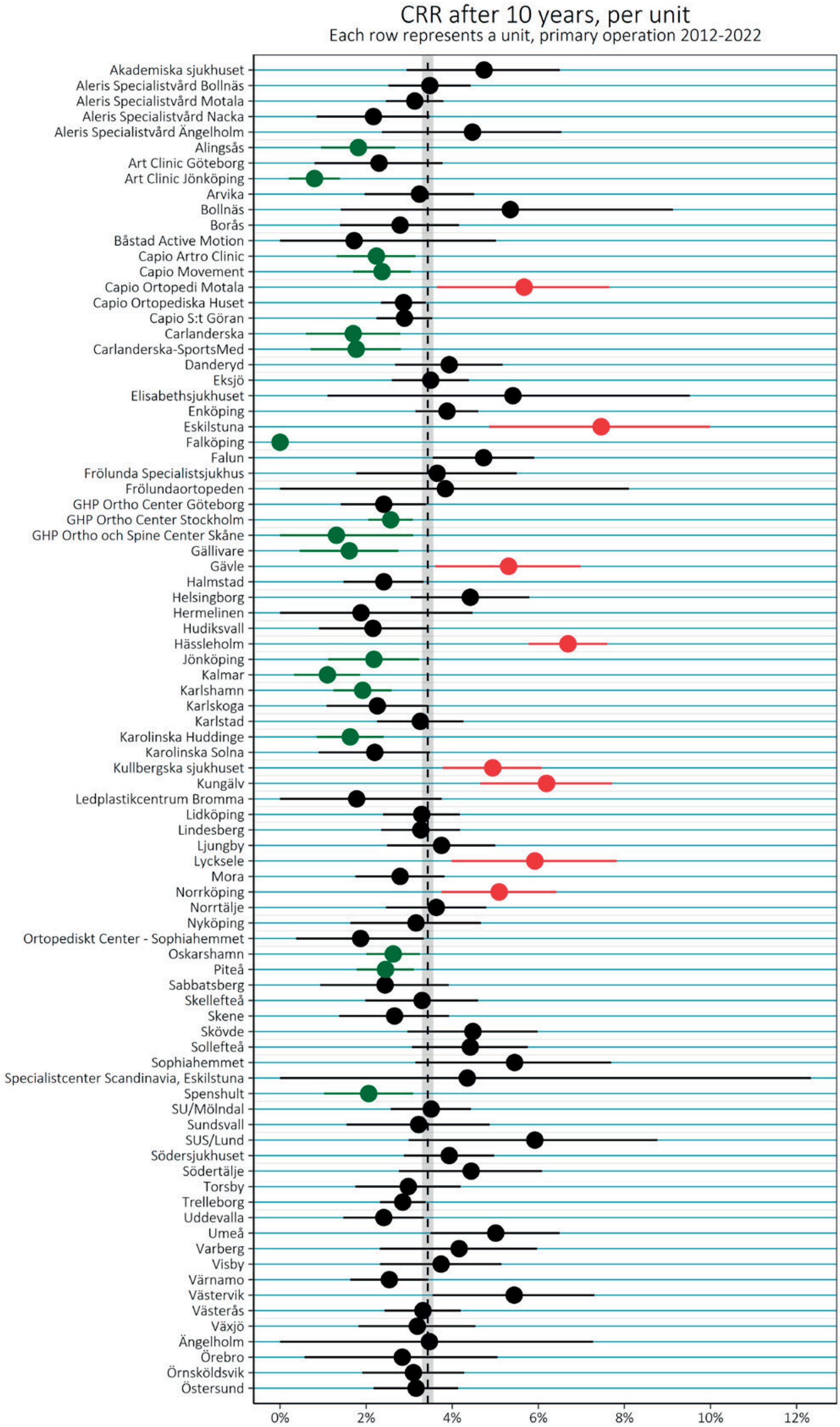

Figure 6.4.12. CRR after ten years per unit (primary operation 2012–2022). Units with fewer than 50 primary operations in the last five years are not presented.

Patellofemoral prosthesis

A patellofemoral prosthesis supplies only the femur patellar compartment and is a less frequently used type of prosthesis. The use has increased in the last 15 years from 10 to 20 per year, to 50 to 60 per year. Figure 6.4.13 shows CRR at nine years (11.6 CI 7.6–15.5) in patellofemoral prostheses operated on in 2013–2022.

Partial resurfacing prosthesis

In 2011, the first partial resurfacing prosthesis, Episealer, was registered and varying numbers have been reported until 2022 when 67 implants were registered. Episealer is a custom made implant based on MR images and is used in the femoral condyles of the knee joint (both medial and lateral), in the trochlea-area of the knee joint or both, mainly in local cartilage injuries. Figure 6.4.14 shows CRR at eight years (9.1 CI 1.1–16.3) for implants inserted in 2013–2022.

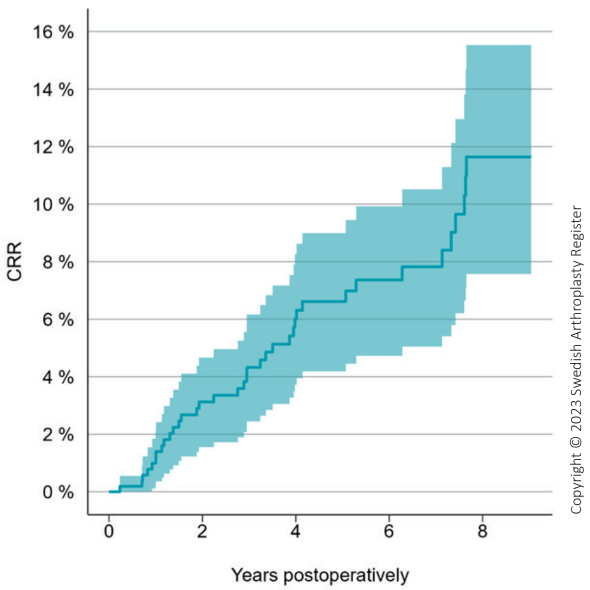

Figure 6.4.13. CRR for patellofemoral replacements inserted in the ten-year period 2013–2022.

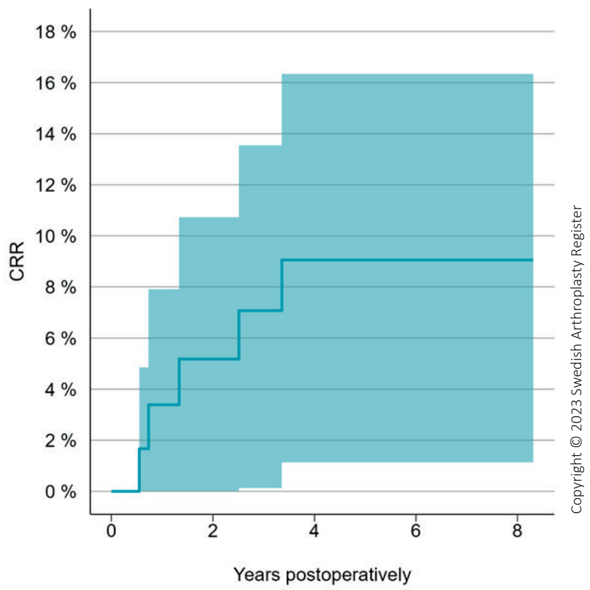

Figure 6.4.14. CRR for partial knee replacements inserted in the ten-year period 2013–2022. Due to that there are relatively few replacements, the curve ends when the number "at risk" is below ten replacements (unlike other CRR figures where the curves end at 50 at risk).

6.5 Evaluation of implants

Authors: Annette W-Dahl and Ola Rolfson

In the evaluation of implants, we have chosen to present relatively modern types of prosthesis with a reasonably long follow-up time. We have used data from the latest ten-year period. A model is reported even after it has ceased to be used as long as there are reasonable numbers available for analysis. Note that the individual prosthesis models, as for example the group NexGen, may represent different prosthesis variants, depending on modularity and marketing, among other factors, but within each model a few combinations tend to dominate. In this year's report models reported in 100 or more operations 2013–2022 have been included. This also includes revision models that are used in primary surgery. Triathlon MBT is reported divided into cemented and uncemented version as Triathlon is the most reported uncemented prosthesis in Sweden. The hazard ratio (HR) is adjusted for sex, age and surgical year (table 6.5.1).

Hazard ratio with 95 % confidence interval in revision TKR/OA

Model	Number	Revised	HR (95 % CI)	p
PFC Sigma TKR MBT	22,608	649	(ref.)	
NexGen APT	**194**	**1**	**0.13 (0.02; 0.91)**	**0.04**
PFC Sigma TKR APT	**6,185**	**114**	**0.57 (0.46; 0.69)**	**< 0.01**
NexGen Trabecular Metal	**2,151**	**47**	**0.61 (0.45; 0.82)**	**< 0.01**
Genesis II MBT	**2,589**	**50**	**0.72 (0.54; 0.96)**	**0.02**
Vanguard I-Beam Modular	**2,361**	**69**	**0.74 (0.58; 0.95)**	**0.02**
NexGen MBT	**61,997**	**1,314**	**0.77 (0.70; 0.85)**	**< 0.01**
Triathlon APT	138	3	0.81 (0.26; 2.53)	0.72
Triathlon MBT cemented	9,752	225	0.90 (0.77; 1.05)	0.17
NexGen Revision	468	13	1.10 (0.63; 1.90)	0.74
Vanguard Finned Stem Modular	1,928	82	1.16 (0.92; 1.46)	0.21
Triathlon MBT uncemented	**6,425**	**204**	**1.19 (1.02; 1.39)**	**0.03**
Persona	3,222	61	1.25 (0.95; 1.63)	0.11
Other	588	24	1.30 (0.86; 1.95)	0.21
Attune MB TKR	962	14	1.38 (0.81; 2.35)	0.24
Profix	116	6	1.39 (0.62; 3.12)	0.42
Legion/Genesis II Pri MBT	**2,151**	**92**	**1.73 (1.39; 2.15)**	**< 0.01**
PFC Sigma TC-3 (revision)	283	12	1.75 (0.99; 3.09)	0.06
Triathlon Total Stabilizer	**722**	**32**	**1.98 (1.39; 2.83)**	**< 0.01**
Nexgen Rotating hinge	**148**	**10**	**2.44 (1.31; 4.56)**	**< 0.01**
Link Endo Rotating hinge	**103**	**8**	**3.10 (1.54; 6.22)**	**< 0.01**
Journey TKR	**190**	**15**	**3.28 (1.96; 5.48)**	**< 0.01**
Sex=Female			**0.89 (0.82; 0.95)**	**< 0.01**
Surgical year			**0.98 (0.96; 0.99)**	**< 0.01**
Age			**0.98 (0.97; 0.98)**	**< 0.01**

Table 6.5.1. Hazard ratio for revision with 95% confidence interval in TKR/OA 2013–2022. Units with significantly better or worse results than the national average are shown in green and red respectively.

As before, PFC-Sigma MBT is used as reference for TKR because it is a well-defined prosthesis, i.e. most of it consists of the same type of femur, tibia plateau and polyethylene insert. Legion/Genesis II MBT, Triathlon MBT uncemented and Journey TKR have a significantly higher risk of revision (higher HR) than the reference PFC-MBT. Journey and Legion/Genesis II MBT were introduced in 2008 and 2013 in Sweden and are still used, as is Triathlon in its uncemented version. In the other end, Genesis II MBT, NexGen APT, NexGen MBT, NexGen TM, PFC-Sigma APT and Vanguard I-Beam all have lower HR than the reference.

Like last year we have chosen to also include revision models if they are reported to a sufficient extent. We are aware that these are used in primaries with a more advanced osteoarthritis/malalignment and in patients with more severe conditions but we think that it is of interest to show how these groups are performing. Of the revision models all show a higher HR than the reference with exception of the PFC Sigma TC-3 (revision) which does not differ significantly from the reference prosthesis.

There are two different variants of the Vanguard prosthesis where the one uses a tibia tray with a beamed stem (I-Beam) while the other uses a tibial tray with a winged stem (finned). The latter started to be used in 2010. In the 2018 report, the winged version had a significantly higher risk than the reference model, but in recent years as well as this year the difference is not significant. Vanguard I-Beam however shows a significantly lower HR in this year's report. As Vanguard is no longer used in Sweden this is mostly of historical interest.

Females have significantly lower ten-year HR for revision (all types) than males, which is mainly explained by male's higher risk of infection, which is most common early postoperatively. As in previous years the risk decreases with increasing age. In this year's analysis the risk is lower with increasing surgical year, which may depend on the number of revisions where the polyethylene insert is replaced in connection with the treatment of verified or suspected infection, does not increase with the same rate as before.

As in previous years Link is the reference for UKR (table 6.5.2). In the case of UKR due to osteoarthritis there are two models, Oxford and Link, that account for 79 % of the operations. None of the UKR-models except Sigma-PKR have significantly different HR compared with the Link reference prosthesis. The risk of revision decreases with increasing age.

The risk of revision is only one of several measures of the outcome of the prosthesis models. The type of revision should also be considered, although it is not reported here. Consequently, a deliberate sparse use of patella component, with a readiness to secondarily resurface patella if necessary, increases the revision rate. We therefore report TKR/OA separately for those with and without patella component. The tables report models that appear both with and without patella. All other models (including revision models) are included as others.

Hazard ratio with 95 % confidence interval in revision UKR/OA

Model	Number	Revised	HR (95 % CI)	p
Link	1,387	83	(ref.)	
Sigma-PKR	311	8	0.48 (0.23; 1.00)	0.05
ZUK	1,062	49	0.75 (0.53; 1.07)	0.12
Oxford	7,877	349	0.90 (0.70; 1.14)	0.38
Triathlon Uni	823	44	1.08 (0.75; 1.57)	0.67
Persona-PK	250	14	1.76 (0.99; 3.13)	0.05
Other	82	11	1.89 (1.00; 3.54)	0.05
Surgical year			0.97 (0.94; 1.01)	0.16
Age			0.98 (0.97; 0.99)	< 0.01
Sex = Female			1.03 (0.87; 1.22)	0.7

Table 6.5.2. Hazard ratio for revision with 95 % confidence interval in UKR/OA 2013–2022. Units with significantly better or worse results than the national average are shown in green and red respectively.

We have divided TKR/OA in two groups: those used without patella component (table 6.5.3) and those with patella component (table 6.5.4). This reduces the number of implants that can be analysed, especially in the group where a patella component has been used. To be able to analyse comparable groups we have combined some groups compared to table 6.5.1.

In the analysis of TKR without patella component (table 6.5.1) it can be noted that the same models have significantly higher or lower HR than the reference model PFC-Sigma MPT as in the analysis of TKR with or without patella (6.5.1).

Hazard ratio with 95 % confidence interval in revision TKR/OA without patella component

Model	Number	Revised	HR (95 % CI)	p
PFC Sigma TKR MBT	21,651	625	(ref)	
PFC Sigma TKR APT	5,831	106	0.56 (0.46; 0.69)	< 0.01
Vanguard I-Beam Modular	2,302	69	0.76 (0.59; 0.98)	0.04
NexGen MBT	61,051	1,287	0.77 (0.70; 0.84)	< 0.01
Triathlon MBT cemented	9,527	218	0.88 (0.76; 1.03)	0.11
Other	12,984	342	1.01 (0.89; 1.16)	0.86
Triathlon MBT uncemented	6,148	200	1.20 (1.02; 1.40)	0.03
Legion/Genesis II Pri MBT	1,988	85	1.70 (1.36; 2.14)	< 0.01
Sex = Female			0.92 (0.85; 0.99)	0.02
Surgical year			0.98 (0.96; 0.99)	< 0.01
Age			0.98 (0.98; 0.98)	< 0.01

Table 6.5.3. Hazard ratio for revision with 95 % confidence interval in TKR/OA without patella component 2013–2022. Units with significantly better or worse results than the national average are shown in green and red respectively.

Hazard ratio with 95 % confidence interval in revision TKR/OA with patella component

Model	Number	Revised	HR (95 % CI)	p
PFC Sigma TKR MBT	957	24	(ref.)	
PFC Sigma TKR APT	354	8	0.83 (0.37; 1.87)	0.65
Triathlon MBT uncemented	277	4	0.88 (0.30; 2.62)	0.82
Attune MB TKR	103	1	0.95 (0.12; 7.29)	0.96
Other	479	14	1.16 (0.60; 2.25)	0.67
NexGen MBT	946	27	1.22 (0.70; 2.13)	0.47
Triathlon MBT cemented	225	7	1.54 (0.66; 3.58)	0.32
Legion/Genesis II Pri MBT	163	7	2.01 (0.86; 4.70)	0.1
Sex = Female			0.37 (0.25; 0.56)	< 0.01
Surgical year			0.98 (0.90; 1.07)	0.68
Age			0.98 (0.96; 1.00)	0.04

Table 6.5.4. Hazard ratio for revision with 95 % confidence interval in TKR/OA with patella component 2013–2022. Units with significantly better or worse results than the national average are shown in green and red respectively.

Since the use of patella component is unusual it becomes more difficult to show and even to interpret significant differences. None of the protheses have significantly better or worse results than the reference if a patella component has been used. Effects of sex, age and increasing surgical year are unchanged whether all TKRs are included or only those without patella component but when only those with patella component are included surgical year is no longer significant.

Just as before, we also present separate tables (6.5.5 and 6.5.6) where exchange of insert for infection is not defined to be a revision. It has been argued that in case of infection the register's definition may disfavour different implant types. The reason is that almost half of all revisions for infection are synovectomies where the plastic insert is exchanged (which makes them revisions).

Hazard ratio with 95 % confidence interval in revision TKR/OA.
Exchange of insert, in case of infection, is not considered to be revision.

Model	Number	Revised	HR (95 % CI)	p
PFC Sigma TKR MBT	22,608	479	(ref)	
NexGen APT	**194**	**1**	**0.16 (0.02; 1.17)**	**0.07**
Genesis II MBT	**2,589**	**28**	**0.56 (0.38; 0.82)**	**< 0.01**
NexGen Trabecular Metal	**2,151**	**47**	**0.72 (0.53; 0.97)**	**0.03**
PFC Sigma TKR APT	**6,185**	**113**	**0.75 (0.61; 0.92)**	**< 0.01**
NexGen MBT	**61,997**	**940**	**0.76 (0.68; 0.85)**	**< 0.01**
Vanguard I-Beam Modular	2,361	56	0.77 (0.59; 1.02)	0.07
Triathlon MBT cemented	**9,752**	**147**	**0.81 (0.67; 0.97)**	**0.02**
NexGen Revision	468	8	0.95 (0.47; 1.90)	0.87
Attune MB TKR	962	5	1.00 (0.41; 2.42)	1
Triathlon APT	138	3	1.15 (0.37; 3.57)	0.81
Other	588	17	1.15 (0.71; 1.86)	0.57
Vanguard Finned Stem Modular	1,928	65	1.19 (0.92; 1.55)	0.19
Persona	3,222	35	1.21 (0.85; 1.71)	0.29
Profix	116	4	1.23 (0.46; 3.29)	0.68
Triathlon MBT uncemented	**6,425**	**156**	**1.25 (1.05; 1.50)**	**0.01**
Link Endo Rotating hinge	103	3	1.45 (0.46; 4.50)	0.52
Triathlon Total Stabilizer	**722**	**19**	**1.63 (1.03; 2.58)**	**0.04**
Legion/Genesis II Pri MBT	**2,151**	**74**	**1.99 (1.55; 2.54)**	**< 0.01**
PFC Sigma TC-3 (revision)	**283**	**11**	**2.20 (1.21; 4.00)**	**< 0.01**
Nexgen Rotating hinge	**148**	**8**	**2.52 (1.25; 5.07)**	**< 0.01**
Journey TKR	**190**	**14**	**4.28 (2.51; 7.29)**	**< 0.01**
Age			**0.96 (0.96; 0.97)**	**< 0.01**
Surgical year			**0.97 (0.95; 0.99)**	**< 0.01**
Sex = Female			1.15 (1.06; 1.25)	< 0.01

Table 6.5.5. Hazard ratio for revision with 95% confidence interval in TKR/OA 2013–2022. Exchange of insert due to infection has not been classified as revision. Units with significantly better or worse results than the national average are shown in green and red respectively.

Hazard ratio with 95 % confidence interval in revision UKR/OA.
Exchange of insert, in case of infection, is not considered to be revision.

Model	Number	Revised	HR (95 % CI)	p
Link	1,387	83	(ref)	
Sigma-PKR	311	8	0.49 (0.24; 1.01)	0.05
ZUK	**1,062**	**45**	**0.69 (0.48; 0.99)**	**0.05**
Oxford	7,877	329	0.85 (0.67; 1.09)	0.2
Triathlon Uni	823	43	1.07 (0.74; 1.56)	0.71
Persona-PK	250	12	1.55 (0.84; 2.86)	0.16
Other	**82**	**11**	**1.88 (1.00; 3.54)**	**0.05**
Surgical year			0.96 (0.93; 1.00)	0.07
Age			**0.98 (0.97; 0.99)**	**< 0.01**
Sex = Female			1.07 (0.90; 1.27)	0.42

Table 6.5.6. Hazard ratio for revision with 95% confidence interval in UKR/OA 2013–2022. Exchange of insert due to infection has not been classified as revision. Units with significantly better or worse results than the national average are shown in green and red respectively.

A synovectomy in a knee where the insert cannot be exchanged is however not considered as a revision, which would benefit that type and therefore it has been argued that exchange of plastic insert should not be considered as a revision but as soft tissue procedure. On the other hand, it can be argued that implants where the insert cannot be exchanged should usually be treated with total revision (because a complete cleaning is not considered possible), which would lead to reverse bias if exchange of the insert was not considered as revision. Without being able to answer with certainty what is the most reasonable to do we have chosen to also present the risk when exchange of insert in case of infection is excluded. Note that such exclusion reduces the number of revisions, which in turn reduce the sensitivity of the statistical calculations.

For TKR/OA without considering patella resurfacing (table 6.5.5) it can be seen, compared with table 6.5.1, that it is the same prostheses that have an increased HR compared to the reference except for Triathlon MBT cemented that now has a significantly lower HR than the reference. Exchange of plastic insert is not possible for NexGen APT, PFC-Sigma APT and the monobloc-variant of NexGen TM and these can therefore not take advantage of that insert exchange are being excluded. Compared to the reference PFC MBT (with polyethylene that can be exchanged) these are still better than the reference.

Females have before exclusion of the exchange of insert in case of infection a lower risk of revision than males but higher risk after exclusion. This may indicate that their risk of revision is higher of other reasons than verified or suspected infection.

Sigma had a significantly lower HR when all revisions were included no longer has it, while ZUK has a lower HR when exchange of insert in case of infection was excluded in UKR/OA (table 6.5.6).

In summary, it can be noted that also in this year's report it does not seem to affects the overall results when exchange of insert in case of infection is not considered as true revision as it has in previous annual reports. HR certainly decreases slightly for the modular models and for those with non-modular tibial component HR increases slightly with this adjustment. One reason for this difference may be that a number of synovectomies without exchange of the plastic insert are successful in curing infections in the non-modular (if they had not been successful the revision would probably have been reported), but unfortunately, we cannot report this because synovectomies are reported inconsistently to the register. Another possible explanation is that the surgeons are more liberal about opening and debriding knees when the plastic insert can be exchanged, which may have led to that knees have been revised that may not have needed it.

6.6. Knee osteotomy

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Joint preserving surgery – knee osteotomy

Tibial osteotomy was introduced in Sweden in 1969 by professor Göran Bauer in Lund as a standard operation for unicompartmental knee osteoarthritis. After the introduction of the modern knee prosthesis in the mid 1970s these instead became relatively quickly the most common surgical treatment of knee osteoarthritis.

The number of osteotomies has since steadily decreased. In 1981, Björn Tjörnstrand estimated in his dissertation "Tibial osteotomy for medial gonarthrosis" that one third of the knee reconstructive surgery was consisted of tibial osteotomies while the Swedish Knee Arthroplasty Register more than ten years later (1994) indicated that osteotomies only accounted for 20 % of the knee reconstructive surgeries.

Of osteotomies performed around the knee joint, tibial osteotomy is by far the most common method. It is most often used for medial osteoarthritis while its use for lateral osteoarthritis is less common. Osteotomies of the femur are less common in Sweden and are mostly performed in more severe deformities, congenital or acquired, and in lateral osteoarthritis.

There are several different techniques in knee osteotomy and the initial fixation of the osteotomy is done in different ways depending on the method used. Closed wedge osteotomy is a "minus osteotomy" where a bone wedge, in size related to the determined degree of correction, is removed. The osteotomy can be fixated with a staple, a plate with screws, or with an external frame. Open wedge osteotomy is a "plus osteotomy" where a wedge is opened up to achieve the decided degree of correction. The fixation of the osteotomy can consist of an internal fixation, with plate and screws, with staples or with an external frame. An internal fixation includes a plate with screws or a staple and sometimes a bone graft or a bone substitute (artificial bone).

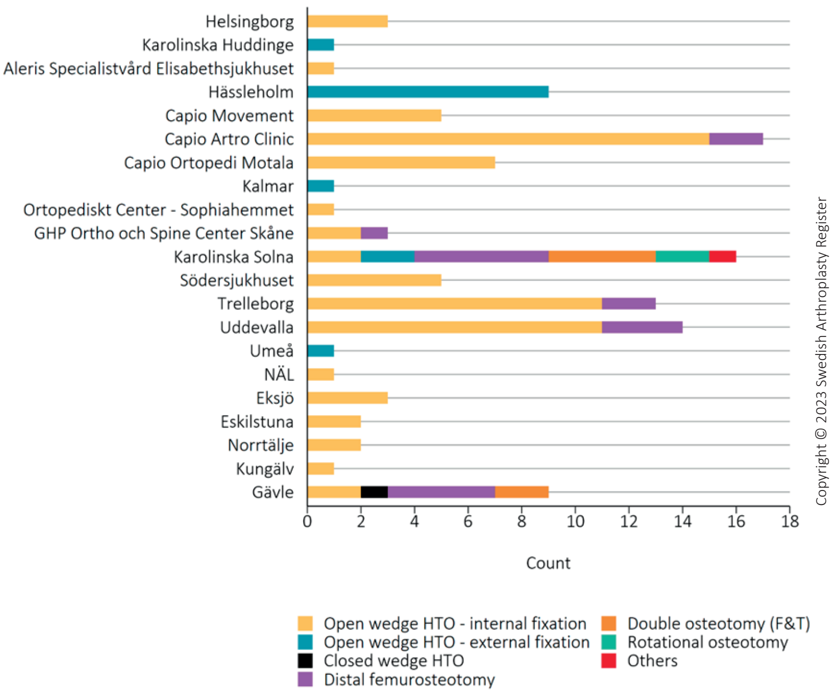


Figure 6.6.1. Number of knee osteotomies and methods per unit 2022.

In open wedge osteotomy with an external fixation it is possible to gradually open the osteotomy over a few weeks which is the biological procedure used for bone lengthening also known as hemicallostasis. Finally, there is also the curved, or "dome" osteotomy which is rare in Sweden. The results after knee osteotomy are related to the ability of achieve and maintain the predetermined correction of the malalignment, which requires achieving the predetermined degree of correction during surgery and to have a stable fixation of the correction until the bone is healed.

The different techniques have their pros and cons and there have been continuous developments of the procedures and the postoperative care with the aim of improving results. The choice of method and technique may have an effect on the short- and long-term risk for complications as well as influence a later knee replacement with respect to techniques used and outcome. The health economic perspective is also important for the health care providers, the society and not least the patients.

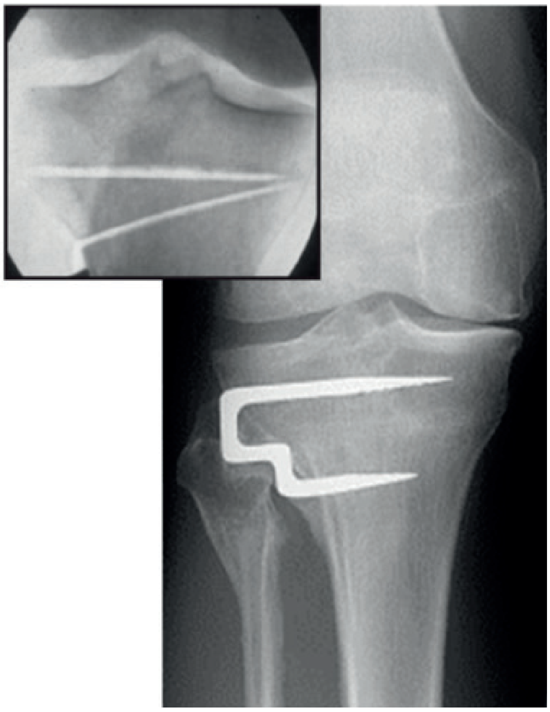


Figure 6.6.2. Closed wedge osteotomy fixed with a staple. The inserted picture above shows the wedge that is removed before the osteotomy is closed.

Figure 6.6.3. Open wedge osteotomy with internal fixation.

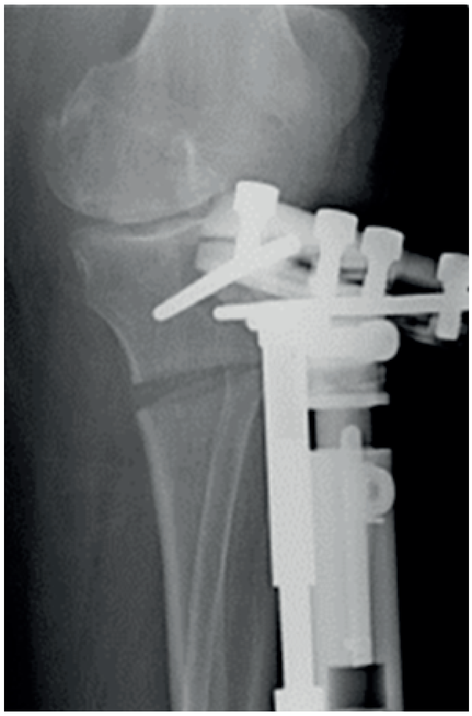


Figure 6.6.4. Open wedge osteotomy with external fixation.

Demography knee osteotomy

	All	Proximal Tibia	Distal Femur
Number	**102**	**85**	**13**
Age			
Median (range)	45 (17–65)	47 (17–65)	35 (17–58)
< 45 years, n, (%)	49 (48)	38	9
45–54 years, n, (%)	37 (36)	33	3
55–64 years, n, (%)	15 (15)	13	1
65–74 years, n, (%)	1 (1)	1	0
75–84 years, n, (%)	0	0	0
≥ 85 years, n, (%)	0	0	0
Sex			
Females, n, (%)	42 (41)	34	7
BMI			
Median (range)	28 (16–39)	29 (16–38)	28 (21–32)
< 18,5, n, (%)	1 (1)	1	0
18,5–24,9, n, (%)	22 (22)	18	2
25–29,9, n, (%)	46 (45)	36	9
30–34,9, n, (%)	25 (24)	23	2
35–40, n, (%)	7 (7)	6	0
> 40, n, (%)	0	0	0
Missing n, (%)	1 (1)	1	0
ASA-class			
I, n, (%)	53 (52)	42	8
II, n, (%)	44 (43)	39	4
III-V, n, (%)	3 (3)	2	1
Missing n, (%)	2 (2)	2	0
Diagnosis OA			
n	73	67	6
Ahlbäck 1, n	31	28	3
Ahlbäck 2, n	27	26	1
Ahlbäck 3-4, n	11	9	2
Missing n	4	4	0
Compartment			
n	102	84	13
Varus, n, (%)	79 (77)	74	2
Valgus, n, (%)	17 (17)	5	10
Missing n, (%)	6 (6)	5	1
Preop HKA-angle			
n	96	79	12
Median (range)	7 (0–25)	7 (0–25)	7 (3–15)

Table 6.6.1. Demography in knee osteotomies 2022.

Sweden was the first country in the world to start a national knee osteotomy registry as a complement to the knee replacement registration (W-Dahl et al. 2014). Australia started in autumn 2016 and New Zealand is planning to launch a comparable registration and, together with their joint replacement registers respectively have harmonised the report questionnaire after Sweden's to facilitate comparisons and collaboration in the future. The UK started its osteotomy registration in autumn 2014 and is funded by the industry and independent of the joint replacement register (Elson et al. 2015).

In total, 102 primary osteotomies were reported from 20 units in 2022. As shown in figure 6.6.1, there was only three units that reported that they had performed ten or more osteotomies in the year. The unit which reported the most was Capio Artro Clinic with 17 procedures. In 2022, 25–35 % more knee osteotomies have been reported than in the pandemic years 2020 and 2021 and 40 % fewer than in 2019.

It is difficult to know how many of the osteotomies performed in the country that are captured by the register. The surgical codes NGK59 and NFK59, which are used for osteotomies performed on the femur and tibia, also apply to osteotomies performed for other reasons than disease or damage in the knee. Data from the National Board of Health and Welfare in an earlier analysis showed that about 400 different diagnoses of which 148 were main diagnoses had been registered for the procedure code NGK59 in the National Patient Register (NPR). 65 % of the surgeries could be attributed to osteoarthritis and instability diagnoses. We extracted the number of NGK59s from the National Board of Health and Welfare's statistics for the years 2014–2021 and compared these with all primary osteotomies operated for osteoarthritis or instability in the knee osteotomy register in the corresponding years. Assuming that the osteotomy register mainly capture osteoarthritis and instability diagnoses we estimate that the completeness of the knee osteotomy register was 75–87 % in the period 2014–2021.

Results

The knee osteotomy register collects the corresponding variables as in knee replacement in the Swedish Arthroplasty Register concerning the patients (BMI, ASA, previous surgery), antibiotics, thrombosis prophylaxis and the surgical technique. In knee osteotomies, information is also collected on malalignment measured by the HKA-angle and grade of osteoarthritis according to the Ahlbäck classification. The result 2022 is presented without percentages as only 102 knee osteotomies were reported.

Surgery	Number
None	43
Fracture surgery	6
Meniscal surgery	18
Cruciate surgery	10
Arthroscopy	20
Other	2
Missing	3
Total	**102**

Table 6.6.2. Previous surgery in the index knee.

Demography

Almost two thirds of the patients were males and the median age was 45 years, which can be compared with the median age for TKR (71 years) and UKR (66 years) in 2022. More than half of the patients were reported to be healthy (ASA class I) and had a median BMI of 28. The majority of the patients were reported to have medial osteoarthritis, grade 1–2 according to the Ahlbäck's classification and median malalignment of 7 degrees varus or valgus. Patients operated on with a distal femoral osteotomy were younger, more of them were females compared to those operated on with a proximal tibial osteotomy but had a similar degree of preoperative malalignment.

Previous surgery

When reporting previous surgery in the index knee it is possible to mark more than one alternative. More than half of the patients were reported to have had some knee operation before the current osteotomy and one forth more than one. This can be compared with the corresponding numbers in knee replacement patients were less than 17 % were reported to have had previous surgery in the index knee and 3 % more than one. What is reported does not give any comprehensive description of the previous surgery that have been performed, but illustrates what was known at the time of the primary osteotomy.

Reason for and type of osteotomy

The majority of the surgeries were performed due to osteoarthritis. The most common method was open wedge osteotomy with internal fixation followed by distal femoral osteotomy. Only one closed wedge osteotomy was reported in 2022. Several different plates for fixation of the osteotomy have been reported. The Tomofix-plate is the most frequently reported in open wedge osteotomy with internal fixation. Six different types of plate fixation have been used in the osteotomies with this technique. In open wedge osteotomy with external fixation only use of Orthofix was reported in 2022. In more than half of open wedge osteotomies with internal fixation, no bone grafting was reported to have been used. When bone grafting was used, synthetic bone was reported as the most frequently, most often in the form of Innotere. In distal femur osteotomies different types of fixations were reported and Tomofix was the most common. At the same time as the knee osteotomy, it was reported that an additional procedure was performed in 28 out of the 102 operations. Arthroscopy was the most reported.

Other surgical variables

General anesthesia was the most reported type of anesthesia and was reported in less in two thirds of the cases. The median surgical time, where the osteotomies with a concomitant surgery were excluded, was shorter in open wedge osteotomies with external fixation (47 min, 27–99 min) than in internal fixation (61 min, 27–171). The median time in distal femoral osteotomy was 97 min (41–150 and in double osteotomy it was 158 min (130–180). Table 6.6.10 shows the median surgical times including those osteotomies performed with concomitant surgery. None of the osteotomies were reported to be performed with the help of navigation (CAS). The use of tourniquet has decreased among Swedish orthopedic surgeons but is reported slightly more frequently in knee osteotomies (two thirds) than in knee replacement (28%). To use drainage has become rarer. All osteotomies were reported to be performed without the use of drainage and corresponding numbers in knee replacements was < 0.5 %.

Diagnosis	Number
Osteoarthritis	74
Acquired deformity	8
Congenital deformity	7
Instability	7
Local cartilage injury	1
Osteonecrosis	0
Patella luxation	1
Other	4
Missing	0
Total	**102**

Table 6.6.3. Reason for surgery.

Type	Number
Open wedge internal fixation	71
Distal femur osteotomy	13
Open wedge external fixation	12
Double osteotomy	4
Closed wedge osteotomy	1
Rotation osteotomy	1
Missing	0
Total	**102**

Table 6.6.4. Type of osteotomy.

Type	Number
Tomofix	30
Puddo	19
Activmotion	10
PEEKPower	7
Arthrxex TOWOP	3
iBalance	1
Missing	1
Total	**71**

Table 6.6.5. Type of fixation in open wedge osteotomy with internal fixation.

Bone graft	Number
None	31
Synthetic bone	29
Auto graft	6
Bank bone	3
Missing	2
Total	**71**
Synthetic bone	
INNOTERE	11
BIOMANTLE	10
ChronOS	7
Missing	1
Total	**29**

Table 6.6.6. The use of bone graft in open wedge osteotomy with internal fixation.

Type	Number
Tomofix	7
Arthrex FOWOP	4
ActivMotion	2
Missing	0
Total	**13**

Table 6.6.7. Type of fixation in distal femur osteotomy.

Surgery	Number
None	73
Arthroscopi	20
Cruciate surgery	5
Other	3
Missing	1
Total	**102**

Table 6.6.8. Concomitant surgery with the knee osteotomy.

Type	Number
General	68
Spinal	30
Combination	2
Missing	2
Total	**102**

Table 6.6.9. Type of anesthesia.

Type of osteotomy	Minutes	Range
Open wedge internal	81	27–397
Open wedge external	46.5	27–99
Distal femur	111	41–179
Double osteotomy	169	130–188

Table 6.6.10. Surgical time including concomitant surgery.

Thrombosis prophylaxis and prophylactic antibiotics

Tinzaparin and Dalteparin were the most commonly reported antithrombotic drugs and NOAC or a combination of injection and NOAC was only reported in 15% of the surgeries. This could be compared with the knee replacements where 71% received NOAC or a combination of injection and NOAC as prophylaxis. Prophylaxis with Dalteparin, Tinzaparin and Enoxaparin started more often postoperatively. In five of the surgeries, it was reported that no thrombosis prophylaxis had been used (table 6.6.11). The duration of prophylaxis varied but in just under three fourths of the surgeries the prophylaxis was planned for 8–14 days (table 6.6.12).

Cloxacillin has been reported as infection prophylaxis in the majority of the knee osteotomies 2022. Clindamycin has been reported in only one of the surgeries (table 6.6.13). The corresponding numbers of Clindamycin in knee replacements 2022 was almost 5%. Since Clindamycin has been shown to have a higher risk of revision due to infection in knee replacement surgery (Robertsson et al. 2017) the PRISS-recommendations have been updated in April 2018 as well as in April 2023 (www.patientforsakringen.se). In almost half of the surgeries 2 g × 3 was planned to be used in the first day of surgery as prophylaxis while one third was planned as a single dose of 2 g (table 6.6.14). At the time of surgery, the concentration of antibiotics in the tissues should be sufficient to counteract any bacteria in the area. Since Cloxacillin has a short half-life, it is important that it is administered within the correct time-interval.

In the updated recommendations from the PRISS-project in April 2018 and April 2023 (www.patientforsakringen.se) the optimal time is 45–30 min before the start of surgery, a narrower range than previously has been recommended (45–15 min). In barely half of the osteotomies, the preoperative dose was reported to be given according to the PRISS-recommendations (table 6.6.15) and two thirds within the previously recommended range.

Prophylaxis – time point	Number
No prophylaxis	5
Dalteparin preop	2
Dalteparin postop	32
Tinzaparin postop	28
Enoxaparin postop	16
Apixaban postop	5
Rivaroxaban	1
Combination of inj and NOAC	9
Long-term treatment	1
Missing	3
Total	**102**

Table 6.6.11. Antithrombotic prophylaxis.

Days	Number
No prophylaxis	5
1–7	19
8–14	73
1–21	0
22–28	1
29–35	0
> 35	0
Long-term treatment	1
Missing	3
Total	**102**

Table 6.6.12. Antithrombotic prophylaxis – planned duration of treatment.

Drug	Number
Cloxacillin	99
Cindamycin	1
Missing	2
Total	**102**

Table 6.6.13. Prophylactic antibiotics – drug.

Dosage	Number
2g × 1	31
2g × 2	25
2g × 3	43
Missing	0
Total	**99**

Table 6.6.14. Dosage of Cloxacillin.

Minutes before surgery	Number
0–29	22
30–45	49
> 45	26
Missing	5
Total	**102**

Table 6.6.15. Prophylactic antibiotics – time of administration (number of minutes before surgery) (PRISS recommendation).

Tourniquet	Number
Yes	60
No	39
Missing	3
Total	**102**

Drainage	Number
Yes	0
No	98
Missing	4
Total	**102**

Table 6.6.16. The use of tourniquet and drainage.

Reoperation

Since the start of the knee osteotomy register in 2013 more than 90 reoperations have been reported. The most common reasons for reoperation have been pain/irritation from the plate, pseudoarthrosis/delayed healing and over or under correction.

Conversion to TKA

The cumulative revision rate (CRR) at nine years in open wedge osteotomies performed in 2013–2022 and followed until the 31st of December 2022 with internal and external fixation respectively was 23.2 (95 % CI 17.6–28.3) and 18.8 (95 % CI 12.6–24.6) respectively (figure 6.6.5).

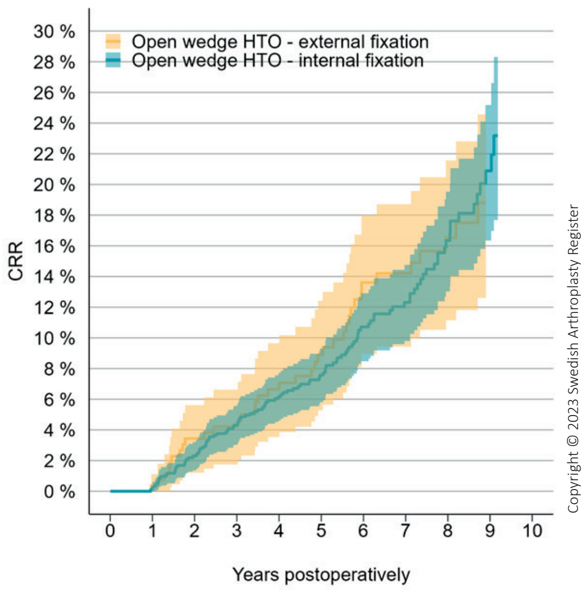
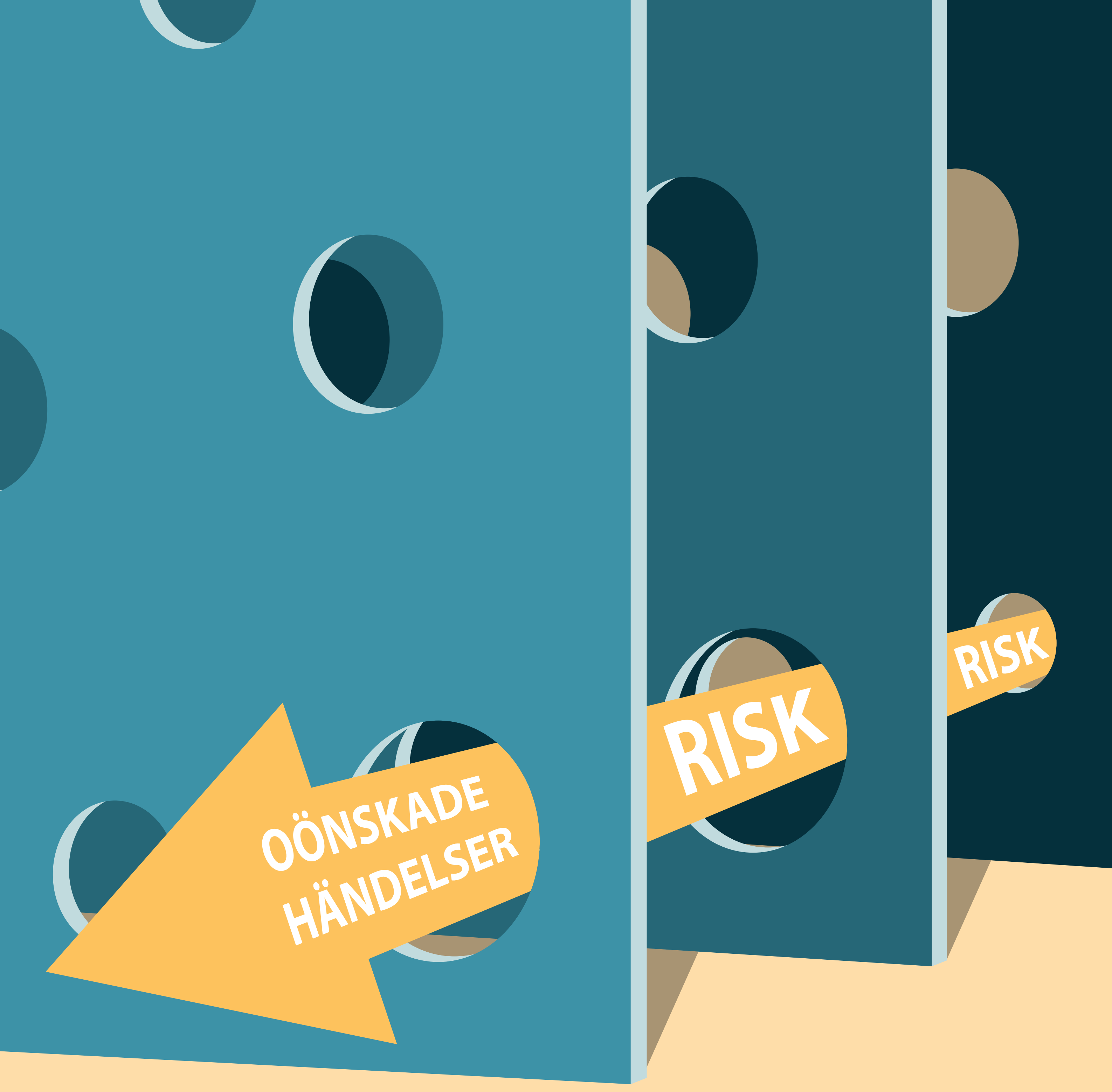


Figure 6.6.5. CRR for conversion to TKR after open wedge osteotomy.



An adverse event is any unfavorable event in a patient that occurs during or after treatment but is not necessarily causally related to that treatment.

7. Adverse events

Authors: Cecilia Rogmark, Annette W-Dahl and Ola Rolfson

7.1. Mortality within 90 days

90-day mortality may assess risks with different medical treatments and is an openly reported variable. This year we report regional level results in both primary hip and knee replacements as well as in hip fractures. The Swedish Arthroplasty Register's database is updated each night regarding the patients' possible date of death from the Swedish Tax Agency. The presentation includes the last three years (2020–2022) to compensate for the risk of a random variation.

A planned orthopaedic operation is usually performed when the health of the individual is optimised. Sometimes the surgical risks are so great that surgery is not recommended. This selection and optimisation of patients results in a low mortality; the 90-day mortality after primary elective total hip replacement is 2 ‰ (table 7.1.1). However, the mortality varies between regions. One region has no deaths within 90 days while another region has a mortality of 8.6 ‰. The mortality after knee replacements is even lower, 1.2 ‰ (table 7.1.1). After knee replacement the regional variations are not as great, 0 to 2.7 ‰. Gotland and Jämtland have a comparatively high mortality after hip replacement, while they are among the lowest in the country after knee replacement. However, these regions are small, and a single death has a greater impact on the total mortality. Kronoberg is above the national average in both hips and knees. Considering mortality after knee replacement the northern regions Norrbotten, Västerbotten and Västnorrland has a higher mortality than average.

Joint replacement surgery is associated with an increased risk for potentially life-threatening complications, such as infections and thromboembolic events. Patients need to be thoroughly informed about potential risks before the decision to undergo a planned surgery. Although the mortality appears to be low, there are room for improvement. In addition, if a newly operated patient develops complications and is treated elsewhere, that unit must report the case to the operating unit. If the orthopaedic surgeon is not aware of these very serious events, it is easy to believe that they do not occur.

The person who fractures the hip is in an acute condition and will have surgery, in most cases, regardless of comorbidity. The mortality within 90 days after hip fracture surgery is therefore high, at national level 13 %, and unchanged compared to earlier periods (table 7.1.2). Some regions have even higher rates, about 15 %. A high mortality can partly be explained by either a large proportion of very sick patients (Västernorrland, Kronoberg), a large proportion of male patients (Jämtland) or a combination of these risk factors (Västmanland). However, high mortality rates should prompt internal analysis.

90-days mortality after primary elective hip replacements and knee replacements

	Hip			Knee		
Region	**Number of operations**	**Number of deaths**	**Mortality ‰**	**Number of operations**	**Number of deaths**	**Mortality ‰**
Blekinge	708	1	1.4	598	0	0,0
Dalarna	992	1	1.0	905	1	1.1
Gotland	349	3	8.6	255	0	0.0
Gävleborg	1,403	4	2.9	1,289	2	1.6
Halland	2,286	7	3.1	2,302	3	1.3
Jämtland	449	3	6.7	235	0	0.0
Jönköping	2,133	1	0.5	2,021	1	0.5
Kalmar	1,565	0	0.0	1,28	1	0.8
Kronoberg	686	3	4.4	531	1	1.9
Norrbotten	1,317	3	2.3	1,094	3	2.7
Skåne	5,119	9	1.8	5,672	7	1.2
Stockholm	11,906	22	1.8	10,765	11	1.0
Sörmland	1,648	2	1.2	1,423	0	0.0
Uppsala	1,813	7	3.9	1,587	2	1.3
Värmland	1,224	2	1.6	1,168	1	0.9
Västerbotten	1,203	2	1.7	939	2	2.1
Västernorrland	1,32	1	0.8	802	2	2.5
Västmanland	828	2	2.4	533	1	1.9
Västra Götaland	6,966	17	2.4	5,785	9	1.6
Örebro	1,117	2	1.8	871	1	1.1
Östergötland	1,764	1	0.6	1,568	3	1.9
Country	**46,796**	**93**	**2.0**	**41,623**	**51**	**1.2**

Table 7.1.1. 90-day mortality after primary elective total hip and knee replacement per region 2020–2022.

90-days mortality after hip fracture

Region	Number of operations [1]	>80 years [2]	Males [3]	ASA III [4]	ASA IV [5]	Acute fracture [6]	Number of deaths	Mortality [7]
Stockholm	3,355	58.1	35.3	65.8	7.4	90.7	419	12.5
Uppsala	768	57.7	36.1	63.1	4.5	94.4	97	12.6
Sörmland	551	55.7	34.3	54.7	7.1	92.7	79	14.3
Östergötland	830	58.0	34.3	50.7	9.5	94.2	92	11.1
Jönköping	599	56.4	35.2	54.5	8.4	96.7	63	10.5
Kronoberg	419	59.4	37.9	57.9	9.7	95.2	67	16.0
Kalmar	528	53.0	35.8	50.6	4.1	94.5	44	8.3
Gotland	158	53.8	37.3	48.3	2.7	95.6	17	10.8
Blekinge	446	62.6	35.7	46.8	4.7	96.6	64	14.3
Skåne	2,681	57.2	36.9	55.7	5.0	93.8	331	12.3
Halland	760	60.4	37.6	44.1	8.0	95.5	99	13.0
Västra Götaland	3,394	58.8	35.7	54.1	6.3	96.3	499	14.7
Värmland	644	57.5	36.6	54.7	5.7	96.1	85	13.2
Örebro	647	53.2	34.2	58.9	8.8	92.7	93	14.4
Västmanland	570	55.4	39.8	62.9	7.3	97.2	87	15.3
Dalarna	658	57.4	38.6	53.4	8.3	95.7	73	11.1
Gävleborg	713	55.4	37.0	43.8	6.7	96.1	82	11.5
Västernorrland	595	55.8	35.3	56.4	12.6	97.3	89	15.0
Jämtland	290	51.0	43.1	54.5	11.3	92.8	43	14.8
Västerbotten	635	54.6	38.6	53.2	5.9	96.1	84	13.2
Norrbotten	698	59.0	41.0	55.3	9.3	94.3	85	12.2
Country	**19,939**	**57.4**	**36.4**	**56.1**	**7.0**	**94.4**	**2,592**	**13.0**

Table 7.1.2. 90-day mortality after hip fracture per region 2020–2022.

1) Number of primary surgeries in the current period
2) Number of surgeries in the age group >80 years.
3) Proportion of males in the current period.
4) Proportion with ASA class III.
5) Proportion with ASA class IV.
6) Proportion with acute fracture.
7) 90-day mortality (proportion who have died within 90 days after surgery).

7.2. Adverse events

Joint replacements are among the interventions that have the greatest cost benefits in healthcare. Although the surgery is considered safe and have few complications some patients experience health problems after surgery that could have arisen or become symptomatic as a result of the surgery.

Description of the analysis

The analysis is performed by linking the register data to the Patient Register of the National Board of Health and Welfare (PAR). We have examined the diagnostic and procedure codes that have been reported to the PAR during and after hip and knee replacement surgery and have identified codes that may represent adverse events during the hospital stay or during readmission within 90 days of surgery (see table 7.2.1).

The altered rules of the National Board of Health and Welfare regarding confidentiality affect the register's ability to present adverse events. It is no longer allowed to present the number of adverse events if they are three or fewer per unit. In order not to risk revealing information on individuals, the National Board of Health and Welfare delivers the number of adverse events as intervals of five events (min, max; 0–4, 5–9, 10–14, etc.), where the actual number of events is within the interval. All proportions are calculated based on the midpoint of the interval (for example, the numerator is set to 12 if the interval is 10–14). The lower bound of the confidence interval is calculated on the lowest possible number of events according to the number interval and the upper limit is calculated based on that the highest possible number. So the confidence interval includes both the uncertainty from the rounding and from the random variation. For the country and larger units, the interval will be roughly the same as before but generally it will be wider range and fewer significant differences.

In the comparison of units, data from five years has been used, 2018–2022. Units with fewer than 40 operations are not shown.

This year, the National Board of Health and Welfare has delivered adverse events after 30 and 90 days per unit in elective hip replacements and total knee replacements due to osteoarthritis respectively, hip replacements due to fracture and those having first-time revision of primary hip and knee replacements. The analyses include partly 2012–2022 and partly the most recent five-year period, 2018–2022.

If both hips/knees have been operated within 90 days only the latter is included and only one hip or knee if both have been operated the same day. The Swedish Arthroplasty Register sends data on all registered operations to the National Board of Health and Welfare which performs the match against the PAR and codes corresponding to the definition of adverse events, during or after the hospital stay, up to 90 days after the operation is sought.

The codes were divided into the following groups (table 7.2.1):

A) Surgical procedure codes that include reoperations of hip or knee replacement and other procedures that may represent a complication.

DA) Diagnosis codes that imply surgical complications.

DB) Diagnosis codes that cover hip/knee-related diseases that may have been used for complication after hip/knee replacement surgery.

DC) Diagnosis codes covering cardiovascular events that may be related to the surgery.

DM) Diagnosis codes considering other medical events not related to the surgery if they occur shortly afterwards.

Sources of error

The definition of an adverse events is based on diagnostic and procedure codes. There may be differences between units in the accuracy of the coding during hospital stay. Information on death after surgery is not depending on coding.

Inadequate registration in the PAR of surgical date can influence if an adverse event during the surgery is included or not. Some units performing hip and knee replacements do not report to the PAR and for those, adverse events occurring during the admission will not be included in the indicator. The PAR lacks certain information on laterality. Therefore, a complication in the other hip/knee than the current will be registered as an adverse event. However, we consider it unlikely that a complication or surgical procedure is registered in the opposite hip or knee within 90 days after hip or knee replacement surgery. That only adverse events that occur during the primary admission or during readmission are included is a weakness of the analysis. Outpatient care is not included. A patient with a closed reduction of a dislocation in an emergency unit and returns to home is not included. This also applies to, for example, venous thromboses, which usually do not lead to inpatient care. Furthermore, the coding routines differ between different units. In some cases, there may exist economic incentives to register many codes to increase the DRG-creep. The threshold for including certain complication codes differs between units.

The unit's result should be followed over time to stimulate local analysis. The panorama of adverse events must be better understood, thereby identifying areas of improvement. The aim of the quality indicator is not primarily to compare results between units. Finally, it is important to realize that many adverse events (especially the medical ones) do not have to have a causally related to the surgery. This implies that local differences in general health (case-mix), the access to healthcare and preventive medicine partly may influence the outcome.

Results

Regarding both hip and knee replacement surgery, elective primary procedures are distinguished. In knee surgery, total replacements due to osteoarthritis are reported. In hip surgery, elective total hip replacements (includes all diagnoses other than hip fracture and tumour) and first-time revisions are reported (figures 7.2.1 and 7.2.2). The results for patients with hip fractures treated with hip replacement are reported separately, as they differ from those having an elective procedure due to osteoarthritis. Those with fracture are older, sicker and often in need of immediate surgery. However, the fracture group also include those who are re-operated with a hip replacement after failed internal fixation. "Fracture cases" means for some elective units only such planned salvage procedures, which may explain a lower incidence of adverse events compared to units doing emergency surgery only. The fracture group has in general the highest incidence of adverse events, about one third are affected in the first 90 days.

The incidence of adverse events is fairly the same after both primary elective hip and knee replacement surgery. After revision of a primary hip replacement, the incidence is 10 percent higher than after revision of a primary knee replacement. We have not analysed the reasons for this, but one possible explanation may be that a number of fracture patients also need revision surgery and then bring their increased risk into the group. It is gratifying that the incidence of adverse events is decreasing in both primary hip and knee replacement 2012–2022. Unfortunately, the incidence is increasing after hip revision (figures 7.2.1 and 7.2.2). Surgical adverse events, decreased somewhat after all procedures/diagnoses (figures 7.2.3 and 7.2.4). The results of each unit must be seen in the light of its case-mix.

Therefore, the proportion of adverse events per unit is presented for both hip replacement and for the "standard patient" (standardised case-mix) (figures 7.2.5 and 7.2.6), and for the fracture patients (figure 7.2.7). The proportion of adverse events after total knee replacement due to osteoarthritis shows relatively large variations between the units (figure 7.2.9). Regarding the proportion of adverse events after hip and knee revision possibly case-mix and varying degrees of complicated revisions explain some of the varying outcome (figures 7.2.8 and 7.2.10). Units with a deviating result here should perform local improvement work.

Codes for adverse events

			HIP ICD-10 and NOMESCO codes		KNEE ICD-10 and NOMESCO codes
Unit	**Used for primary surgeries**	**Used for reoperations and revisions**	**Additional codes for fractures**		
Surgical					
A NOMESCO codes Complications and suspected complications	If the procedure occur after the operation date OR during an admission after the operation	If the proucedure occur during an admission after the operation	Exact code NFA02, NFA11, NFA12, NFA20, NFA21, NFA22, NFQ09, NFU09, NFU19, NFU39, NFU89, NFU99, QDA10, QDB00, QDB05, QDB99, QDE35, QDG30, TNF05, TNF10 Start with NFC.., NFF.., NFG.., NFH.., NFJ.., NFK.., NFL.., NFM.., NFS.., NFT.., NFW..		Exact code NFQ09, NFQ19, NFQ99, NGB59* NGF01, NGF02, NGF10, NGF11, NGF12, NGF91, NGF92, NGK09, NGK19, NGM09, NGQ09, NGT09, NGT19, QDA10, QDE35, TNG05, TNG10 Start with NGA.., NGC.., NGE.., NGG.., NGH.., NGJ.., NGL.., NGS.., NGU.., NGW.., QDB.., QDG..
	If the procedure occur during an admission after the operation	If the procedure occur during an admission after the operation	NFU49		NGB59
DA ICD-10 codes Surgical complications	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	If they occur as main diagnosis at re-admission	G978, G979, M966F, M968, M969, T810, T812, T813, T814, T815, T816, T817, T818, T818W, T819, T840, T840F, T843, T843F, T844, T844F, T845, T845F, T847, T847F, T848, T848F, T849, T888, T889		G978, G979, M966G, M968, M969, T810, T812, T813, T814, T815, T816, T817, T818, T818W, T819, T840, T840G,T843, T843G, T844, T844G, T845, T845G, T847, T847G, T848, T848G, T849, T888, T889
DB ICD-10 codes for hip/knee related conditions	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	If they occur as main diagnosis at re-admission	G570, G571, G572, M000, M000F, M002F, M008F, M009F, M243, M244, M244F, S730. Start with S74.., S75.., S76..		G573, G574, M000, M000G, M002G, M008G, M009G, M220, M221, M236, M244G, M621G, M662G, M663G, M843G, S342, S800, S810, S830, S831, S834L, S834M, S835R, S835S, S835X, S840, S841
	If they occur as main diagnosis at re-admission	If they occur as main diagnosis at re-admission	M240F, M245F, M246F, M610F, M621F, M662F, M663F, M843F, M860F, M861F, M866, M866F, M895E		M235, M240, M245, M246, M256, M659G, M860G, M861G, M866, M866G, M895G

The table continues on the next page.

			HIP ICD-10 and NOMESCO codes		KNEE ICD-10 and NOMESCO codes
Unit	**Used for primary surgeries**	**Used for reoperations and revisions**		**Additional codes for fractures**	
Cardiovascular					
DC ICD-10 codes for serious cardiovascular conditions	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	Exact code I260, I269, I460, I461, I469, I490, I649, I770, I771, I772, I819, I978, I979, J809, J819, T811 Start with I21.., I24.., I60.., I61.., I62.., I63.., I65.., I66.., I72.., I74.., I82..		Exact code I260, I269, I460, I461, I469, I490, I649, I770, I771, I772, I819, I978, I979, J809, J819,T811 Start with I21.., I24.., I60.., I61.., I62.., I63.., I65.., I66.., I72.., I74.., I82..
Medical					
DM ICD-10 codes for other medical conditions	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	If they occur as main or co-diagnosis at the time for surgery or as main code at re-admission	Exact code J952, J953, J955, J958, J959, J981, N990, N998, N999, R339 Start with I80.., J13.., J14.., J15.., J16.., J17.., J18.., J96.., K25.., K26.., L89.., N17..	N300, N308, N309, N390	Exact code J952, J953, J955, J958, J959, J981, N990, N998, N999, R339, Start with I80.., J13.., J14.., J15.., J16.., J17.., J18.., K25.., K26.., K27.., L89..,N17..
	If they occur as main diagnosis at re-admission	If they occur as main diagnosis at re-admission	Exact code K590, N991 Start with J20.., J21.., J22.., K29..		Exact code K590, N991 Start with J20.., J21.., J22.., K29..

Table 7.2.1. Codes for adverse events.

** Only for readmission.*

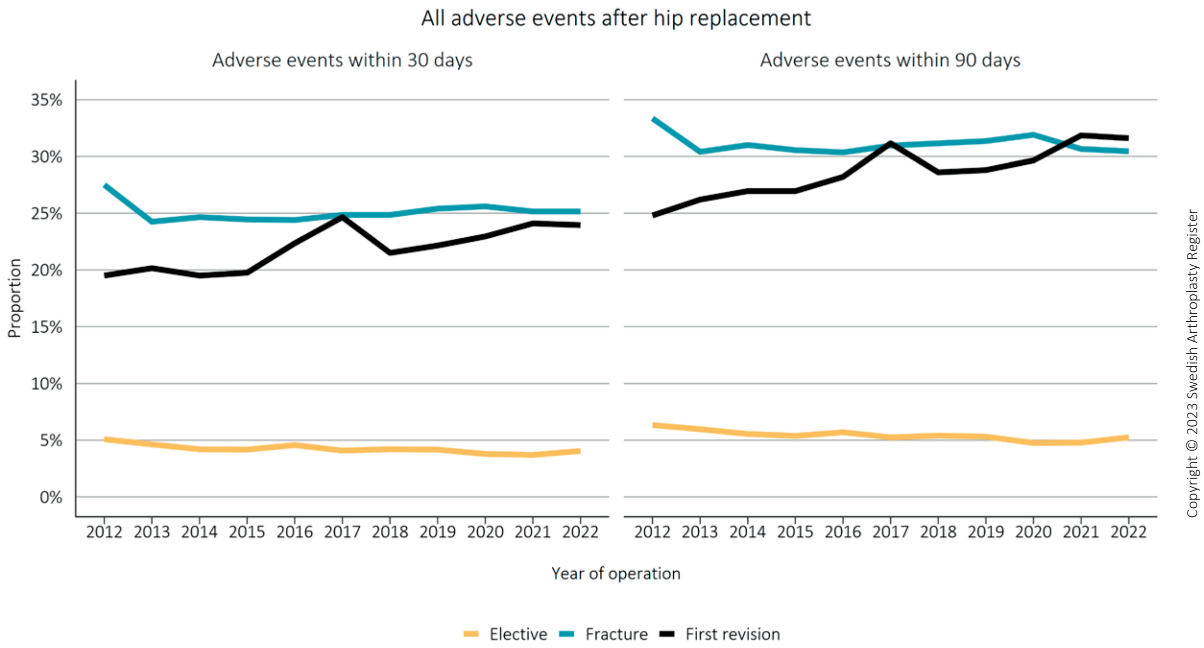


Figure 7.2.1. Adverse events within 30 and 90 days after primary hip replacement and hip revision 2012–2022.

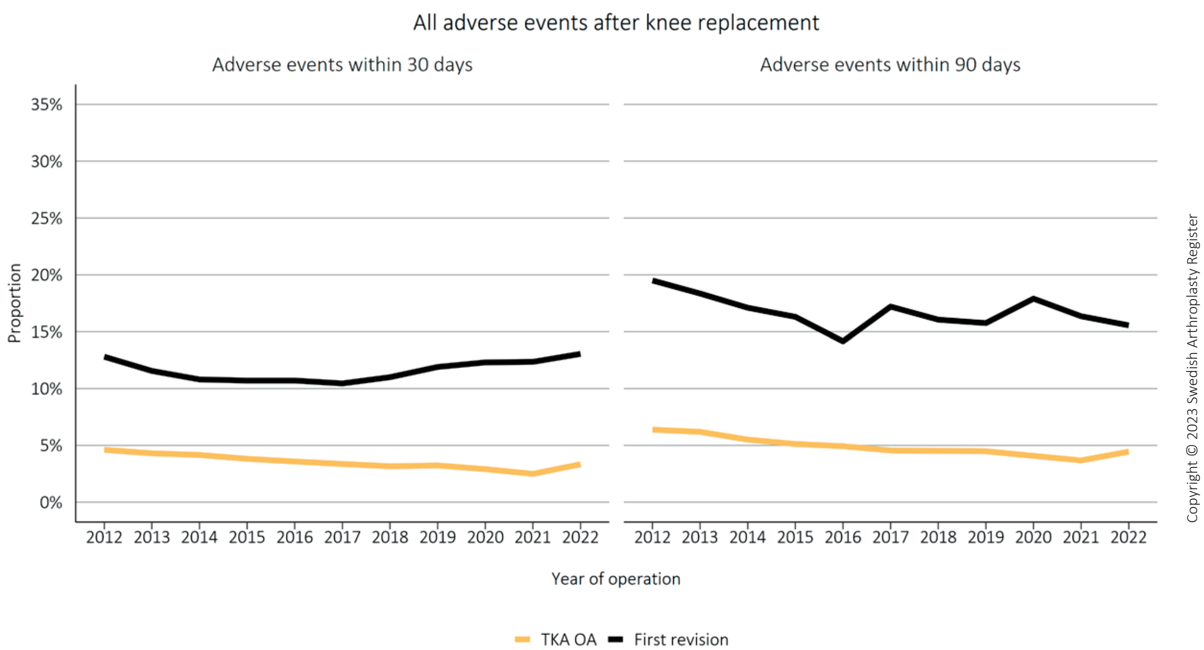


Figure 7.2.2. Adverse events within 30 and 90 days after primary total knee replacement and knee revision 2012–2022.

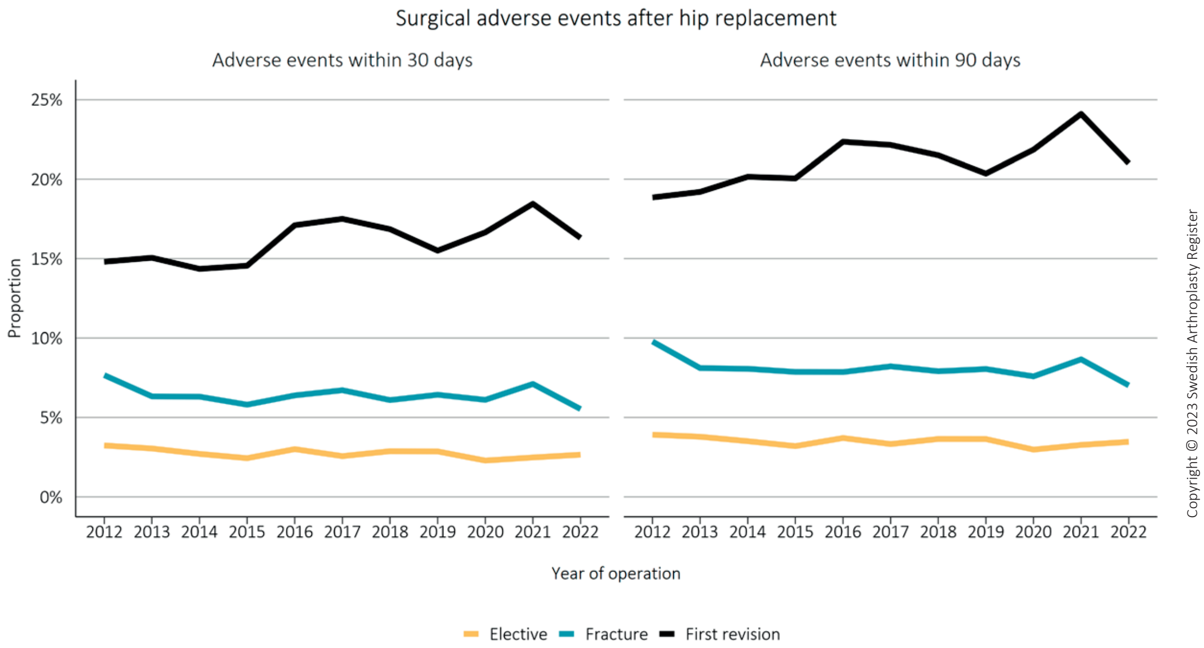


Figure 7.2.3. Adverse surgical events within 30 and 90 days after primary hip replacement and hip revision 2012–2022.

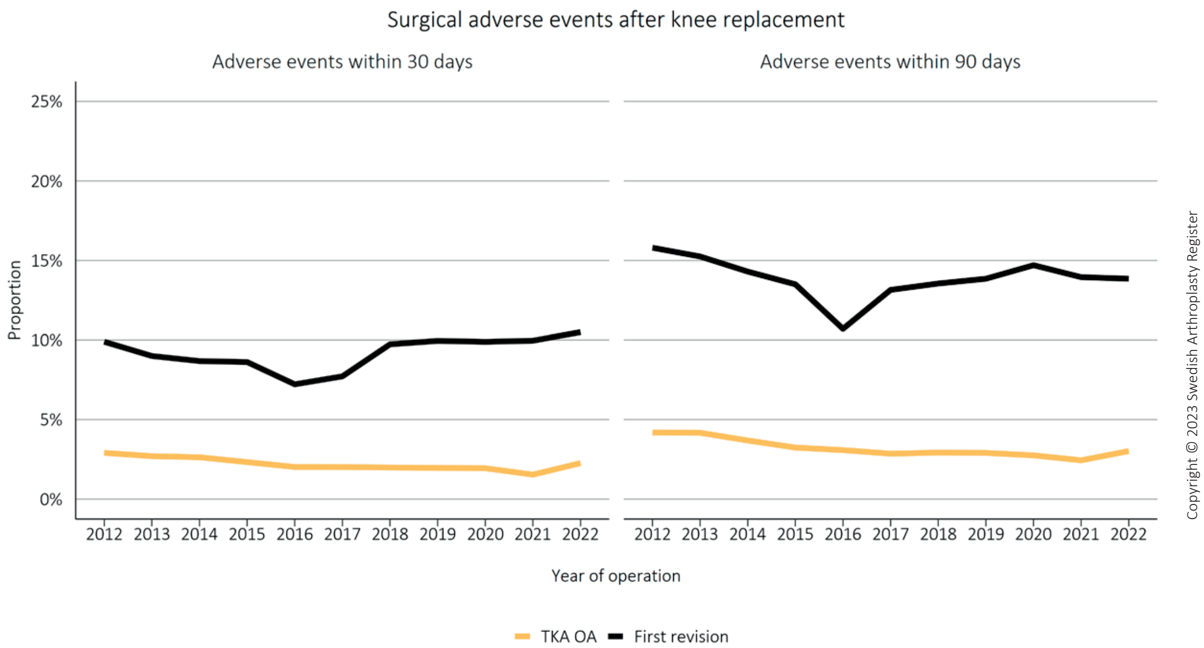


Figure 7.2.4. Adverse surgical events within 30 and 90 days in primary total knee replacement and knee revision 2012–2022.

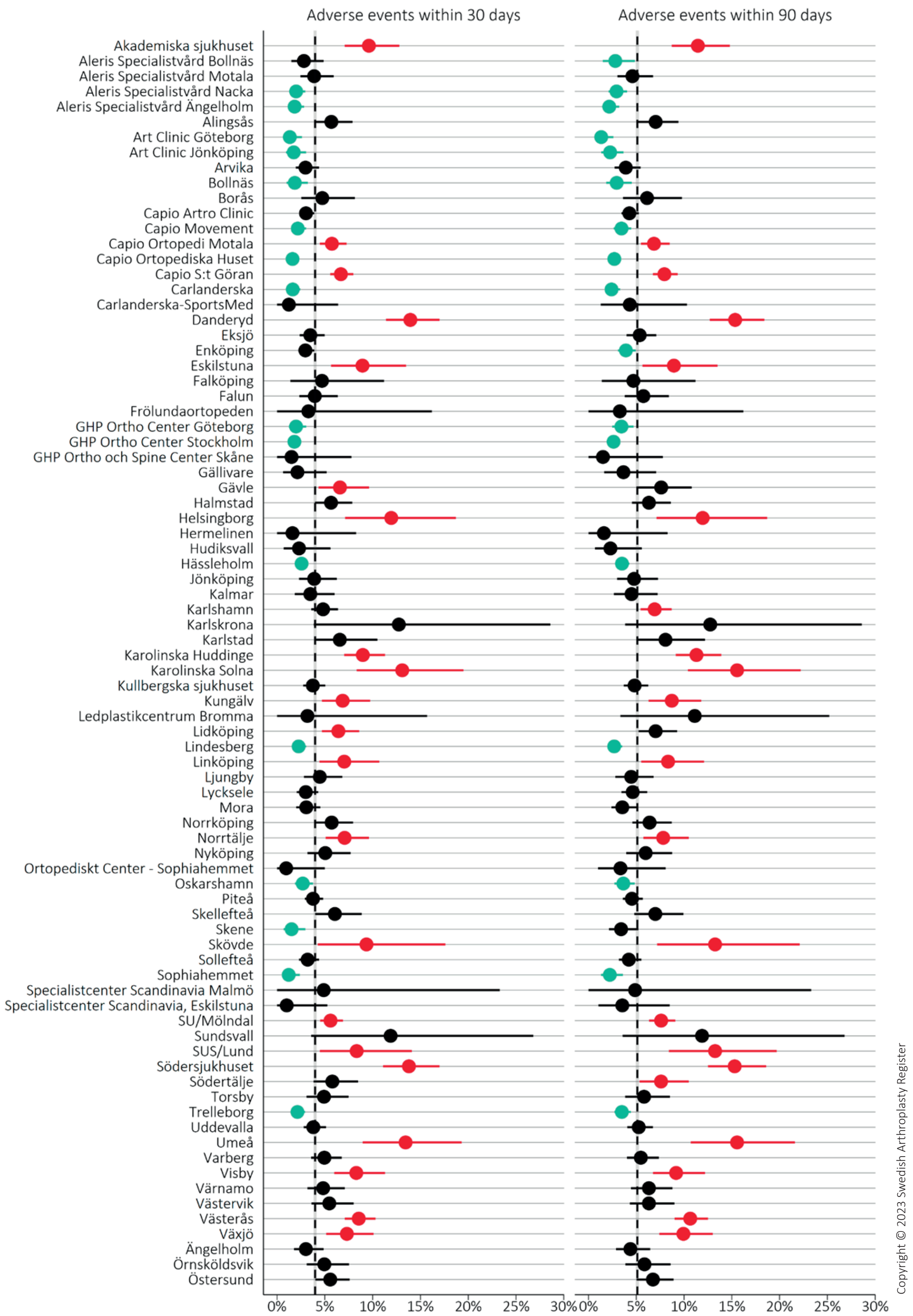


Figure 7.2.5. Adverse events per unit 2018–2022, elective hip replacement.

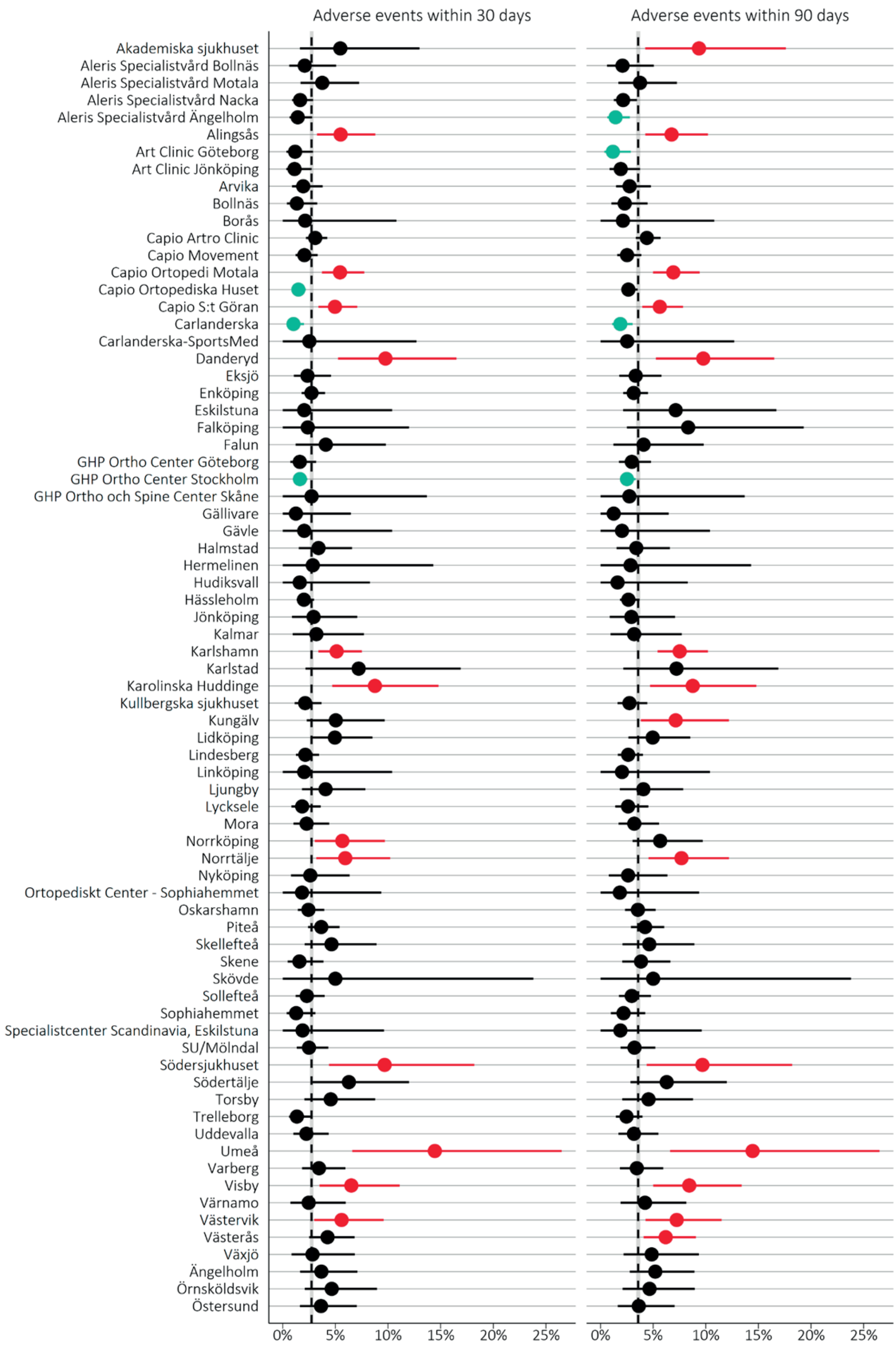


Figure 7.2.6. Adverse events per unit 2018–2022, "standard patient".

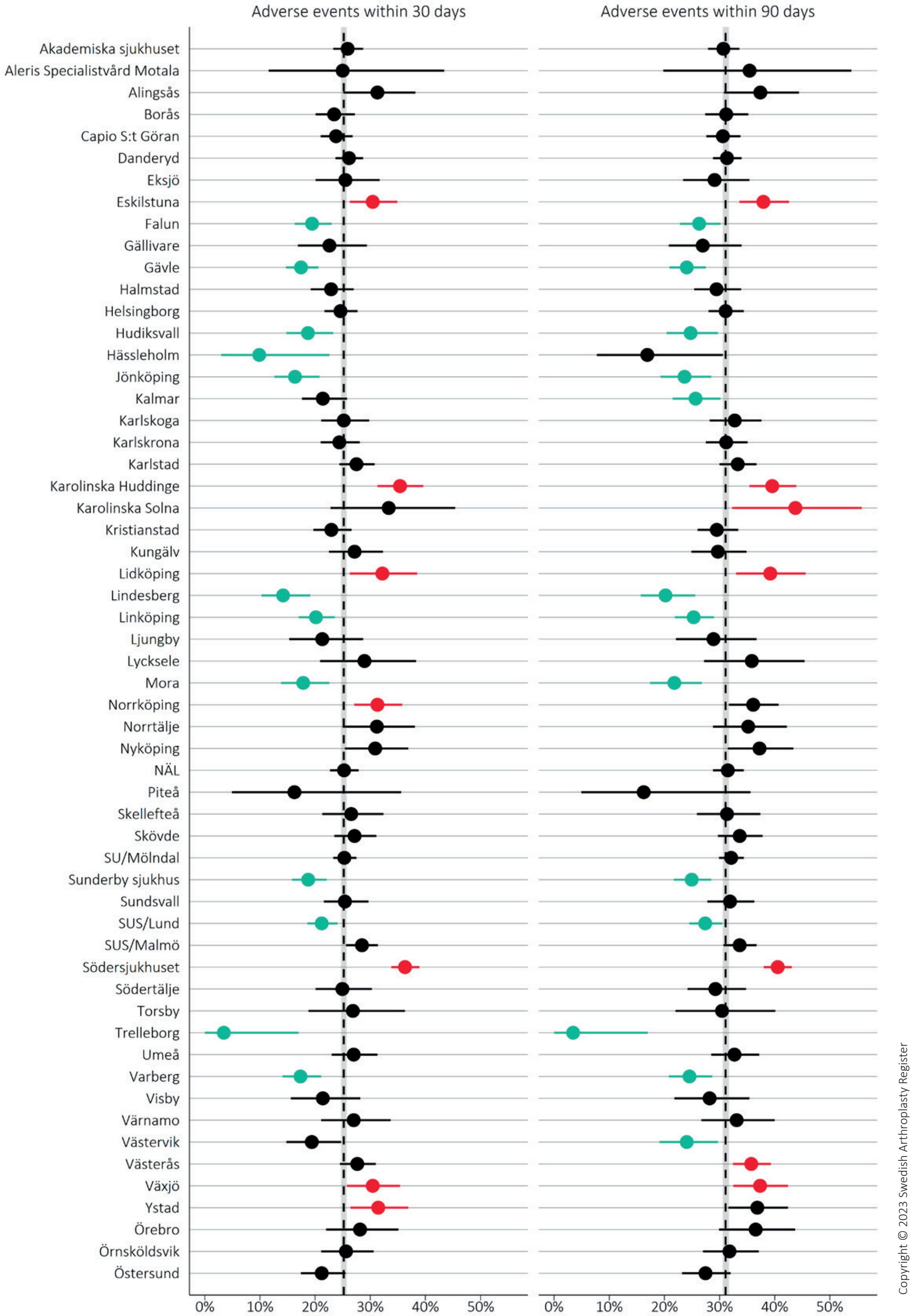


Figure 7.2.7. Adverse events per unit 2018–2022, hip replacement due to fracture.

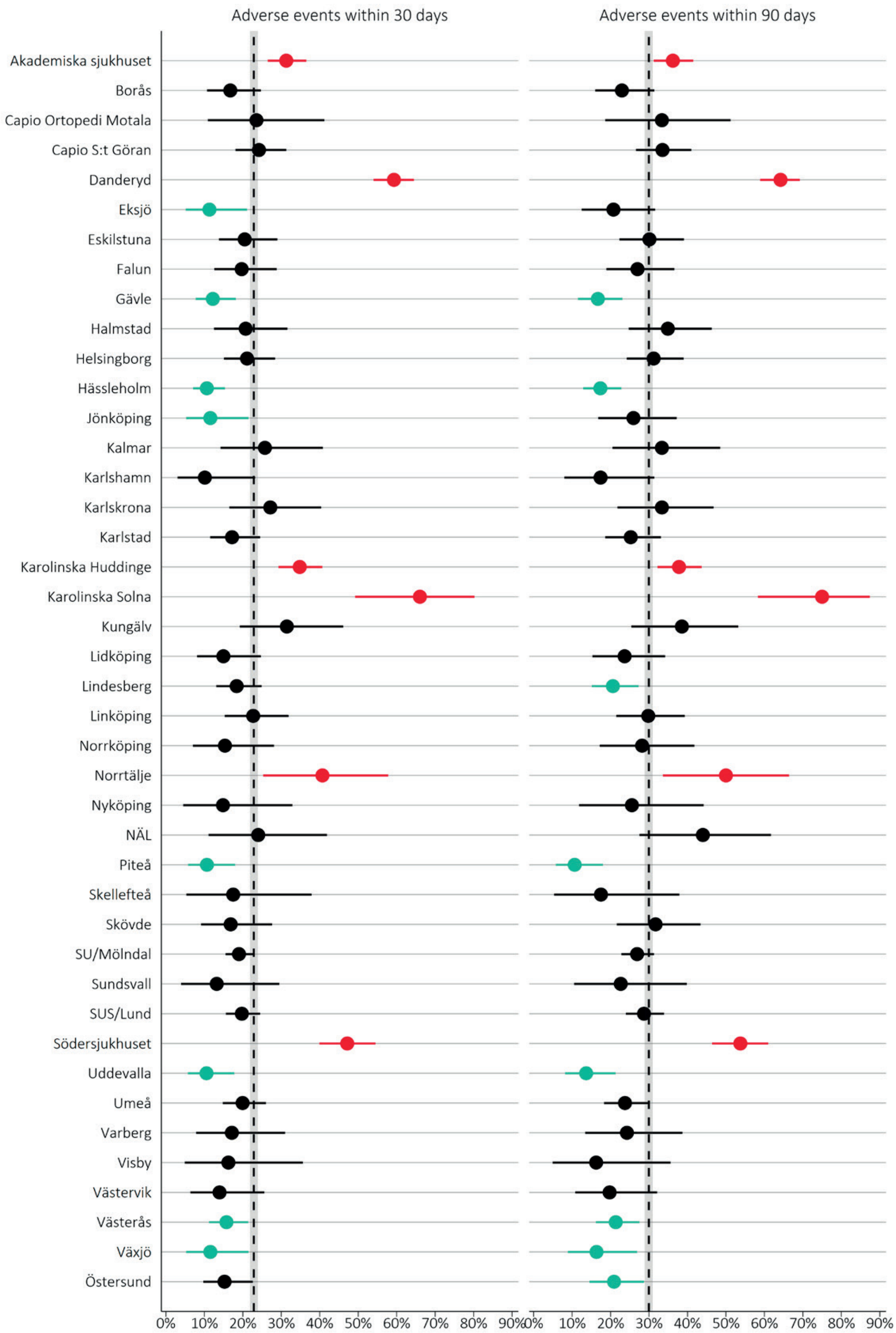


Figure 7.2.8. Adverse events per unit 2018–2022, first hip revision.

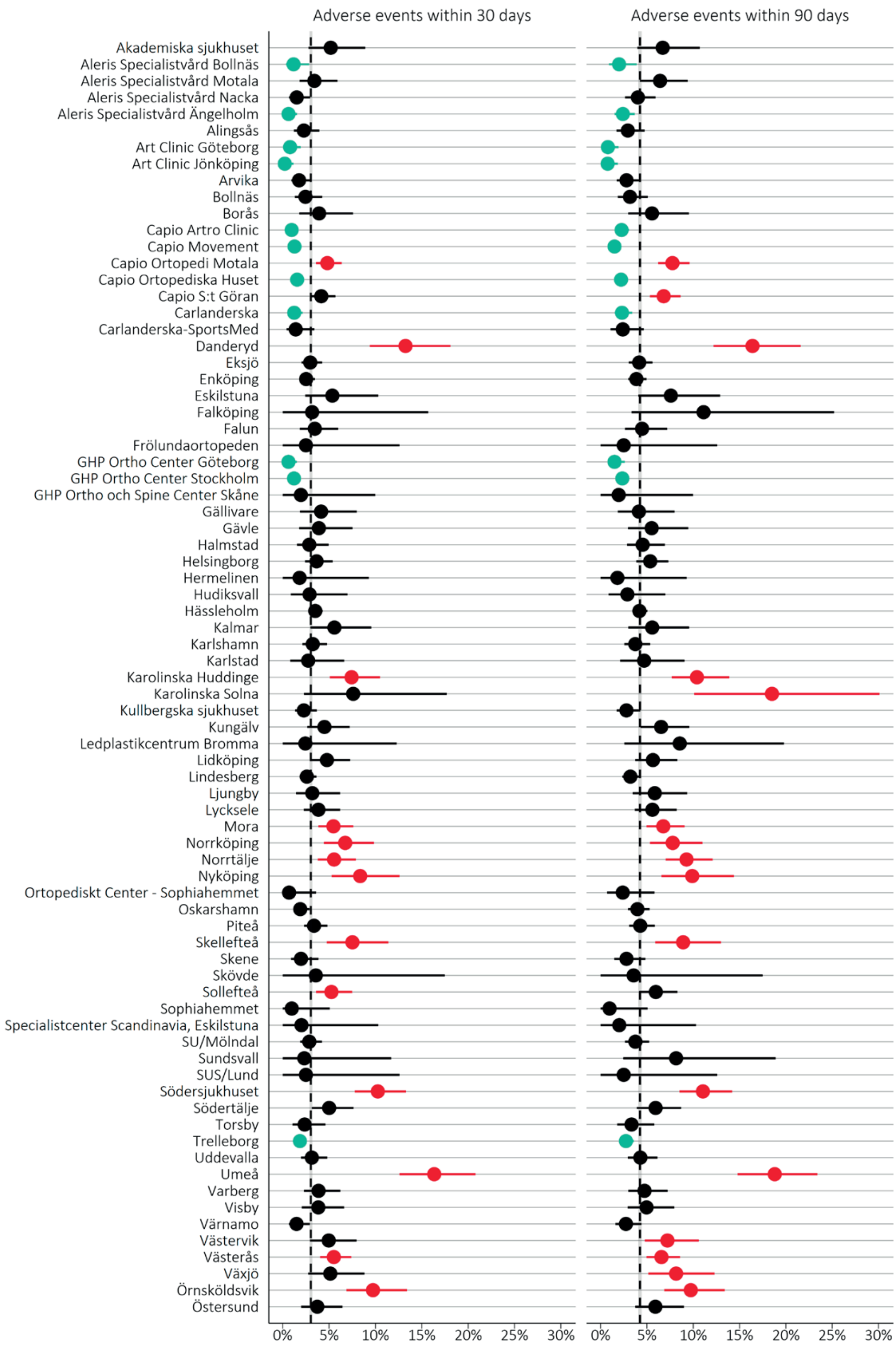


Figure 7.2.9. Adverse events per unit 2018–2022, total knee replacement due to OA.

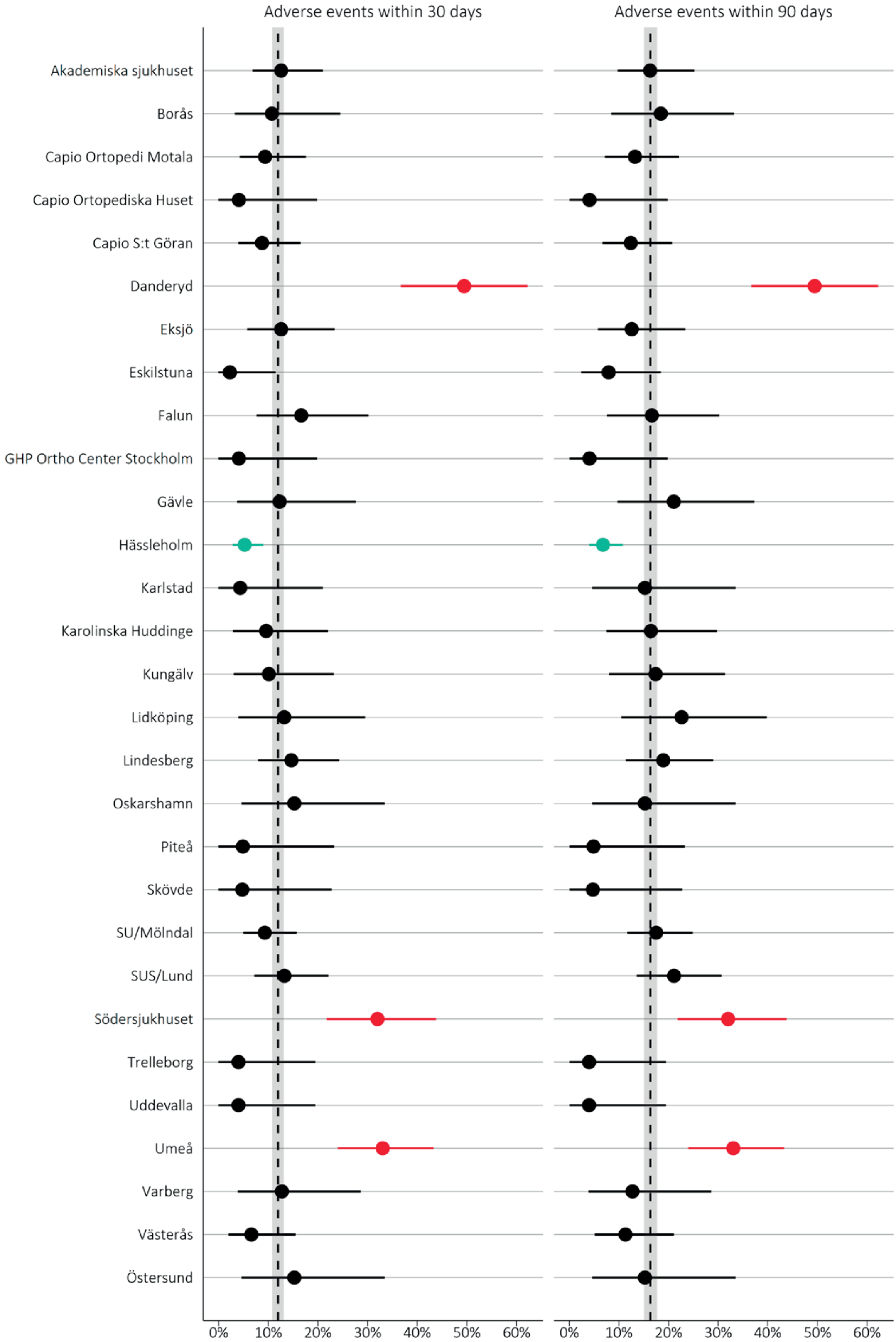


Figure 7.2.10. Adverse events per unit 2018–2022, first knee revision.

Joint replacement surgery aims to reduce pain, improve daily function, and enhance health-related quality of life.

8. Patient-reported outcome measures

Authors: Annette W-Dahl and Ola Rolfson

Patient-reported outcome measures (PROMs), are tools used to measuring the patient's own experience of health and health-related aspects. The tools or instruments that are used to measure patient-reported outcomes consist of standardised questionnaires that are answered by patients without interference of or the interpretation by anyone else. The main goal with most of the hip and knee replacements is to decrease pain and improve the function, thereby improving the individual's health-related quality of life.

Development of PROMs collection in hip and knee replacements

The PROM-routine in hip replacements started in 2002 as a pilot-project in Norrland and in region Västra Götaland. Gradually more units joined and since 2008 all units participate in the follow-up routine. For knee replacement surgery the PROM collection started in 2008 as a pilot-project with data from Trelleborg. The rest of region Skåne was included in the coming years. Units that wanted to participate in the project were invited to participate and at the turn 2012/2013, Norrköping, Motala and Oskarshamn joined. Gradually, more units have joined and in 2021, PROMs were registered in more than 50 % of all primary surgeries. The units have been able to choose if they want to collect all the PROMs that are included in the project or parts of it. When the merging of the hip and knee arthroplasty registries into the Swedish Arthroplasty Register took place, we harmonised our PROMs, and the collection of PROMs for knee replacements now covers all units, just as for the hip replacements.

Outcome measures

All patients scheduled for elective total hip or knee replacement surgery are asked before the surgery to answer a questionnaire including 25 questions (previously 12 questions) for hip and 24 questions for knee (previously 60 questions) preoperatively and postoperatively one additional question on satisfaction with the result of the surgery on a five-point Likert scale. The questionnaire includes questions on comorbidity and walking ability in order to decide Charnley category, questions on hip pain (left and right hip) and knee pain respectively (current knee) on a five-point Likert scale and the EQ-5D-instrument that measures general health status. In 2017 the new version of the EQ-5D-instrument (EQ-5D-5L) started to be used instead of the previous EQ-5D-3L in elective total hip replacement and with the merger of the registries we started to use it in knee replacement as well.

EQ-5D-5L consists of two parts; the first part includes five general questions with five response alternatives each which gives a health profile which can be translated to an index. The second part of the EQ-5D questionnaire include a thermometer, EQ VAS (analogue visual scale), where the patient marks the current health status on a scale from 0–100. We present the EQ-5D-index calculated with the Swedish value-set, that is the algorithm that is used to calculate the index. There is one that computes values to VAS-units (from the worst possible to the best possible health 0–100) and one that can be translated to the scale dead to full health that range from 0–1.

The question on smoking that has existed for hips since 2013 has now been added for knees since 1st of September 2021. New from the merger in 2021 is also two questions regarding how much time that is devoted to physical training and everyday exercise, respectively, each week, as recommended by the National Board of Health and Welfare. As part of the harmonisation of PROMs, the full-scale KOOS (Knee injury and Osteoarthritis Outcome Score) including 42 questions has been replaced by KOOS-12 and the hip specific questionnaire HOOS-12 (Hip dysfunction and Osteoarthritis Outcome Score 12) has been used since the 1st of September 2021 in elective total hip replacements. Both KOOS-12 and HOOS-12 includes three subscales; pain, function in daily life (ADL) and quality of life (QoL). In KOOS-12 and HOOS-12 a total score can also be calculated by using the mean value of the three subscales.

"Responder" is one way of evaluating the proportion of hip and knee replacement patients that have improved preoperatively to one year postoperatively instead of using for example a PROM mean value that hide both bad and good results. The Osteoarthritis Research Society International (OARSI) has, through its Outcome Measures in Arthritis Clinical Trials working group (OMERACT-OARSI), established criteria for defining responders. These criteria, utilized in past annual reports for knee replacement patients, are founded on the WOMAC assessment. Since we have moved to KOOS-12 from the full-scale KOOS it is no longer possible to convert to WOMAC. However, the criteria for OMERACT-OARSI-responders can also be used for KOOS/HOOS-12 by using a combination of absolute and relative changes in KOOS/HOOS-12 pain, ADL and total score one year after the hip or knee replacement surgery. A "high responder" is a patient who has improved 50 % or more and have an absolute improvement of 20 points or more in KOOS/HOOS-12 pain or ADL. If these criteria are not met, the patient can still be classified as a "low responder" if the improvement is 20 % or more and the absolute change 10 points or more in two of KOOS/HOOS-12 pain, ADL or total score. We classify each patient according to these criteria one year after the surgery as responders (high or low) or "non-responders". The proportion of responders is presented as a percentage.

Until the merger of the registries, there was a question in the hip questionnaire if the patient had met a physiotherapist and/or participated in education and training regarding osteoarthritis. The question has now been removed from the questionnaire. Instead, we link the Swedish Arthroplasty Register with the Swedish Osteoarthritis Registry (previously the BOA-register) to find out what proportion of the hip and knee replacements that have a registration in the Swedish Osteoarthritis Registry.

Collection methods

The methods of collecting PROMs differ somewhat in hip and knee replacement surgery. While the knee replacements are followed per surgery (both right and left) i.e. all primary surgeries and reoperations are followed-up after one year, the latest performed hip surgery is followed-up after one, six and ten years, including reoperations. There are two different follow-up questionnaires for knee; one for a unilateral knee replacement and one for patients that have both knees operated at the same time. Also, for hip there are two different follow-up questionnaires; one for those having a prosthesis in only one hip (unilateral) and one for those having prostheses in both hips (bilateral). The follow-up routine is managed by the contact secretaries that send out questionnaires, enter the answers in the PROM-database and send a reminder if there is no answer after about two months. For those patients that have provided an e-mail address preoperatively receive the follow-up questionnaires by e-mail. The possibility to receive the follow-up questionnaire by e-mail cease by 24th of May 2023 and will be replaced by a message from 1177 that there is a follow-up questionnaire to fill-in with a link to svara.registercentrum.se.

Patients who have not activated their 1177 will also in the future receive a paper questionnaire and those who do not answered receives a reminder with a paper questionnaire. The new routine will relieve the units by eliminating them from enter the answers from the questionnaires. It is also possible for the units to collect PROMs digitally preoperatively. However, the units will not be able to download these digitally collected pre- and postoperative results on patient level as has previously been possible but can be accessed by requesting a data extract for the unit's PROM response. The display of statistics is not affected by the new routine.

Considering that EQ-5D-5L being collected in knee replacements from September 1st 2021, the EQ-5D will be presented in knee replacement surgery performed from September 1st 2021 to December 31st 2021 in this year's report. Knee pain that previously been reported by VAS and satisfaction with the surgical outcome which has also been measured by VAS but categorized into a 5-point scale from very satisfied to very dissatisfied is reported as a 5-point Likert-scale. The VAS results from previous years have been converted to a Likert scale on the equivalent as previously done in hip replacements.

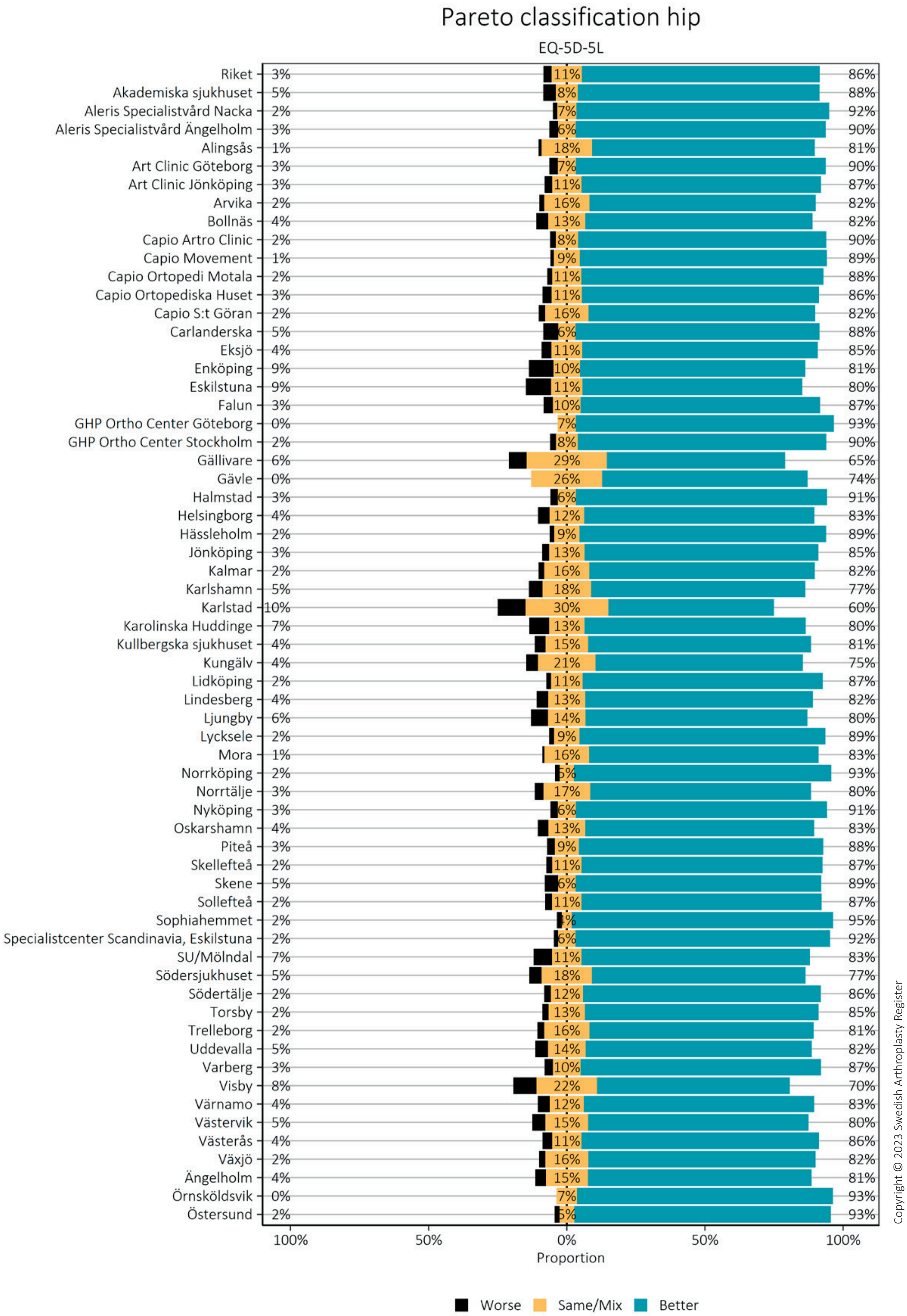


Figure 8.1. Pareto classification EQ-5D-5L, elective total hip replacement 2021.

PROMs in hip replacement 2019–2022

	Primary operation				Revision	
	Preoperatively	Postoperatively			Preoperatively	Postoperatively
		1 year	6 years	10 years		1 year
Hip pain, n (%)	**50,236**	**56,721**	**44,834**	**32,512**	**1,668**	**6,291**
None	373 (0.7)	29,638 (52.6)	24,862 (55.8)	17,519 (54.3)	72 (4.3)	2,058 (32.9)
Very mild	436 (0.9)	13,267 (23.5)	8,275 (18.6)	5,765 (17.9)	80 (4.8)	1,406 (22.5)
Mild	1,386 (2.8)	6,559 (11.6)	4,938 (11.1)	3,924 (12.2)	152 (9.2)	1,021 (16.3)
Moderate	16,304 (32.6)	5,365 (9.5)	4,912 (11.0)	3,902 (12.1)	590 (35.6)	1,263 (20.2)
Severe	31,451 (63.0)	1,550 (2.7)	1,529 (3.4)	1,130 (3.5)	765 (46.1)	502 (8.0)
Mobility, n (%)						
I have no problems in walking about	1,365 (2.7)	27,953 (49.3)	21,266 (47.4)	14,168 (43.6)	134 (8.0)	1,758 (27.9)
I have slight problems in walking about	4,934 (9.8)	14,111 (24.9)	9,844 (22.0)	7,242 (22.3)	226 (13.5)	1,584 (25.2)
I have moderate problems in walking about	16,486 (32.8)	9,543 (16.8)	8,401 (18.7)	6,407 (19.7)	536 (32.1)	1,601 (25.4)
I have severe problems in walking about	25,709 (51.2)	4,510 (8.0)	4,589 (10.2)	3,907 (12.0)	643 (38.5)	1,045 (16.6)
I am unable to walk about	1,742 (3.5)	604 (1.1)	734 (1.6)	788 (2.4)	129 (7.7)	303 (4.8)
Self-care, n (%)						
I have no problems washing or dressing myself	14,134 (28.1)	41,882 (73.8)	33,268 (74.2)	23,077 (71.0)	715 (42.9)	3,558 (56.6)
I have slight problems washing or dressing myself	16,139 (32.1)	10,179 (17.9)	7,015 (15.6)	5,446 (16.8)	457 (27.4)	1,488 (23.7)
I have moderate problems washing or dressing myself	14,740 (29.3)	3,590 (6.3)	3,238 (7.2)	2,659 (8.2)	355 (21.3)	847 (13.5)
I have severe problems washing or dressing myself	5,010 (10.0)	845 (1.5)	910 (2.0)	912 (2.8)	118 (7.1)	275 (4.4)
I am unable to wash or dress myself	213 (0.4)	225 (0.4)	403 (0.9)	418 (1.3)	20 (1.2)	115 (1.8)
Usual activities, n (%)						
I have no problems doing my usual activities	2,511 (5.0)	27,951 (49.3)	22,076 (49.2)	14,984 (46.1)	179 (10.8)	1,822 (29.0)
I have slight problems doing my usual activities	8,370 (16.7)	16,041 (28.3)	11,420 (25.5)	8,287 (25.5)	361 (21.7)	1,825 (29.1)
I have moderate problems doing my usual activities	16,107 (32.1)	8,259 (14.6)	6,907 (15.4)	5,427 (16.7)	482 (29.0)	1,466 (23.4)
I have severe problems doing my usual activities	18,527 (36.9)	3,466 (6.1)	3,293 (7.3)	2,700 (8.3)	444 (26.7)	790 (12.6)
I am unable to do my usual activities	4,721 (9.4)	1,004 (1.8)	1,138 (2.5)	1,114 (3.4)	197 (11.8)	375 (6.0)
Pain/discomfort, n (%)						
I have no pain or discomfort	128 (0.3)	20,242 (35.7)	15,444 (34.4)	10,709 (32.9)	43 (2.6)	1,305 (20.8)
I have slight pain or discomfort	1,421 (2.8)	19,570 (34.5)	13,532 (30.2)	9,550 (29.4)	193 (11.6)	2,058 (32.8)
I have moderate pain or discomfort	17,764 (35.4)	12,572 (22.2)	11,544 (25.7)	8,855 (27.2)	668 (40.2)	2,012 (32.0)
I have severe pain or discomfort	27,391 (54.5)	4,007 (7.1)	3,939 (8.8)	3,054 (9.4)	659 (39.6)	799 (12.7)
I have extreme pain or discomfort	3,532 (7.0)	330 (0.6)	375 (0.8)	344 (1.1)	100 (6.0)	106 (1.7)

The table continues on the next page.

PROMs in hip replacement 2019–2022, cont.

	Primary operation				Revision	
	Preoperatively	Postoperatively			Preoperatively	Postoperatively
		1 year	6 years	10 years		1 year
Anxiety/depression, n (%)						
I am not anxious or depressed	17,806 (35.4)	38,739 (68.3)	29,706 (66.3)	20,613 (63.4)	643 (38.6)	3,305 (52.6)
I am slightly anxious or depressed	20,008 (39.8)	12,901 (22.7)	10,687 (23.8)	8,298 (25.5)	610 (36.6)	1,863 (29.6)
I am moderately anxious or depressed	8,891 (17.7)	3,687 (6.5)	3,212 (7.2)	2,572 (7.9)	274 (16.5)	768 (12.2)
I am severely anxious or depressed	3,027 (6.0)	1,168 (2.1)	1,025 (2.3)	861 (2.6)	118 (7.1)	287 (4.6)
I am extremely anxious or depressed	504 (1.0)	226 (0.4)	204 (0.5)	168 (0.5)	20 (1.2)	61 (1.0)
EQ VAS, mean (SD)	55.6 (22.3)	74.8 (19.4)	71.5 (21.0)	69.7 (21.7)	56.4 (22.4)	65.7 (22.3)
Satisfaction with the surgery, n (%)						
Very dissatisfied		1,087 (1.9)	1,207 (2.7)	778 (2.4)		444 (7.1)
Dissatisfied		2,091 (3.7)	1,975 (4.5)	1,239 (3.9)		639 (10.2)
Neither satisfied nor dissatisfied		4,368 (7.8)	3,596 (8.1)	2,676 (8.4)		1,032 (16.5)
Satisfied		12,551 (22.4)	10,056 (22.8)	7,787 (24.3)		1,849 (29.6)
Very satisfied		35,885 (64.1)	27,315 (61.9)	19,541 (61.0)		2,284 (36.6)
EQ5D-index, Swedish TTO, mean (SD)	0.64 (0.14)	0.86 (0.13)	0.85 (0.14)	0.84 (0.15)	0.68 (0.15)	0.79 (0.16)
EQ5D-index, Swedish VAS, mean (SD)	46.94 (13.30)	72.90 (15.97)	71.57 (16.92)	70.08 (17.51)	51.01 (15.85)	63.87 (18.40)

Table 8.1. PROMs in hip replacements 2019–2022.

PROM in hip replacement surgery 2019–2022

Table 8.1 is a summary of all PROM-answers received in 2019–2022 divided into preoperatively, one, six and ten years postoperatively in primary surgeries and preoperatively and one year postoperatively in reoperations. Note that the summary includes cross-sectional data for patients who responded in the time-period and not longitudinal data. In more than 95 % of the cases the patients reported moderate or severe pain in the affected hip preoperatively. In the one-year follow-up 76 % reported no or very mild pain in the operated hip. Even if the proportion of problem free was lower at the six- and ten-year follow-ups, most seem to maintain a relatively good general health status in the long-term follow-ups.

There are considerably more one-year follow-ups after revision of hip replacements compared with preoperative answers. The routine for collecting preoperative PROMs in reoperations does not seem to have be established as well as in primary surgeries. On the other hand, the follow-up seems to function satisfactorily. Some of the loss may of course be explained by the fact that many reoperations are performed sub-acutely and the patients therefore do not undergo the elective enrolment process. The Swedish Arthroplasty Register appeals to the units to review the routines for collecting preoperative PROMs also for reoperations, not least considering that patient-reported health one year after reoperation is considerably worse compared to the situation after primary surgery. More than 17 % were dissatisfied or very dissatisfied and 28 % reported moderate or severe pain in the operated hip one year after the reoperation.

PROMs in hip replacement 2021

	Primary operation	
	Preoperatively	1 year postoperatively
Hip pain, n (%)	**9,358**	**9,358**
None	72 (0.8)	5,079 (54.8)
Very mild	83 (0.9)	2,184 (23.5)
Mild	249 (2.7)	976 (10.5)
Moderate	3,053 (32.8)	803 (8.7)
Severe	5,850 (62.9)	234 (2.5)
Mobility, n (%)		
I have no problems in walking about	245 (2.6)	4,920 (52.6)
I have slight problems in walking about	908 (9.7)	2,255 (24.1)
I have moderate problems in walking about	3,020 (32.3)	1,409 (15.1)
I have severe problems in walking about	4,866 (52.0)	697 (7.4)
I am unable to walk about	319 (3.4)	77 (0.8)
Self-care, n (%)		
I have no problems washing or dressing myself	2,605 (27.8)	7,258 (77.6)
I have slight problems washing or dressing myself	3,093 (33.1)	1,514 (16.2)
I have moderate problems washing or dressing myself	2,735 (29.2)	464 (5.0)
I have severe problems washing or dressing myself	892 (9.5)	105 (1.1)
I am unable to wash or dress myself	33 (0.4)	17 (0.2)
Usual activities, n (%)		
I have no problems doing my usual activities	481 (5.1)	5,040 (53.9)
I have slight problems doing my usual activities	1,511 (16.1)	2,546 (27.2)
I have moderateproblems doing my usual activities	2,975 (31.8)	1,172 (12.5)
I have severe problems doing my usual activities	3,488 (37.3)	488 (5.2)
I am unable to do my usual activities	903 (9.6)	112 (1.2)
Pain/discomfort, n (%)		
I have no pain or discomfort	19 (0.2)	3,353 (35.8)
I have slight pain or discomfort	270 (2.9)	3,300 (35.3)
I have moderate pain or discomfort	3,335 (35.6)	1,998 (21.4)
I have severe pain or discomfort	5,078 (54.3)	634 (6.8)
I have extreme pain or discomfort	656 (7.0)	73 (0.8)
Anxiety/depression, n (%)		
I am not anxious or depressed	3,292 (35.2)	6,427 (68.7)
I am slightly anxious or depressed	3,759 (40.2)	2,183 (23.3)
I am moderately anxious or depressed	1,688 (18.0)	557 (6.0)
I am severely anxious or depressed	512 (5.5)	160 (1.7)
I am extremely anxious or depressed	107 (1.1)	31 (0.3)

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PROMs in hip replacement 2021, cont.

	Primary operation	
	Preoperatively	1 year postoperatively
EQ VAS, mean (SD)	55.6 (22.2)	74.5 (18.8)
Satisfaction with the surgery, n (%)		
Very dissatisfied		146 (1.6)
Dissatisfied		303 (3.3)
Neither satisfied nor dissatisfied		668 (7.2)
Satisfied		1,847 (20.0)
Very satisfied		6,265 (67.9)
EQ5D-index, Swedish TTO, mean (SD)	0.64 (0.14)	0.87 (0.13)
EQ5D-index, Swedish VAS, mean (SD)	46.90 (13.30)	73.96 (15.36)

Table 8.2. PROMs pre- and one-year postoperatively in primary total hip replacements 2021.

PROMs in elective total hip replacement 2021

Table 8.2 shows data for those operated with a hip replacement in 2021 and that had complete preoperative and one-year postoperative PROMs. 88 % reported that they were satisfied or very satisfied with the surgery and more than 78 % reported no or very mild pain in the hip. It is noted that the mean change in EQ VAS was 19 units on the 100-unit scale. In terms of the EQ-5D-dimensions, pain, mobility and everyday activities had improved the most.

Change in the EQ-5D-dimensions can be described by the so-called Pareto-classification. If there is an improvement in one or several dimensions without worsening in any other dimension, it is classified as "better". If there is a worsening in one or several dimensions without an improvement in any other dimension, it is classified as "worse". No change is classified as "same/mix" and change in different directions is classified as "mix". Figure 8.1 shows how the EQ-5D-dimensions change at different units after primary elective total hip replacement. In the country 86 % improved and only 3 % worsened. However, there was a wide variation across the country. The highest proportion of patients that had improved was at Sophiahemmet (97 %) while 65 % had improved in Gällivare. At some hospitals none or only 1% became worse while 10 % of the patients in Karlstad and 9 % in Enköping and Eskilstuna became worse. There was also a wide variation in the proportion of patients who had the same or mixed change (5–30 %).

The proportion of satisfied and responders after primary total hip replacement per unit

Table 8.3 shows response rate and the proportion of satisfied (very satisfied or satisfied) with the result of the surgery in those operated on with elective primary total hip replacement in 2021 and completed the one-year follow-up. Table 8.3 also shows response rate and the proportion of responders in patients operated September 1st 2021 to December 31st 2021 and that have responded to HOOS-12 both preoperatively and one year postoperatively. Results for units with fewer than 20 answers are not presented but included in "the country". 88 % of the patients reported that they were satisfied with the result of the surgery but the differences between the units is wide; the proportion of satisfied ranged between 73 and 99 %. Ten units had a lower proportion of satisfied patients than 80 % and 19 units had 90 % or higher of satisfied patients. Among the high volume producers, it can be noted that Hässleholm and Ortho Center Stockholm have a continued large proportion of satisfied patients. The differences in the proportion classified as responder ranged from 87 to 100 % which is not as large variation as for satisfaction, but there are only three units (Bollnäs, Karlshamn and Kullbergska sjukhuset) with a relatively high response rate (≥ 70 %) and ≥ 70 surgeries, and the proportion of responders at these units varies from 92 % in Karlshamn to 96 % in Bollnäs. The response rate is relatively high in satisfaction while it is low in responders, which probably reflects that the collection of HOOS-12 has recently started.

Proportion of satisfied and responders after primary total hip replacement per unit 2021

Unit	Number response	Response rate %	Proportion satisfied %	Number response	Response rate %	Proportion responders %
Akademiska sjukhuset	112	74	85	35	36	94
Aleris Specialistvård Nacka	325	83	94	92	61	98
Aleris Specialistvård Ängelholm	296	66	90	65	33	99
Alingsås	99	87	78	41	59	93
Art Clinic Göteborg	266	84	89	42	39	100
Art Clinic Jönköping	272	92	89	66	65	99
Arvika	198	69	83	0		
Bollnäs	318	88	85	112	87	96
Borås	30	79	80	<20		
Capio Artro Clinic	499	78	91	91	35	98
Capio Movement	405	85	94	45	30	98
Capio Ortopedi Motala	312	88	89	54	30	96
Capio Ortopediska Huset	660	85	86	0		
Capio S:t Göran	217	63	79	31	14	97
Carlanderska	245	44	89	<20		
Danderyd	93	77	88	<20		
Eksjö	221	88	86	58	54	90
Enköping	296	64	77	<20		
Eskilstuna	51	72	73	23	55	96
Falun	37	37	89	<20		
GHP Ortho Center Göteborg	270	85	90	34	31	100
GHP Ortho Center Stockholm	669	82	92	159	48	98
Gällivare	38	83	82	26	61	89
Gävle	53	84	77	22	61	96
Halmstad	103	89	85	<20		
Helsingborg	40	73	85	<20		
Hermelinen	<20			<20		
Hudiksvall	43	80	81	<20		
Hässleholm	549	86	92	120	39	99
Jönköping	46	81	87	20		
Kalmar	49	83	84	<20		
Karlshamn	147	84	91	76	72	92
Karlstad	29	66	76	<20		
Karolinska Huddinge	138	71	83	23	21	100
Karolinska Solna	20	56		0	0	
Kullbergska sjukhuset	263	83	82	137	84	93

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Proportion of satisfied and responders after primary total hip replacement per unit 2021, cont.

Unit	Number response	Response rate %	Proportion satisfied %	Number response	Response rate %	Proportion responders %
Kungälv	44	77	77	<20		
Lidköping	72	67	85	36	54	94
Lindesberg	256	62	89	<20		
Linköping	83	90	83	0	0	
Ljungby	80	78	90	27	54	93
Lycksele	185	79	94	69	59	100
Mora	186	90	86	<20		
Norrköping	98	74	80	35	39	94
Norrtälje	96	77	85	39	46	95
Nyköping	95	87	91	30	53	93
Oskarshamn	261	86	86	82	62	98
Piteå	253	74	85	89	49	96
SU/Mölndal	178	77	78	23	17	100
SUS/Lund	28	62	86	<20		
Skellefteå	89	93	92	38	49	87
Skene	76	61	82	0		
Skövde	20	77	78	<20		
Sollefteå	335	88	93	117	69	97
Sophiahemmet	184	72	96	<20		
Specialistcenter Scandinavia, Eskilstuna	83	84	94	40	67	100
Södersjukhuset	46	72	83	20	47	
Södertälje	62	59	84	<20		
Torsby	137	82	85	0		
Trelleborg	326	87	89	97	63	95
Uddevalla	198	81	82	84	51	91
Umeå	33	87	88	<20		
Varberg	136	88	88	<20		
Visby	106	84	78	34	59	91
Värnamo	147	85	82	50	67	98
Västervik	111	84	83	30	46	97
Västerås	171	64	94	<20		
Växjö	68	81	93	28	49	96
Ängelholm	95	81	92	37	53	97
Örnsköldsvik	76	92	87	26	84	92
Östersund	71	90	99	20	65	
Country	**11,928**	**77.8**	**87.6**	**2,618**	**36**	**95.8**

Table 8.3. Response rate and proportion of satisfied and responders after primary total hip replacement per unit 2021.

HOOS-12 response per unit 2021 och 2022

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			%	%	pre	1 year	pre	1 year	pre	1 year
Akademiska sjukhuset	2021	34	35	38	32 (15)	81 (19)	37 (17)	83 (17)	20 (12)	74 (21)
	2022	134	71	36	27 (15)		35 (19)		16 (13)	
Aleris Malmö Arena	2021									
	2022	0	0							
Aleris Specialistvård Nacka	2021	84	55	32	31 (16)	89 (17)	37 (19)	88 (15)	21 (14)	82 (18)
	2022	481	89	38	32 (14)		37 (17)		21 (13)	
Aleris Specialistvård Ängelholm	2021	65	33	20	31 (14)	87 (18)	36 (17)	86 (17)	21 (15)	82 (18)
	2022	370	71	39	28 (14)		32 (16)		18 (12)	
Alingsås	2021	40	55	35	34 (13)	84 (21)	40 (16)	80 (19)	22 (14)	75 (24)
	2022	177	93	39	33 (14)		37 (17)		21 (14)	
Art Clinic Göteborg	2021	42	39	26	33 (16)	86 (20)	36 (16)	86 (17)	20 (15)	81 (22)
	2022	234	84	32	31 (13)		37 (17)		20 (14)	
Art Clinic Jönköping	2021	65	64	22	30 (14)	87 (18)	38 (15)	87 (16)	20 (12)	79 (20)
	2022	257	97	34	28 (13)		33 (16)		20 (12)	
Arvika	2021	0	0							
	2022	116	38	43	28 (15)		32 (15)		19 (13)	
Bollnäs	2021	99	77	36	32 (14)	86 (18)	38 (17)	83 (20)	24 (15)	80 (20)
	2022	332	95	33	30 (15)		34 (17)		19 (14)	
Borås	2021	<20								
	2022	36	52	33	25 (18)		29 (17)		16 (15)	
Capio Artro Clinic	2021	89	34	26	31 (17)	87 (19)	39 (19)	86 (18)	20 (13)	78 (22)
	2022	561	78	33	32 (15)		39 (19)		21 (14)	
Capio Movement	2021	44	29	34	36 (16)	89 (18)	43 (17)	87 (19)	24 (13)	83 (18)
	2022	242	51	35	35 (14)		42 (18)		25 (14)	
Capio Ortopedi Motala	2021	53	29	26	30 (14)	84 (20)	35 (16)	81 (20)	21 (13)	77 (23)
	2022	346	76	36	29 (13)		33 (15)		20 (12)	
Capio Ortopediska Huset	2021	0	0							
	2022	0	0							
Capio S:t Göran	2021	31	14	36	32 (13)	76 (23)	37 (15)	74 (23)	23 (12)	66 (27)
	2022	256	72	38	31 (17)		35 (18)		20 (14)	
Carlanderska	2021	<20								
	2022	91	25	30	31 (15)		37 (19)		21 (16)	
Carlanderska-SportsMed	2021									
	2022	35	16	14	31 (15)		36 (15)		21 (12)	
Danderyd	2021	<20								
	2022	71	33	46	31 (15)		35 (19)		18 (14)	
Eksjö	2021	57	53	25	30 (15)	84 (22)	33 (17)	82 (20)	23 (14)	74 (23)
	2022	265	84	31	31 (15)		34 (18)		21 (13)	
Enköping	2021	<20								
	2022	348	65	32	29 (14)		33 (16)		20 (13)	

The table continues on the next page.

HOOS-12 response per unit 2021 och 2022, cont.

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			%	%	pre	1 year	pre	1 year	pre	1 year
Eskilstuna	2021	23	55	35	30 (16)	76 (23)	34 (22)	79 (18)	15 (13)	68 (27)
	2022	41	67	38	24 (16)		27 (17)		17 (16)	
Falun	2021	<20								
	2022	142	84	38	27 (18)		31 (20)		18 (16)	
GHP Ortho Center Göteborg	2021	34	30	21	33 (17)	87 (19)	39 (20)	87 (18)	18 (11)	75 (21)
	2022	160	51	28	31 (13)		41 (16)		21 (12)	
GHP Ortho Center Stockholm	2021	158	47	31	32 (15)	88 (18)	40 (19)	86 (17)	21 (13)	79 (20)
	2022	727	85	33	33 (15)		39 (18)		22 (14)	
GHP Ortho och Spine Center Skåne	2021									
	2022	123	60	33	32 (17)		40 (19)		23 (16)	
Gällivare	2021	26	61	42	32 (16)	76 (26)	37 (11)	72 (26)	19 (13)	67 (26)
	2022	27	66	41	27 (17)		32 (16)		19 (18)	
Gävle	2021	21	58	48	27 (14)	78 (23)	33 (20)	74 (27)	14 (13)	68 (28)
	2022	76	78	50	23 (14)		26 (17)		13 (12)	
Halmstad	2021	<20								
	2022	87	72	37	28 (14)		34 (17)		18 (13)	
Helsingborg	2021	<20								
	2022	40	71	48	29 (13)		31 (18)		18 (16)	
Hermelinen	2021									
	2022	28	74	25	33 (13)		40 (18)		21 (11)	
Hudiksvall	2021	<20								
	2022	55	80	47	27 (13)		29 (14)		15 (12)	
Hässleholm	2021	118	39	32	33 (15)	86 (19)	38 (17)	84 (19)	24 (14)	79 (20)
	2022	532	84	37	30 (15)		36 (17)		22 (15)	
Jönköping	2021	20	69	40	26 (17)	80 (23)	29 (17)	73 (26)	17 (15)	73 (27)
	2022	110	73	39	31 (13)		37 (19)		23 (15)	
Kalmar	2021	<20								
	2022	81	91	36	30 (14)		34 (15)		19 (13)	
Karlshamn	2021	76	72	34	34 (17)	84 (20)	39 (19)	80 (21)	25 (16)	76 (22)
	2022	259	92	32	30 (14)		34 (16)		21 (13)	
Karlstad	2021	<20								
	2022	28	70	36	30 (18)		33 (20)		17 (20)	
Karolinska Huddinge	2021	23	21	61	26 (16)	79 (20)	32 (19)	78 (20)	15 (14)	70 (25)
	2022	191	64	45	29 (17)		32 (19)		17 (12)	
Karolinska Solna	2021									
	2022	<20								
Kullbergska sjukhuset	2021	138	84	29	32 (15)	83 (19)	39 (19)	82 (19)	22 (13)	74 (22)
	2022	357	99	35	30 (14)		36 (16)		22 (15)	
Kungälv	2021	<20								
	2022	42	40	46	25 (13)		28 (19)		15 (14)	

The table continues on the next page.

HOOS-12 response per unit 2021 och 2022, cont.

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			%	%	pre	1 year	pre	1 year	pre	1 year
Ledplastikcentrum Bromma	2021									
	2022	104	40	29	32 (15)		39 (18)		21 (13)	
Lidköping	2021	35	52	37	27 (12)	80 (23)	33 (16)	78 (24)	17 (13)	69 (26)
	2022	178	83	43	28 (16)		32 (18)		17 (14)	
Lindesberg	2021	<20								
	2022	200	56	27	27 (14)		31 (17)		17 (12)	
Linköping	2021	0	0							
	2022	40	47	39	25 (13)		36 (17)		17 (13)	
Ljungby	2021	27	54	52	32 (16)	83 (21)	41 (20)	79 (22)	27 (15)	80 (22)
	2022	89	85	33	35 (14)		39 (18)		26 (15)	
Lycksele	2021	69	59	23	28 (14)	90 (16)	38 (19)	88 (17)	21 (14)	81 (20)
	2022	207	90	45	31 (16)		34 (17)		19 (14)	
Mora	2021	<20								
	2022	202	79	39	29 (16)		31 (18)		17 (13)	
Norrköping	2021	35	39	31	24 (14)	79 (20)	29 (15)	77 (21)	15 (15)	67 (25)
	2022	86	60	50	27 (16)		30 (19)		16 (14)	
Norrtälje	2021	38	40	40	31 (13)	79 (22)	39 (18)	76 (22)	22 (13)	74 (23)
	2022	128	85	39	36 (15)		40 (16)		25 (14)	
Nyköping	2021	30	53	33	28 (15)	84 (22)	33 (18)	80 (22)	22 (15)	74 (22)
	2022	102	80	45	27 (14)		30 (15)		17 (11)	
Ortopediskt Center Sophiahemmet	2021									
	2022	250	85	21	34 (15)		41 (19)		23 (14)	
Oskarshamn	2021	81	61	43	29 (13)	84 (21)	35 (18)	84 (19)	19 (13)	78 (22)
	2022	395	94	36	29 (14)		34 (17)		20 (14)	
Piteå	2021	87	48	35	28 (14)	84 (20)	34 (18)	80 (21)	18 (12)	73 (23)
	2022	310	78	44	26 (15)		33 (18)		16 (13)	
SU/Mölndal	2021	23	17	44	31 (14)	77 (23)	39 (15)	74 (22)	21 (12)	67 (25)
	2022	356	80	44	27 (15)		31 (18)		17 (13)	
SUS/Lund	2021									
	2022	20	67	75	21 (13)		20 (17)		11 (12)	
Skellefteå	2021	37	47	30	42 (18)	89 (15)	59 (17)	89 (14)	27 (17)	81 (16)
	2022	60	44	38	29 (12)		42 (14)		18 (13)	
Skene	2021	0	0							
	2022	0	0							
Skövde	2021	<20								
	2022	37	77	51	31 (14)		35 (15)		25 (15)	
Sollefteå	2021	114	68	32	30 (13)	85 (20)	36 (16)	83 (21)	20 (14)	78 (22)
	2022	354	93	32	32 (14)		35 (16)		20 (13)	

The table continues on the next page.

HOOS-12 response per unit 2021 och 2022, cont.

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			%	%	pre	1 year	pre	1 year	pre	1 year
Sophiahemmet	2021	<20								
	2022									
Specialistcenter Scandinavia Malmö	2021									
	2022	34	67	27	29 (15)		32 (19)		21 (16)	
Specialistcenter Scandinavia, Eskilstu-na	2021	37	62	38	33 (16)	91 (12)	36 (18)	89 (14)	22 (14)	84 (17)
	2022	102	82	30	31 (12)		36 (14)		21 (13)	
Södersjukhuset	2021	<20								
	2022	88	62	43	31 (17)		38 (20)		19 (14)	
Södertälje	2021	<20								
	2022	78	76	44	30 (15)		36 (16)		19 (14)	
Torsby	2021	0	0							
	2022	100	80	37	28 (14)		36 (17)		20 (13)	
Trelleborg	2021	92	60	35	29 (16)	83 (22)	36 (19)	78 (23)	20 (15)	76 (23)
	2022	246	89	40	29 (16)		36 (22)		20 (15)	
Uddevalla	2021	84	51	43	32 (16)	78 (23)	38 (19)	74 (22)	22 (17)	70 (24)
	2022	281	88	41	29 (16)		31 (17)		18 (14)	
Umeå	2021	<20								
	2022	<20								
Varberg	2021	<20								
	2022	130	69	36	28 (14)		33 (16)		18 (13)	
Visby	2021	32	55	41	31 (17)	79 (24)	37 (19)	80 (21)	19 (13)	73 (25)
	2022	94	86	39	27 (13)		32 (17)		20 (13)	
Värnamo	2021	48	64	21	28 (11)	84 (21)	33 (18)	81 (21)	19 (13)	78 (23)
	2022	148	94	37	30 (14)		33 (16)		20 (13)	
Västervik	2021	31	46	42	29 (14)	81 (19)	31 (15)	78 (21)	19 (13)	69 (25)
	2022	82	70	48	29 (16)		34 (19)		21 (15)	
Västerås	2021	<20								
	2022	261	74	40	26 (14)		30 (17)		17 (13)	
Växjö	2021	28	46	46	32 (14)	79 (23)	39 (18)	79 (20)	23 (15)	72 (24)
	2022	52	28	44	36 (15)		39 (17)		24 (14)	
Ängelholm	2021	36	51	36	33 (15)	84 (22)	41 (16)	80 (23)	23 (13)	79 (23)
	2022	153	82	41	30 (15)		35 (19)		20 (16)	
Örnsköldsvik	2021	24	77	50	36 (14)	83 (19)	39 (16)	81 (24)	21 (15)	76 (20)
	2022	141	88	39	27 (15)		31 (15)		17 (12)	
Östersund	2021	20	65	32	26 (23)	96 (9)	34 (23)	91 (12)	18 (18)	86 (15)
	2022	158	80	37	30 (16)		37 (17)		20 (15)	
Country	**2021**	**2,557**	**35**	**34**	**31 (15)**	**84 (20)**	**37 (18)**	**82 (21)**	**21 (14)**	**76 (23)**
	2022	**12,760**	**69**	**37**	**30 (15)**		**35 (18)**		**20 (14)**	

Table 8.4. HOOS-12, elective total hip replacement per unit 2021 and 2022.

HOOS-12 – elective total hip replacement per unit

Table 8.4 shows the results for HOOS-12 three subscales, secondly, the proportion classified as Charnley C per unit. HOOS-12 is presented in elective total hip replacement patients who are operated on from September 1st 2021 to December 31st 2021 and has responded both preoperatively and one year postoperatively as well as those who responded preoperatively operated in 2022. The proportion classified as Charnley class C at units that reported HOOS was 34 % in 2021 and 37 % in 2022 and varied among the units in 2021 from 20 % at Aleris Specialistvård Ängelholm to 61% at Karolinska Huddinge and in 2022 from 14 % at Carlanderska-SportsMed to 75 % at SUS/Lund. The proportions must be interpreted with some caution given the relatively low response rate.

There are only three units (Bollnäs, Karlshamn and Kullbergska sjukhuset) with a relatively high response rate (≥ 70 %) and ≥ 70 operations in 2021 and the difference in HOOS-12 different subscales vary between one to three points preoperatively and between three and six points one year postoperatively. For other units, the variation is larger. The response rate for preoperative HOOS-12 is considerably higher in those who had surgery in 2022 and all units except two had reported HOOS-12 preoperatively. Preoperatively, the variation is between ten and 15 points in the HOOS different subscales among the units with a relatively high response rate (≥ 70 %) and ≥ 70 operations. Even here the results must be interpreted with caution when comparing different units considering the relatively low response rate.

Patient-reported outcome in primary knee replacements 2021

Due to the harmonisation of PROM in the merger the units' response rate has been negatively affected. Some units have experienced problems with the so-called PROM-manager (especially Capio Ortopedi Motala) or misunderstanding when entering data (for example Capio Ortopediska huset). In addition, the units' response rate is dependent on when each unit started to use the new questionnaires and how well they were in phase they were with the entering of PROM-questionnaires when the registration in the Swedish Knee Arthroplasty Register closed, and the Swedish Arthroplasty Register started September 1st 2021. Note that for units with few operations and/or low response rate, results and percentages may be misleading. The results in units with fewer than 20 responses are not presented but accounted for in the "Country".

Table 8.5 shows that general health (EQ VAS) was reported to have improved preoperatively to one year postoperatively and that the average change was 12 units on the 100-point scale in TKR and 14 units in UKR. 94 and 93 % of the TKR and UKR patients respectively reported moderate or severe pain in the operated knee preoperatively. One year postoperatively, 65 % of the TKR patients and 64 % of the UKR patients reported no or very mild pain in the operated knee. Knee-related pain, ADL-function and QoL measured with KOOS-12 improved on group level preoperatively to one-year postoperatively. In general health, knee pain and KOOS-12 three subscales the results were relatively similar in TKR and UKR and a slightly higher reporting that they were satisfied (very satisfied or satisfied) with the result of the surgery after UKR (83 %) compared than TKR (81%).

The change in the EQ-5D dimensions can be described with so called Pareto classification. If there is an improvement in one or several dimensions without worsening in any other dimension, it is classified as "better". If there is a worsening in one or several dimensions without improving in any other dimension, it is classified as "worse". No change is classified as "same" and change in different directions is classified as "mix".

Figure 8.2 shown how the EQ-5D dimensions change at different units after primary knee replacement. For the country, 75 % improved and 6 % worsened. There was however a large variation within the country. The largest proportion of patients that had improved were at Specialistcenter Scandinavia Eskilstuna (91 %) while 55 % had improved in Enköping. At some units there were none or a smaller proportion that had worsened while 17 % of the patients in Ljungby and in Västerås had worsened. There was also a great variation in the proportion of patients that had the same or mixed change (3–40 %).

PROM response in primary knee replacements 2021 with both pre and 1-year postoperative response

	TKR		UKR	
	Preoperatively	1 year postoperatively	Preoperatively	1 year postoperatively
Knee pain in the operated knee, n (%)	**3,135**	**3,135**	**538**	**538**
None	7 (0)	1 097 (35)	0 (0)	195 (36)
Very mild	30 (1)	937 (30)	6 (1)	153 (28)
Mild	152 (5)	567 (18)	33 (6)	104 (19)
Moderate	1,535 (49)	423 (13)	254 (47)	67 (13)
Severe	1,411 (45)	111 (4)	245 (46)	19 (4)
Satisfaction with the surgery, n (%)		**5,533**		**884**
Very dissatisfied		149 (3)		27 (3)
Dissatisfied		294 (5)		42 (5)
Neither satisfied nor dissatisfied		587 (11)		83 (9)
Satisfied		1,569 (28)		239 (27)
Very satisfied		2,934 (53)		493 (56)
Charnley class, n (%)	**5,056**		**866**	
A	1,700 (34)		310 (36)	
B	1,576 (31)		307 (35)	
C	1,780 (35)		249 (29)	
Number	**2,712**	**2,712**	**502**	**502**
KOOS-12, mean (SD)				
Pain	37 (15)	77 (22)	37 (16)	78 (22)
Function in daily living	38 (17)	76 (21)	38 (17)	77 (21)
QoL	22 (14)	68 (23)	22 (13)	68 (24)
Number	**3 369**	**3 369**	**696**	**696**
EQ VAS, mean (SD)	61 (21)	73 (19)	61 (22)	75 (18)
Number	**1 353**	**1 353**	**243**	**243**
EQ5D-index, Swedish TTO, mean (SD)	0.74 (0.12)	0.87 (0.12)	0.72 (0.13)	0.88 (0.13)
Number	**1 343**	**1 343**	**243**	**243**
EQ5D-index, Swedish VAS, mean (SD)	56.49 (13.11)	74.44 (14.36)	55.01 (12.64)	74.58 (15.06)

Table 8.5. PROMs in primary knee replacements 2021 with both pre- and one-year postoperative response.

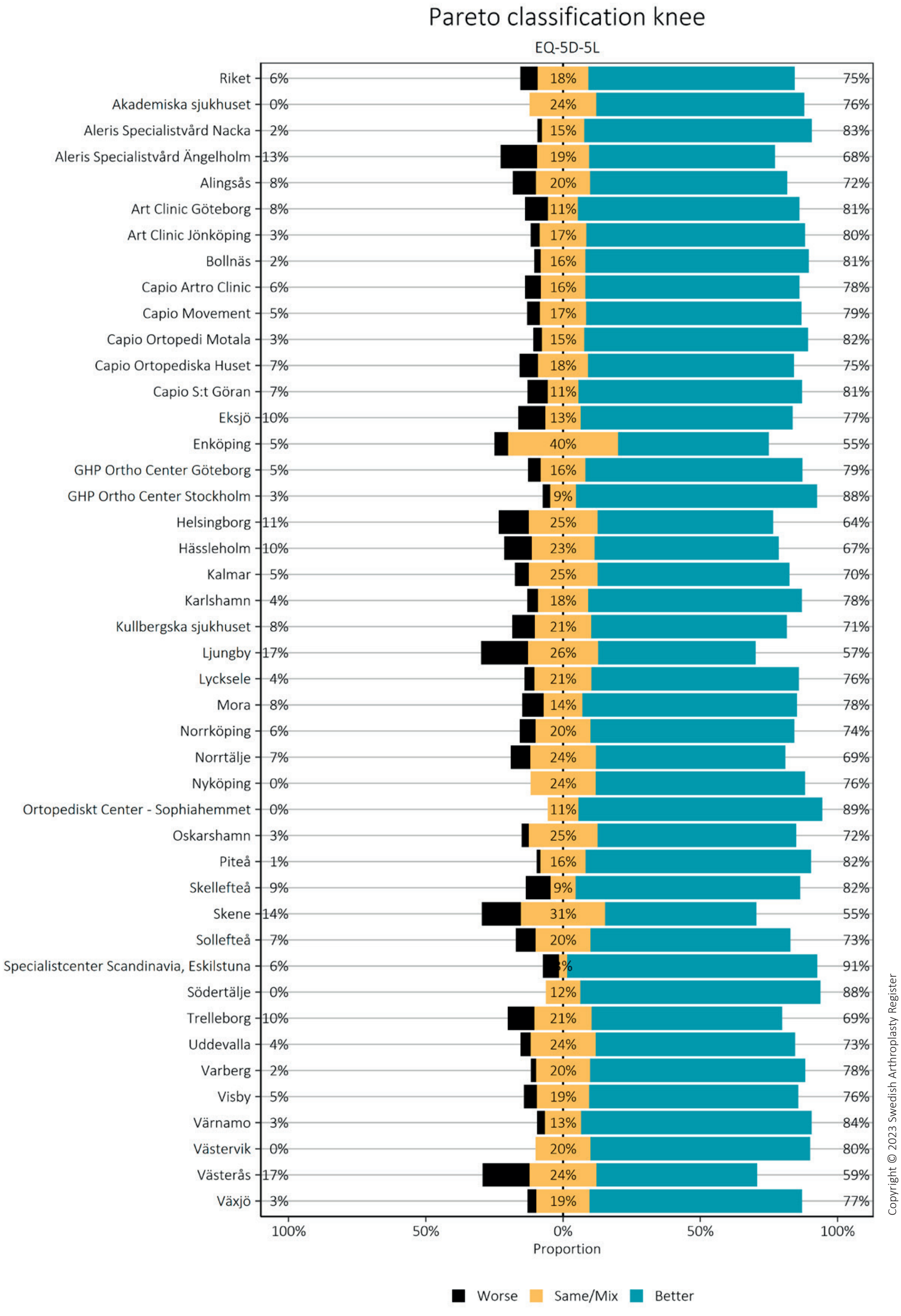

Figure 8.2. Pareto classification EQ-5D-5L, knee replacement 2021.

The proportion of satisfied and responders after primary knee replacement per unit

Table 8.6 shows the proportion of satisfied (very satisfied or satisfied) with the surgical result. At units with a relatively high response rate (≥ 70 %) and ≥ 70 knee replacements, the proportion of satisfied varies greatly from 66 % in Enköping to 94 % in Alingsås. 92 % of the reported primary knee replacements operated on in 2021 were classified as responders. Only four units (Art Clinic Jönköping, Bollnäs, Eksjö and Oskarshamn) had a relatively high response rate (≥ 70 %) and ≥ 70 operations and ranged from 96% in Oskarshamn to 88% in Eksjö. For units with a low response rate and/or few operations, the proportion of responders varied between 79 and 95 %. The relatively low response rate probably reflects the changes in PROM collection which was made in connection with the merger.

General health in primary TKR and UKR

General health (EQ VAS) in TKR and UKR at each unit respectively is shown in table 8.7. Preoperative general health was reported from 51 to 68 units preoperatively on the 100-point scale and from 59 to 78 units postoperatively in TKR. For the relatively few units with a relatively high response rate (≥ 70 %) and ≥ 70 operations EQ VAS varied from 57 to 65 units preoperatively and from 70 to 76 units one year postoperatively. In UKA, general health varied from 57 to 67 units preoperatively and from 68 to 84 units postoperatively from the few units with 20 or more responses.

KOOS-12 – TKA

Table 8.8 shows the results for KOOS-12's the three subscales with both preoperative and one-year postoperative responses, and the proportion classified as Charnley C in TKR operated on 2021 at each unit respectively and with preoperative responses in TKR operated on 2022. The proportion classified as Charnley class C at the three units (Bollnäs, Eksjö and Oskarshamn) with a relatively high response rate (≥ 70 %) and ≥ 70 operations that reported KOOS in 2021 was 34 % and varied among the units from 35 % in Bollnäs to 39 % in Eksjö. The corresponding numbers in 2022 were 33 % with 22 % at Art Clinic Göteborg and Ortopediskt Center, Sophiahemmet to 47 % in Trelleborg.

The difference in KOOS different subscales varies the most preoperatively with four points for the three units and between two and three points postoperatively in 2021. The response rate for preoperative KOOS-12 is considerably higher in those operated in 2022 and all units except five have reported KOOS-12 preoperatively. In 2022, only preoperative responses are available and vary between 11 and 15 points in KOOS-12 different subscales at the units.

KOOS-12 – UKA

Table 8.9 shows the results in KOOS-12's three subscales with both preoperative and one-year postoperative responses, and the proportion classified as Charnley C in UKR operated on 2021 at each unit respectively and preoperative responses in TKR operated on 2022. The proportion classified as Charnley class C at the units that reported KOOS was 27 % and varied among the units from 17 % at Capio Art Clinic and at GHP Ortho Center Stockholm to 35 % at Aleris Specialistvård Ängelholm and in Bollnäs. The corresponding proportions in 2022 were 25 % with 7 % at Capio Movement to 41 % in Östersund.

None of the units that report KOOS-12 in UKR have a relatively high response rate (≥ 70 %) and ≥ 70 for operations 2021 and the results in KOOS-12 different subscales varies greatly both preoperatively and postoperatively. In 2022, there were two units (Aleris Specialistvård Nacka and GHP Ortho Center Stockholm) with a relatively high response rate (≥ 70 %) and ≥ 70 operations that reported KOOS-12 and show a difference of two to three points in the three subscales.

Variations in result between units

The results on group level vary among comparable units, those with a relatively high response rate (≥ 70 %) and ≥ 70 operations. When a unit has relatively few operations and/or have a large non-response rate, it is difficult to compare their results with other units. Further, we do not consider case-mix, which can reduce or increase differences between units, when we present patient-reported outcomes in this year's report.

Proportion of satisfied and responders after primary knee replacement per unit 2021

Unit	Number response	Response rate %	Proportion satisfied %	Number response	Response rate %	Proportion responders %
Akademiska	45	76	73	30	51	93
Aleris Specialistvård Nacka	228	79	85	176	61	95
Aleris Specialistvård Ängelholm	329	71	84	236	51	91
Alingsås	90	82	94	72	65	96
Art Clinic Göteborg	244	87	79	188	67	94
Art Clinic Jönköping	177	88	91	153	76	95
Arvika	89	74	90	<20		
Bollnäs	289	87	82	274	83	92
Borås	17	89	82	<20		
Capio Artro Clinic	203	77	81	145	55	91
Capio Movement	152	81	91	110	59	97
Capio Ortopedi Motala	378	83	81	40	9	90
Capio Ortopediska Huset	599	87	84	56	8	95
Capio S:t Göran	126	76	75	<20		
Carlanderska	<20			<20		
Carlanderska-SportsMed	<20			0		
Danderyd	25	57	72	0		
Eksjö	241	89	83	216	79	88
Enköping	151	75	66	<20	5	90
Eskilstuna	0			0		
Falun	0			0		
Frölundaortopeden	0			0		
GHP Ortho Center Göteborg	77	82	91	49	51	94
GHP Ortho Center Stockholm	557	84	85	343	51	90
Gällivare	0			0		
Gävle	<20			0		
Halmstad	70	85	80	0		
Helsingborg	122	84	82	<20		
Hermelinen	0			0		
Hudiksvall	11	18	82	<20		
Hässleholm	689	90	75	359	47	88
Kalmar	<20			<20		
Karlshamn	46	45	74	<20		
Karlstad	0			0		
Karolinska Huddinge	51	50	82	<20		
Karolinska Solna	0			0		
Kullbergska sjukhuset	29	21	72	27	20	74

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Proportion of satisfied and responders after primary knee replacement per unit 2021, cont.

Unit	Number response	Response rate %	Proportion satisfied %	Number response	Response rate %	Proportion responders %
Kungälv	20	50	75	<20		
Lidköping	0			0		
Lindesberg	112	93	77	0		
Ljungby	<20			0		
Lycksele	94	85	77	<20		
Mora	79	86	85	<20		
Norrköping	<20			<20		
Norrtälje	63	61	79	52	50	92
Nyköping	0			0		
Ortopedisk Center Sophiah.	<20			<10		
Oskarshamn	187	94	86	182	91	96
Piteå	243	88	84	151	55	92
Skellefteå	0			0		
Skene	29	29	76	23	23	78
Skövde	<20			<20		
Sollefteå	24	36	88	<20		
Specialistcenter Scandinavia Eskilstuna	37	84	81	35	80	91
Specialistcenter Scandinavia Johanniskliniken	<20			<20		
SU/Mölndal	50	53	74	0		
SU/Sahlgrenska	<20			<20		
Sundsvall	0			0		
SUS/Lund	0			0		
Södersjukhuset	0			0		
Södertälje	0			0		
Torsby	<20	19		0		
Trelleborg	304	82	83	103	28	90
Uddevalla	<20			<20		
Umeå	0			0		
Varberg	24	32	75	<20		
Visby	0			0		
Värnamo	64	36	83	58	33	93
Västervik	<20			<20		
Västerås	<20			<20		
Växjö	<20			<20		
Örnsköldsvik	<20			<20		
Östersund	0			0		
Country	**6,464**	**68**	**82**	**3,209**	**34**	**92**

Table 8.6. Response rate and proportion of satisfied and responders after primary knee replacement per unit 2021.

EQ VAS in primary knee replacement 2021

	Number response	Response rate	TKR mean (SD)		Number response	Response rate	UKR mean (SD)	
Enhet		%	pre	1 year		%	pre	1 year
Akademiska	28	51	65 (21)	71 (20)	<20			
Aleris Specialistvård Nacka	107	78	64 (19)	75 (19)	114	77	64 (21)	76 (16)
Aleris Specialistvård Ängelholm	112	39	58 (26)	76 (17)	78	45	56 (27)	74 (20)
Alingsås	73	66	61 (21)	73 (19)				
Art Clinic Göteborg	163	65	61 (20)	74 (18)	<20			
Art Clinic Jönköping	134	74	65 (22)	76 (20)	<20			
Arvika	<20							
Bollnäs	207	83	57 (22)	73 (19)	59	83	58 (21)	71 (21)
Borås	<20							
Capio Artro Clinic	120	54	63 (21)	76 (17)	20	53	58 (16)	68 (16)
Capio Movement	107	62	67 (20)	77 (17)	<20			
Capio Ortopedi Motala	84	22	57 (20)	75 (16)	<20			
Capio Ortopediska Huset	425	68	64 (20)	76 (17)	36	61	57 (21)	74 (18)
Capio S:t Göran	32	25	65 (19)	71 (18)	<20			
Carlanderska	0	0			0	0		
Carlanderska-SportsMed	<20				0	0		
Danderyd	<20				<20			
Eksjö	194	75	61 (20)	73 (18)	<20			
Enköping	20	10	55 (23)	65 (25)	<20			
Eskilstuna	<20							
Falun	0	0			0	0		
Frölundaortopeden	<20				0	0		
GHP Ortho Center Göteborg	43	47	60 (19)	76 (15)	<20			
GHP Ortho Center Stockholm	341	66	65 (21)	77 (18)	94	64	67 (21)	76 (17)
Gällivare	<20							
Gävle	0	0			0	0		
Halmstad	<20				<20			
Helsingborg	61	42	56 (25)	68 (20)				
Hermelinen	<20							
Hudiksvall	<20				0	0		
Hässleholm	334	46	64 (21)	74 (17)	<20			
Kalmar	26	79	63 (16)	76 (15)				
Karlshamn	73	76	64 (19)	74 (16)	<20			
Karlstad	<20							
Karolinska Huddinge	31	34	61 (24)	61 (20)	<20			
Karolinska Solna	<20							
Kullbergska sjukhuset	89	78	58 (17)	70 (20)	<20			

The table continues on the next page.

EQ VAS in primary knee replacement 2021, cont.

	Number response	Response rate	TKR mean (SD)		Number response	Response rate	UKR mean (SD)	
Enhet		**%**	**pre**	**1 year**		**%**	**pre**	**1 year**
Kungälv	20	63	51 (22)	68 (22)	<20			
Lidköping	<20							
Lindesberg	<20				0	0		
Ljungby	24	77	64 (19)	63 (23)	<20			
Lycksele	55	65	61 (20)	71 (16)	<20			
Mora	42	53	58 (19)	71 (18)	<20			
Norrköping	33	46	56 (23)	66 (23)	<20			
Norrtälje	59	61	68 (17)	72 (19)	<20			
Nyköping	22	76	53 (18)	59 (21)	<20			
Ortopedisk Center Sophiah.	25	51	68 (15)	78 (17)	<20			
Oskarshamn	173	87	62 (22)	75 (18)				
Piteå	90	47	54 (22)	71 (21)	45	58	57 (19)	77 (13)
Skellefteå	21	64	59 (21)	74 (20)				
Skene	50	51	59 (25)	72 (19)	<20			
Skövde	<20							
Sollefteå	56	85	64 (22)	73 (21)				
Specialistcenter Scandinavia Eskilstuna	<20				24	67	57 (26)	84 (12)
Specialistcenter Scandinavia Johanniskliniken	0				<20			
SU/Mölndal	<20				0	0		
SU/Sahlgrenska	0							
Sundsvall	0	0						
SUS/Lund	<20							
Södersjukhuset	<20							
Södertälje	21	30	58 (22)	75 (15)	<20			
Torsby	0	0			<20			
Trelleborg	113	34	62 (22)	70 (20)	<20			
Uddevalla	46	65	58 (20)	68 (18)				
Umeå	<20							
Varberg	42	66	53 (19)	72 (18)	<20			
Visby	20	51	66 (20)	72 (21)				
Värnamo	114	66	60 (22)	70 (19)	<20			
Västervik	70	64	55 (26)	73 (18)				
Västerås	38	33	53 (23)		<20			
Växjö	21	58	66 (19)	80 (16)	<20			
Örnsköldsvik	0	0			0	0		
Östersund	<20				<20			
Riket	**4 100**	**50**	**61 (21)**	**73 (19)**	**696**	**56**	**61 (22)**	**75 (16)**

Table 8.7. EQ VAS in primary knee replacement per unit.

KOOS-12 per unit TKR 2021 and 2022

Unit	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
			%	%	pre	1 year	pre	1 year	pre	1 year
Akademiska	2021	28	51	43	32 (12)	69 (23)	35 (14)	70 (19)	18 (11)	58 (20)
	2022	88	88	45	29 (14)		31 (16)		18 (12)	
Aleris Specialistvård Malmö	2021									
	2022	0	0							
Aleris Specialistvård Nacka	2021	88	64	33	36 (13)	79 (22)	38 (16)	79 (21)	21 (13)	69 (23)
	2022	161	88	33	35 (15)		40 (17)		21 (12)	
Aleris Specialistvård Ängelholm	2021	152	52	37	36 (15)	75 (22)	37 (18)	76 (21)	21 (14)	64 (24)
	2022	325	68	32	33 (15)		36 (16)		23 (13)	
Alingsås	2021	72	65	37	39 (13)	79 (21)	40 (17)	78 (20)	25 (13)	72 (23)
	2022	185	91	32	37 (13)		43 (16)		24 (13)	
Art Clinic Göteborg	2021	170	68	28	37 (14)	75 (22)	38 (18)	76 (21)	20 (12)	65 (24)
	2022	284	83	22	35 (15)		40 (19)		22 (13)	
Art Clinic Jönköping	2021	139	76	36	37 (15)	85 (18)	38 (17)	83 (18)	23 (15)	76 (21)
	2022	212	91	29	33 (14)		38 (17)		22 (13)	
Arvika	2021	<20								
	2022	13	4	25	38 (11)		39 (10)		21 (9)	
Bollnäs	2021	212	85	35	37 (14)	79 (22)	36 (16)	75 (21)	22(13)	68 (24)
	2022	307	94	32	35 (14)		37 (17)		22 (14)	
Borås	2021	<20								
	2022	28	70	46	28 (11)		28 (16)		18 (12)	
Capio Artro Clinic	2021	123	55	17	37 (16)	79 (24)	42 (19)	79 (22)	22 (13)	69 (25)
	2022	475	69	25	38 (15)		43 (19)		23 (14)	
Capio Movement	2021	100	58	20	39 (15)	83 (18)	46 (17)	82 (17)	26 (15)	72 (20)
	2022	251	54	32	38 (15)		44 (18)		27 (15)	
Capio Ortopedi Motala	2021	32	8	46	37 (16)	77 (22)	36 (18)	74 (19)	20 (13)	69 (20)
	2022	134	34	27	31 (16)		33 (18)		21 (14)	
Capio Ortopediska Huset	2021	52	8	31	37 (15)	84 (16)	38 (17)	82 (18)	23 (15)	77 (19)
	2022	0	0							
Capio S:t Göran	2021	<20								
	2022	178	75	36	33 (16)		38 (20)		22 (15)	
Carlanderska	2021	<20								
	2022	106	32	31	35 (13)		39 (17)		22 (12)	
Carlanderska-SportsMed	2021	0	0							
	2022	48	28	29	35 (15)		39 (21)		20 (15)	
Danderyd	2021	0	0							
	2022	33	29	23	32 (16)		36 (23)		18 (13)	
Eksjö	2021	211	81	39	39 (16)	77 (22)	38 (15)	76 (19)	25 (14)	68 (23)
	2022	271	89	31	35 (14)		41 (16)		25 (13)	
Enköping	2021	<20								
	2022	143	31	33	30 (14)		33 (16)		20 (13)	

The table continues on the next page.

KOOS-12 per unit TKR 2021 and 2022, cont.

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			%	%	pre	1 year	pre	1 year	pre	1 year
Eskilstuna	2021	0	0							
	2022	45	90	42	31 (13)		30 (14)		19 (13)	
Falun	2021	0	0							
	2022	0	0							
Frölundaortopeden	2021	0	0							
	2022	<20	22	0	39 (23)		43 (21)		23 (19)	
GHP Ortho Center Göteborg	2021	46	50	32	34 (15)	77 (20)	37 (18)	78 (19)	18 (13)	67 (19)
	2022	165	60	27	33 (15)		40 (18)		22 (14)	
GHP Ortho Center Stockholm	2021	274	53	30	39 (14)	79 (21)	40 (18)	78 (22)	22 (13)	69 (23)
	2022	574	85	28	36 (15)		40 (18)		23 (14)	
GHP Ortho and Spine Center Malmö	2021									
	2022	85	52	21	32 (14)		38 (20)		24 (13)	
Gällivare	2021	0	0							
	2022	<20								
Gävle	2021	0	0							
	2022	44	81	41	36 (12)		37 (14)		21 (14)	
Halmstad	2021	0	0							
	2022	39	42	36	37 (17)		40 (23)		23 (15)	
Helsingborg	2021	<20								
	2022	154	63	29	34 (13)		40 (17)		23 (15)	
Hermelinen	2021	0	0							
	2022	24	69	0	38 (17)		42 (17)		25 (12)	
Hudiksvall	2021	<20								
	2022	32	84	50	33 (14)		35 (18)		19 (12)	
Hässleholm	2021	353	48	38	37 (15)	72 (23)	37 (18)	73 (22)	23 (14)	64 (25)
	2022	663	88	33	35 (15)		38 (18)		24 (14)	
Kalmar	2021	<20								
	2022	84	93	37	39 (17)		41 (18)		26 (17)	
Karlshamn	2021	<20								
	2022	206	92	28	37 (15)		42 (17)		25 (14)	
Karlstad	2021	0	0							
	2022	<20								
Karolinska Huddinge	2021	<20								
	2022	77	46	35	27 (15)		27 (19)		14 (12)	
Karolinska Solna	2021	0	0							
	2022	27	64	44	33 (13)		35 (16)		22 (15)	
Kullbergska sjukhuset	2021	23	20	27	32 (18)	64 (25)	37 (18)	63 (23)	23 (16)	61 (23)
	2022	289	99	28	34 (13)		39 (15)		25 (14)	
Kungälv	2021	<20								
	2022	65	78	40	30 (16)		31 (19)		18 (15)	

The table continues on the next page.

KOOS-12 per unit TKR 2021 and 2022, cont.

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			%	%	pre	1 year	pre	1 year	pre	1 year
Ledplastikcentrum Bromma	2021									
	2022	93	45	39	35 (16)		37 (18)		23 (13)	
Lidköping	2021	0	0							
	2022	73	79	35	32 (15)		33 (16)		20 (14)	
Lindesberg	2021	0	0							
	2022	56	18	35	34 (18)		36 (20)		22 (17)	
Ljungby	2021	0	0							
	2022	82	98	36	38 (13)		45 (16)		30 (14)	
Lycksele	2021	<20								
	2022	163	90	39	34 (12)		38 (16)		23 (13)	
Mora	2021	<20								
	2022	114	63	34	33 (15)		37 (21)		22 (14)	
Norrköping	2021	0	0							
	2022	63	59	40	30 (14)		33 (19)		20 (13)	
Norrtälje	2021	49	51	29	38 (13)	75 (23)	34 (17)	70 (25)	22 (12)	60 (26)
	2022	121	78	40	35 (14)		40 (17)		24 (13)	
Nyköping	2021	0	0							
	2022	62	85	32	33 (14)		38 (18)		22 (13)	
Ortopedisk Center Sophiah.	2021	<20								
	2022	106	80	22	40 (13)		46 (16)		26 (12)	
Oskarshamn	2021	182	91	36	37 (14)	81 (21)	34 (14)	78 (20)	21 (14)	70 (22)
	2022	327	95	30	34 (14)		37 (16)		23 (13)	
Piteå	2021	113	59	43	37 (15)	81 (21)	34 (16)	77 (22)	18 (13)	70 (22)
	2022	213	79	44	30 (14)		33 (17)		19 (12)	
Skellefteå	2021	0	0							
	2022	43	60	29	42 (14)		44 (21)		29 (17)	
Skene	2021	23	23	33	44 (14)	76 (24)	43 (19)	70 (29)	31 (17)	65 (28)
	2022	117	64	38	39 (15)		36 (18)		20 (15)	
Skövde	2021	<20								
	2022	32	86	44	36 (11)		43 (18)		27 (14)	
Sollefteå	2021	<20								
	2022	138	95	33	34 (14)		36 (15)		22 (12)	
Specialistcenter Scandinavia Eskilstuna	2021	<20								
	2022	103	94	32	33 (11)		38 (14)		20 (11)	
Specialistcenter Scandinavia Johannisskliniken	2021	0	0							
	2022	0	0							
Specialistcenter Scandinavia Malmö	2021									
	2022	<20								
SU/Mölndal	2021	0	0							
	2022	227	79	39	30 (15)		33 (18)		18 (13)	

The table continues on the next page.

KOOS-12 per unit TKR 2021 and 2022, cont.

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			%	%	pre	1 year	pre	1 year	pre	1 year
SU/Sahlgrenska	2021	0	0							
	2022	0	0							
Sundsvall	2021	0	0							
	2022	<20								
SUS/Lund	2021	0	0							
	2022	<20								
Södersjukhuset	2021	0	0							
	2022	103	72	40	33 (15)		37 (19)		20 (14)	
Södertälje	2021	0	0							
	2022	97	71	45	32 (15)		34 (17)		20 (12)	
Torsby	2021	0	0							
	2022	84	75	36	34 (15)		40 (20)		23 (14)	
Trelleborg	2021	95	29	21	36 (16)	72 (23)	35 (17)	69 (23)	23 (14)	64 (24)
	2022	230	72	47	30 (14)		32 (16)		21 (14)	
Uddevalla	2021	<20								
	2022	123	80	38	31 (15)		33 (19)		20 (14)	
Umeå	2021	0								
	2022	<20								
Varberg	2021	<20								
	2022	63	62	40	35 (13)		36 (15)		21 (14)	
Visby	2021	0	0							
	2022	58	78	27	32 (14)		36 (16)		22 (14)	
Värnamo	2021	58	39		39 (14)	78 (20)	39 (18)	79 (17)	23 (13)	69 (21)
	2022	177	93	34	34 (14)		38 (17)		24 (13)	
Västervik	2021	<10								
	2022	103	91	35	34 (14)		37 (16)		22 (13)	
Västerås	2021	<20								
	2022	190	78	41	32 (15)		34 (16)		21 (13)	
Växjö	2021	<20								
	2022	24	21	42	37 (12)		38 (14)		24 (16)	
Örnsköldsvik	2021	<20								
	2022	0	0							
Östersund	2021	0	0							
	2022	68	91	41	30 (14)		29 (16)		17 (11)	
Country	**2021**	**2,712**	**33**	**34**	**37 (15)**	**77 (22)**	**38 (17)**	**76 (21)**	**22 (14)**	**68 (23)**
	2022	**9,343**	**63**	**33**	**34 (15)**		**38 (18)**		**22 (14)**	

Table 8.8. KOOS-12 per unit TKR 2021 and 2022.

KOOS-12 per unit UKR 2021 and 2022

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			%	%	pre	1 year	pre	1 year	pre	1 year
Akademiska	2021	<20								
	2022									
Aleris Specialistvård Malmö	2021									
	2022	0	0							
Aleris Specialistvård Nacka	2021	90	60	27	37 (16)	79 (20)	37 (16)	78 (18)	21 (13)	71 (20)
	2022	308	92	28	33 (13)		41 (17)		23 (13)	
Aleris Specialistvård Ängelholm	2021	86	50	35	36 (15)	77 (22)	36 (11)	75 (21)	19 (12)	64 (23)
	2022	84	61	24	34 (12)		41 (16)		20 (11)	
Art Clinic Göteborg	2021	20	74	29	37 (11	71 (20)	37 (11)	75 (15)	20 (11)	62 (18)
	2022	<20								
Art Clinic Jönköping	2021	<20								
	2022	<20								
Bollnäs	2021	57	80	35	35 (15)	77 (26)	35 (15)	74 (26)	21 (10)	69 (28)
	2022	41	98	30	37 (13)		44 (16)		27 (9)	
Capio Artro Clinic	2021	22	58	17	34 (19)	74 (20)	34 (19)	78 (20)	23 (15)	63 (24)
	2022	61	67	28	35 (15)		42 (21)		22 (14)	
Capio Movement	2021	<20								
	2022	43	66	7	34 (11)		48 (20)		30 (16)	
Capio Ortopedi Motala	2021	<20								
	2022	<20								
Capio Ortopediska Huset	2021	<20								
	2022	0	0							
Capio S:t Göran	2021	0	0							
	2022	33	79	19	37 (13)		49 (20)		30 (16)	
Carlanderska	2021	0	0							
	2022	<20								
Carlanderska-SportsMed	2021	0								
	2022	<20								
Danderyd	2021	0	0							
	2022	22	31	38	35 (18)		42 (20)		24 (15)	
Eksjö	2021	<20								
	2022	<20								
Enköping	2021	<20								
	2022	<20	36							

The table continues on the next page.

KOOS-12 per unit UKR 2021 and 2022, cont.

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			%	%	pre	1 year	pre	1 year	pre	1 year
Falun	2021	0	0							
	2022	0	0							
Frölundaortopeden	2021	0	0							
	2022	0	0							
GHP Ortho Center Göteborg	2021	<20								
	2022	<20								
GHP Ortho Center Stockholm	2021	73	50	17	38 (13)	78 (22)	38 (13)	77 (20)	21 (14)	70 (24)
	2022	169	85	25	36 (15)		43 (19)		25 (13)	
GHP Ortho och Spine Center Malmö	2021									
	2022	<20								
Gävle	2021	0	0							
	2022	<20								
Halmstad	2021	0	0							
	2022	<20								
Helsingborg	2021									
	2022	<20								
Hudiksvall	2021	0	0							
	2022									
Hässleholm	2021	<20								
	2022	<20								
Karlshamn	2021									
	2022	<20								
Karolinska Huddinge	2021	<20								
	2022	<20								
Karolinska Solna	2021									
	2022									
Kullbergska sjukhuset	2021	<20								
	2022	46	100	20	36 (15)		42 (19)		25 (14)	
Kungälv	2021	<20								
	2022	<20								
Ledplastikcentrum Bromma	2021									
	2022	31	31	29	34 (14)		42 (16)		25 (13)	
Lidköping	2021									
	2022	<20								

The table continues on the next page.

KOOS-12 per unit UKR 2021 and 2022, cont.

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			%	%	pre	1 year	pre	1 year	pre	1 year
Lindesberg	2021									
	2022	<20								
Ljungby	2021	0	0							
	2022	28	100	21	38 (13)		44 (16)		25 (13)	
Lycksele	2021	<20								
	2022	34	89	29	37 (11)		42 (15)		24 (12)	
Mora	2021									
	2022	31	66	23	33 (15)		37 (16)		18 (15)	
Norrköping	2021	<20								
	2022	<20								
Norrtälje	2021	<20								
	2022	<20								
Nyköping	2021	0	0							
	2022	30	81	34	36 (12)		42 (17)		26 (14)	
Ortopedisk Center Sophiah.	2021	0	0							
	2022	70	80	21	34 (14)		42 (20)		23 (13)	
Oskarshamn	2021									
	2022	<20								
Piteå	2021	39	50	33	40 (15)	82 (21)	40 (15)	78 (20)	21 (12)	69 (25)
	2022	44	75	30	29 (12)		36 (16)		16 (10)	
Skene	2021									
	2022	<20								
Specialistcenter Scandinavia Eskilstuna	2021	28	78	33						
	2022	<20								
Specialistcenter Scandinavia Johanniskliniken	2021	<20								
	2022	0	0							
Specialistcenter Scandinavia Malmö	2021									
	2022	<20								
SU/Mölndal	2021	0								
	2022	<20								
Södertälje	2021	0	0							
	2022									
Torsby	2021	0	0							
	2022	<20								

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KOOS-12 per unit UKR 2021 and 2022, cont.

	Year	Number response	Response rate	Proportion Charnley C	Pain mean (SD)		ADL mean (SD)		QoL mean (SD)	
Unit			**%**	**%**	**pre**	**1 year**	**pre**	**1 year**	**pre**	**1 year**
Trelleborg	2021	<20								
	2022	<20								
Varberg	2021	0	0							
	2022	<20								
Visby	2021									
	2022	<20								
Värnamo	2021									
	2022	<20								
Västerås	2021	0	0							
	2022									
Växjö	2021	<20								
	2022	0	0							
Örnsköldsvik	2021	0	0							
	2022	0	0							
Östersund	2021	0	0							
	2022	23	88	41	29 (16)		41 (18)		19 (14)	
Country	**2021**	**506**	**40**	**27**	**37 (16)**	**78 (22)**	**37 (16)**	**77 (21)**	**22 (13)**	**68 (24)**
	2022	**1,332**	**63**	**25**	**35 (14)**		**42 (18)**		**23 (13)**	

Table 8.9. KOOS-12 per unit UKR 2021 and 2022.

Small differences in results since 2009

Since 2009 when patient-reported outcomes were presented in TKR from Trelleborg the first time until this year's report which refers to TKRs performed in 2021, the variation has been small. General health one year postoperatively has varied from 75 to 78. The proportion of OMERACT-OARSI-responders was 85 % in 2009 and in recent years has been 89 %. In 2020 the proportion of responders was 93 % and in 2021 it was 92 % using KOOS-12. The proportion of satisfied patients has increased since 2009 (only Trelleborg patients) from 81% to vary in later years between 81 % and 88 %. In the full-scale KOOS (42 questions) five subscales, the variation has been small over the years, between 1 and 4 points. There are small variations between the years considering that there are different patients each year who report. With the KOOS-12 three subscales, we can see that the score is slightly lower in general for the subscale ADL-function, which probably is due to fewer questions than in the full-scale KOOS. For the subscale pain there is a minor difference of 3 to 4 points just as in previous years while the subscale knee-related quality of life (QoL) is the same as in full-scale KOOS and the difference between operations in 2020 and in 2021 is one point.

Everyday exercise and physical activity in elective total hip replacement and knee replacement

In table 8.10 we present the two new questions regarding how much time is spent on everyday exercise and physical activity respectively each week. The table includes those patients who are operated September 1st 2021 to December 31st 2021and that have pre and one-year postoperative responses per unit. Even here, the response frequency is low, probably due to the same reasons that have been mentioned earlier in this chapter and for units with few operations and/or with a low response rate results and proportions may be misleading. 22 % of the hip replacement and 28 % of the knee replacement patients reported that they practiced everyday exercise > 150 minutes per week preoperatively and 34 % one year postoperatively in both the hip and the knee patients. The corresponding figures for physical activity > 60 minutes per week was 22 % and 28 % in hip and knee replacement patients respectively preoperatively and 31% and 37 % respectively one year postoperatively.

Hip and knee replacements with a registration in the Swedish Osteoarthritis Registry before surgery

The aim with the Swedish Osteoarthritis Registry is to follow up and improve the first-line treatment in patients with osteoarthritis. The first-line treatment consists of information, training and weight control which the patients may access by Supported Osteoarthritis Self-management Programme (SOASP) an intervention registered in the Osteoarthritis Registry. In this year's report we have linked the Swedish Osteoarthritis Registry with the Swedish Arthroplasty Register to find out how large proportion of total hip and knee replacements surgeries performed in 2020 and 2021 due to osteoarthritis having a registration in the Swedish Osteoarthritis Registry. In table 8.11 we can see that there is approximately the same proportion of total hip replacement surgeries (24 %) such as knee replacements (25 %) that are registered in the Swedish Osteoarthritis Registry. The table also shows that the variation between different units is large. In Gällivare only 1 % of total hip replacements have a registration in the Osteoarthritis Registry and 3 % of the knee replacements while 49 % of the hip replacements in Falun have a registration and 48 % of knee replacements in Alingsås. Table 8.12 shows the corresponding information but per region. Also, at the regional level the variation is large from just below 9 % and 10 % respectively in Norrbotten in hip and knee replacements respectively to 47 % and 45 % respectively in Dalarna.

The reasons for the relatively low proportion and large variation in total hip replacements and knee replacement surgeries who have a registration in the Swedish Osteoarthritis Registry in 2021 and 2022 may be several. The pandemic may be one reason as individuals with osteoarthritis may have avoided contact with the healthcare and the healthcare providers has had limited options. Another reason may be that the units' routines to recommend or require completion of SOAPS before surgery varies and in the regions the politicians' priorities may be different.

Everyday exercise and physical activity in hip and knee replacement 2021

	Hip						Knee					
	Number response	Response rate %	Everyday exercise >150 min/ week %		Physical activity >60 min/ week %		Number response	Response rate %	Everyday exercise >150 min/ week %		Physical activity >60 min/ week %	
Unit			pre	1 year	pre	1 year			pre	1 year	pre	1 year
Akademiska	36	37	30	37	37	28	30	49	33	37	30	43
Aleris Specialistvård Nacka	89	59	20	38	26	35	103	81	33	39	30	40
Aleris Specialistvård Ängelholm	62	31	33	40	34	33	58	27	33	45	28	34
Alingsås	40	55	21	41	23	32	54	72	24	35	35	35
Art Clinic Göteborg	44	40	32	45	20	37	78	68	32	45	32	38
Art Clinic Jönköping	69	68	24	33	15	35	56	80	23	41	30	45
Arvika	0	0					<20					
Bollnäs	105	81	19	34	24	22	118	90	23	28	23	34
Borås	<20						<20					
Capio Artro Clinic	93	36	36	41	30	46	137	51	37	41	39	50
Capio Movement	46	30	25	51	32	38	115	61	30	46	33	42
Capio Ortopedi Motala	60	33	29	35	21	27	59	24	29	25	27	37
Capio Ortopediska Huset	131	42	30	38	36	43	168	57	31	34	33	42
Capio S:t Göran	33	15	15	27	21	30	22	16	9	41	32	41
Carlanderska	<20						<20					
Carlanderska-SportsMed							<20					
Danderyd	<20						<20					
Eksjö	56	52	13	35	14	27	88	77	32	32	22	34
Enköping	<20						21	10	24	19	14	24
Eskilstuna	24	57	25	23	6	20	<20					
Falun	<20						0					
Frölundaortopeden							<20					
GHP Ortho Center Göteborg	36	32	26	46	29	48	42	42	36	40	41	62
GHP Ortho Center Stockholm	165	50	31	38	28	43	137	50	31	37	42	52
Gällivare	26	61	11	11	11	23	<20					
Gävle	21	58	17	20	8	20	<20					
Halmstad	<20						<20					
Helsingborg	<20						59	63	32	37	17	31
Hermelinen							<20					
Hudiksvall	<20						<20					
Hässleholm	121	40	32	40	19	33	235	65	39	40	29	35
Jönköping	20	69	14	20	9	16						

The table continues on the next page.

Everyday exercise and physical activity in hip and knee replacement 2021, cont.

	Hip						Knee					
	Number response	Response rate %	Everyday exercise >150 min/ week %		Physical activity >60 min/ week %		Number response	Response rate %	Everyday exercise >150 min/ week %		Physical activity >60 min/ week %	
Unit			pre	1 year	pre	1 year			pre	1 year	pre	1 year
Kalmar	<20						<20					
Karlshamn	81	76	22	34	19	26	75	72	21	39	25	35
Karlstad	<20						<20					
Karolinska Huddinge	25	23	28	24	16	26	<20					
Karolinska Solna							0					
Kullbergska sjukhuset	134	81	27	42	25	34	108	76	31	38	28	33
Kungälv	<20						<20					
Lidköping	36	54	8	24	9	13	<20					
Lindesberg	<20						<20					
Linköping	0	0										
Ljungby	32	64	19	26	29	26	38	76	21	24	30	29
Lycksele	70	60	21	36	23	33	71	63	24	32	23	45
Mora	21	20	13	30	17	24	50	52	20	28	20	26
Norrköping	35	39	10	29	16	25	34	52	15	24	29	29
Norrtälje	38	40	20	32	12	26	39	57	18	26	21	44
Nyköping	31	54	28	22	22	22	36	75	28	28	22	36
Ortopedisk Center Sophiah.							39	56	41	46	62	62
Oskarshamn	84	63	27	43	24	33	112	89	32	35	29	35
Piteå	87	48	7	25	18	30	68	41	21	22	10	29
Skellefteå	41	53	14	29	26	31	21	64	19	48	19	29
Skene	0	0					0					
Skövde	<20						<20					
Sollefteå	109	65	24	37	18	31	53	79	26	32	28	21
Sophiahemmet	<20											
Specialistcenter Scandinavia Eskilstuna	36	60	23	40	18	32	30	68	23	37	20	50
Specialistcenter Scandinavia Johanniskliniken							<20					
SU/Mölndal	23	17	4	22	7	30	0					
Sundsvall							0					
SUS/Lund							<20					
Södersjukhuset	<20						20	41	20	25	20	40
Södertälje	<20						<20					

The table continues on the next page.

Everyday exercise and physical activity in hip and knee replacement 2021, cont.

	Hip						Knee					
	Number response	Response rate %	Everyday exercise >150 min/ week %		Physical activity >60 min/ week %		Number response	Response rate %	Everyday exercise >150 min/ week %		Physical activity >60 min/ week %	
Unit			pre	1 year	pre	1 year			pre	1 year	pre	1 year
Torsby	0	0					0					
Trelleborg	99	65	22	38	21	31	125	63	16	26	28	30
Uddevalla	82	49	20	27	19	25	49	63	27	33	16	31
Umeå	<20						<20					
Varberg	<20						48	65	27	19	19	38
Visby	36	62	30	52	35	36	20	49	45	60	30	35
Värnamo	46	61	26	37	13	25	59	72	22	28	16	34
Västervik	30	44	24	30	18	25	20	42	30	30	15	35
Västerås	<20						36	30	14	11	14	17
Växjö	29	48	27	30	11	20	25	56	12	32	16	28
Ängelholm	27	39	23	37	26	35						
Örnsköldsvik	27	87	10	39	17	43	0					
Östersund	<20						<20					
Country	**2,733**	**38**	**22,4**	**34,2**	**21,5**	**31,4**	**2,880**	**47**	**28**	**34**	**28**	**37**

Table 8.10. Proportion everyday exercise >150 min/week and physical activity >60 min/week preoperatively and one year postoperatively in hip and knee replacement 2021.

Proportion of hip and knee replacements for OA with a registration in the Osteoarthritis registry before the replacement per unit

	Total hip		Knee	
Unit	**Number in SAR**	**% in OA registry**	**Number in SAR**	**% in OA registry**
Akademiska sjukhuset	263	18.3	179	21.8
Aleris Malmö Arena	31	25.8	34	20.6
Aleris Specialistvård Nacka	908	24.1	813	22.9
Aleris Specialistvård Ängelholm	938	18.7	1,068	19.9
Alingsås	287	42.5	313	47.9
Art Clinic Göteborg	592	39.0	635	39.4
Art Clinic Jönköping	561	30.7	455	31.4
Arvika	570	26.7	572	36.2
Bollnäs	652	13.3	685	15.2
Borås	77	15.6	69	24.6
Capio Artro Clinic	1,322	22.2	1,464	21.0
Capio Movement	949	26.6	1,042	26.1
Capio Ortopedi Motala	799	40.7	918	41.7
Capio Ortopediska Huset	1,538	27.2	1,552	26.7
Capio S:t Göran	664	20.6	445	18.7
Carlanderska	900	33.6	735	32.7
Carlanderska-SportsMed	215	23.3	321	19.0
Danderyd	284	11.6	238	13.0
Eksjö	544	15.8	587	17.2
Enköping	939	20.8	907	18.3
Eskilstuna	102	18.6	74	24.3
Falun	245	49.0	275	46.2
Frölundaortopeden	29	13.8	51	25.5
GHP Ortho Center Göteborg	558	25.3	563	26.6
GHP Ortho Center Stockholm	1,638	27.2	1,549	28.9
GHP Ortho och Spine Center Skåne	194	24.7	179	16.8
Gällivare	85	1.2	64	3.1
Gävle	99	7.1	95	4.2
Halmstad	214	13.6	257	13.2
Helsingborg	83	4.8	393	17.6
Hermelinen	65	12.3	67	9.0
Hudiksvall	105	9.5	100	17,0
Hässleholm	1,132	14.1	1,454	19.5
Jönköping	192	19.8		

The table continues on the next page.

Proportion of hip and knee replacements for OA with a registration in the Osteoarthritis registry before the replacement per unit, cont.

	Total hip		Knee	
Unit	Number in SAR	% in OA registry	Number in SAR	% in OA registry
Kalmar	107	33.6	101	22.8
Karlshamn	437	22.7	411	33.1
Karlstad	42	26.2	39	10.3
Karolinska Huddinge	399	22.3	242	20.7
Karolinska Solna	21	28.6	42	11.9
Kullbergska sjukhuset	665	29.5	601	24.1
Kungälv	130	28.5	137	29.9
Ledplastikcentrum Bromma	250	33.2	300	27.7
Lidköping	289	35.3	119	34.5
Lindesberg	672	22.2	593	25.1
Linköping	143	42.7		
Ljungby	184	19.0	218	23.9
Lycksele	436	17.0	393	21.1
Mora	458	40.8	394	43.9
Norrköping	234	39.7	193	47.2
Norrtälje	268	23.1	272	21.0
Nyköping	225	21.8	179	22.9
Ortopediskt Center - Sophiahemmet	290	23.1	386	14.0
Oskarshamn	712	32.4	528	34.8
Piteå	675	9.0	580	11.0
SU/Mölndal	526	33.8	367	29.7
SUS/Lund	27	7.4		
Skellefteå	218	9.6	114	5.3
Skene	317	34.7	283	26.5
Skövde	67	40.3	40	47.5
Sollefteå	736	14.4	275	14.9
Sophiahemmet	253	13.0		
Specialistcenter S:t Johanniskliniken			101	22.8
Specialistcenter Scandinavia Malmö	51	13.7	28	35.7
Specialistcenter Scandinavia, Eskilstuna	220	29.1	184	28.8
Sundsvall			25	4.0
Södersjukhuset	159	18.9	176	23.9
Södertälje	190	15.8	211	15.2
Torsby	288	34.4	289	34.6

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Proportion of hip and knee replacements for OA with a registration in the Osteoarthritis registry before the replacement per unit, cont.

	Total hip		Knee	
Unit	**Number in SAR**	**% in OA registry**	**Number in SAR**	**% in OA registry**
Trelleborg	516	16.7	699	18.7
Uddevalla	503	30.4	275	35.3
Umeå	58	17.2	55	18.2
Varberg	316	11.4	199	13.1
Visby	223	22.4	184	39.1
Värnamo	325	14.5	374	14.2
Västervik	228	18.4	222	27.5
Västerås	543	36.1	395	43.8
Växjö	260	21.2	173	19.1
Ängelholm	285	18.6		
Örnsköldsvik	229	15.3	272	21.7
Östersund	231	31.2	126	33.3
Country	31,216	24.4	28,965	25.3

Table 8.11. Proportion of total hip and knee replacements due to OA with a registration in the Swedish Osteoarthritis Registry before the replacement per unit 2021 and 2022. Units with fewer than 20 operations are excluded.

Proportion of hip and knee replacements for OA with a registration in the Osteoarthritis registry before the replacement per region

	Total hip		Knee	
Region	**Number in SAR**	**% in OA registry**	**Number in SAR**	**% in OA registry**
Blekinge	452	23.2	411	33.1
Dalarna	703	43.7	669	44.8
Gotland	223	22.4	184	39.1
Gävleborg	856	12.1	880	14.2
Halland	1,479	21.4	1,498	22.2
Jämtland	231	31.2	126	33.3
Jönköping	1,622	21.1	1,416	21.0
Kalmar	1047	29.5	851	31.5
Kronoberg	444	20.3	391	21.7
Norrbotten	827	8.5	711	10.1
Skåne	3,258	16.7	3,871	19.2
Stockholm	8,184	23.8	7,690	23.3
Sörmland	1,212	27.1	1,038	24.8
Uppsala	1,202	20.2	1,187	19.2
Värmland	900	29.1	900	34.6
Västerbotten	712	14.7	562	17.6
Västernorrland	979	14.4	572	17.7
Västmanland	543	36.1	395	43.8
Västra Götaland	4,494	32.7	3,909	32.3
Örebro	672	22.2	593	25.1
Östergötland	1,176	40.7	1,111	42.7
Country	**31,216**	**24.4**	**28,965**	**25.3**

Table 8.12. Proportion of total hip and knee replacements due to OA with a registration in the Swedish Osteoarthritis Registry before the replacement per region 2021 and 2022.

In-depth analyses to gain deeper knowledge in selected topics.

9. In-depth analyses

9.1. Compensation claims after primary knee and hip replacement surgery

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Despite the intention to provide patients with the best possible care, injuries and malpractices do occur. In the Patient Safety Act, patient injury refers to suffering, physical or mental injury or illness, as well as death which could have been avoided if adequate measures had been taken in the patient's contact with the healthcare.

A person who suffered an avoidable healthcare or dental care injury may be entitled to financial compensation according to the Swedish Patient Safety Act. Patients being cared for in public healthcare are automatically insured via their care provider in LÖF (the Mutual Insurance Company of Swedish County Councils). Patients operated on in private units as an insured patient or pay for their surgery themselves are covered by the respective private unit's insurance company.

LÖF annually receives approximately 20,000 claims and around 40 % of the claims are compensated. Orthopaedics is one of the areas where claims are most common. A person can report own injury or injury that has afflicted someone else. A report should be submitted within ten years (for injuries caused after 2014, from 1997–2014 applies for three years) from that the patient has been informed that the claim can be made valid, meaning when the injury is objectively noticeable and that it is related to the treatment. Healthcare provider have an obligation to inform patients and relatives that a patient injury has occurred and the possibility to claim compensation.

This in-depth analysis describes how many avoidable patient injuries have been reported and approved after knee and hip replacement surgery due to osteoarthritis 2012–2021. We also investigate whether the incidence differs between the regions.

Method

We have received information from LÖF of all reports with claim dates 2012 to 2021 for all types of primary knee and hip replacements with the diagnostic indication osteoarthritis and if the claim has been approved or not. The claim date constitutes in most cases the date of surgery. Number of knee and hip replacements due to osteoarthritis performed 2012–2021 were obtained from the Swedish Arthroplasty Register. Surgeries performed at private units that only perform surgeries on insurance patients or on patients paying for their surgery themselves were excluded.

We describe the number and proportion of reported and approved claims per year and calculated the incidence of approved claims per 1,000 operations in the regions in the ten-year period.

What did the results show?

1,462 claims were reported to LÖF after knee replacement surgery 2012 to 2021 whereof 1,081 (74 %) were approved as avoidable patient injury. The corresponding numbers for hip replacement surgery was 2,108 reported claims whereof 1,564 (76 %) were approved. The proportion of claims decreased over time in both knee and hip replacements while the proportion of approved claims increased slightly from 2012 to 2021. During the pandemic years, fewer surgeries were performed and relatively few claims were reported (figures 9.1.1 a-b).

The incidence of approved claims per 1,000 operations is higher in hip replacement surgery (11.4) than in knee replacement surgery (8.1) and the variation is large in the regions. The lowest incidence in knee replacement surgery was in Blekinge and Jämtland (5.4) and the highest in Kronoberg and Västerbotten (15.4 and 15.5 respectively). In hip replacement surgery the lowest incidence was in Kalmar (4.9) and the highest in Värmland (30.3) (table 9.1.1).

There were 175 injury diagnoses for hip and 170 for knee. Most of these codes were related to infection and mechanical complication.

How should these results be interpreted?

The large variation in incidence between the regions in both knee and hip replacement surgery is difficult to interpret, as there are several explanations. For example, a region with low incidence actually have a low complication rate or the care providers may be bad informing patients about an injury that has occurred and the right to claim compensation and vice versa for regions with a high incidence.

The proportion of approved claims based on the information from LÖF 2012–2021 tends to decrease, but as a patient/relative can report an injury up to ten years after that the patient has been made aware that the claim can be enforced, the decline is uncertain.

As a comparison to the Swedish incidence, there are studies from Finland, Norway and Denmark which have the equivalent insurance system such as LÖF. In Finland, the incidence for approved claims were estimated to 10 and 12 respectively for primary knee and hip replacement surgery (operations performed 1998–2003) (Järvelin et al, 2012). And from Norway was corresponding incidence 4 for primary knee replacement surgery (operations performed 2008–2018) (Randsborg et al, 2021) and 9 for primary hip replacement surgery (2008–2018) (Aae et al., 2021). In Denmark, the incidence was estimated to 25 after total hip replacement surgery 2005–2017 (Kahn et al, 2020).

The great variation in the regions indicates that information from the care provider to patients and relatives that a patient injury has occurred and the possibility of compensation claim need to be raised. To increase and equalize patient safety in the regions, claims to LÖF needs to be followed regularly. Furthermore, reasons for patient injuries are needed to be studied more in-depth in order to be able to avoid them as much as possible in the future.

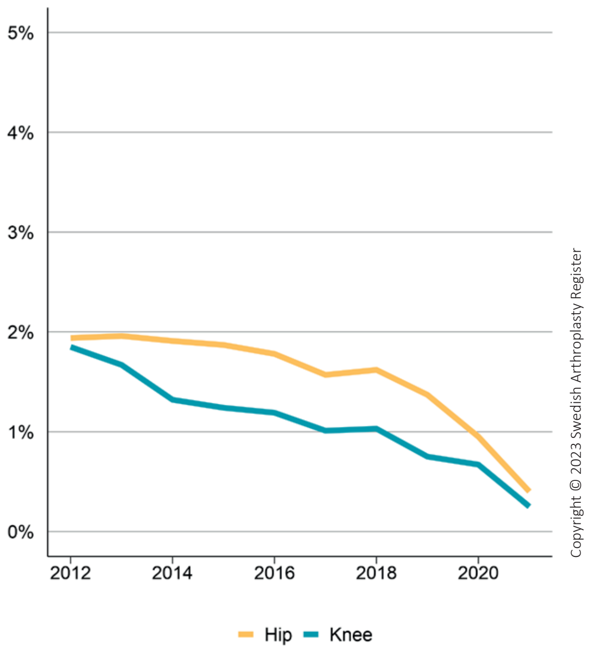


Figure 9.1.1 a. Proportion of compensation claims after knee and hip replacement surgery with the diagnosis of osteoarthritis 2012–2021.

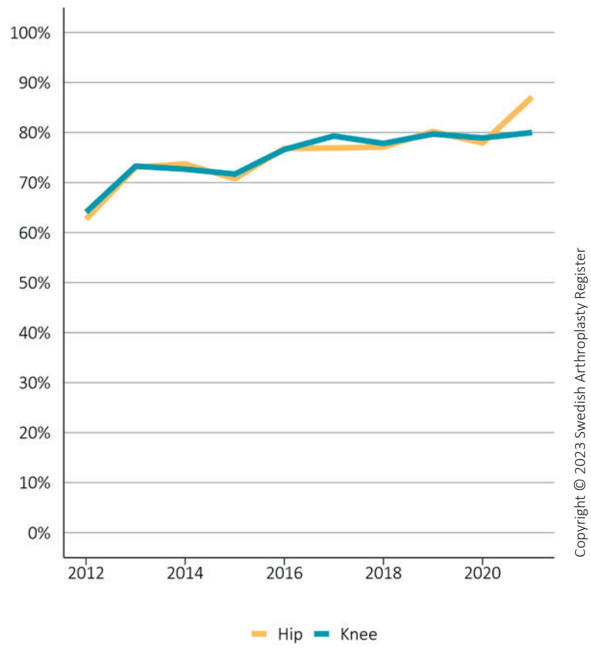


Figure 9.1.1b. Proportion of approved claims after knee and hip replacement surgery with a diagnosis of osteoarthritis by injury years 2012-2021.

The incidence per 1,000 operations for approved healthcare injuries by region

	Knee			Hip		
Region	Number operations	Number approved	Incidence per 1,000 operations	Number operations	Number approved	Incidence per 1,000 operations
Stockholm	27,156	209	7.7	27,946	349	12.5
Uppsala	4,65	53	11.4	4,847	64	13.2
Sörmland	3,658	30	8.2	4,127	68	16.5
Östergötland	6,416	53	8.3	6,802	65	9.6
Jönköping	5,642	54	9.6	5,449	80	14.7
Kronoberg	2,212	34	15.4	2,362	36	15.2
Kalmar	4,623	36	7.8	4,919	24	4.9
Gotland	858	8	9.3	1,085	11	10.1
Blekinge	2,412	13	5.4	2,237	23	10.3
Skåne	18,087	105	5.8	15,290	94	6.1
Halland	8,1	60	7.4	7,254	76	10.5
Västra Götaland	18,571	129	6.9	20,229	225	11.1
Värmland	4,412	50	11.3	4,022	122	30.3
Örebro	3,760	29	7.7	4,515	40	8.6
Västmanland	2,233	22	9.9	2,690	28	10.4
Dalarna	3,994	37	9.3	4,131	53	12.8
Gävleborg	4,959	45	9.1	4,646	47	10.1
Västernorrland	2,835	28	9.9	3,830	35	9.1
Jämtland	1,306	7	5.4	1,892	17	9
Västerbotten	3,106	48	15.5	4,077	46	11.3
Norrbotten	3,647	31	8.5	4,462	61	13.7
Country	**132,702**	**1,081**	**8.1**	**136,812**	**1,564**	**11.4**

Table 9.1.1. Incidence per 1,000 operations for approved claims after knee and hip replacement surgery with a diagnosis of osteoarthritis in the regions 2012–2021.

9.2. Bone cement in primary hip replacement

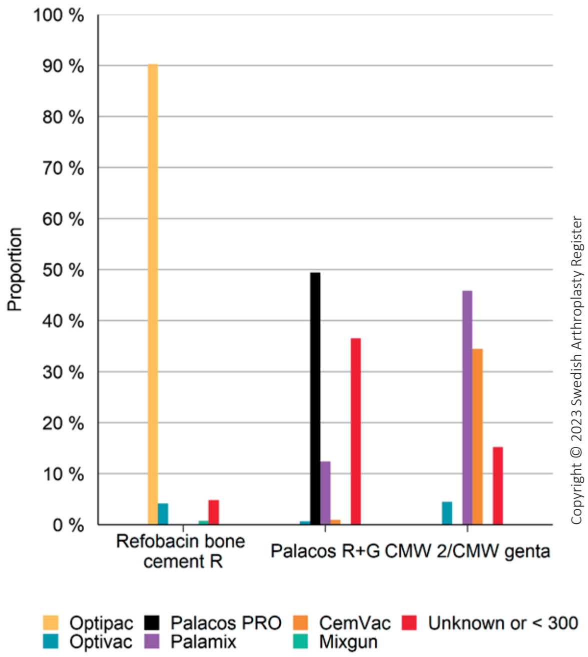
Author: Johan Kärrholm

In this in-depth analysis we try to evaluate how choice of bone cement may influence the risk of revision in total hip replacement. Since the potential influence of the cement could vary depending on if the cup or the stem is fixated with cement, we have initially performed two separate analyses. They are based on 99,276 cemented cups, whereof 85 % also have a cemented stem and 83,489 cemented stems, whereof 91.3 % also have a cemented cup.

The choice of bone cement in hip replacement surgery has been registered since 1992 while mixing systems were first recorded as a separate variable in 2006. The registration of bone cement has been relatively complete since 1992, in contrast to the choice of mixing system where the proportion of missing observations was higher than 30 % until 2016 and is now reduced to less than one percent. Several cements are delivered in a specific mixing system which means that analysis of how a certain mixing system affects the outcome regarding the risk of future revision is difficult or impossible to evaluate (figures 9.2.1 a and b).

In cases where the same cement has not been used for both cup and stem, alternatively if one of the components have been fixated without cement, we do not know if this choice affects the risk of revision of the cemented component being evaluated. If this would be the case, this has not been considered. In the groups (figures 9.2.2 a and b) where both cup and stem are cemented, the same type of cement has been used for both components in the majority of the cases using Refobacin Bone Cement R and Palacos R + G.

This means that the question of how the choice of cement for the stem when evaluating the cup and vice versa becomes less relevant as far as it is not a hybrid or reversed hybrid. When CMW 2 or CMW genta were chosen for the cup, the stem has been cemented with the same cement in only 62.6 % of the cases. In other cases, Palacos R + G has mainly been used followed by Refobacin Bone Cement R.



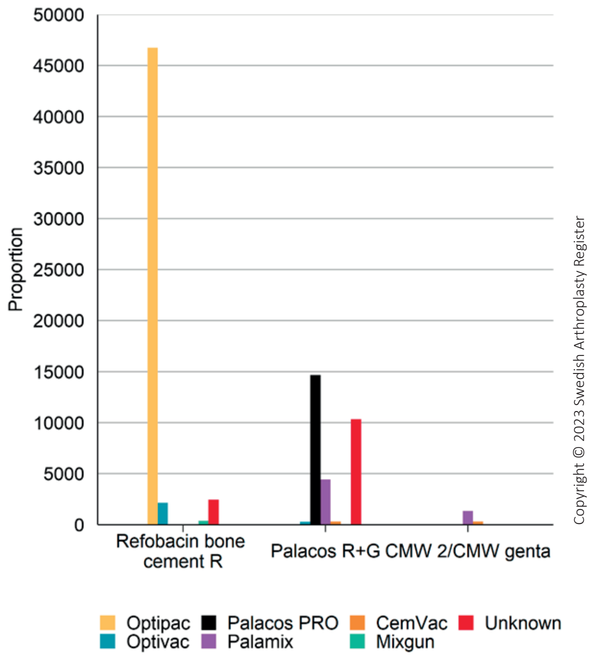


Figure 9.2.1. Distribution of mixing systems for the three bone cements selected for the depth analysis of cups (a) and stems (b). Evaluation of mixing systems is not included in this in-depth analysis (see text).

Flow chart cemented stem

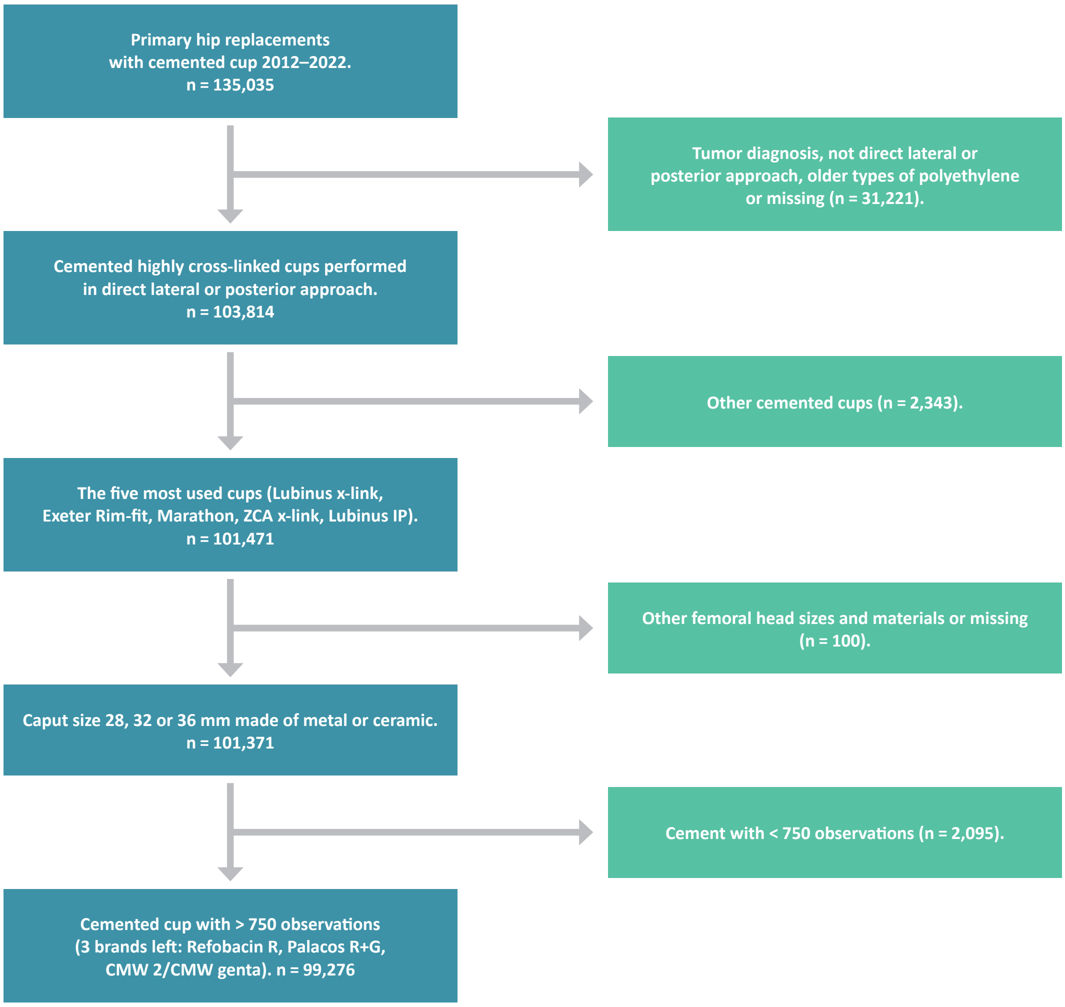


Figure 9.2.2a. Flow chart showing selection criteria for the cemented cups included in the analysis of bone cement. After selection, 84,403 fully cemented hip replacements, 14,530 reverse hybrids and 343 cemented cups with unknown stem fixation are included.

Flow chart cemented stem

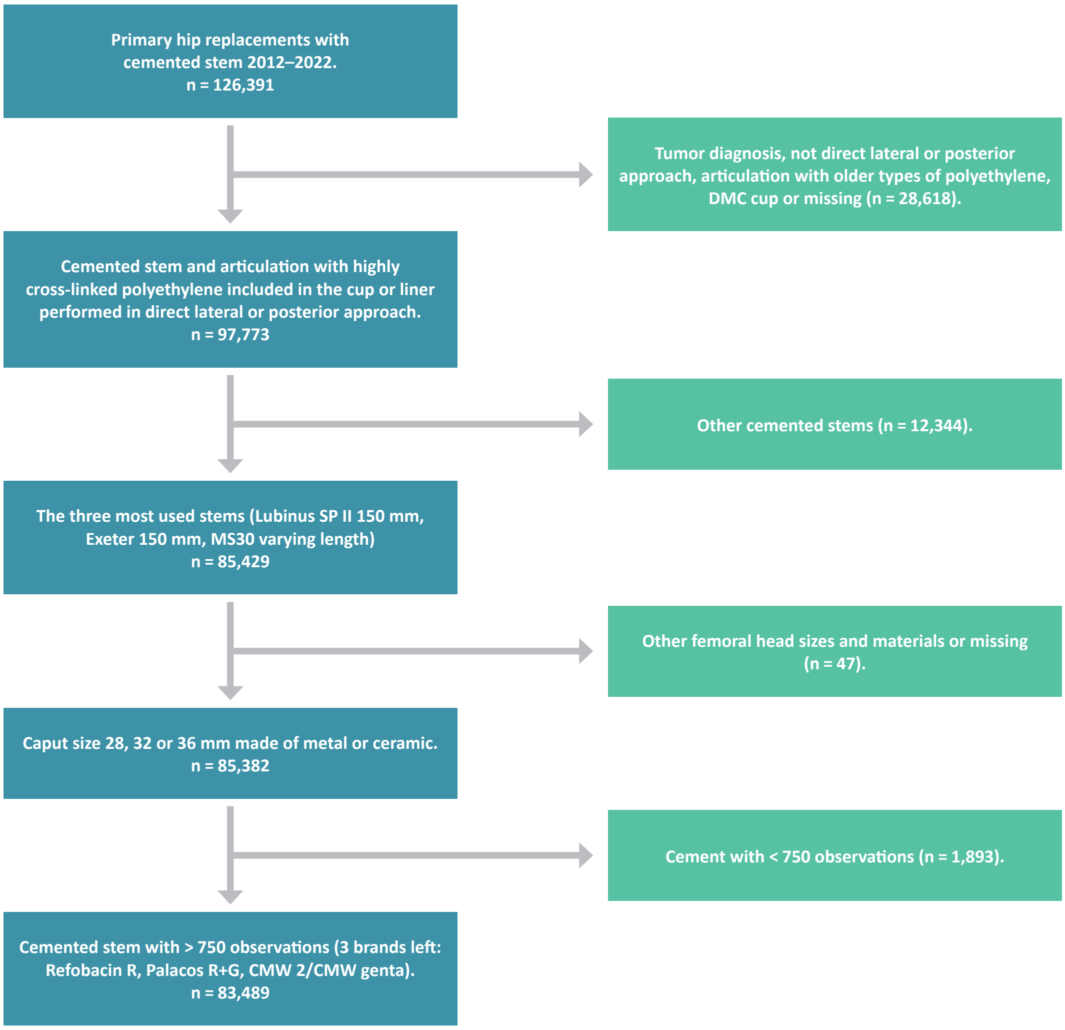


Figure 9.2.2b. Flow chart showing selection criteria for the cemented stems included in the bone cement analysis. After selection, 78,679 fully cemented hip replacements, 7,327 hybrids and 124 cemented stems with unknown cup fixation are included. Fully cemented hip replacements in the third analysis (post-hoc) where both cup and stem are fixed with the same bone cement (either Refobacin Bone Cement R or Palacos R+G) have been extracted from the two groups selected according to figure 9.2.1 a and b (details not shown).

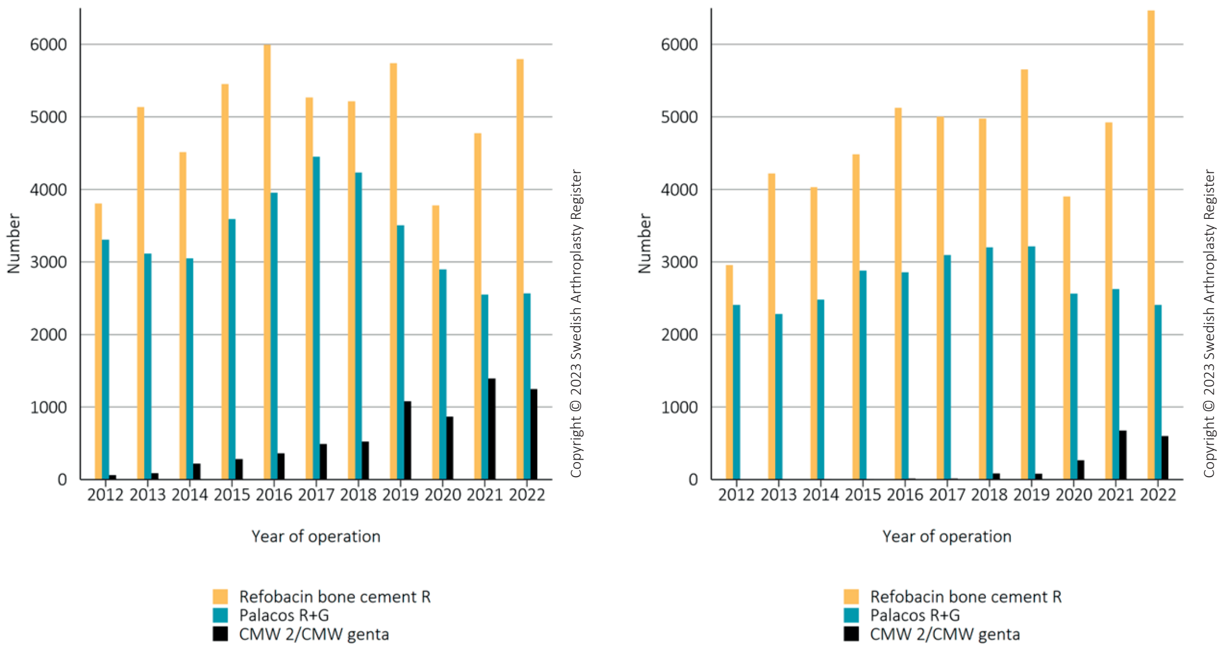


Figure 9.2.3. Annual distribution of the three most used types of cement in 2012 to 2022 after selection according to figure 1. CMW 2/CMW genta has been used to a greater extent on the acetabular side (a) than on the femoral side (b).

Selection and heterogeneity

The analysis group includes only the five most used cups and the three most used stems operated in 2012 to 2022. All hips have an articulation including highly cross-linked polyethylene. Dual Mobility (DM) cups have not been used together with stems cemented with CMW cement and have therefore been excluded and no one of the five most used cups is of DM-type. In order to make the analysis meaningful, several types of cement with only sporadic use have been excluded (for example Simplex with Tobramycin, different variants of revision cement) (figures 9.2.1 a and b).

Refobacin Bone Cement R has been the most used followed by Palacos R + G throughout the period. CMW 2/CMW genta have been used for fixation of the cup throughout the period and of the stem mainly during its latter part (figures 9.2.3 a and b). CMW 2 is a cement with high viscosity with a relatively short curing time and is above all intended for the cup but has according to the reports to the SAR also been used for fixation of the stem. CMW 2/CMW genta constitute the smallest group in the two analyses. These cements have mainly been used in primary osteoarthritis, in patients classified as ASA class I-II and with Rim-fit or Marathon cup or MS30 or Exeter stem, respectively (tables 9.2.1 and 9.2.2).

Choice of outcome

The optimal choice of outcome is not obvious. Theoretically, the cement can influence the risk of loosening, which we have seen several examples of. The occurrence of loosening, the elasticity of the cement, strength and curing properties may probably also affect the risk of periprosthetic fracture around a cemented stem and how easy or difficult it is to position above all the cup but maybe also the stem.

All cements included in the analysis contain antibiotics. The amount of antibiotics and how antibiotics is released from the cement after curing may certainly also affect the risk of infection. Against this background, we have chosen to select cup and stem revision as outcome both when

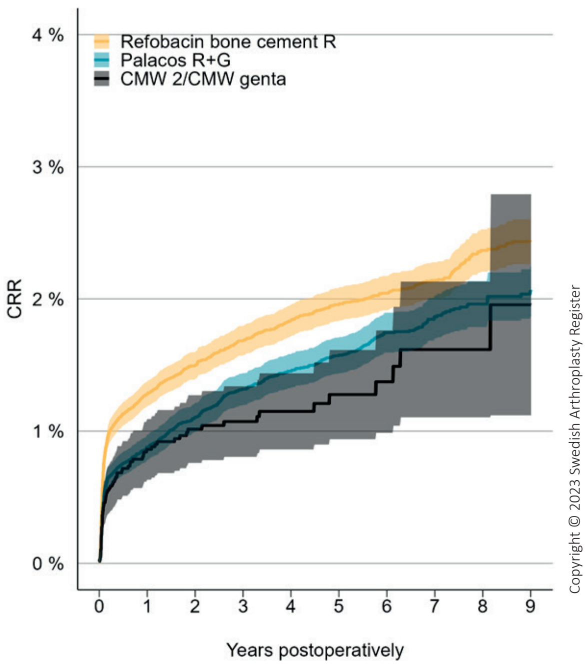


Figure 9.2.4. Cumulative risk of cup revision or infection regardless of procedure when using three different types of cement regardless of whether the stem was cemented or not and regardless of which cement was possibly used for the stem.

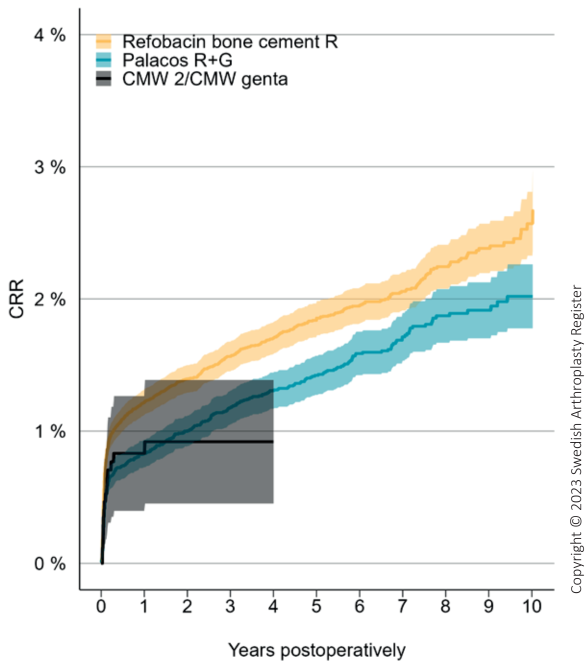


Figure 9.2.5. Cumulative risk of stem revision or infection regardless of procedure when using three different types of cement regardless of whether the cup was cemented or not and regardless of which cement was possibly used for the cup.

analysing cup and stem and include all revisions performed due to infection. As the first-line action, infections are often treated with DAIR (Debridement Antibiotics Implant Retention) where only the femoral head and possibly liner are exchanged.

Cemented cup

The cumulative risk of revision of the cup is highest when using Refobacin Bone Cement R and lowest in the CMW-group (figure 9.2.4, table 9.2.1). Since the CMW-group is relatively small and does not show the same variation regarding background variables as the Refobacin and Palacos groups, we have performed two separate analyses. In the first, we compare Refobacin Bone Cement R with Palacos R + G. Without adjusting for differences in background variables, we find that the risk of cup revision and/or infection is approximately 19 % lower when using Palacos R + G. In the adjusted analysis, the difference decreases marginally to 17 %. If the variables BMI and ASA class is added, which means slightly less observations, the result is the same (data not shown). If infection as outcome is excluded and instead, cup-revision due to non-infectious reasons is outcome the statistically significant difference between the groups disappears (adjusted risk ratio: 1.12 (95 % CI: 0.95–1.31, p = 0.2)).

In the other evaluation where the CMW-group is included we have chosen to include only the diagnosis primary osteoarthritis, Lubinus x-link, Marathon and Rim-fit cups, femoral heads with diameter of 28 and 32 millimetres, since CMW cement was used mainly in primary osteoarthritis, only in a few cases with ZCA x-link or IP cup and only in one case with a 36 millimetres femoral head. We find here that the difference between Palacos R + G and Refobacin R remains, however with reduced statistical precision. The risk ratio for CMW 2/CMW genta is also lower compared to Refobacin but not statistically significant. If ASA class and BMI are included in the analysis, which means a small further reduction of the number of observations, the risk is marginally affected in the group cemented with Palacos and more pronounced in the CMW-group (table 9.2.1).

Demographics, approaches, implant choice and results related to the three most common cement types for primary cup insertion 2012–2022

	Type of bone cement		
	Refobacin R	**Palacos R+G**	**CMW 2/CMW genta**
Number	55,457	37,210	6,609
Follow-up year, mean (SD)	4.9 (3.1)	5.1 (2.9)	3.1 (2.4)
Age, mean (95% CI)	72.5 (72.4–72.6)	72.2 (72.1–72.3)	69.1 (68.9–69.3)
Proportion females %	62.4	63.7	64.3
Diagnosis, n (%)			
Osteoarthritis	45,254 (81.6)	31,075 (83.5)	6,222 (94.1)
Fracture/Trauma*	6,440 (11.6)	3,549 (9.5)	154 (2.3)
Other diagnosis	3,763 (6.8)	2,586 (6.9)	233 (3.5)
ASA-class			
I–II	41,497 (75.0)	29,340 (78.8)	5,408 (81.8)
III–V	13,081 (23.6)	7,606 (20.4)	1,180 (17.9)
Missing n (%)	779 (1.4)	264 (0.7)	21 (0.3)
BMI			
Mean (SD)	26.9 (4.4)	26.9 (4.5)	26.3 (4.2)
Missing n (%)	1,955 (3.5)	1,159 (3.1)	65 (1.0)
Approach n (%)			
Posterior	30,500 (55.0)	18,644 (50.1)	950 (14.4)
Direct lateral *lateral or supine position*	24,957 (45.0)	18,566 (49.9)	5,659 (85.6)
Type of cup n (%)			
Lubinus x-link	32,391 (58.4)	15,238 (41.0)	768 (11.6)
Exeter Rim-fit	8,57 (15.6)	14,201 (38.2)	2,446 (37.0)
Marathon	7,758 (14.0)	4,885 (13.1)	3,351 (50.7)
ZCA x-link	4,713 (8.5)	2,058 (5.5)	0
Lubinus IP	1,938 (3.5)	828 (2.2)	44 (0.7)
Caput size n (%)			
28	3,134 (5.7)	3,625 (9.7)	3,036 (45.9)
32	49,109 (88.6)	30,523 (82.0)	3,572 (54.0)
36	3,214 (5.8)	3,062 (8.2)	1 (0.0)
Caput material n (%)			
Metal	45,352 (81.8)	33,581 (90.2)	4,961 (75.1)
Ceramic	10,105 (18.2)	3,629 (9.8)	1,648 (24.9)

The table continues on the next page.

Demographics, approaches, implant choice and results related to the three most common cement types for primary cup insertion 2012–2022, cont.

	Type of bone cement		
	Refobacin R	Palacos R+G	CMW 2/CMW genta
Cause of revision n (%)			
All causes	1,044 (1.9)	584 (1.6)	72 (1.1)
Loosening	158 (0.3)	132 (0.4)	16 (0.2)
Infection	657 (1.2)	301 (0.8)	52 (0.8)
Dislocation	191 (0.3)	120 (0.3)	1 (0.0)
Other causes	33 (0.1)	27 (0.1)	3 (0.0)
All observations n	55,457	37,210	6,609
CRR revision[1] (95 % CI)	2.4 (2.3–2.5)	2.1 (2.0–2.2)	2.0 (1.6–2.5)
Risk ratio unadjusted (95 % CI)	1 (reference)	0.81 (0.73–0.90) p<0.001	[2]
Risk ratio adjusted[3] (95 % CI)	1 (reference)	0.83 (0.75–0.92) p=0.001	[2]
Selected observations[4] **n**	36,620	26,272	6,119
Risk ratio unadjusted (95 % CI)	1 (reference)	0.81 (0.66–0.98) p=0.03	0.72 (0.53–0.97) p=0.03
Risk ratio adjusted[5] (95 % CI)	1 (reference)	0.82 (0.72–0.94) p=0.004	0.84 (0.64–1.12) p=0.23
Risk ratio adjusted[6] (95 % CI)	1 (reference)	0.83 (0.72–0.95) p=0.07	0.90 (0.68–1.20) p=0.46

Table 9.2.1. Demography, choice of approach and implant, cumulative risk of revision and risk ratios related to the three most commonly used cement types used to fix the cup during 2012–2022.

1) Cup revision and all other revisions due to infection are included (e.g. caput replacement due to infection).
Values are given after 9 years of observation as 135 observations remain in the smallest group (CMW 2/CMW genta).

2) Excluded from this analysis due to few or no observations for some variables.

3) Adjusted for age, sex, diagnosis, type of approach, type of cup, caput size and material.

4) Only Exeter and MS30, only primary osteoarthritis, 28 and 32 mm caput.

5) Adjusted for age, sex, type of approach, type of cup, cup size and material.

6) Adjusted for age, sex, type of approach, type of cup, caput size, caput material, ASA-class and BMI.

Demographics, approach, implant choice and results related to the three most common cement types for primary stem insertion 2012–2022

	Type of cement		
	Refobacin R	**Palacos R+G**	**CMW 2/CMW genta**
Number	51,732	30,018	1,739
Follow-up year, mean (SD)	4.5 (3.1)	4.8 (3.0)	1.6 (1.3)
Age, mean (SD)	73.3 (7.8)	73.5 (7.7)	72.4 (7.5)
Proportion females %	62.2	63.6	69.6
ASA-class			
I–II	38,793 (75.0)	23,167 (77.2)	1,571 (90.3)
III–V	12,163 (23.5)	6,642 (22.1)	163 (9.4)
Missing n (%)	776 (1.5)	209 (0.7)	5 (0.3)
BMI			
Mean (SD)	26.8 (4.4)	26.8 (4.5)	25.9 (3.9)
Missing n (%)	1,882 (3.6)	1,028 (3.5)	26 (1.5)
Diagnosis n (%)			
Osteoarthritis	42,171 (81.5)	24,610 (82.0)	1,644 (94.5)
Fracture/Trauma*	6,107 (11.8)	3,249 (10.8)	31 (1.8)
Other diagnosis	3,454 (6.7)	2,159 (7.2)	64 (3.7)
Approach n (%)			
Posterior	28,747 (55.6)	16,001 (53.3)	448 (25.8)
Direct lateral *lateral or supine position*	22,985 (44.4)	14,017 (46.7)	1,291 (74.2)
Type of stem n (%)			
MS30	6,944 (13.4)	5,459 (18.2)	1,372 (78.9)
Lubinus SP II	33,289 (64.3)	13,608 (45.3)	1 (0.1)
Exeter	11,499 (22.2)	10,951 (36.5)	366 (21.0)
Caput size n (%)			
28	1,940 (3.8)	1,697 (5.7)	301 (17.3)
32	44,643 (86.3)	25,098 (83.6)	1,438 (82.7)
36	5,149 (10.0)	3,223 (10.7)	-
Caput marerial n (%)			
Metal	43,444 (84.0)	27,250 (90.8)	1,138 (65.4)
Ceramic	8,288 (16.0)	2,768 (9.2)	601 (34.6)

The table continues on the next page.

Demographics, approach, implant choice and results related to the three most common cement types for primary stem insertion 2012–2022, cont.

	Type of cement		
	Refobacin R	Palacos R+G	CMW 2/CMW genta
Cause of revision n (%)			
All causes	902 (1.7)	418 (1.4)	16 (0.9)
Loosening	99 (0.2)	64 (0.2)	-
Infection	634 (1.2)	247 (0.8)	12 (0.7)
Periprosthetic fractures	94 (0.2)	703 (0.2)	3 (0.2)
Dislocation	68 (0.1)	28 (0.1)	1 (0.1)
Other causes	7 (0.0)	9 (0.0)	-
All observations	55,457	37,210	6,609
CRR stem revision 0–4 years[1]			
0–4 years (95 % CI)	1.7 (1.6–1.8)	1.3 (1.2–1.4)	0.9 (0.7–1.2)
0–10 years (95 % CI)	2.6 (2.5–2.7)	2.1 (2.0–2.2)	[2]
Risk ratio 0–11 years unadjusted (95 % CI)	1 (reference)	0.77 (0.69–0.87) p<0.001	[2]
Risk ratio 0–11 years ajusted3 (95 % CI)	1 (reference)	0.75 (0.67–0.85) p<0.001	[2]
Selected observations[4] **n**	8,940	9,296	1,349
Risk ratio 0–4 years unadjusted (95 % CI)	1 (reference)	0.89 (0.68–1.17) p=0.4	0.93 (0.51–1.70) p=0.8
Risk ratio 0–4 years adjusted[5] (95 % CI)	1 (reference)	0.82 (0.62–1.09) p=0.15	0.87 (0.43–1.75) p=0.7

Table 9.2.2. Demography, choice of approach and implant, cumulative risk of revision and risk ratios related to the three most commonly used cement types used to fix the stem during 2012–2022.

1) Stem revision as well as all other revisions due to infection have been selected as outcomes. Values are given after 4 and 10 years of observation, respectively. In the first case there remain 112 observations in the smallest group (CMW 2/CMW genta), in the second case 1,567 (Palacos R+G).

2) Excluded from this analysis due to few or no observations for some variables.

3) Adjusted for age, sex, diagnosis, type of approach, type of stem, caput size and material.

4) Only Exeter and MS30, only primary osteoarthritis, 32 mm caput and ASA-class 1–2.

5) Adjusted for age, sex, type of approach, type of stem and caput material.

Cemented stem

The cumulative risk of revision of the stem is lower when using Palacos R+G compared to Refobacin Bone Cement R. The CMW-group tends to be even lower after four years, whereafter the number of observations becomes too small for further analysis (figure 9.2.5, table 9.2.2). The regression analysis shows the same association, namely an increased risk of revision using Refobacin Bone Cement R. When we look at the reason for revision in both groups, here as in the evaluation on the cup side, we find that Refobacin is revised more frequently due to infection, which is investigated further in a post-hoc analysis. It should be noted that CMW 2/CMW genta has been used in relatively few operations and mainly in the last four years.

Due to few observations and a small variation regarding background factors this evaluation is limited to operations where Exeter or MS30 stems have been used with 32 millimetres femoral head. Further, only patients classified as ASA I or II are included. The observation time possible to be studied is short, only four years. The risk of stem revision all causes, including infected cases where the stem is left untouched does not differ statistically for the Palacos R+G or the CMW 2/CMW genta-groups compared to the reference group.

Protheses where both the cup and the stem have been cemented with the same cement

In a third post-hoc analysis, we have limited the analysis to those surgeries included in the two selected groups according to figures 9.2.1 a and b and where both the cup and the stem have been cemented with the same cement. The analysis is limited to the two most used bone cements and includes 71,612 fully cemented hip replacements (45,265 Refobacin Bone Cement R, 26,347 Palacos R+G). Also, in this analysis, the cumulative risk of revision regardless of reason and procedure is increased in the Refobacin-group (figure 9.2.6).

If the reason is divided in infection and other reasons, we find that the difference is found in the first but not in the second evaluation (figures 9.2.7 and 9.2.8). This is reflected also in the regression models where the risk of revision regardless of procedure and reason is increased for fully cemented hip replacements in the Refobacin-group. The increase amounts to 13 or 15 % depending on whether adjustment for differences in background variables is done or not (table 9.2.3).

Breakdown of the outcome into infectious or non-infectious reasons also shows that fully cemented hip replacements in the Palacos-group are revised less often due to infection (risk ratio = 0.66, 9 % CI 0.56–0.78). The risk of revision due to non-infectious reasons does not differ (risk ratio = 1.10, 95 % CI 0.94–1.28). Further analysis with addition of ASA class, BMI and surgical year gives only a very marginal change of this result.

In the eleven years covered by the study, 17 out of 92 units have used both Refobacin Bone Cement R and Palacos R+G in different periods and per unit reported at least 226 cemented total hip replacements with the cement that they used least frequently. Together, these units have performed 10,384 fully cemented hip replacements with Refobacin and 10,113 with Palacos R+G. In an unadjusted analysis of this selection is the risk of revision due to infection not statistically significant different between these two bone cements (Palacos R+G/Refobacin R: 0.83, 95 % CI 0.65–1.08, p = 0.16). If adjusting for the same background variables that were used in the extended analysis above, the risk ratio is reduced, however without reaching statistical significance (0.77, 95 % CI 0.59–1.01, p = 0.06).

Summary

The risk of revision due to infection is higher when using Refobacin Bone Cement R compared with Palacos R + G. We find a similar tendency to increased risk of revision for Refobacin R when compared with CMW 2/CMW genta but the results are difficult to interpret due to few observations in the latter group which also shows limited variation regarding background variables.

Regardless that we have performed a relatively extensive analysis, register data cannot form the basis for a reliable cause-and-effect analysis. Thus, we cannot say with certainty that the observed differences can be attributed to intrinsic properties of the bone cements studied. Revision due to infection after a primary surgery is a relatively rare event. A register-based prospective multi-centre study is motivated to improve the state of knowledge.

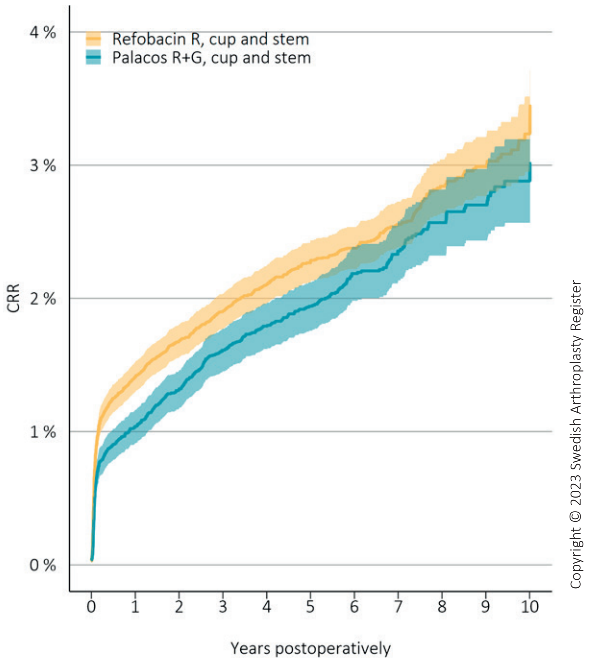


Figure 9.2.6. Cumulative risk of revision regardless of cause and procedure when using the same cement, either Refobacin Bone Cement R or Palacos R+G for both components.

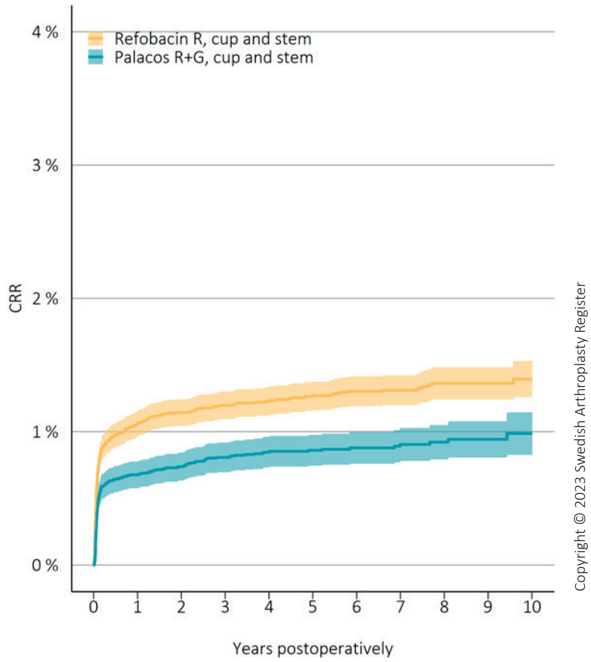


Figure 9.2.7 Cumulative risk of revision due to infection regardless of procedure when using the same cement, either Refobacin Bone Cement R or Palacos R+G for both components.

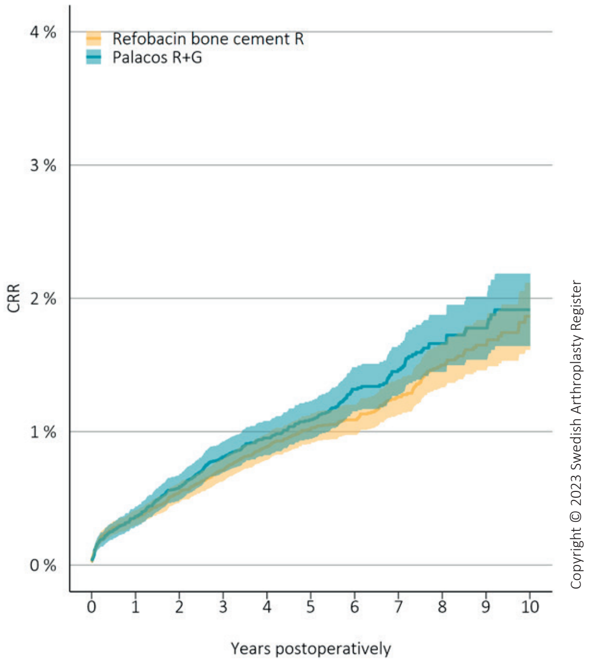


Figure 9.2.8 Cumulative risk of revision due to all causes and procedures excluding infection when using the same cement, either Refobacin Bone Cement R or Palacos R+G to both components.

Demographics, approach, implant choice and results related to the two most common types of cement when inserting a cemented hip replacement using the same type of cement for both cup and stem 2012–2022

	Type of cement	
	Refobacin Bone Cement R	**Palacos R+G**
Number	45,265	26,347
Follow-up year, mean (SD)	4.7 (3.0)	5.0 (3.0)
Age mean (95% CI)	73.6 (7.6)	73.8 (7.5)
Proportion females %	62.4	63.5
Diagnosis, n (%)		
Osteoarthritis	36,619 (80.9)	21,403 (81.2)
Fracture/Trauma*	5,888 (13.0)	3,103 (11.8)
Other diagnosis	2,758 (6.1)	1,841 (7.0)
ASA-class		
I–II	33,609 (74.2)	20,259 (76.9)
III–V	10,985 (24.3)	5,897 (22.4)
Missing n (%)	671 (1.5)	191 (0.7)
BMI		
Mean (SD)	26.8 (4.4)	26.8 (4.5)
Missing n (%)	1,727 (3.8)	974 (3.7)
Approach n (%)		
Posterior	24,328 (53.7)	13,847 (52.6)
Direct lateral *lateral or supine position*	20,937 (46.3)	12,500 (47.4)
Type of cup n (%)		
Lubinus x-link	27,744 (61.3)	12,167 (46.2)
Exeter Rim-fit	6,600 (14.6)	9,630 (36.6)
Marathon	4,862 (10.7)	2,017 (7.7)
ZCA x-link	4,285 (9.5)	1,732 (6.6)
IP cup	1,774 (3.9)	801 (3.0)
Type of stem n (%)		
MS30	5,101 (11.3)	3,432 (13.0)
Lubinus SP II	31,534 (69.7)	12,865 (48.8)
Exeter	8,630 (19.1)	10,050 (38.1)
Caput size n (%)		
28	1,769 (3.9)	1,320 (5.0)
32	40,820 (90.2)	22,473 (85.3)
36	2,676 (5.9)	2,554 (9.7)

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Demographics, approach, implant choice and results related to the two most common types of cement when inserting a cemented hip replacement using the same type of cement for both cup and stem 2012–2022, cont.

	Type of cement	
	Refobacin Bone Cement R	Palacos R+G
Caput marerial n (%)		
Metal	37,354 (82.5)	23,946 (90.9)
Ceramic	7,911 (17.5)	2,401 (9.1)
Cause of revision n (%)		
All causes	986 (2.2)	514 (2.0)
Loosening	137 (0.3)	97 (0.8)
Fracture	74 (0.2)	65 (0.2)
Infection	550 (1.2)	220 (0.8)
Dislocation	186 (0.4)	111 (0.4)
Other causes	39 (0.1)	21 (0.1)
CRR revision[1] (95 % CI)		
All causes	3.2 (2.9–3.5)	2.9 (2.6–3.2)
Infection	1.4 (1.3–1.5)	1.0 (0.8–1.2)
Risk ratio (95 % CI)		
All causes unadjusted	1 (reference)	0.87 (0.78–0.96) p=0.008
All causes adjusted[2]	1 (reference)	0.85 (0.76–0.95) p=0.004
Infection adjusted[2]	1 (reference)	0.66 (0.56–0.78) p<0.001
Aseptic cause adjusted[2]	1 (reference)	1.10 (0.94–1.28) p=0.24

Table 9.2.3. Demographics, approach, implant choice and results related to the two most common types of cement when inserting a cemented hip replacement using the same type of cement for both cup and stem 2012–2022.

1) Includes all procedures. Values are given after 10 years of observation when 1,457 observations remain in the smallest group (Palacos R+G).

2) Adjusted for age, sex, diagnosis, type of approach, type of cup and stem, caput size and material.

9.3. Bone cement in primary total knee replacement

Author: Annette W-Dahl

In Sweden, the majority of the primary total knee replacements (TKR) are cemented and there are basically two cement types which dominate, Refobacin Bone Cement R and Palacos R+G while Smartset GHV constitutes a smaller proportion. Together, they constitute 95 % to 99 % of the cement types reported in 2012 to 2022 (figure 9.3.1). Both Refobacin Bone Cement R and Palacos R+G are also available in prefilled systems, Optipac Refobacin Bone Cement R and Palacos R+G Pro. The prefilled Optipac Refobacin Bone Cement R has been more commonly used than Refobacin Bone Cement R except in 2017. The prefilled Palacos R+G Pro became more common than Palacos R+G in 2017 (figure 9.3.1). All cement types/prefilled systems have a high viscosity and contain gentamycin.

Since 2007 there has been a label with the article number for the cement and been used in almost all operations where cement has been used, hence cement type/prefilled system can be reliably identified. The aim of the in-depth analysis was to compare the risk of first-time revision depending on which cement type/prefilled system that had been used with the five most common TKR-models reported 2012–2022.

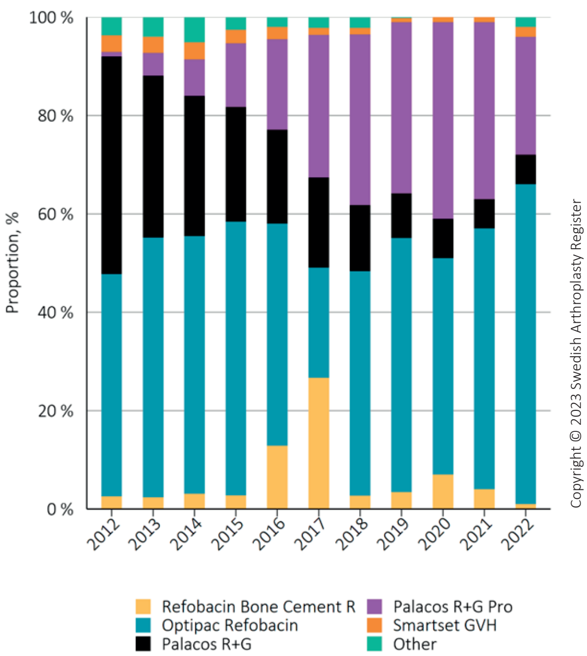


Figure 9.3.1. Proportion of reported cement types/prefilled systems 2012–2022.

The method for the in-depth analysis

In this in-depth analysis we analysed the most frequently reported cement types (Refobacin Bone Cement R and Palacos R+G and Smartset GHV) and cement with prefilled systems (Optipac Refobacin Bone Cement R and Palacos R+G Pro). We only included operations performed with the five most used TKR-models (NexGen MBT, PFC Sigma TKA MBT, Triathlon TKA MBT, Persona TKA and Genesis II MBT) and were operated 2012 to 2022 (figure 9.3.2)).

The primary outcome was first revision, all reasons, and we followed all prostheses until December 31st 2022. We performed analyses for the respective cement type and for respective cement type/prefilled system. We estimated the cumulative risk of revision with 95 % confidence interval (CI) for all reasons excluding infection and loosening at five and ten years.

In separate multiple Cox regression analyses, the different cement types/pre-filled systems were compared and adjusted for age, sex, ASA class ≥III (yes/no), surgical year, use of patella component or not and operative time. These analyses were performed for all reasons of revision, all reasons except infection and for loosening alone.

What did the results show?

The analysis included 110,706 cemented TKRs, of which the majority had been cemented with Optipac Refobacin Bone Cement R (n = 54,723, 49 %). Smartset GVH had been used in a smaller number of operations (n = 1,425, 1.3 %) and at few units. This group was older, consisted to a higher extent of females, had a higher proportion of ASA class ≥III, had more often been supplied with a patella component and had a shorter surgical time than the other groups (table 9.3.1). The proportion of revisions was the highest for Smartset GVH (3.6 %) and the lowest for Palacos R+G Pro (1.6 %).

Infection was the most common reason for revision in all groups but lowest in the group Refobacin Bone Cement R. Loosening was only one out of 52 revisions in the group Smartset GVH while it was 15 % to 22 % in the other groups (table 9.3.2). Palacos R+G Pro had the lowest cumulative risk of revision all reasons (2.85, 95 % CI 2.04; 3.65) and any reasons except infection (1.73, 95 % CI 1.11; 2.34) while SmartSet GVH had the lowest risk of revision for loosening (0.08, 95 % CI 0.00; 0.25) at ten years (table 9.3.2). When we analysed the cement types regardless of cement mixing system the cumulative risk of revision at both five and ten years was relatively similar for Refobacin Bone Cement R and Palacos R+G but higher for SmartSet GVH except for revision due to loosening which was lower (table 9.3.3).

In the Cox-regression with all cement types/pre-filled systems Palacos R+G Pro was associated with a lower risk of revision for all reasons (HR 0.86, 95 % CI 0.76; 0.96) while SmartSet GVH had a higher risk (HR 1.62, 95 % CI 1.22; 2.15) (table 9.4.4). Both Refobacin Bone Cement R and Smartset GVH had higher risk of revision all reasons excluding infection (table 9.3.5) and for revision due to loosening we found no difference in risk of revision between the groups (table 9.3.6). Among the confounding factors considered in the analyses, younger age was associated with risk reduction and a longer operative time was associated with increased risk in all three analyses. ASA class ≥III was associated with increased risk of revision all reasons and female sex was a risk factor for revision all reasons excluding infection and for loosening.

Flow chart

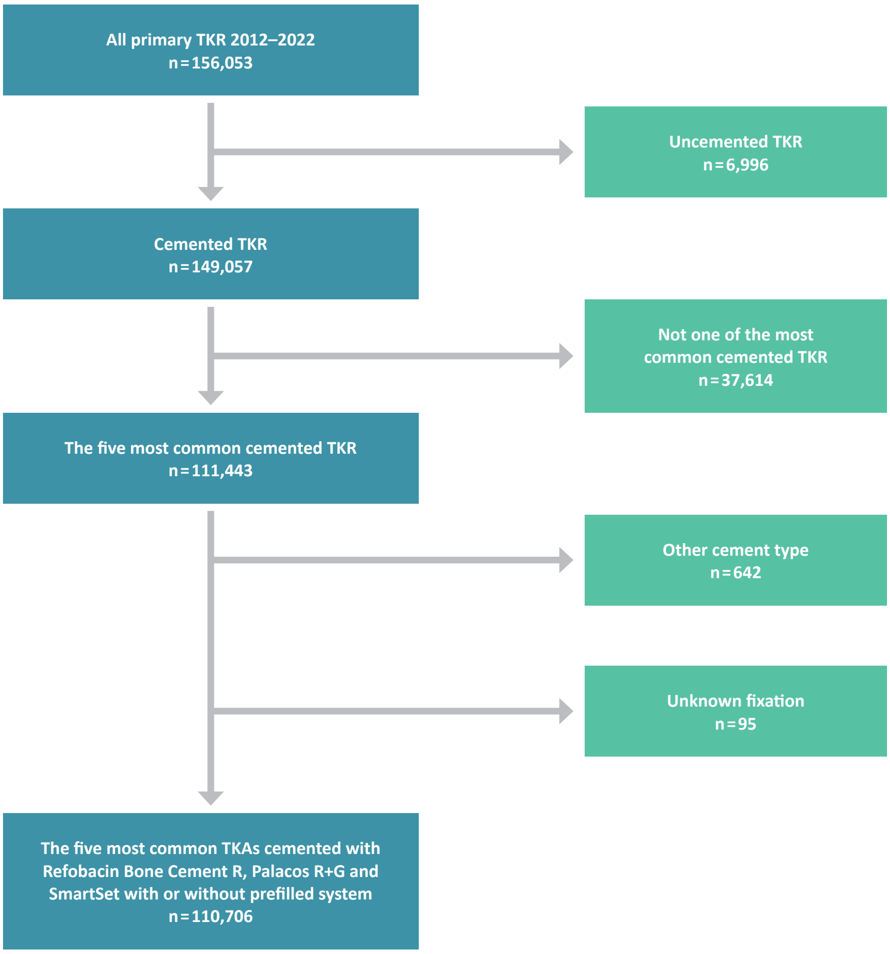


Figure 9.3.2. Flow chart, in-depth analysis of bone cement in primary total knee replacement.

Demographics and surgical variables for the different cement types and prefilled systems

	Alla	Optipac Refobacin	Refobacin	Palacos R+G	Palacos R+G Pro	SmartSet GHV
Number	110,706	54,723	6,800	21,459	26,299	1,425
Mean age (SD)	69.5 (8.8)	69.5 (8.9)	69.0 (8.7)	69.8 (8.7)	69.1 (8.7)	72.5 (8.8)
Females n (%)	63,058 (57.0)	31,029 (56.7)	3,716 (54.6)	12,560 (58.5)	14,881 (56.6)	872 (61.2)
BMI mean (SD)	29.0 (4.43)	29.0 (4.5)	29.1 (4.3)	29.2 (4.6)	28.7 (4.3)	28.1 (4.2)
ASA-class ≥III n (%)	19,308 (17.5)	10,281 (18.8)	1,127 (16.6)	3,775 (17.6)	3,775 (14.4)	350 (24.6)
Use of patella n (%)	2,555 (2.3)	855 (1.6)	461 (6.8)	572 (2.7)	501 (1.9)	166 (11.6)
Surgical time mean (SD)	76.2 (34.2)	77.4 (40.1)	74.3 (24.9)	83.3 (24.3)	69.6 (28.6)	57.9 (17.4)

Table 9.3.1. Demographics and surgical variables for the different cement types and prefilled systems.

When we analysed cement types, regardless of cement mixing systems, SmartSet GVH was associated with an increased risk of revision all reasons (HR 1.56, 95 % CI 1.18;2.07) and all reasons excluding infection (HR 1.68, 95 % CI 1.17;2.4) while Palacos R+G was associated with a lower risk of revision all reasons excluding infection (HR 0.87, 95 % CI 0.78;0.97) and for loosening (HR 0.81, 95 % CI 0.66;0.99) (table 9.3.7–9). Among the confounding factors included in the analyses, younger age was associated with risk reduction and longer operative time was associated with increased risk in all three analyses. ASA class ≥III was associated with increased risk of all reasons, increasing surgical year was associated with lower risk of revision all reasons and all causes excluding infection while being female was associated with an increased risk for all reasons and in the case of loosening.

How should these results be interpreted?

The risk of revision, all reasons, was lower with the pre-filled system Palacos R+G Pro compared to Optipac Refobacin Bone Cement R while Refobacin Bone Cement R showed a higher risk all reasons excluding infection compared with the pre-filled Optipac Refobacin Bone Cement R. Palacos R+G, regardless of cement mixing system, showed a lower risk for all reasons excluding infection and for loosening compared to Refobacin Bone Cement R.

The results may indicate that pre-filled systems may be an advantage and that Palacos R+G, regardless of cement mixing system, may have a lower risk of revision due to other reasons than infection. However, Smartset GVH showed 56 % and 68 % higher risk of revision due to all reasons and all reasons except infection, respectively, but significantly lower, although not statistically significant, risk of revision due to loosening.

The results are difficult to interpret and there may be other factors that influence the risk of revision (for example the handling and storage of cement and cementing technique) which we have no possibility to control for. Further, the number of surgeries and revisions are relatively low in the group SmartSet GVH, which is reflected in the relatively wide confidence intervals and that there are basically two units that reported SmartSet GVH, which means that the results must be interpreted with caution.

The findings in the in-depth analysis with different types of cement in total hip replacements (see previous in-depth analysis) further complicate the interpretation of the results as it showed that the risk of revision due to infection was higher when using Refobacin Bone Cement R compared to Palacos R+G. Further, in a study from the Norwegian Arthroplasty Register analysing the five most used cement types including Optipac Refobacin Bone Cement R, Refobacin Bone Cement R and Palacos R+G in more than 26,000 TKRs operated 1997–2013 and they could not show any difference in risk of revision (Birkeland et al., 2017).

Despite the relatively large and representative cohorts, register based observational studies can show what it looks like when different cement types/prefilled systems and different prosthesis models are used by Swedish orthopaedic surgeons, but is more difficult to explain why it looks as it does.

Description of cause of revision, procedure and results for the different cement types and pre-filled systems

	Optipac Refobacin	Refobacin Bone Cement R	Palacos R+G	Palacos R+G Pro	SmartSet GHV
Number	**1,144**	**182**	**584**	**424**	**52**
Cause of revision, n (%)					
Infection	468 (41.2)	56 (31.1)	253 (43.4)	179 (42.3)	19 (37.3)
Loosening	200 (17.6)	40 (22.2)	98 (16.8)	63 (14.9)	1 (2.0)
Instability	210 (18.5)	28 (15.6)	87 (14.9)	60 (14.2)	10 (19.6)
Patella	179 (15.7)	43 (23.9)	106 (18.2)	86 (20.3)	11 (21.6)
Progress of osteoarthritis	10 (0.9)	0 (0.0)	7 (1.2)	11 (2.6)	1 (2.0)
Wear	4 (0.4)	0 (0.0)	1 (0.2)	0 (0.0)	3 (5.9)
Joint stiffness	17 (1.5)	4 (2.2)	10 (1.7)	4 (0.9)	1 (2.0)
Fracture	24 (2.1)	2 (1.1)	6 (1.0)	6 (1.4)	3 (5.9)
Other	25 (2.2)	7 (3.9)	15 (2.6)	14 (3.3)	2 (3.9)
Revision procedure, n (%)					
Stabilized (rotating) prosthesis with/without patella	56 (5.0)	9 (5.0)	15 (2.6)	11 (2.7)	4 (8.0)
TKR without patella	209 (18.7)	39 (21.8)	86 (15.0)	78 (18.9)	5 (10.0)
TKR with patella	38 (3.4)	10 (5.6)	19 (3.3)	16 (3.9)	2 (4.0)
Exchange femur	13 (1.2)	4 (2.2)	7 (1.2)	6 (1.5)	0 (0.0)
Exchange tibia	51 (4.6)	4 (2.2)	28 (4.9)	3 (0.7)	1 (2.0)
Exchange insert	503 (45.0)	56 (31.3)	253 (44.1)	177 (43.0)	23 (46.0)
Patella addition	186 (16.6)	46 (25.7)	116 (20.2)	95 (23.1)	13 (26.0)
Extraction, arthrodesis, amputation	63 (5.6)	11 (6.1)	50 (8.7)	26 (6.3)	2 (4.0)
Kaplan-Meier estimate five years					
All causes	2.39 (2.24; 2.53)	2.74 (2.33; 3.14)	2.46 (2.25; 2.68)	1.97 (1.77; 2.17)	3.21 (2.23; 4.17)
All causes excluding infection	1.46 (1.34; 1.58)	1.95 (1.60; 2.29)	1.38 (1.22; 1.54)	1.21 (1.05; 1.37)	1.76 (1.01; 2.51)
Loosening	0.42 (0.35; 0.48)	0.63 (0.43; 0.83)	0.38 (0.29; 0.47)	0.31 (0.22; 0.39)	0.08 (0.00; 0.25)
Kaplan-Meier estimate ten years					
All causes	3.00 (2.80; 3.20)	3.50 (2.58; 4.42)	3.26 (2.97; 3.54)	2.85 (2.04; 3.65)	4.56 (3.26; 5.85)
All causes excluding infection	1.93 (1.77; 2.10)	2.25 (1.69; 2.79)	1.93 (1.70; 2.15)	1.73 (1.11; 2.34)	3.14 (1.98; 4.28)
Loosening	0.66 (0.55; 0.76)	0.67 (0.46; 0.88)	0.60 (0.48; 0.73)	0.39 (0.28; 0.49)	0.08 (0.00; 0.25)

Table 9.3.2. Description of reason for revision, procedures and result for the different cement types and prefilled systems.

Description of cause of revision, procedure and results for the different types of cement

	Refobacin Bone Cement R	Palacos R+G	SmartSet GHV
Number	**1,326**	**1,008**	**52**
Cause of revision, n (%)			
Infection	524 (39.8)	432 (42.9)	19 (37.3)
Loosening	240 (18.2)	161 (16.0)	1 (2.0)
Instability	238 (18.1)	147 (14.6)	10 (19.6)
Patella	222 (16.9)	192 (19.1)	11 (21.6)
Progress of osteoarthritis	10 (0.8)	18 (1.8)	1 (2.0)
Wear	4 (0.3)	1 (0.1)	3 (5.9)
Joint stiffness	21 (1.6)	14 (1.4)	1 (2.0)
Fracture	26 (2.0)	12 (1.2)	3 (5.9)
Other	32 (2.4)	29 (2.9)	2 (3.9)
Revision procedure, n (%)			
Stabilized (rotating) prosthesis with/without patella	65 (5.0)	26 (2.6)	4 (8.0)
TKR without patella	248 (19.1)	164 (16.6)	5 (10.0)
TKR with patella	48 (3.7)	35 (3.5)	2 (4.0)
Exchange femur	17 (1.3)	13 (1.3)	0 (0.0)
Exchange tibia	55 (4.2)	31 (3.1)	1 (2.0)
Exchange insert	559 (43.1)	430 (43.6)	23 (46.0)
Patella addition	232 (17.9)	211 (21.4)	13 (26.0)
Extraction, arthrodesis, amputation	74 (5.7)	76 (7.7)	2 (4.0)
Kaplan-Meier estimate five years			
All causes	2.44 (2.30; 2.57)	2.22 (2.08; 2.37)	3.21 (2.23; 4.17)
All causes excluding infection	1.52 (1.41; 1.63)	1.31 (1.19; 1.42)	1.76 (1.01; 2.51)
Loosening	0.44 (0.38; 0.51)	0.36 (0.29; 0.42)	0.08 (0.00; 0.25)
Kaplan-Meier estimate ten years			
All causes	3.06 (2.87; 3.25)	2.99 (2.77; 3.22)	4.56 (3.26; 5.85)
All causes excluding infection	1.99 (1.83; 2.14)	1.83 (1.65; 2.02)	3.14 (1.98; 4.28)
Loosening	0.67 (0.57; 0.77)	0.56 (0.46; 0.66)	0.08 (0.00; 0.25)

Table 9.3.3. Description of reason for revision, procedures and results for the different cement types.

Hazard ratio with 95 % CI for first revision regardless of reason by cement type/prefilled system

Variable	HR	95% CI	p-value
Optipac Refobacin R	Ref.		
Refobacin Bone Cement R	1.14	0.97; 1.34	0.100
Palacos R+G	1.04	0.94; 1.16	0.427
Palacos R+G Pro	0.86	0.76; 0.96	0.009
SmartSet GHV	1.62	1.22; 2.15	0.0008
Age	0.98	0.97; 0.98	<0.0001
Male	Ref.		
Female	0.93	0.86; 1.01	0.072
ASA-class <III	Ref.		
ASA ≥III	1.38	1.25; 1.53	<0.0001
Surgical year	0.99	0.97; 1.01	0.255
Patella			
Yes	Ref.		
No	0.83	0.66; 1.06	0.138
Surgical time (per ten minutes)	1.02	1.02; 1.03	<0.0001

Table 9.3.4. Hazard ratio with 95% CI for first revision regardless of reason by cement type/prefilled systems.

Hazard ratio with 95 % CI for first revision regardless of reason excluding infection by cement type/prefilled system

Variable	HR	95% CI	p-value
Optipac Refobacin R	Ref.		
Refobacin Bone Cement R	1.3	1.07; 1.58	0.008
Palacos R+G	0.93	0.81; 1.07	0.311
Palacos R+G Pro	0.87	0.75; 1.02	0.080
SmartSet GHV	1.75	1.22; 2.51	0.002
Age	0.96	0.95; 0.96	<0.0001
Male	Ref.		
Female	1.44	1.29; 1.61	<0.0001
ASA-class <III	Ref.		
ASA ≥III	1.12	0.97; 1.29	0.120
Surgical year	0.98	0.96; 1.00	0.061
Patella			
Yes	Ref.		
No	0.96	0.70; 1.33	0.819
Surgical time (per ten minutes)	1.02	1.01; 1.0.4	<0.0001

Table 9.3.5. Hazard ratio with 95% CI for first revision regardless of reason excluding infection by cement type/prefilled systems.

Hazard ratio with 95 % CI for first revision caused by loosening by cement type/prefilled system

Variable	HR	95% CI	p-value
Optipac Refobacin R	Ref.		
Refobacin Bone Cement R	1.4	0.99; 1.97	0.057
Palacos R+G	0.88	0.68; 1.12	0.301
Palacos R+G Pro	0.8	0.60; 1.08	0.149
SmartSet GHV	0.17	0.02; 1.24	0.081
Age	0.95	0.94; 0.96	<0.0001
Male	Ref.		
Female	1.36	1.11; 1.67	0.003
ASA-class <III			
ASA ≥III	1.17	0.90; 1.53	0.249
Surgical year	0.97	0.93; 1.02	0.22
Patella			
Yes	Ref.		
No	0.71	0.42; 1.22	0.219
Surgical time (per ten minutes)	1.03	1.02; 1.05	<0.0001

Table 9.3.6. Hazard ratio with 95% CI for first revision caused by loosening by cement type/prefilled systems.

Hazard ratio with 95 % CI for first revision regardless of reason by cement type

Variable	HR	95% CI	p-value
Refobacin Bone Cement R	Ref.		
Palacos R+G	0.94	0.86; 1.02	0.131
SmartSet GHV	1.56	1.18; 2.07	0.002
Age	0.98	0.97; 0.98	<0.0001
Male	Ref.		
Female	0.93	0.86; 1.01	0.075
ASA-class <III	Ref.		
ASA ≥III	1.38	1.25; 1.53	<0.0001
Surgical year	0.98	0.97; 1.00	0.023
Patella			
Yes	Ref.		
No	0.81	0.64; 1.03	0.091
Surgical time (per ten minutes)	1.02	1.02; 1.03	<0.0001

Table 9.3.7. Hazard ratio with 95% CI for first revision regardless of reason by cement type.

Hazard ratio with 95 % CI for first revision regardless of reason excluding infection by cement type

Variable	HR	95% CI	p-value
Refobacin Bone Cement R	Ref.		
Palacos R+G	0.87	0.78; 0.97	0.014
SmartSet GHV	1.68	1.17; 2.40	0.005
Age	0.96	0.95; 0.96	<0.0001
Male	Ref.		
Female	1.44	1.29; 1.61	<0.0001
ASA-class <III	Ref.		
ASA ≥III	1.12	0.97; 1.29	0.128
Surgical year	0.98	0.96; 1.00	0.032
Patella			
Yes	Ref.		
No	0.93	0.67; 1.28	0.648
Surgical time (per ten minutes)	1.02	1.01; 1.03	<0.0001

Table 9.3.8. Hazard ratio with 95% CI for first revision regardless of reason excluding infection by cement type.

Hazard ratio with 95 % CI for the first time revision caused by loosening by cement type

Variable	HR	95% CI	p-value
Refobacin Bone Cement R	Ref.		
Palacos R+G	0.81	0.66; 0.99	0.036
SmartSet GHV	0.16	0.02; 1.17	0.071
Age	0.95	0.94; 0.96	<0.0001
Male	Ref.		
Female	1.36	1.11; 1.67	0.003
ASA-class <III	Ref.		
ASA ≥III	1.16	0.89; 1.52	0.262
Surgical year	0.97	0.93; 1.01	0.178
Patella			
Yes	Ref.		
No	0.68	0.40; 1.16	0.155
Surgical time (per ten minutes)	1.03	1.02; 1.05	<0.0001

Table 9.3.9. Hazard ratio with 95% CI for first revision caused by loosening by cement type.

9.4. Exeter stem 125 mm at primary operation and revision

Author: Johan Kärrholm

We have from the Swedish Arthroplasty Register previously highlighted the results after use of Exeter stem 150 mm from various aspects and above all related to risk of revision or reoperation due to periprosthetic fracture. In this year's analysis we have especially reviewed the most used shorter variant, Exeter 125 mm. Stems used in hemiarthroplasties (n = 619) are excluded in this analysis. The analysis also includes the 125 mm short revision stem. We do not report specific names here since we believe that the registration is not completely reliable. The first 125 mm stems were reported in 2001, which is the starting year for this evaluation. The operations that for different reasons have been excluded from the analyses are shown in figure 9.4.1. After selection, 3,685 stems that have been used in primary surgery remain and 1,075 stems that have been used in stem revision regardless if the cup or liner also have been exchanged.

Flow chart

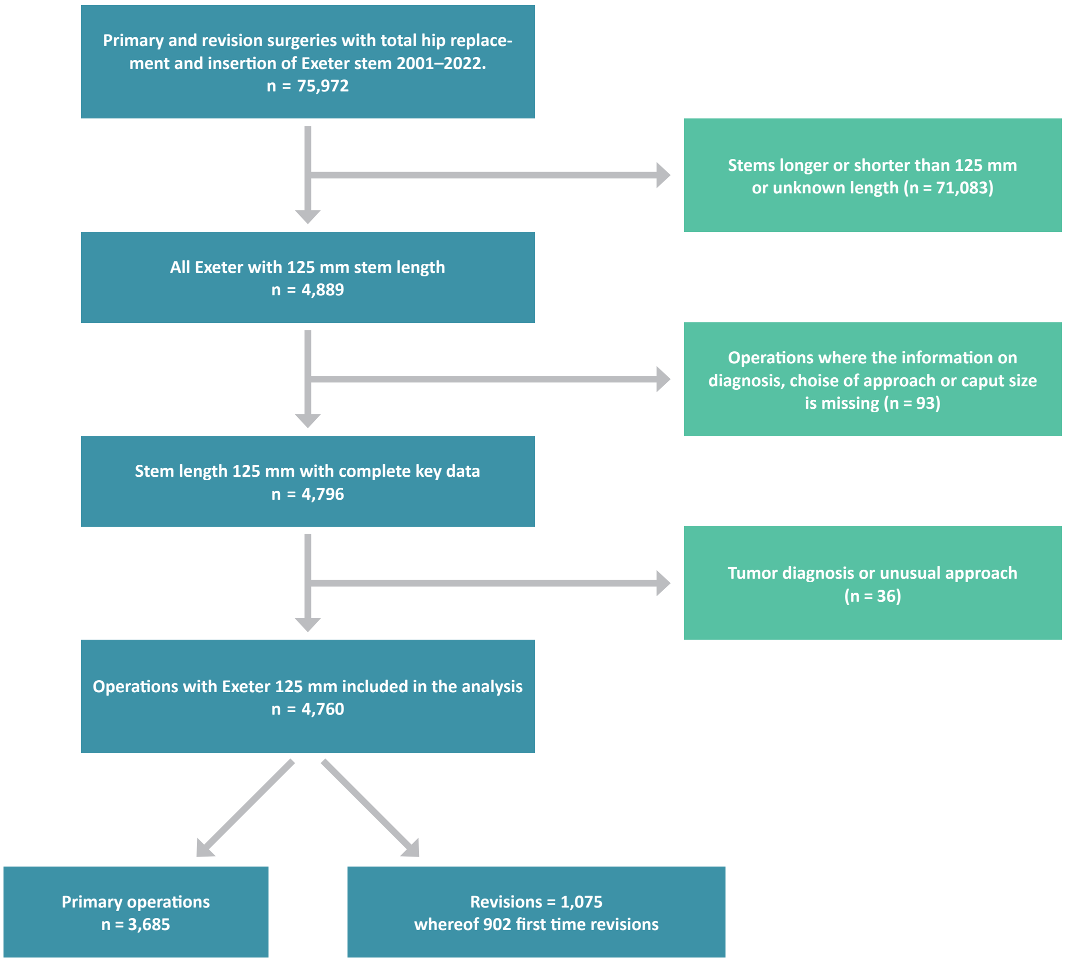


Figure 9.4.1. The flow chart shows numbers and reasons for exclusion before analysis of Exeter 125 mm stem in primary total hip replacements and revision of total hip replacements.

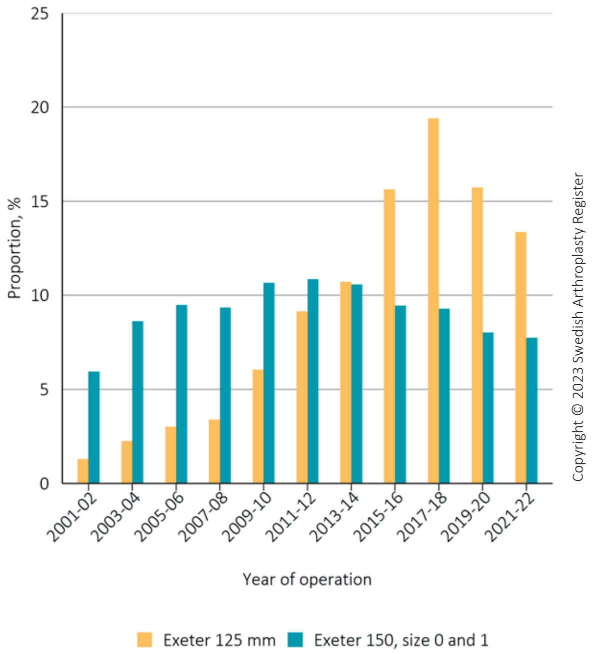


Figure 9.4.2a. Percentage distribution of primary Exeter 125 mm and 150 mm size 0 and 1 stems related to 2-year periods between 2001 and 2022.

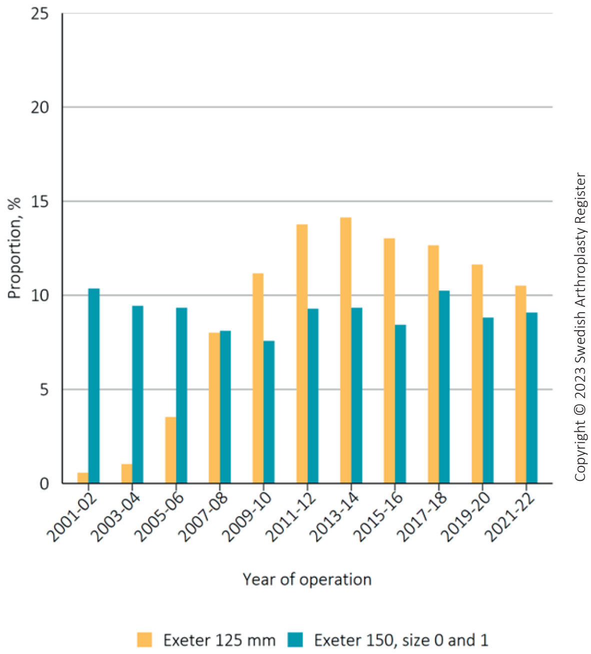


Figure 9.4.2b. Percentage distribution of Exeter 125 mm and 150 mm size 0 and 1 stems used as revision stem related to 2-year intervals between 2001 and 2022.

To place the results into perspective, we have selected a comparison group. It consists of Exeter stem 150 mm, size 0 and 1, a choice that can be discussed. However, we think that these stems often, although not always, can be chosen as an alternative to get a longer anchorage. The selection of the control implants follows strictly the same terms as for the 125 mm stems, but is not reported here in detail. In figure 9.4.2a shows that the majority of the primary 125 mm stems were inserted between 2015 and 2022, while stem sizes 0 and 1, 150 mm shows a more even distribution in the last two decades.

In revision, a similar pattern can be seen with a slightly earlier peak for the 125 mm stems. Both in primary surgery and revision the use of the 125 mm stem tends to decrease in the last years. As most, 715 insertions were reported in primary surgery 2017 to 2018. In the period 2021 to 2022 the number was 492. For revisions the corresponding number was 152 in the period 2013 to 2014 which decreased to 113 reported insertions in the period 2021 to 2022.

As is shown in table 9.4.1 the control group is more than ten times larger than the study group. In addition, there are more or less considerable differences regarding follow-up time, demography, choice of surgical approach, and choice of articulation. It is especially evident that the 125 mm stems more often are used in females, more often are operated with a posterior approach, with a larger femoral head and with highly cross-linked polyethylene cup or liner. Further, there are obvious differences in the choice of offset partly due to that the 150 mm stem does not exist with less than 37.5 mm offset. The reason for stem revision is relatively evenly distributed between the groups, possibly with a tendency to more stem fractures when using the short stem and perhaps fewer periprosthetic fractures. Since the compared groups differ regarding background variables according to the above, however, it is not possible to draw any reliable conclusions whether the differences observed have any relation to length of the stem.

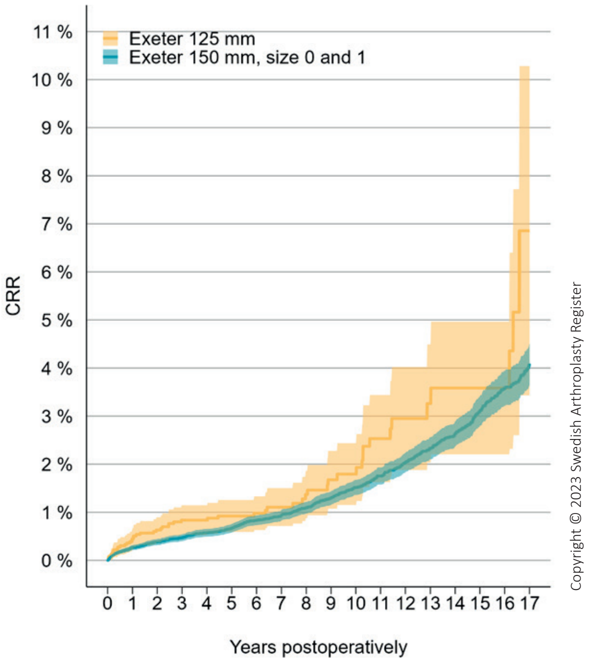


Figure 9.4.3. Cumulative risk of revision of Exeter 125 mm and 150 mm size 0 and 1) in primary hip replacements. At 17 years, there remain 89 observations in the 125 mm stem group and 2,921 in the control group.

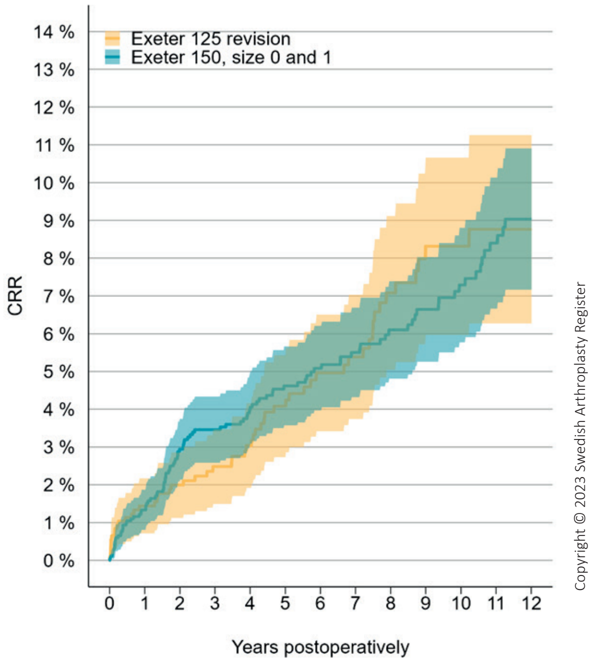


Figure 9.4.4. Cumulative risk of re-revision of Exeter 125 mm and 150 mm size 0 and 1 at revision regardless of number of previous revisions. At 17 years, there remain 116 observations in the 125 mm stem group and 367 in the control group.

The cumulative risk of stem revision (CRR) is higher for the short stem. At 17 years, 89 observations remain in the group with the 125 mm stem and 2,921 in the control group (figure 9.4.3). In a regression analysis we found that the risk of stem revision, excluding infections, is higher in the group with the short stem both before and after adjustment for age, sex, diagnosis and choice of surgical approach. If we also adjust for choice of femoral head size in three groups (less than or equal to 28 mm/32 mm/more or equal to 36 mm) and choice of articulation (older polyethylene/highly cross-linked polyethylene/others) the risk ratio increases to 1.7 (95 % CI 1.3–2.3; $p \leq 0.001$). To further try to reduce bias, we have performed an even stricter analysis and excluded all dual mobility cups and those with an unknown articulation. We then get three groups with femoral head size < 32 mm, 32 mm and 36 mm or larger. The risk ratio then increases further slightly to 1.9 (95 % CI 1.4–2.5; $p < 0.001$). Although proportionality between the groups is not entirely optimal, these data suggest to choose a 150 mm instead of a 125 mm stem in primary surgery provided that the anatomical conditions allow it.

In the revision groups, the same tendency towards skewed distribution is seen between the groups as in the primary material regarding demography, femoral head size and choice of articulating surface but not regarding surgical approach (table 9.4.2). The differences between the groups can probably be explained by the fact that the 125 mm stems in general are inserted later than those in the 150 mm group. The reason for revision appears to vary between the groups in the same way as in primary surgery with a tendency, among other things, to relatively more stem fractures and fewer periprosthetic fractures for the short stem. Here as well, is it impossible to draw any reliable conclusions due to, if possible, even more varying background data regarding choice of surgical technique. The short stem for example, is used much more often in cement-in-cement revision and the longer more often with bone transplantation (use of impaction grafting technique is not explicitly recorded in the SAR). The cumulative risk of re-revision appears relatively similar between the groups with short and standard stem size 0 and 1 (figure 9.4.4). After 12 years, the risk of stem revision due to non-infectious reasons is slightly higher when using the short stem, however without significant difference (table 9.4.2, log rank test = 0.9).

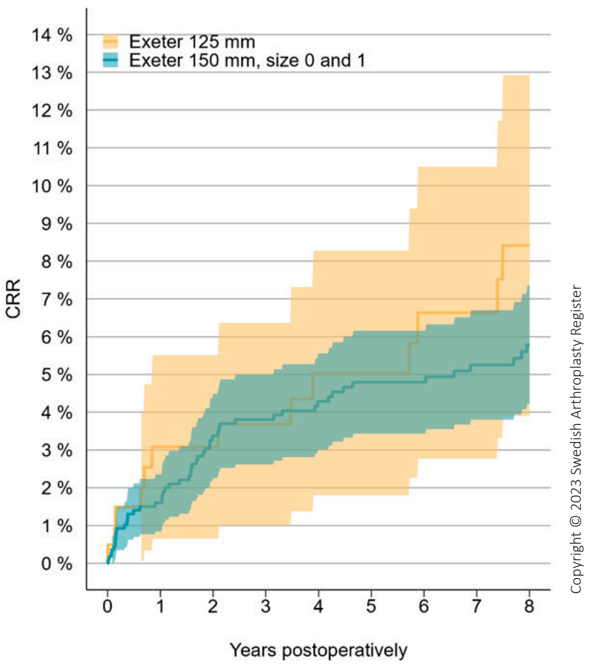


Figure 9.4.5. Cumulative risk of re-revision of Exeter 125 mm and 150 mm size 0 and 1 when used in cement-in-cement revision regardless of number of previous revisions. At 8 years, there remain 260 observations in the 125 mm stem group and 224 in the control group.

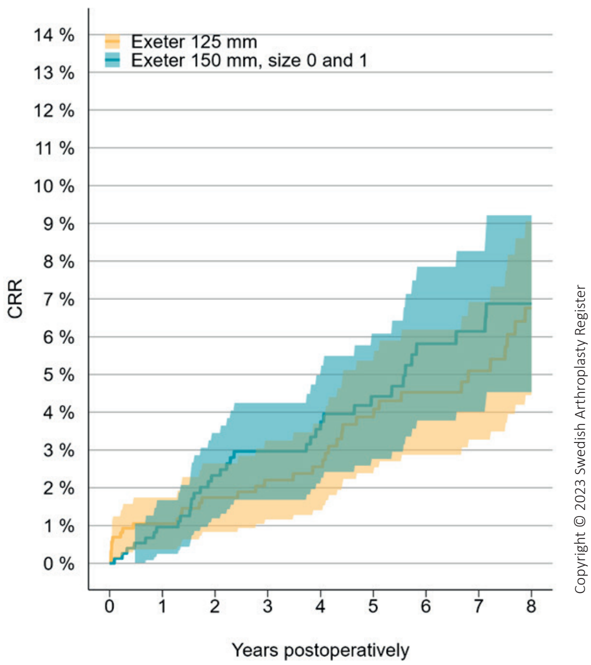


Figure 9.4.6. Cumulative risk of re-revision of Exeter 125 mm and 150 mm size 0 and 1) when revising uncemented stems or cemented stems where the cement mantle has been removed. First and multiple revisions as well as revisions with and without bone grafting are included. At 8 years, there remain 96 observations in the 125 mm stem group and 526 in the control group.

In general, the risk of stem re-revision due to non-infectious reasons is about 4% higher after a multiple revision compared with a first-time revision if including all 125 mm and all 150 mm stem sizes 0 and 1 (CRR in first-time revision after 10 years with 118 observations in the smallest group: 7.4%, 95% CI 6.9-8.9, at multiple revision 11.6%, 95% CI 8.1-15.1).

Regardless if we analyse the entire material, divide into first-time and multiple revision or in revisions of the type cement-in-cement revision and other types of revision with extraction of the cement mantle alternatively extraction of uncemented stem, the curves cross each other which means that a Cox regression cannot be used. Additional groupings may be able to solve this problem, but the number of observations is too small for a reliable analysis. As an example, we show the cumulative risk of revision with use of cement-in-cement revision (figure 9.4.5) and with use of removal of the cement mantel or revision of an uncemented stem (figure 9.4.6).

Summary

In the 21st century, the 125 mm Exeter stem has been used more often as primary prosthesis until 2017 to 2018 and as revision stem until 2013–2014. After this, the number of reported cases has successively reduced in both primary surgery and revision.

In primary surgery the risk of revision for the 125 mm stem is higher than for the 150 mm stem of sizes 0 and 1.

In revision we see no definite difference between the groups regardless of whether it is a cement-in-cement revision or not. The number of observations in this evaluation is fewer and the result of the analysis more uncertain.

Primary Exeter stems 125 mm and 150 mm long. The latter group only includes sizes 0 and 1.

	Type of stem-primary prosthesis	
	125 mm	150 mm, size 0 and 1[1]
Number	3,685	37,240
Follow-up year, mean (max value)	6.3 (21.3)	8.5 (22.0)
Age mean (95% CI)	70.7 (70.3–80.0)	72.0 (71.9–72.1)
Sex male/female n (%)	309/3,376 (8.4/91.6)	10,314/26,926 (27.7/72.3)
Diagnosis n (%)		
Osteorthritis	3,013 (81.8)	29,933 (80.4)
Fracture/Trauma	283 (7.7)	3,524 (9.5)
Other diagnosis	389 (10.6)	3,783 (10.2)
Approach n (%)		
Posterior	2,369 (64.3)	16,297 (43.8)
Direct lateral lateral or supine position n (%)	1,316 (35.7)	20,943 (56.2)
Offset		
35,5	2,049 (55.6)	–
37,5	866 (23.5)	10,951 (29.4)
44	740 (20.1)	24,588 (66.0)
50–	30 (0.8)	1,693 (4.6)
Caput size n (%)		
22, 26, 30 mm	61 (1.7)	1,348 (3.6)
28	872 (23.7)	18,027 (48.4)
32	2,015 (54.7)	15,713 (42.2)
36–44	737 (20.0)	2,152 (5.8)
Caput material n (%)		
Metal	3,608 (97.9)	36,776 (98.8)
Ceramic	77 (2.1)	464 (1.2)
Joint surface n (%)		
Older polyetylene	709 (19.2)	16,605 (44.6)
Highly cross-linked	2,919 (79.2)	20,296 (54.5)
DMC cup	50 (1.4)	309 (0.8)
Unknown	7 (0.2)	29 (0.1)

The table continues on the next page.

Primary Exeter stems 125 mm and 150 mm long. The latter group only includes sizes 0 and 1, cont.

	Type of stem-primary prosthesis	
	125 mm	150 mm, size 0 and 1[1]
Cause of stem revision[2] n (%)		
All causes	55 (1.5)	597 (1.6)
Loosening	25 (0.7)	231 (0.6)
Periprosthetic fractures	20 (0.5)	263 (0.7)
Stem fracture	7 (0.2)	34 (0.1)
Dislocation	2 (0.1)	60 (0.2)
Other causes	–	9 (<0.1)
Stem revision[2] CRR (95 % CI) 17 år	6.9 (3.5–10.3)	4.1 (3.7–4.5)
Hazard ratio unadjusted (95 % KI)	1.4 (1.1–1.9) p=0.02	1 (reference)
Hazard ratio adjusted[3] (95 % CI)	1.6 (1.2–2.1) p=0.002	1 (reference)

Table 9.4.1. Primary Exeter stems 125mm and 150mm long. The latter group only includes sizes 0 and 1.

1) Number of size 0/1 = 16,596/20,644.

2) Excluding infections, 89 observations in the smallest group (125 mm stem). Log-rank test: p=0.014.

3) Adjusted for age, sex, diagnosis and approach (see text for supplementary analysis).

Exeter stems 125 mm and 150 mm long used in revision surgery.
The latter group only includes sizes 0 and 1.

	Type of stem-revision prosthesis	
	125 mm	150 mm, size 0 and 1[1]
Number	1,075	1,874
Proportion multi-time revisions n (%)	173 (16.1)	326 (17.4)
Follow-up year, mean (max value)	6.3 (21.3)	8.5 (22.0)
Age mean (95% KI)	74.2 (73.6–74.8)	72.2 (71.8–72.7)
Sex male/female n (%)	393/682 (36.6/63.4)	834/1,040 (44.5/55.5)
Diagnosis n (%)		
Osteorthritis	821 (76.4)	1,497 (79.9)
Fracture/Trauma	93 (8.7)	149 (8.0)
Other diagnosis	161 (15.0)	228 (12.2)
Approach n (%)		
Posterior	601 (55.9)	1,310 (69.9)
Direct lateral lateral or supine position	474 (44.1)	564 (30.1)
Offset		
35,5	140 (13)	423 (26.6)
37,5	69 (6.4)	1,396 (74.5)
44	842 (78.3)	52 (2.8)
50–	24 (2.2)	3 (0.2)
Caput size n (%)		
22, 26, 30 mm	58 (5.4)	137 (7.3)
28	341 (31.7)	870 (46.4)
32	442 (41.1)	608 (32.4)
36–44	234 (21.8)	259 (13.8)
Caput material n (%)		
Metal	1,058 (98.4)	1,814 (96.8)
Ceramic	17 (1.6)	60 (3.2)
Joint surface n (%)		
Older polyetylene	142 (13.2)	651 (34.7)
Highly cross-linked	614 (57.1)	772 (41.2)
DMC cup	91 (8.5)	81 (4.3)
Unknown, CoC[2], cup not exchanged	228 (21.2)	370 (19.8)

The table continues on the next page.

Exeter stems 125 mm and 150 mm long used in revision surgery.
The latter group only includes sizes 0 and 1, cont.

	Type of stem-revision prosthesis	
	125 mm	150 mm, size 0 and 1[1]
Indication for revision n (%)		
Loosening	743 (69.1)	1,340 (71.5)
Dislocation	166 (15.4)	165 (8.8)
Infection/insertion after extraction	40 (3.7)	215 (11.5)
Peroprosthetic fracture	60 (5.6)	71 (3.8)
Implant breakage	33 (3.1)	28 (1.5)
Other/Unknown cause	33 (3.1)	55 (2.9)
Cement in cement procedure n (%)	873 (81.2)	778 (41.5)
Bone transplantation-femur n (%)	98 (9.1)	673 (35.9)
Cause of re-revision stem[2] n (%)		
All causes	55 (1.5)	597 (1.6)
Loosening	25 (0.7)	231 (0.6)
Peroprosthetic fracture	20 (0.5)	263 (0.7)
Stem fracture	7 (0.2)	34 (0.1)
Dislocation	2 (0.1)	60 (0.2)
Other causes	–	9 (<0.1)
Stem revision[3] CRR (95% CI) 12 years	10.4 (7.0–13.8)	9.0 (7.1–10.9)

Table 9.4.2. Exeter stems 125 mm and 150 mm long used in revision surgery. The latter group only includes sizes 0 and 1.

1) Number of size 0/1=720/1,154.

2) Ceramic-ceramic articulation, one in each group

3) Excluding infections, 116 observations left in the smallest group at 12 years (125 mm stem), log rank test: p=0.9.

9.5. Conventional versus highly cross-linked polyethylene in total knee replacement

Authors: Annette W-Dahl and Ola Rolfson

There is convincing evidence that the highly cross-linked polyethylene (HXLPE) is better than the conventional polyethylene (UHMWPE) in total hip replacement surgery. It is however uncertain if highly cross-linked polyethylene has advantages in total knee replacement surgery.

The intention with the highly cross-linked polyethylene is to reduce wear and debris-induced osteolysis. It has been described that the polyethylene may be subject to a higher risk of wear in knee replacement than in hip replacement by delamination, pitting, and fatigue failure as the movements of the knee joint are different from those of the hip joint. In order to meet these demands and improve wear behaviour, the manufacturers have used their own unique methods when processing their highly cross-linked polyethylene.

A study from the National Joint Registry (NJR) showed no advantage with the highly cross-linked polyethylene compared to the conventional polyethylene 12 years after total knee replacement surgery (Partridge et al. 2020) while the Australian register (AOANJRR) has reported a lower revision rate for the highly cross-linked polyethylene. However, the results were dependent on which prosthesis model that was studied (de Steiger et al. 2015). The most recent meta-analyses have not been able to show that the highly cross-linked polyethylene improves clinical and radiological results compared with the conventional polyethylene in total knee replacement (Sheridan et al. 2021, Gkiatas et al. 2022, Bistolfi et al. 2022).

The highly cross-linked polyethylene began to be used in Sweden in 2006 has gradually increased and has been reported in just over 20 % of the primary total knee replacements in recent years. The majority of the implants where the highly cross-linked polyethylene has been used in Sweden are Triathlon (X3 polyethylene), PFC (XLK polyethylene) and Persona (Vivacit-E polyethylene).

The aim of the in-depth analysis was to compare the risk of first-time revision regardless of reason and to describe reasons for revision of the conventional polyethylene and the highly cross-linked polyethylene and divided into respective prosthesis model.

Method of the in-depth analysis

Surgeries with the three prosthesis models (Triathlon TKR MBT, PFC Sigma TKR MBT and Persona TKR) due to osteoarthritis from 2009 to 2022 were included. We divided the tibia polyethylene into the conventional polyethylene (Triathlon CR Tibial insert, Triathlon CS Tibial Insert, PFC Sigma Curved GVF Tibial Insert and Persona CR Articular Surface) and the highly cross-linked polyethylene (Triathlon CS Insert X3, Triathlon CR Insert X3, PFC Sigma Curved XLK Insert and Persona Vivacit-E Articular Surface). We also analysed respective prosthesis model with type of tibia polyethylene. The primary outcome measure was first revision regardless of reason and we followed all prostheses until December 31st 2022.

Further, we analysed the conventional polyethylene and the highly crosslinked polyethylene regarding the risk of first revision, all reasons, in a multiple Cox regression and adjusted for age group (< 55, 55–64, 65–74, 75–84 and ≥ 85), sex, BMI category (18.5–24.9, 25–29.9, 30–34.9, 35–39.9 and ≥ 40), surgical year, use of patella component or not, fixation (cemented, uncemented), form (ordinary CR-polyethylene – Cruciate Retaining) and the curved CS-polyethylene – Cruciate Stabilizing) and prosthesis model (Triathlon TKR MBT, PFC Sigma TKR MBT and Persona TKR).

We performed a sensitivity analysis with multiple Cox regression where we excluded uncemented prostheses and adjusted for the same variables as in the above mentioned analysis excluding fixation.

Demographics and description of total knee replacements with conventional polyethylene and highly cross-linked

	All	Conventional polyethylene	Highly cross-linked polyethylene
Number	42,208	15,749	26,459
Mean age (SD)	69.6 (8.9)	69.8 (8.8)	69.46 (8.90)
Females n (%)	23,974 (56.8)	9,027 (57.3)	14,947 (56.5)
BMI mean (SD)	29.08 (4.48)	29.16 (4.56)	29.03 (4.43)
ASA-class ≥ III n (%)			
Yes	7,942 (18.8)	2,905 (18.4)	5,037 (19.0)
No	34,140 (80.9)	12,756 (81.0)	21,384 (80.8)
Missing	126 (0.3)	88 (0.6)	38 (0.1)
Previous surgery in the index knee n (%)			
No	34,886 (82.7)	13,070 (83.0)	21,816 (82.5)
Yes	6,789 (16.1)	2,463 (15.6)	4,326 (16.3)
Missing	533 (1.3)	216 (1.4)	317 (1.2)
Cemented n (%)	35,866 (85.0)	15,067 (95.7)	20,799 (78.6)
CS polyethylene n (%)	31,796 (75.3)	13,951 (88.6)	17,845 (67.4)
Patella in primary surgery n (%)	1,378 (3.3)	727 (4.6)	651 (2.5)
Tourniquet n (%)			
No	19,165 (45.4)	4,872 (30.9)	14,293 (54.0)
Yes	22,806 (54.0)	10,777 (68.4)	12,029 (45.5)
Missing	237 (0.6)	100 (0.6)	137 (0.5)

Table 9.5.1. Demographics and description of total knee replacements with conventional and highly cross-linked polyethylene.

What did the results show?

The analysis included 42,208 total knee replacements with the indication osteoarthritis whereof 26,459 used the highly cross-linked polyethylene (63 %) and 15,749 the conventional polyethylene. The differences in patient characteristics were small between the groups. The group with highly crosslinked polyethylene had a higher proportion of uncemented and CS-polyethylene while the proportion with a primary patella component and tourniquet had been used was higher in the group with the conventional polyethylene (table 9.5.1).

The mean follow-up time was just over two years shorter for the highly cross-linked polyethylene. There was in total 457 revisions (2.9 %) in the group with conventional polyethylene and 884 (3.3 %) in the group with highly crosslinked polyethylene (table 9.5.2). The cumulative risk of revision at 10 years, all reasons, was 5 % for the highly cross-linked polyethylene which was statistically significantly higher than for the conventional polyethylene which had a risk of revision of 3 %. Infection was the most common reason for revision and exchange of polyethylene the most common procedure in both groups. There were 24 polyethylene fractures and 51 polyethylene wear among the reasons for revision and all except one polyethylene fractures and two polyethylene wear were in the group with highly crosslinked polyethylene. The separate analyses of the reasons for revision polyethylene wear and polyethylene fracture included few revisions and differed only in the confidence intervals.

Description and results of total knee replacements with conventional and highly cross-linked polyethylene

			Triathlon MBT		PFC Sigma TKA MBT		Persona TKA	
	Conventional polyethylene	Highly cross-linked polyethylene	Conventional polyethylene	Highly cross-linked polyethylene	Conventional polyethylene	Highly cross-linked polyethylene	Conventional polyethylene	Highly cross-linked polyethylene
Number	15,749	26,459	731	13,205	13,220	12,392	1,798	862
Follow-up year mean (SD)	7.9 (4.2)	5.7 (3.5)	1.3 (0.8)	6.8 (3.6)	9.0 (3.5)	4.9 (3.0)	1.9 (1.6)	1.9 (1.5)
Cause of revision n (%)								
Not revised	15,292 (97.1)	25,575 (97.7)	723 (98.9)	12,710 (96.3)	12,801 (96.8)	12,022 (97.0)	1,768 (98.3)	843 (97.8)
Fracture	3 (0.0)	15 (0.1)	1 (0.1)	9 (0.1)	1 (0.0)	6 (0.0)	1 (0.1)	
Infection	222 (1.4)	314 (1.2)	2 (0.3)	159 (1.2)	204 (1.5)	151 (1.2)	16 (0.9)	4 (0.5)
Instability (not polyethylene breakage and wear)	54 (0.3)	138 (0.5)		95 (0.7)	51 (0.4)	40 (0.3)	3 (0.2)	3 (0.3)
Joint stiffness	7 (0.0)	17 (0.1)		6 (0.0)	6 (0.0)	11 (0.1)	1 (0.1)	
Loosening	64 (0.4)	132 (0.5)		37 (0.3)	60 (0.5)	90 (0.7)	4 (0.2)	5 (0.6)
Patella	88 (0.6)	165 (0.6)	3 (0.4)	108 (0.8)	81 (0.6)	52 (0.4)	4 (0.2)	5 (0.6)
Polyethylene breakage	1 (0.0)	23 (0.1)		21 (0.2)	1 (0.0)	1 (0.0)		1 (0.1)
Polyethylene wear	2 (0.0)	49 (0.2)		48 (0.4)	2 (0.0)	1 (0.0)		
Wear (not polyethylene wear)	1 (0.0)				1 (0.0)			
Other and unknown	15 (0.1)	31 (0.1)	2 (0.1)	12 (0.1)	12 (0.1)	18 (0.1)	1 (0.1)	1 (0.1)
Revision procedure n (%)								
Not revised	15,292 (97.1)	25,575 (96.7)	723 (98.9)	12,710 (96.3)	12,801 (96.8)	12,022 (97.0)	1,768 (98.3)	843 (97.8)
Exchange femur	5 (0.0)	2 (0.0)		2 (0.0)	5 (0.0)			
Exchange tibia	9 (0.1)	50 (0.2)		15 (0.1)	9 (0.1)	35 (0.3)		
Exchange tibial insert	195 (1.2)	344 (1.3)	3 (0.4)	200 (1.5)	174 (1.3)	139 (1.1)	18 (1.0)	5 (0.6)
Patella addition	87 (0.6)	180 (0.7)	3 (0.4)	120 (0.9)	79 (0.6)	54 (0.4)	5 (0.3)	6 (0.7)
Extraction, arthrodesis and amputation	46 (0.3)	45 (0.2)	1 (0.1)	19 (0.1)	44 (0.3)	26 (0.2)	1 (0.1)	
Stabilized (hinged) protesis with/without patella	23 (0.1)	32 (0.1)	1 (0.1)	22 (0.2)	21 (0.2)	9 (0.1)	1 (0.1)	1 (0.1)
TKR with patella	21 (0.1)	41 (0.2)		28 (0.2)	20 (0.2)	11 (0.1)	1 (0.1)	2 (0.2)
TKR without patella	69 (0.4)	165 (0.6)		76 (0.6)	65 (0.5)	84 (0.7)	4 (0.2)	5 (0.6)
Other and unknown	2 (0.0)	25 (0.1)		13(0.1)	2 (0.0)	11 (0.1)		
Kaplan-Meier estimate five years								
All causes	97 (96.9; 97.5)	97 (96.6; 97.1)	98 (97.1; 99.6)	97 (96.7; 97.3)	97 (96.9; 97.5)	97 (96.4; 97.1)	97 (96.5; 98.4)	94 (89.7; 98.5)
Polyethylene wear	100 (100.0; 100.0)	100 (99.9; 100.0)	100 (100.0; 100.0)	100 (99.9; 100.0)	100 (100.0; 100.0)	100 (100.0; 100.0)	100 (100.0; 100.0)	100 (100.0; 100.0)
Polyethylene breakage	100 (100.0; 100.0)	100 (99.9; 100.0)	100 (100.0; 100.0)	100 (99.9; 100.0)	100 (100.0; 100.0)	100 (100.0; 100.0)	100 (100.0; 100.0)	100 (99.3; 100.0)

The table continues on the next page.

Description and results of total knee replacements with conventional and highly cross-linked polyethylene, cont.

			Triathlon MBT		PFC Sigma TKA MBT		Persona TKA	
	Conventional polyethylene	Highly cross-linked polyethylene	Conventional polyethylene	Highly cross-linked polyethylene	Conventional polyethylene	Highly cross-linked polyethylene	Conventional polyethylene	Highly cross-linked polyethylene
Kaplan-Meier estimae ten years								
All causes	97 (96.4; 97.0)	95 (94.9; 95.6)	98 (97.1; 99.6)	95 (94.6; 95.5)	97 (96.4; 97.0)	96 (95.6; 96.5)	97 (96.5; 98.4)	94 (89.7; 98.5)
Polyethylene wear	100 (100.0; 100.0)	100 (99.4; 99.7)	100 (100.0; 100.0)	99 (99.1; 99.5)	100 (100.0; 100.0)	100 (100.0; 100.0)	100 (100.0; 100.0)	100 (100.0; 100.0)
Polyethylene breakage	100 (100.0; 100.0)	100 (99.7; 99.9)	100 (100.0; 100.0)	100 (99.6; 99.8)	100 (100.0; 100.0)	100 (100.0; 100.0)	100 (100.0; 100.0)	100 (99.3; 100.0)

Table 9.5.2. Description and results of total knee replacements with conventional and highly cross-linked polyethylene.

In the Cox regression with all TKRs included, the highly cross-linked polyethylene was associated with increased risk of revision, all reasons (HR 1.34, 95 % CI 1.16–1.55) (table 9.5.3). Among the confounding factors included in the analysis were females and age, 55 years and older, associated with a lower risk of revision while uncemented (HR 1.58, 95 % CI 1.32–1.89) and Persona TKR (HR 1.61, 95 % CI 1.14–2.28) was associated with a higher risk of revision (table 9.5.3).

In the analysis of the three prosthesis models Triathlon TKR MBT, PFC Sigma TKR MBT and Persona TKR where both the conventional and the highly crosslinked polyethylene has been used, the highly cross-linked polyethylene was most prevalent with Triathlon (95 %) followed by PFC Sigma (48 %) and Persona (32 %). There was a relatively large difference in the follow-up time from 1.3 years for Triathlon with the conventional polyethylene to 9.2 years for PFC Sigma with the conventional polyethylene (table 9.5.2). Among reasons for revision 21/24 were polyethylene fractures and 48/51 were polyethylene wear in the group Triathlon with the highly cross-linked polyethylene. In all three prosthesis models the cumulative risk of revision at 10 years was higher for the highly crosslinked polyethylene and varied between 3 % and 6 % compared to 2 % and 3 % for the conventional polyethylene (table 9.5.2).

For PFC Sigma TKR MBT there was a relatively even distribution in the numbers of the conventional polyethylene and the highly crosslinked polyethylene with a relatively small difference in cumulative risk of revision (figure 9.5.1). CRR-curves for Triathlon MBT and Persona TKR are not shown as there was few of the conventional polyethylene and relatively few operations, respectively.

In the sensitivity-analysis where we excluded uncemented prostheses reduced the number of prostheses with the conventional polyethylene with 4 % and the highly cross-linked polyethylene with 21 % (table 9.5.4). Since Triathlon is one of the included prostheses that occur mostly with an uncemented version, the number is markedly affected. Only 51 prostheses remained in the Triathlon group with the conventional polyethylene and the Triathlon group with highly cross-linked polyethylene was reduced by just over one third. The numbers in the other two prosthesis models decreased marginally. The sensitivity-analysis changed the result slightly, but the highly cross-linked polyethylene showed still a statistically significantly higher risk of revision, all reasons (HR 1.21, 95 % 1.04–1.41) and Persona TKR still had a higher risk of revision but was no longer statistically significant (HR 1.34, 95 % CI 0.93–1.91) (table 9.5.4).

How should these results be interpreted?

The result of the initial analysis with the conventional and highly cross-linked polyethylene is not consistent with previous studies and showed a statistically significant disadvantage for the highly cross-linked polyethylene with 34 % higher risk of revision, all reasons. Since there was a risk that the problems with Triathlon's uncemented version that we reported in last year's report (chapter 9.2) affected the result, we performed a sensitivity analysis where we excluded uncemented prostheses.

The majority of the revisions due to polyethylene problems were in the Triathlon group with highly cross-linked polyethylene and uncemented showed an increased risk of revision by 58 % in the Cox regression. In the sensitivity analysis the risk increase for the highly cross-linked polyethylene was not as tangible, 21 %, but we still found a statistically significant higher risk of revision compared to conventional polyethylene.

It is important to remember that the methods to increase the durability of the highly cross-linked polyethylene types by radiation and/or supply of antioxidants is very different for different manufacturers. In our analysis it is difficult to draw conclusions on respective prosthesis model's highly cross-linked polyethylene as the number of conventional polyethylene in the Triathlon group was few and in the Persona group relatively small. For the PFC Sigma group with a larger number and a more even distribution of conventional polyethylene and highly cross-linked polyethylene the difference was small.

Considering results from other registries and studies there is a need to follow-up the results of the conventional and highly cross-linked polyethylene and include it as a part of the chapter "Knee replacement" in the future. Since our results show better results with conventional polyethylene and other observational studies have not shown any obvious advantage with highly cross-linked polyethylene, we currently recommend the use of conventional polyethylene in total knee replacement surgery.

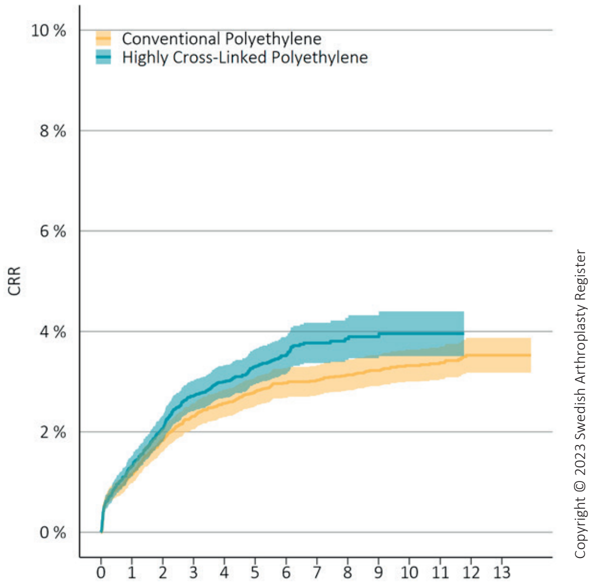


Figure 9.5.1. CRR for PFC Sigma TKR MBT conventional and highly cross-linked polyethylene inserted 2009–2022. (The curves end when 50 at risk).

Hazard ratio with 95 % CI for first revision regardless of cause

Variable	HR	95 % CI	p value
Type of polyethylene			
Conventional polyethylene	Ref.		
Highly cross-linked polyethylene	1.34	1.16–1.55	<0.001
Age			
< 45 years	Ref.		
45–54 years	0.73	0.42–1.26	0.3
55–64 years	0.44	0.26–0.75	0.002
65–74 years	0.37	0.22–0.63	<0.001
75–84 years	0.30	0.17–0.51	<0.001
≥ 85 years	0.28	0.15–0.53	<0.001
Sex			
Males	Ref.		
Females	0.86	0.77–0.96	0.006
BMI			
< 18.5	Ref.		
18.5–24.9	0.41	0.15–1.11	0.079
25–29.9	0.47	0.17–1.25	0.13
30–34.5	0.54	0.20–1.45	0.2
35–39.9	0.44	0.16–1.19	0.11
≥ 40	0.56	0.19–1.60	0.3
Surgical year	0.99	0.97–1.01	0.3
Patella			
Yes	Ref.		
No	0.86	0.63–1.17	0.3
Cemented			
Yes	Ref.		
No	1.58	1.32–1.89	<0.001
Design			
CR	Ref.		
CS	1.05	0.87–1.26	0.6
Implant model			
Triathlon MBT	Ref.		
PFC Sigma TKR MBT	1.19	0.96–1.47	0.12
Persona TKR	1.61	1.14–2.28	0.007

Table 9.5.3. Hazard ratio with 95% CI for first revision regardless of cause.

Hazard ratio with 95 % CI for first revision regardless of cause excluding uncemented replacements

Variable	HR	95 % CI	p-value
Type of polyethylene			
Conventional polyethylene	Ref.		
Highly cross–linked polyethylene	1.21	1.04–1.41	0.015
Age			
< 45 years	Ref.		
45–54 years	0.75	0.40–1.40	0.4
55–64 years	0.39	0.22–0.72	0.003
65–74 years	0.34	0.18–0.61	<0.001
75–84 years	0.27	0.15–0.49	<0.001
≥ 85 years	0.23	0.11–0.47	<0.001
Sex			
Males	Ref.		
Females	0.83	0.73–0.94	0.003
BMI			
< 18.5	Ref.		
18.5–24.9	0.45	0.14–1.42	0.2
25–29.9	0.51	0.16–1.59	0.2
30–34.5	0.61	0.19–1.90	0.4
35–39.9	0.47	0.15–1.50	0.2
≥ 40	0.62	0.19–2.07	0.4
Surgical year	1.00	0.98–1.02	> 0.9
Patella			
Yes	Ref.		
No	0.87	0.62–1.21	0.4
Design			
CR	Ref.		
CS	1.20	0.92–1.55	0.2
Implant model			
Triathlon MBT	Ref.		
PFC Sigma TKR MBT	1.01	0.78–1.30	> 0.9
Persona TKR	1.34	0.93–1.91	0.11

Table 9.5.4. Hazard ratio with 95% CI for first revision regardless of cause excluding uncemented replacements.

The Swedish Arthroplasty Register and clinical research

Author: Ola Rolfson

The government together with the Swedish Association of Local Authorities and Regions have made an agreement about the financing of Swedish national quality registries. The vision is that the registries should be an integrated part in a national system for centralized knowledge management with follow-up of Swedish healthcare. The registries are to contribute to learning and improvement, quality development, saving lives, achieve equal health, research, resource-effective healthcare, improvement work among healthcare providers and as a source of clinical research, including cooperation with the life science-sector. Apart from financing costs for managing the registries, the allocations from the Swedish Association of Local Authorities and Regions and the government go to the two first missions. The idea is that register-based research should be financed by other means.

What is research and what is operational analysis?

The line between what is deemed clinical research and operational analysis or improvement work is blurry. All register analysis that has an aim at to feedback results to improve healthcare activities rests on scientific methods. Within the register we make targeted in-depth analyses, validity studies and co-linking of data with other health data registries that are performed according to established register research methods. There is continuous work along scientific principals' in improving and developing the methods that are used in the register work. Even though the central allocations are not meant for research, the Swedish Association of Local Authorities and Regions and the Swedish Agency for Health and Care Services Analysis regularly evaluate the registers' research activity. A high research activity is a criterion to give a register the highest level of certification.

63 dissertations from the Swedish Arthroplasty Register

When all dissertations that are wholly or in part based on data from the Swedish Hip and Knee Arthroplasty registries are taken together it can be said that we have had an impressive research production since we started in the mid-70s. The sum of all research publications from the registries amounts to over 450 and only in the last five-year period we have published 143 articles.

Within the Swedish Arthroplasty Register we will continue the strategic work to maintain the research infrastructure with the aim of maintaining high research activity. It is especially gratifying that the PhD-students that currently have ongoing dissertation work with data from the Swedish Arthroplasty Register represent seven Swedish universities (Uppsala University, Lund University, Göteborg University, Umeå University, Linköping University, Karolinska institutet and Örebro University).

Defences of dissertations in 2022

In 2022, three dissertation works were defended that partly was based on data from the Swedish Arthroplasty Register:

- Periprosthetic Joint Infections. Clinical and Epidemiological Aspects. Olof Thompson, 2022-10-07.
- On hip fractures in adults under the age of 60. Sebastian Ström Rönnquist, 2022-09-16.
- Knee replacement revision: an international comparison. Peter Lewis, 2022-09-08.

Why is observational research needed?

Register studies and randomised clinical trials (RCT) complement each other. Research within joint replacement surgery demands a long follow-up time and many patients. Some important outcome parameters (reoperations, prosthesis survival and mortality) happen relatively seldom. This makes register studies especially well-suited for research in joint replacement surgery. Register studies have advantages that can be highlighted in this context:

- Register studies represent results in practice. This means that the results have a high degree of generalisability. A register study gives a just picture of how a certain treatment works in routine healthcare in the normal population.

- Regardless of if exposure or outcome are studied, the register study enables, due to its size and long follow-up time, that events which occur seldom can be studied.

- The registration of an individual in a quality register does not require written informed consent. This means that it is easier to collect complete data and that the collection of data can be performed at a low cost.

- The continuous longitudinal collection of data enables analyses of changes in patient demography, treatment and results over time.

What is needed to use register data for research purposes?

All register-based research with individual data requires approval of the Ethics Review Authority (EPM). All information in the register is considered as public but is secrecy-protected according to the Public Access to Information and Secrecy Act (Offentlighet- och sekretesslagen). The Region of Västra Götaland is the central data controlling authority (CPUA) and the head of department at Centre of Registers Västra Götaland has the task to assess secrecy and prejudicial requests for disclosure of data. We use special forms for the data request that can be downloaded from the website of Registercentrum (registercentrum.se/forskning). Rules and regulations considering register research are available at the website of the Swedish Association of Local Authorities and Regions on quality registries (https://skr.se/kvalitetsregister/forskning.43894.html). If you want to discuss a research project, we recommend that you contact the register management. The register management is open for ideas, proposals and discussion on collaboration in new register studies. The database of the register is also well-suited for research projects during residency (ST) and master thesis projects.

Research meeting

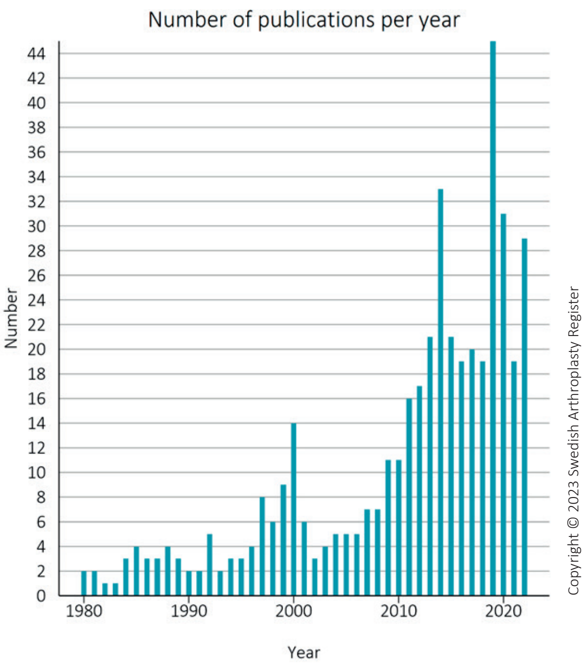
Since 2012 we have annually arranged a two-days research meeting. PhD students, supervisors and other researchers that work with register studies within the musculoskeletal disorders and injuries have participated. As well general as specific research questions are discussed in workshops. However, in 2022 we canceled the meeting due to the pandemic, but in January 2023 we again organized a fruitful two-day meeting.

Many researchers contribute to the register activities

Within the register management and the steering committee there are senior researchers who are supervisors and co-supervisors for PhD students that are affiliated to the register. In addition, there are other researchers who, in collaboration with register management team, conduct research within the area. There are ongoing studies about different implants and type of fixation, epidemiology, health economics, equal care, hip fracture and prosthesis surgery, periprosthetic fractures, revision surgery, statistical methodology, infections and patient-reported outcome after joint replacement.

International research collaborations

The register has an intensive research collaboration within the NARA (Nordic Arthroplasty Register Association), a register collaboration between Finland, Norway, Denmark and Sweden since 2007 and a common database is created annually. The NARA-group has now published almost 50 scientific papers and further manuscripts are in progress. The NARA-data are available for Swedish PhD students. The register has research collaborations with about ten other arthroplasty registers in the world through the International Society of Arthroplasty Registers (ISAR).



Scientific production of publications with data from the Swedish Arthroplasty Register over the years.

International work

Author: Ola Rolfson

An important forum for our international work is the NARA-collaboration (Nordic Arthroplasty Register Association). Since 2007 we have regularly combined de-identified hip and knee replacement data from Denmark, Norway, Sweden and Finland to do unique studies. This has so far resulted in more than 50 scientific publications that in different ways have contributed to deepening the evidence within joint replacement surgery. The collaboration has also led to a harmonisation of research methods and the way of analysing and presenting register data. The collaboration has gained new momentum after the pandemic under the leadership of Professor Nils Hailer who also is a member of the Swedish Arthroplasty Register's steering group.

Another important forum for the international work is the International Society of Arthroplasty Registries (ISAR). From the register management, we participate very actively in the management of the organisation and in work groups. The ISAR-collaboration has led to several projects where we combine data from several registries.

From one of the working groups in ISAR we have contributed to a review and comparison of PROMs from several arthroplasty registries around the world (Ingelsrud et al. How do Patient-reported Outcome Scores in International Hip and Knee Arthroplasty Registries Compare? Clin Orthop Relat Res. 2022 Oct 1; 480 (10): 1884-1896.). That study was made possible by us together with other registries participated in the OECD's (Organisation for Economic Co-operation and Development) working group for "Patient-Reported Indicator Surveys (PaRIS) on Hip and Knee Replacement Surgery". The first report was published in 2019, the second in 2022 (Kendir, C., et al. (2022), "International assessment of the use and results of patient-reported outcome measures for hip and knee replacement surgery: Findings of the OECD Patient-Reported Indicator Surveys (PaRIS) working group on hip and knee replacement surgery", OECD Health Working Papers, No. 148, OECD Publishing, Paris, https://doi.org/10.1787/6da7f06b-en.) and we have recent data for the next OECD-report.

Through the ISAR collaboration, we have also participated in a large international study on dual-mobility cups in hip fracture which was published in 2022 (Farey et al. Do Dual-mobility Cups Reduce Revision Risk in Femoral Neck Fractures Compared With Conventional THA Designs? An International Meta-analysis of Arthroplasty Registries. Clin Orthop Relat Res. 2022 Oct 1; 480 (10): 1912–1925).

Another example is the collaboration with Australia and Kaiser Permanente in the US. In September 2022 Peter Lewis defended his PhD-work including studies on revision after total knee replacement using information from arthroplasty registries in the three countries (Knee replacement revision – An international comparison, https://lup.lub.lu.se/record/552b6f5e-0ab1-44f6-90f5-615a334135a4).

The Swedish Arthroplasty Register has been represented at several international meetings in 2022, which were organised by, among others the European Federation of National Associations of Orthopaedics and Traumatology, the Osteoarthritis Research Society International and the International Society of Arthroplasty Registries. At these meetings, research results from the Swedish Arthroplasty Register has been presented.

In addition, that such collaboration projects lead to interesting results, they contribute to the various actors receiving information about each other's methods for registration, selection, analyses and reporting. In turn, this also hopefully means that the registries are approaching each other so that in the future it will become easier to compare the individual countries' results in scientific articles and reports.

We believe that the growing international cooperation in recent years has had a positive impact both on research, activities and not least for patients.

Publication 2021–2023

Scientific articles published from 1 January 2021 to 31 July 2023, which have used data from the Swedish Arthroplasty Register or its predecessors, are listed below. For a complete list of publications, please refer to the Register's website.

2023 (until 31 July)

Jolbäck P, Bedeschi Rego De Mattos C, Rogmark C, Chen AF, Nauclér E, Tsikandylakis G. Patient-reported Outcomes After Primary Total Hip Arthroplasty Are Not Affected by the Sex of the Surgeon: A Register-based Study of 8,383 Procedures in Western Sweden. J Am Acad Orthop Surg. 2023 Apr 28.

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Teni FS, Burström K, Devlin N, Parkin D, Rolfson O; Swedish Quality Register (SWEQR) Study Group. Experience-based health state valuation using the EQ VAS: a register-based study of the EQ-5D-3L among nine patient groups in Sweden. Health Qual Life Outcomes. 2023 Apr 10;21(1):34.

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Dissertations 2022

The following theses with data from the Swedish Arthroplasty Register or its predecessors were defended in 2022. For a complete list of dissertations, please refer to the Register's website.

- Periprosthetic Joint Infections. Clinical and Epidemiological Aspects. Olof Thompson, 2022-10-07.
- On hip fractures in adults under the age of 60. Sebastian Ström Rönnquist, 2022-09-16.
- Knee replacement revision: an international comparison. Peter Lewis, 2022-09-08.

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