Swedish Hip Arthroplasty Register

Annual report 2019

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Contents

The English version of the annual report contains selected tables and graphs.
The online Swedish version contain all the tables and graphs and is published on the website www.shpr.se.

Wordlist

Adverse event	An unexpected negative event, in this case, as a consequence of a hip arthroplasty, for example an infection.
ASA classification	American Society of Anaesthesiologist physical status classification: classification of patients based on the physical health status of the patient. The higher value of the ASA classification, the poorer the physical health status.
Aseptic loosening	Loosening that is not caused by an infection.
Bilateral prosthesis	Prosthesis in both the right and left hip.
Bipolar head	Composite femoral head 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 acetabular cup.
BMI	Body Mass Index. BMI = weight/length^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	Musculoskeletal comorbidity measure. Class A refers to unilateral hip disease, class B refers to bilateral hip disease, and class C refers to multiple hip disease or other medical conditions that affect the walking ability.
Closed reduction	Repositioning of a body part or a fracture to the right position.
Completeness	Completeness rate.
Confidence interval (C.I.)	An estimate of uncertainty by using a lower and an upper limit.
Consumption	Refers to the number of hip arthroplasties per 100,000 inhabitants regardless of where the operation has been carried out.
Coverage	Affiliation rate.
Cox regression	Regression model used to study potential associations between survival rate and one or more predictors.
CPUA	Central Data Controlling Responsibility
DAIR	Debridement, Antibiotics, Implant, Retention; measure taken during deep infection with the aim to keep bone-anchored prosthesis components by debriding, rinsing, and administrating antibiotics to heal the infection.
DMC	Dual Mobility Cup
Elective surgery	Planned operation.
EQ-5D	A standardised instrument, questionnaire, to measure general health.
Fast track	Care concept based on thorough preoperative information, early mobilization and effective pain relief to minimize care time in
HA	Hydroxyapatite.
Hardinge approach	Direct lateral approach in back position.
Hazard ratio (HR)	The relation in risk for an event between two studied groups.
Hybrid total arthroplasty	Uncemented cup and cemented stem.
ICD-10	Code system that classifies diagnoses.
Incidence	The number of events in a certain population during a delimited time.
Internal fixation	Plates, screws, or nails used to treat a fracture.
ISAR	International Society of Arthroplasty Registries.
Kaplain-Meier analysis	Statistical method for estimating the probability of survival (eg for an implant) after a certain given time.
KVÅ code	Code system that classifies care measures.
Likert	A scale where the respondent's different attitudes are measured. Likert scales usually have five levels, but seven levels also exist.
Log rank test	Statistical hypothesis test to compare the difference between two or several survival distributions (Kaplan-Meier), where the hypothesis is that the distributions are equal.
Medical Device Regulation (MDR)	Regulation on medical devices within the EU.
NARA	Nordic Arthroplasty Register Association.

Nationella program-områden (NPO)	A national system for knowledge management in Swedish healthcare.
NOAC	Non-vitamin K antagonist oral anticoagulants.
One session procedure	Operation carried out in one session.
Osteoarthritis exercise program	The osteoarthritis exercise program provides core treatment during osteoarthritis, which means information and training.
Osteolysis	Loosening of bone tissue.
Patient Register	The Patient Register (National Board of Health and Welfare).
PPFF	Periprosthetic femoral fracture.
Prevalence	Refers to the proportion of individuals in a population who suffer from a certain disease or have a certain condition.
Primary osteoarthritis	Osteoarthritis developed without any known cause.
Production	Refers to the number of total hip arthroplasties per 100,000 inhabitants regardless of where the patient being operated on lives.
PROM	Patient Reported Outcome Measurement.
p-value	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	All open procedures of which revisions form a part.
Reverse hybrid total arthroplasty	Cemented cup and uncemented stem.
Revision	Exchange or extraction of one or more inserted prosthesis components.
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.
Secondary osteoarthritis	Osteoarthritis developed as a consequence of a known disease or injury.
Sequelae	Impairment after disease, injury, or trauma.
SD	Standard deviation.
SHAR	Swedish Hip Arthroplasty Register
SHPR	Svenska Höftprotesregistret (Swedish)
Standard patient	A man or a woman with primary osteoarthritis who have undergone a total arthroplasty and who is 55-85 years old, with an ASA class of I or II, and with a BMI less than 30.
Sveriges Kommuner och Regioner (SKR)	Swedish Association of Local Authorities and Regions
THA	Total hip arthroplasty.
Two session procedure	Operation carried out in two sessions.
Unilateral prosthesis	Prosthesis only in one hip (the right or the left hip).
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.

1. Introduction

In 2019, the Swedish Hip Arthroplasty Register's 40th anniversary year, several new records were set. Never have so many hip arthroplasties been undertaken and never have so many research papers using data from the register been published during one operational year. The 40th anniversary was celebrated with a symposium that was attended by 130 participants with a strong international representation. This year's report encompasses all hip arthroplasties in Sweden up to the 31st of December 2019, which was the 41st operational year of the Swedish Hip Arthroplasty Register (SHAR). This is the last annual report with the current organisation. In the beginning of 2020, the Swedish Arthroplasty Registry was formed by the joining of the Swedish hip and knee arthroplasty registries, just as portrayed on the cover. An intensive work effort is laid down in order to make all the practical details of the union a reality.

This year's production

The production continued to increase in 2019 (figures 1.1.1 and 1.1.2). All in all, 25,556 hip arthroplasties were registered during 2019. 19,692 primary total hip arthroplasties were carried out, which corresponds to 373 procedures per 100,000 inhabitants 40 years of age or older. 4,465 primary hemiarthroplasties were registered, which is on par with the mean production during the last ten years. In total, 2,399 reoperations, of which 2,111 were revisions, were registered.

This year's in-depth analyses and improvement works

An important part of the register-operation is to stimulate improvement works. In this year's report there is an account of how Södertälje sjukhus has improved their care of patients with an acute hip fracture during hip arthroplasty.

This year's report as usual contains several in-depth analyses. Among other things we have investigated the risk of revision during the use of dual-mobility cups in two analyses. We could not find any support for a decreased risk of revision as compared to traditional articulation. Resurfacing prosthesis was a hot media topic during 2019 that warranted an in-depth analysis. It demonstrated that patients with a resurfacing implant have a considerably increased risk of revision compared with matched patients operated with conventional implants. In an exciting analysis of extracapsular hip fractures treated with a hip arthroplasty, we show that the risk of revision is at the same level as for those who have undergone hip arthroplasty due to an intra-

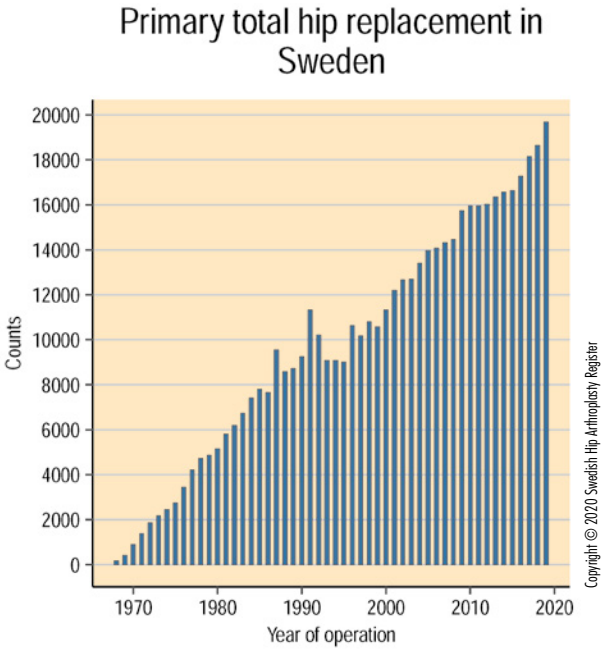

Figure 1.1.1

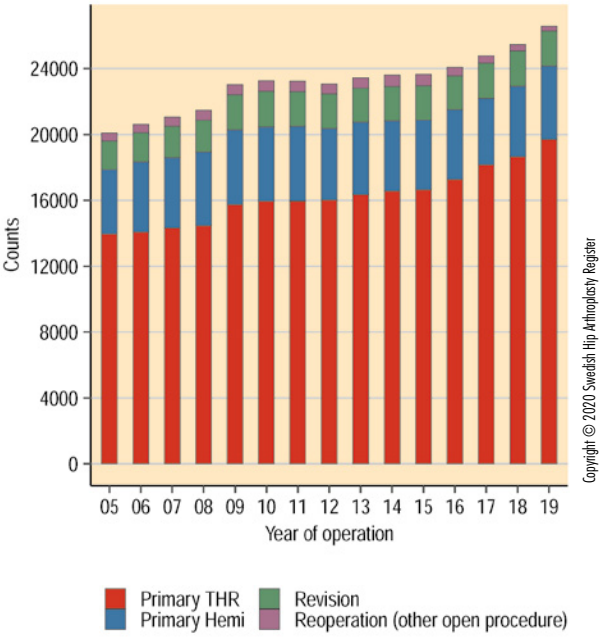

Figure 1.1.2

capsular fracture. The Corail stem is the most used uncemented hip stem in Sweden today. The standard variant comes in two types, one with a collar and one without – and there are two more versions – one with an increased offset and one for coxa vara. The outcome for these different stem versions has been thoroughly analysed where the only variant that had a poorer implant survival was the one with an increased offset.

This year's report also contains an updated in-depth analysis of primary hip arthroplasties with an incomplete documentation in Sweden. Most of the implants that have been introduced on the Swedish market since 2008, show good or acceptable results, but some of them do not quite reach today's standard. The reason for this can be an adverse case-mix or other reasons that are not obvious in a registry analysis.

Furthermore, we have investigated the outcome after first revision due to loosening depending on if cup or stem are changed, or both, and we find that the risk of revision is lower among those that have undergone a total revision.

The Covid-19 pandemic

When the covid-19 pandemic hit Sweden in the beginning of March 2020, a large portion of the healthcare readjusted in order to meet the need for care that arose as a result. In addition, a comprehensive effort was made to protect individuals in risk groups. This resulted in a drastic decrease of elective hip arthroplasties. In this year's report we have investigated how the production and different types of hip arthroplasties changed during the first four months of this year, differences between regions, and mortality, and compared the same time-period during the previous three years. This analysis is an exception from the rule to only use data for the time-period the annual report pertains to and should therefore be interpreted with care since the reporting has some backlog.

The Swedish Hip Arthroplasty Register and clinical research

The research activity within the register has been very high during the last ten years. This is among other things shown by the fact that 22 PhD-students are affiliated with the registry. The PhD-students base whole or parts of their dissertation on data from the Swedish Hip Arthroplasty Register and represent seven Swedish universities (Uppsala University, Lund University, Gothenburg University, Umeå University, Linköping University, Karolinska Institutet and Örebro University). During the anniversary year 2019, 41 research papers with a connection to the register were published and we held over 70 presentations at international or national meetings. Since the start of the SHAR, 30 PhD-students have defended their dissertation based on data from the register under the supervision of registry co-workers. This year's report contains summaries of four dissertations using register-data (Georgios Chatziagorou, Urban Berg, Ammar Jobory and Per Jolbäck).

Thank you to all co-workers and financiers

A prerequisite for the functioning of the SHAR is registration and the provision of necessary information by the units. We appreciate the commitment and work put-in by the contact secretaries and contact surgeons all over the country. A big thank you for all input during last year.

We would also like to thank Svensk Ortopedisk Förening and the Swedish Association of Local Authorities and Regions, which support the extensive work with the joining of the hip and knee arthroplasty registries financially.

Göteborg, August 2020

The Register Management Team

2. Data quality and validation process

Author: Ola Rolfson

The register-data is continuously validated and quality controlled. We use several methods to ascertain and maintain a high data quality, and to be able to improve in the areas where there are shortcomings.

2.1 Completeness analysis

An important part of the validation process is the annual coverage analysis that is carried out through linkage with the Patient Register of the National Board of Health and Welfare. The method is explained in tables 2.1.1 and 2.1.2. The analysis encompasses all primary operations, divided into total and hemiarthroplasties. Since there is a delay before the data from the Patient Register for the previous operational year is ready, the completeness analysis for the operational year 2018 is presented. There are instances when units during ex-post facto control, or in connection with a reoperation, find that they have failed to register a primary operation in the register, and do an ex-post facto registration. This accounts for fewer than 50 operations per year. To investigate trends in the reporting frequency, we have produced numbers for the last ten years (2009–2018). The completeness rate for total hip arthroplasties has stayed between 97 % and 99 % and in 2018 it was 98 % (figure 2.1.1). For hemiarthroplasties the coverage rate was 96 % in 2018 and the reporting frequency has hovered between 94 % and 97 % during the last ten years.

During the last two years we have also reported the completeness rate for revisions. In order to carry out the analysis we have linked data regarding operations that we have classified as revisions (that is extraction, change or addition of any implant) from the Swedish Hip Arthroplasty Register to data in the Patient Register of the National Board of Health and Welfare. The correct classification of care measures (KVÅ) for revision are codes in the group NFC (secondary hip arthroplasties), NFU09 (extraction of part of a total arthroplasty or of a hemiarthroplasty from hip) or NFU19 (extraction of a total arthroplasty from hip). Of the 2,169 revisions that were registered during 2018, 1,930 could be matched to the Patient Register, which contained an additional 217 operations with a revision code. This gives a completeness rate of 91 %. Viewed over the whole time-period, the reporting has improved steadily from just under 90 % to 95 % at its peak in 2015 (figure 2.1.1). Whether the 217 operations with a revision code that were found in the Patient Register really were revisions, is anyone's guess but it gives an indication of how we may improve the reporting. We call for accuracy and good registration routines – many units have a 100 % completeness rate for all types of operations.

2.2 Completeness analysis per unit

We present completeness rates for total arthroplasties, hemiarthroplasties and revisions per unit for the operational year 2018 in the report (tables 2.2.1, 2.2.2 and 2.2.3). The analysis in question encompasses information on unit level for the whole time-period 2009–2018 and if there is an interest in data concerning 2009–2017 which is not shown in the tables, the registry is more than happy to provide this. Units with values below the lower confidence level for the national mean are given red figures in the table. 24 units are given such a marking during 2018 for total arthroplasties, 12 for hemiarthroplasties and 15 for revisions. The deviations are small for most units but despite the high national mean, there is a clear room for improvement for some units.

2.3 The data quality of the PROM-programme

Since 2008, all units carrying out hip arthroplasties in Sweden are part of the register's follow-up routine for patient reported outcome measures, the PROM-programme. The response rate for the preoperative questionnaire, which, for natural reasons, is intended for elective patients, has been very high.

Since the input functionality in the old PROM-database required an answer to every question, the registered questionnaires are complete. The contact secretaries may complete incomplete forms by contacting the patient by phone or mail. If the questionnaire is not complete, the answers were not possible to register in the database. In our new platform (Stratum), which became operational in January 2017, it is possible to register incomplete PROM-questionnaires, but the system issues a warning when all questions are not answered.

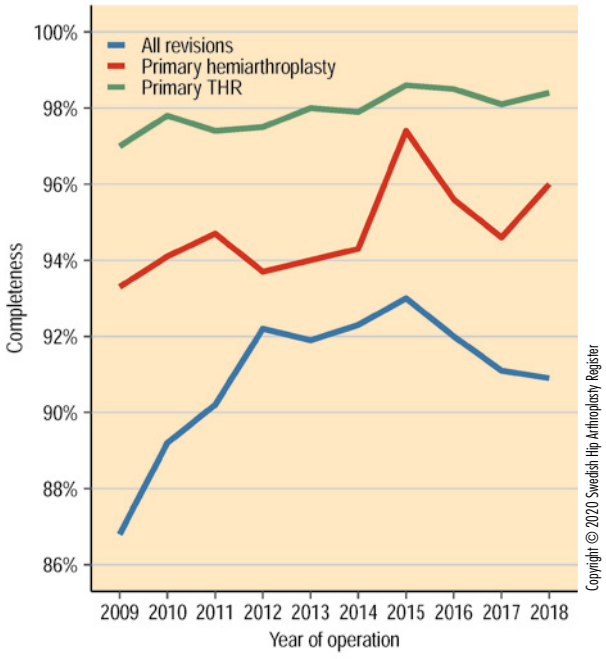

Figure 2.1.1

Since the migration to Stratum in the beginning of 2017, the response rate has decreased. We suspect that a change of the input and mailings routines may have contributed to the decrease and hope that the "teething troubles" that arose during the transition from the old to the new platform now have passed. During 2018, the response rate was 83 % preoperatively and 81 % postoperatively (table 2.3.1).

2.4 Missing variables

For patients operated electively with a total arthroplasty, we have selected the variables diagnosis, ASA, BMI, fixation and articulation to illustrate the data quality of the register in terms of how large a proportion of the registered operations that have the data in question. Some entries of the registration form are compulsory (personal identity number (PIN)), date of surgery, side and diagnosis). Here the data is complete. When it comes to ASA and BMI (requires weight and height), these were complete in 99.6 % and 99.3 % of the registrations respectively during 2019. Fixation (cemented, uncemented, hybrid or reverse hybrid) requires data on fixation for both cup and stem. Here, the completeness was 99.9 % for all registrations during 2019. Articulation is a computational variable, which requires the input of both caput and cup components, and that we have data on the nature of the component. For registrations during 2019, we were able to make a computation of articulation in 99.8 % of cases during 2019.

For fracture patients that underwent a hemiarthroplasty or a total arthroplasty during 2019 we have chosen to present ASA, BMI, dementia (yes, suspected, no), diagnosis and fixation (table 2.4.1). BMI was missing in 20.9 % of cases but it is still a substantial improvement compared to previous years. One should consider that it is not possible to acquire data on current weight of fracture patients in many cases. Data on dementia was missing in 15.5 % of the registrations.

2.5 Validation processes

In addition to the completeness analysis described above, the following validation processes are applied in the Swedish Hip Arthroplasty Register:

- During registration there are compulsory entries that cannot be left blank if the data is to be saved.
- The web input module comes with automatically generated controls of for example personal identity number, side, unit, implant combinations and type of fixation.
- Control reports are automatically generated if operation-data for one or more variables is missing or if the data is inconsistent. In these cases, the unit in question is contacted and corrects the data itself or a medical record is sent to the register for follow-up.
- Contact secretaries and contact doctors receive a balancing report twice per year in order to be able to check that the reported operations balances with the real production. Each

Completeness analysis total and hemiarthroplasties
Total and hemiarthroplasties respectively are compared with the corresponding selection from the Patient Register. The completeness rate is calculated as a percentage according to: *Numerator* All total and hemiarthroplasties respectively in the Swedish Hip Arthroplasty Register. *Denominator* All total and hemiarthroplasties respectively in the Swedish Hip Arthroplasty Register, or total and hemiarthroplasties respectively in the Patient Register.
About the comparison Here, all total and hemiarthroplasties respectively in the Swedish Hip Arthroplasty Register are compared with the corresponding operations in the Patient Register.
Selection from the Swedish Hip Arthroplasty Register All primary total and hemiarthroplasties in the Swedish Hip Arthroplasty Register, carried out during the past year. A maximum of one measure per individual and date has been included.
Selection from the Patient Register Hip arthroplasties registered in the Patient Register, inpatient care, carried out during the past year. Registrations with measure codes NFB29, NFB49, NFB62 or NFB99 for total arthroplasties and NFB09 or NFB19 for hemiarthroplasties were included. A maximum of one measure per individual and date has been included.
Procedure One operation per surgery date is included. If several hip arthroplasties were carried out on the same patient the same day, only one is included in the comparison.
Matching criteria Total arthroplasties in the Swedish Hip Arthroplasty Register are matched with the Patient Register on personal identity numbers and dates of measure +/-7 days.

Table 2.1.1

unit is requested to control its register-balance with the local patient administrative system.
- The medical records of all reoperations are routinely sent to the register for registration of an in-depth part. During registration of the in-depth part, a register coordinator checks that the data registered is complete and correct.
- When it comes to PROM-data, controls of late and missing registration are carried out respectively through a semi-automated statistics package. Every year a balancing is made where each unit is given access to information on the number of operations and the number of registered preoperative questionnaires.

2.6 Non-response analysis for revisions

In order to better understand why certain revisions are missing in the Swedish Hip Arthroplasty Register, we have conducted a missing-data analysis with the assistance of Registerservice at the National Board of Health and Welfare. Revisions should have a measure code in the NFC group (secondary hip arthroplasties), NFU09 (extraction of part of total arthroplasty or hemiarthroplasty from hip) or NFU19 (extraction of total arthroplasty from hip) in the Patient Register. We investigated operations with any of these measure codes registered in the Patient Register with a date of surgery in 2009–2018. From the Swedish Hip Arthroplasty Register the personal identity number (PIN) and date of revision was linked with the data in the Patient Register in the same way as during the completeness analysis. We investigated if the reasons for revision (main diagnosis in the Patient Register) was different between the operations that were in both registries and the operations that were missing in the Swedish Hip Arthroplasty Register.

During 2009–2018, 1,964 revisions were identified that were only in the Patient Register. Of the 18,821 revisions that were in both registries, 63 % had a main diagnosis indicating loosening/osteolysis, 18 % indicating infection, 9 % indicating periprosthetic fracture and 6 % indicating dislocation. The corresponding numbers for the revisions that were only present in the Patient Register were 35 % for loosening/osteolysis, 29 % for infection, 18 % for periprosthetic fracture and 10 % for dislocation. Other causes accounted for 4 % and 9 % respectively but had the largest proportion of missing registrations. The lowest missing-data rate was found for the revisions with diagnoses indicating loosening/osteolysis, while infection, periprosthetic fracture and dislocation diagnoses had missing-data rates of 17–19 %. The acute reasons for revision are considerably more common among the revisions that have not been registered in the Swedish Hip Arthroplasty Register. Observe that the analysis does not include the revisions that are only found in the Swedish Hip Arthroplasty Register. This makes the missing-data rate look larger than what it really is. If the analysis is confined only to the operational year 2018, the missing-data rate is lower (8 %), and infection and dislocation is proportionally more common (14 % each) compared to periprosthetic fracture (7 %). Even if there has been an improvement over time, there is still room for a considerable increase of the reporting of revisions due to infection and dislocation.

Completeness analysis revisions
Revisions of hip arthroplasties are compared with the corresponding selection from the Patient Registre. The completeness rate is calculated as a percentage with: *Numerator* All revisions or hip prosthesis in the Swedish Hip Arthroplasty Register. *Denominator* All revisions of hip prostheses in the Swedish Hip Arthroplasty Register, or revisions of hip prostheses according to the Patient Register.
Selection from the Swedish Hip Arthroplasty Register Hip arthroplasty revisions in the Swedish Hip Arthroplasty Register, undertaken during the current year. A maximum of one measure per individual and day has been included.
Selection from the Patient Register Hip arthroplasties registered in the Patient Register, inpatient care, carried out during the current year. Registrations with measure codes NFC, NFU09 of NFU19 were included. Maximally one measure per individual and day has been included.
Data gathering (other information) One operation per date of surgery is included. If several revisions were carried out on the same patient the same date, only one is included in the comparison.
Matching criteria Total arthroplasties in the Swedish Hip Arthroplasty Register are matched with the Patient Register on personal identity numbers and dates of measure +/-7 days.

Table 2.1.2

Completeness rate for total arthroplasty 2018

Unit	Number[1)]	SHAR, %[2)]	Patient Register, %[3)]
University or regional hospital			
Karolinska/Huddinge	183	97.3	95.2
Karolinska/Solna	106	92.2	94.8
Linköping	82	97.6	97.6
SU/Mölndal	585	97.8	98.7
SUS/Lund	118	100	94.9
SUS/Malmö	50	96.2	98.1
Umeå	78	96.3	95.1
Uppsala	215	98.6	97.7
Örebro	56	98.2	100
County hospital			
Borås-Skene	334	97.9	98.2
Danderyd	255	97.7	96.9
Eksjö	253	100	99.6
Eskilstuna	135	98.5	97.8
Falun	175	98.9	99.4
Gävle	183	94.8	90.7
Halmstad	205	100	99
Helsingborg	46	93.9	98
Hässleholms sjukhus	761	99.6	99.7
Jönköping	258	99.2	99.2
Kalmar	179	98.9	98.9
Karlshamn-Karlskrona	318	100	99.4
Karlstad	178	98.9	97.2
Kristianstads sjukhus	49	100	93.9
Norrköping	245	99.6	100
Sundsvall	40	87	89.1
Södersjukhuset	275	98.2	97.9
Uddevalla-NÄL	406	99.5	99.5
Varberg	293	100	99.3
Västerås	494	96.5	98.4
Växjö	130	97	74.6
Ystad	3	18.8	93.8
Östersund	311	97.5	97.5
Local hospital			
Alingsås	191	99.5	97.4
Arvika	216	96.4	97.3
Enköping	441	100	100
Gällivare	119	98.3	99.2
Hudiksvall	94	98.9	91.6
Karlskoga	31	100	100
Katrineholm	260	99.2	98.9
Kungälv	175	98.3	97.2
Lidköping-Skövde	303	98.1	96.1
Lindesberg	690	100	99.7
Ljungby	198	99.5	69.3
Lycksele	318	98.1	98.5
Mora	269	98.5	99.3
Norrtälje	169	98.3	98.3
Nyköping	186	100	95.2
Oskarshamn	289	98.6	98.3
Piteå	444	98.9	99.1
Skellefteå	148	98.7	98.7
Sollefteå	317	98.4	99.1
Sunderby	35	76.1	89.1
Södertälje	182	100	99.5
Torsby	120	100	100
Trelleborg	690	99.4	98.6
Visby	137	90.1	94.1
Värnamo	154	99.4	98.7
Västervik	147	98.7	98.7
Ängelholm – Aleris Specialistvård Ängelholm	237	99.2	97.1
Örnsköldsvik	134	99.3	98.5
Private hospital			
Aleris Specialistvård Bollnäs	338	99.1	98.5
Aleris Specialistvård Motala	608	100	99.8
Aleris Specialistvård Nacka	243	99.6	98
Art Clinic Göteborg	109	100	99.1
Art Clinic Jönköping	137	100	94.2
Capio Artro Clinic	358	99.7	94.2
Capio Movement*	367	-	0
Capio Ortopediska Huset	631	98.1	98.9
Capio S:t Göran	556	94.9	98
Carlanderska*	263	-	0
Frölundaortopeden*	13	-	0
Hermelinen Specialistvård*	20	-	0
Ortho Center IFK-kliniken	233	100	99.6
Ortho Center Stockholm	732	99.9	93.2
Sophiahemmet	267	98.9	86.3
Country	18,568	98.4	93.9

Table 2.2.1 Red markings correspond to values below the lower confidence band in relation to the national mean.

[1)] The number of registrations in the Swedish Hip Arthroplasty Register (SHAR).

[2), 3)] The proportion of registrations in each register respectively.

** Since these units do not have any reported operations in the Patient Register, completeness analysis is not possible to perform.*

Data for other care units are not presented separately in the table but are part of the summary for the nation as a whole.

Completeness rate for hemiarthroplasties 2018

Unit	Number[1]	SHAR, %[2]	Patient Register, %[3]
University or regional hospitals			
Karolinska/Huddinge	80	83.3	80.2
Karolinska/Solna	32	91.4	88.6
Linköping	84	97.7	95.3
SU/Mölndal	282	98.6	93.4
SUS/Lund	172	99.4	96
SUS/Malmö	176	98.9	92.1
Umeå	58	100	94.8
Uppsala	135	99.3	99.3
Örebro	46	83.6	100
County hospitals			
Borås-Skene	92	96.8	94.7
Danderyd	209	96.8	95.4
Eksjö	41	97.6	92.9
Eskilstuna	71	98.6	90.3
Falun	123	97.6	92.9
Gävle	93	97.9	90.5
Halmstad	54	100	92.6
Helsingborg	179	99.4	98.9
Jönköping	60	100	95
Kalmar	63	100	93.7
Karlshamn-Karlskrona	105	97.2	94.4
Karlstad	116	99.1	93.2
Kristianstads sjukhus	129	100	90.7
Norrköping	61	98.4	96.8
Sundsvall	87	86.1	88.1
Södersjukhuset	244	94.6	95.7
Uddevalla-NÄL	219	100	97.3
Varberg	81	100	91.4
Västerås	6	100	50
Växjö	49	98	90
Ystad	39	54.9	98.6
Östersund	68	100	94.1

Unit	Number[1]	SHAR, %[2]	Patient Register, %[3]
Local hospitals			
Alingsås	41	95.3	100
Gällivare	26	100	96.2
Hudiksvall	61	100	98.4
Karlskoga	78	100	96.2
Kungälv	66	95.7	95.7
Lidköping–Skövde	108	94.7	92.1
Lindesberg	6	100	100
Ljungby	21	100	95.2
Lycksele	13	100	84.6
Mora	45	93.8	89.6
Norrtälje	30	100	96.7
Skellefteå	36	100	97.2
Sunderby	88	78.6	98.2
Södertälje	24	96	100
Torsby	18	94.7	100
Visby	23	85.2	88.9
Värnamo	38	100	97.4
Västervik	54	98.2	96.4
Örnsköldsvik	79	96.3	96.3
Private hospitals			
Aleris Specialistvård Motala	30	100	100
Capio S:t Göran	161	97	90.4
Country	4,300	96	94.2

Table 2.2.2

Red markings correspond to values below the lower confidence band in relation to the national mean.

[1] *The number of registrations in the Swedish Hip Arthroplasty Register (SHAR).*

[2], [3] *The number of registrations in each register respectively.*

The data of other units is not presented separately in the table but are included in the national mean.

Completeness rate revisions 2018

Unit	Number[1)]	SHAR, %[2)]	Patient Register, %[3)]
University or regional hospitals			
Karolinska/Huddinge	89	93.7	93.7
Karolinska/Solna	45	90	94
Linköping	45	83.3	81.5
SU/Mölndal	163	85.8	90.5
SUS/Lund	120	96.8	96
SUS/Malmö	6	100	66.7
Umeå	85	94.4	93.3
Uppsala	115	95.8	95.8
Örebro	14	87.5	75
County hospitals			
Borås-Skene	45	77.6	91.4
Danderyd	120	91.6	92.4
Eksjö	27	96.4	92.9
Eskilstuna	54	98.2	81.8
Falun	40	100	85
Gävle	75	96.2	87.2
Halmstad	40	100	75
Helsingborg	53	91.4	75.9
Hässleholms sjukhus	103	98.1	97.1
Jönköping	35	92.1	84.2
Kalmar	21	95.5	81.8
Karlstad	50	94.3	90.6
Kristianstads sjukhus	9	100	44.4
Norrköping	32	97	87.9
Sundsvall	12	75	87.5
Södersjukhuset	55	87.3	96.8
Uddevalla-NÄL	66	95.7	98.6
Varberg	18	100	100
Västerås	67	93.1	90.3
Växjö	38	97.4	82.1
Östersund	60	95.2	82.5
Local hospitals			
Kungälv	17	94.4	72.2
Lidköping-Skövde	87	96.7	82.2
Lindesberg	59	100	100
Ljungby	5	83.3	83.3
Mora	11	91.7	83.3
Norrtälje	16	88.9	94.4
Nyköping	14	82.4	94.1
Piteå	56	94.9	98.3
Skellefteå	12	85.7	92.9
Sunderby	7	36.8	100
Visby	9	64.3	85.7
Västervik	26	92.9	85.7
Örnsköldsvik	5	83.3	100
Private hospitals			
Aleris Specialistvård Motala	28	87.5	100
Capio S:t Göran	53	63.1	94
Ortho Center Stockholm	7	100	85.7
Country	2,169	90.9	90.2

Table 2.2.3

Red markings corresponds to values below the lower confidence band in relation to the national mean.

[1)] The number of registrations in the Swedish Hip Arthroplasty Register (SHAR).

[2), 3)] The number of registrations in each register respectively.

The data of other units is not presented separately in the table but are included in the national mean.

PROM data quality 2015–2018

	2015	2016	2017	2018
All elective operations with total arthroplasty				
Total number of operations	14,603	15,168	15,997	16,382
Deceased within one year (as first event)	118	132	123	118
Reoperated within one year (as first event)	233	276	274	314
Part of the follow-up routine one year	14,252	14,760	15,600	15,950
Preoperative response	11,964	12,512	13,033	13,560
Proportion of all, %	81.9	82.5	81.5	82.8
One year postoperative response	12,662	12,825	13,253	12,945
Proportion of those that are part of the follow-up routine, %	88.8	86.9	85	81.2
Preoperative and one-year postoperative response	10,522	10,673	10,826	10,779
Proportion of those that are part of the follow-up routine, %	73.8	72.3	69.4	67.6
All operations with total arthroplasty due to primary osteoarthritis				
Total number of operations	13,443	13,999	14,769	15,112
Deceased within one year (as first event)	100	104	95	97
Reoperated within one year (as first event)	195	239	247	266
Part of the follow-up routine one year	13,148	13,656	14,427	14,749
Preoperative response	11,124	11,680	12,154	12,655
Proportion of all, %	82.7	83.4	82.3	83.7
One year postoperative response	11,790	11,947	12,322	12,047
Proportion of those that are part of the follow-up routine, %	89.7	87.5	85.4	81.7
Preoperative and one-year postoperative response	9,854	10,029	10,133	10,121
Proportion of those that are part of the follow-up routine, %	74.9	73.4	70.2	68.6

Table 2.3.1

Data quality variables 2015–2019

Year of operation	2015	2016	2017	2018	2019
Available data for all elective operations with a total hip arthroplasty					
Total number of operations	14,603	15,168	15,997	16,382	17,513
Articulation, %	99.9	99.9	99.8	99.8	99.8
ASA-class, %	98.8	99.2	99.4	98.9	99.6
BMI, %	98.3	98.7	98.8	98.4	99.3
Diagnosis, %	100	100	100	100	100
Fixation, %	99.9	99.9	98.2	100	99.9
Available data for all hip arthroplasties due to fracture					
Total number of operations	6,104	6,173	6,043	6,394	6,509
ASA-class, %	96.8	95.1	95.4	95.2	96.9
BMI, %	71.7	72.7	73.3	73.4	79.1
Dementia, %	64.4	62.7	90.4	86.6	84.5
Diagnosis, %	100	100	100	100	100
Fixation, %	99.9	99.9	99.3	99.9	99.8

Table 2.4.1

Non-response analysis for revisions 2009–2018

Diagnosis	Number (%) SHPR+PAR	Number (%) only in PAR	Proportion of missing variables
Loosening/osteolysis	11,783 (63%)	693 (35%)	6%
Infection	3,433 (18%)	575 (29%)	17%
Periprosthetic fracture	1,771 (9%)	328 (18%)	19%
Dislocation	1,151 (6%)	195 (10%)	17%
Other	683 (4%)	173 (9%)	25%
Total	**18,821**	**1,964**	**10%**

Table 2.6.1 Swedish Hip Arthroplasty Register = SHAR, Patient Register = PAR.

3. Epidemiology, availability, and gender aspects

Authors: Ola Rolfson, Cecilia Rogmark

3.1 Total hip arthroplasty in Sweden

Incidence

Ever since the start of the Swedish Hip Arthroplasty Register, the incidence for total hip arthroplasty has steadily increased in Sweden. During 2019, 19 692 primary total hip arthroplasties were carried out in Sweden, which corresponds to 373 procedures per 100 000 inhabitants 40 years of age or older. This is an increase with 13 units since 2018. In an international comparison with the countries that report the frequency of procedures in national quality registries, Sweden is among the countries with the highest incidence. A natural explanation for the increasing incidence is the increase in life expectancy and that the proportion of the elderly in the population is increasing.

Prevalence

We have also studied how the prevalence has changed over the years. The analysis comprises all patients who have undergone a total hip arthroplasty since 1992. We present the prevalence of prosthesis-bearers who either have unilateral or bilateral implants, and prosthesis-bearers who have bilateral implants. The prevalence is given as the number of prosthesis-bearers per 100 000 inhabitants aged 40 years or more at the end of each year.

At the end of 2019, 188 428 individuals had undergone at least one total hip arthroplasty after 1991. This means that 3.6 % of the population, aged 40 years or more, were prosthesis-bearers, an increase with 0.1 percentage points compared to last year. Of these, 51 524 individuals (27 %) had undergone bilateral hip arthroplasties. Averaged over the whole Swedish population in 2019, 1.8 % had undergone at least one primary hip arthroplasty after 1991. The prevalence among those aged 40 years or more was lower in men (3.0 %) than in women (4.1 %) at the end of 2019.

Of those individuals that had undergone a primary hip arthroplasty, 13 % were alive at the end of 2019. The numbers reflect the "true" prevalence increasingly well the more time after 1992 that passes. The number of individuals who underwent a primary hip arthroplasty before 1992 and were still alive at the end of 2019 is assumingly very low.

Number of individuals with at least one hip prosthesis in Sweden

Number per age group	2004	2009	2014	2019
< 40	767	841	840	949
40–49	2,012	2,778	3,441	3,230
50–59	8,246	9,546	11,464	14,215
60–69	20,872	30,075	34,548	35,234
70–79	32,898	42,706	55,486	70,912
80–89	27,085	35,560	42,467	51,803
90 +	3,889	6,442	9,750	12,085
Total	95,769	127,948	157,996	188,428
Prevalence per 100,000 > = 40	2,101	2,670	3,145	3,585
Men				
< 40	323	385	398	461
40–49	974	1,433	1,831	1,715
50–59	3,988	4,836	6,004	7,471
60–69	9,394	13,818	16,200	16,956
70–79	13,216	17,440	23,124	30,164
80–89	8,688	11,694	14,730	18,527
90 +	843	1,538	2,401	3,044
Total	37,426	51,144	64,688	78,338
Prevalence per 100,000 > = 40	1,709	2,203	2,641	3,037
Women				
< 40	444	456	442	488
40–49	1,038	1,345	1,610	1,515
50–59	4,258	4,710	5,460	6,744
60–69	11,478	16,257	18,348	18,278
70–79	19,682	25,266	32,362	40,748
80–89	18,397	23,866	27,737	33,276
90 +	3,046	4,904	7,349	9,041
Total	58,343	76,804	93,308	110,090
Prevalence per 100,000 > = 40	2,463	3,108	3,624	4,111

Table 3.1.1. Number of individuals with at least one total hip prosthesis who have been operated after 1991.

Number of individuals with bilateral hip prostheses in Sweden

Number per age group	2004	2009	2014	2019
< 40	167	202	189	176
40–49	359	544	687	660
50–59	1,566	1,935	2,560	3,292
60–69	4,283	7,087	8,483	9,122
70–79	5,994	10,101	15,047	20,160
80–89	3,919	7,088	10,639	15,097
90 +	362	951	1,966	3,017
Total	16,650	27,908	39,571	51,524
Prevalence per 100,000 > = 40	365	582	788	982

Table 3.1.2. Number of individuals with bilateral hip prothesis who have been operated after 1991.

3.2 Regional production and geographical inequality

"The aim of the healthcare system is a good health and care on equal terms for the whole population. Healthcare should be provided with due respect shown for the equal value of all people and the dignity of each individual. Individuals who are in greatest need of the healthcare system should be given priority." This is what is stated in the Healthcare Act (SFS 2017:30).

An important aspect of equality is geographical differences in how healthcare is run and provided within the country. Equality may, in a broad sense of the word, be related to where in the country you live. The 21 regions exercise self-government but are to follow the Healthcare Act. During several years now, we have taken an interest in geographical differences in frequency of procedures and result. The mapping of Sweden has shown a remarkably large variation between the regions.

Production and consumption per 100 000 inhabitants per region

These numbers are based on data from the Swedish Hip Arthroplasty Register, the population statistics of Statistics Sweden and the address register of the Swedish Tax Agency as of December 31st, 2019. Production refers to the total number of hip arthroplasties per 100 000 inhabitants regardless of where the individual undergoing the procedure lives. Consumption refers to the total number of hip arthroplasties per 100 000 inhabitants regardless of where the operation has taken place. Thus, consumption means that the inhabitants of the regions have access to hip arthroplasty independently of if the procedure is carried out in the home region or somewhere else in the country.

The spread of both production and consumption per 100 000 inhabitants shows a large variation between the principals (the private contractors are included geographically). The production varies between 151–300 and the consumption between 147–292 per 100 000 inhabitants. This means that the region that produces the most has a double production rate compared to the region that produces the least. When it comes to consumption, the incidence in the region that consumes the most is twice that of the incidence in the region that consumes the least. Even after correcting for differences in age structure (the population over 40 years of age), there are considerable differences in the consumption. In this year's report we have also carried out a new type of age standardisation by using population data from the European Standard Population. This standardisation describes what the incidence would have been for a region if all regions would have had the same age distribution. The lowest age standardised consumption incidence can be found in Östergötland with 172 per 100 000 inhabitants and the highest in Jämtland with 258 per 100 000 inhabitants.

3.3 Gender aspects on treatment with hip arthroplasty

The Swedish Hip Arthroplasty Register has presented gender distribution, results dived by gender and other gender aspects on hip arthroplasty treatment in detail for many years, for both the elective and the acute care. Since these results are stationary, we refer to earlier reports this year, and only publish some graphs uncommented.

Production

County	Incidence [1]	Incidence for patients 40 years old and older [2]	Age-standardised incidence [3]
Stockholms län	181	379	212
Uppsala län	158	329	169
Södermanlands län	200	375	180
Östergötlands län	173	337	170
Jönköpings län	216	424	212
Kronobergs län	186	365	179
Kalmar län	300	535	257
Gotlands län	255	440	205
Blekinge län	221	405	194
Skåne län	159	314	163
Hallands län	243	455	228
Västra Götalands län	178	351	182
Värmlands län	179	324	153
Örebro län	221	427	212
Västmanlands län	206	391	190
Dalarnas län	151	273	128
Gävleborgs län	240	437	205
Västernorrlands län	209	375	179
Jämtlands län	223	407	198
Västerbottens län	187	361	178
Norrbottens län	288	518	247
Country	191	373	191

Table 3.2.1

[1] Number of operations per 100,000 inhabitants

[2] Number of operations per 100,000 inhabitants for patients 40 years old and older

[3] Number of operations per 100,000 inhabitants adjusted for age

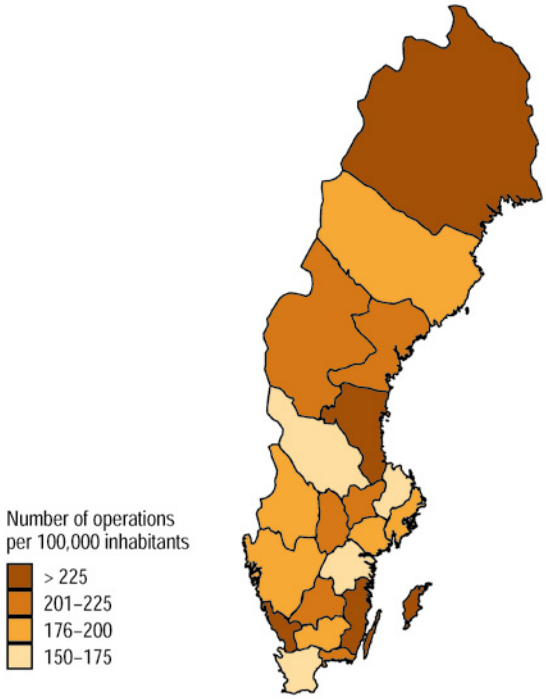

Figure 3.2.1a. Production.

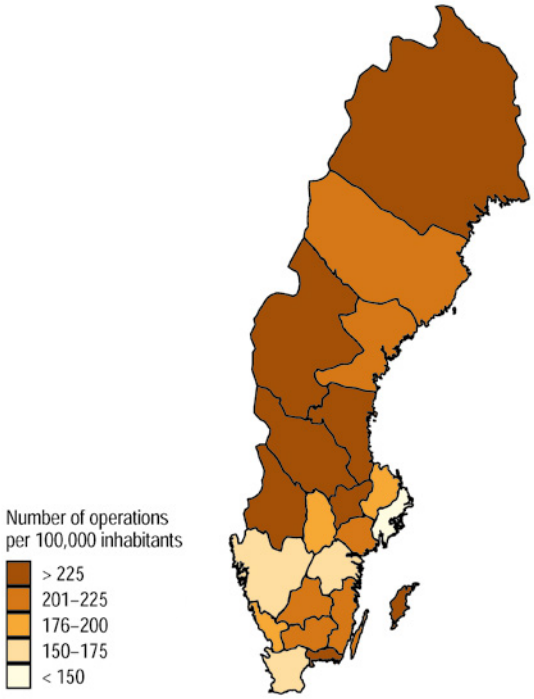

Figure 3.2.1b. Consumption.

Consumption

County	Incidence [1]	Incidence for patients 40 years old and older [2]	Age-standardised incidence [3]
Stockholms län	147	308	173
Uppsala län	182	378	195
Södermanlands län	224	420	203
Östergötlands län	174	340	172
Jönköpings län	207	406	203
Kronobergs län	220	435	214
Kalmar län	222	395	189
Gotlands län	292	504	237
Blekinge län	227	415	201
Skåne län	167	329	171
Hallands län	198	370	186
Västra Götalands län	174	344	178
Värmlands län	227	411	197
Örebro län	191	370	185
Västmanlands län	238	451	223
Dalarnas län	242	438	208
Gävleborgs län	257	466	221
Västernorrlands län	214	383	185
Jämtlands län	287	526	258
Västerbottens län	217	423	208
Norrbottens län	276	495	236
Country	191	373	191

Table 3.2.2

[1] Number of operations per 100,000 inhabitants

[2] Number of operations per 100,000 inhabitants for patients 40 years and older

[3] Number of operations per 100,000 inhabitants adjusted for age

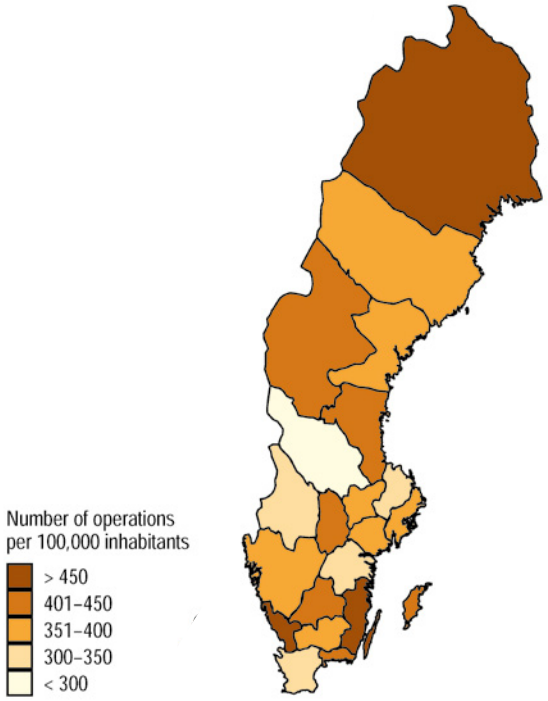

Figure 3.2.2 a. Production for patients 40 years and older.

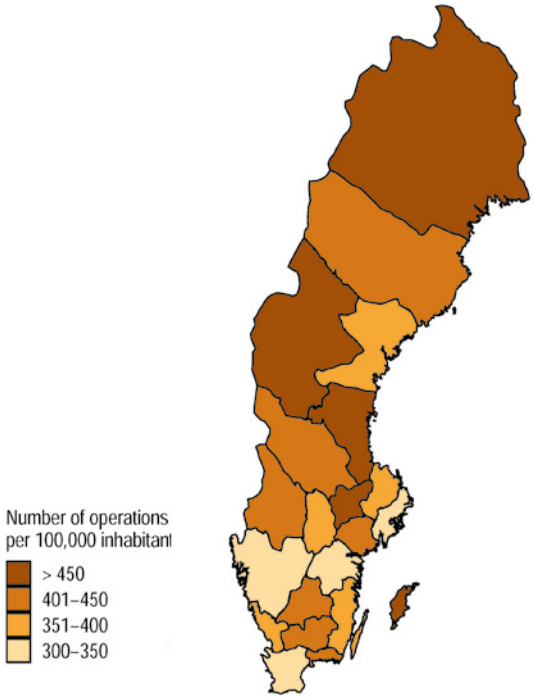

Figure 3.2.2 b. Consumption for patients 40 years and older.

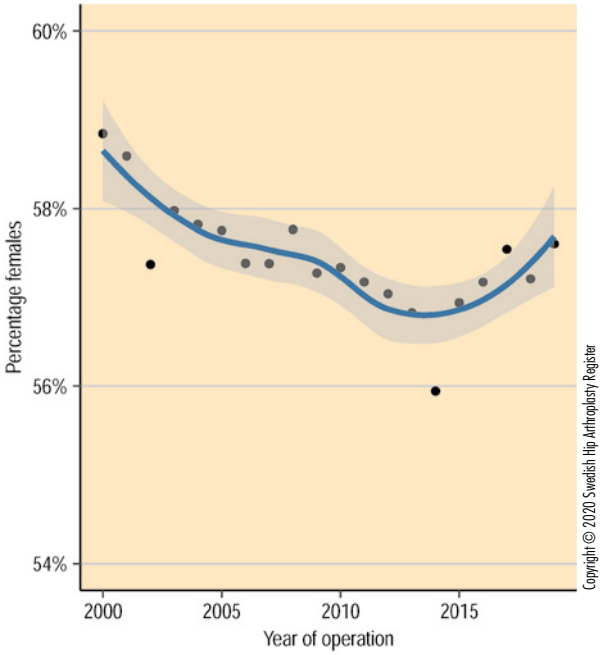

Figure 3.3.1. Total proportion of women.

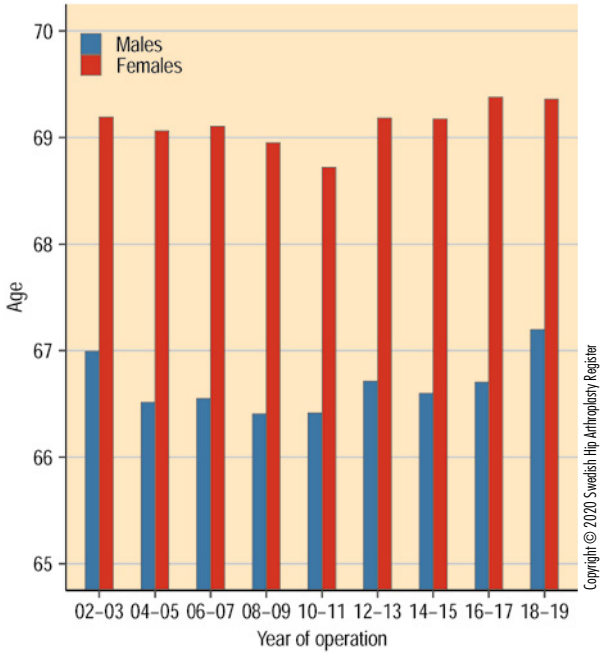

Figure 3.3.2. The mean age of men and women during 2-year periods 2002–2019.

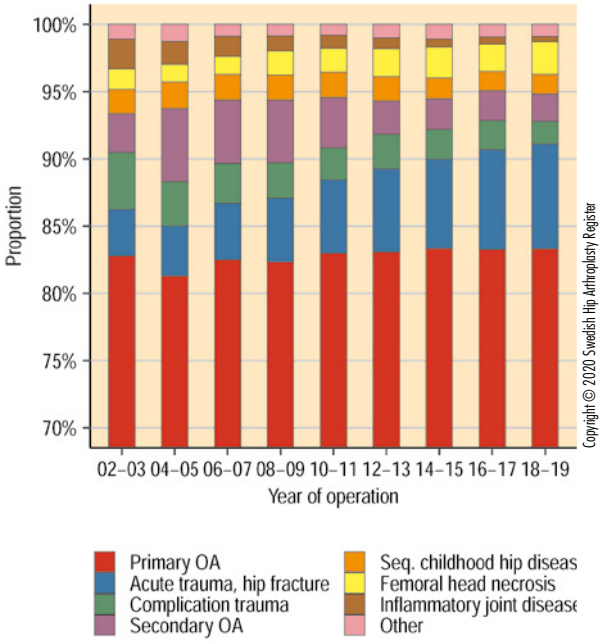

Figure 3.3.3a. Diagnosis-distribution in men during 2-year periods 2002–2019. Observe that the y-axis does not start at 0 %.

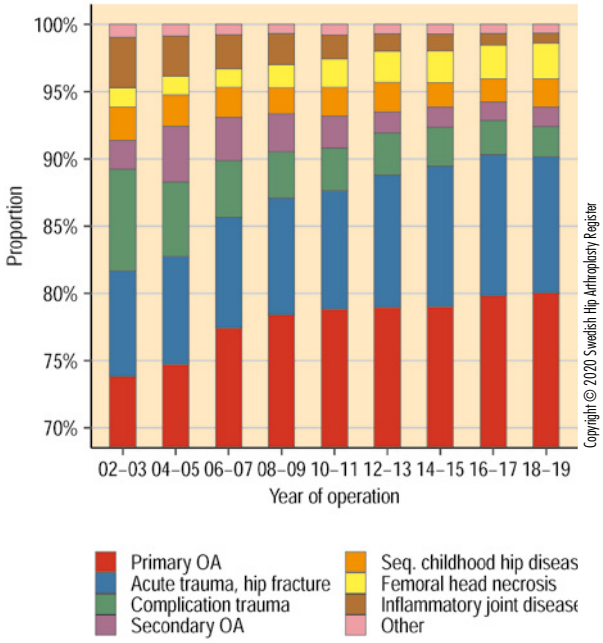

Figure 3.3.3b. Diagnosis-distribution in women during 2-year periods 2002–2019. Observe that the y-axis does not start at 0 %.

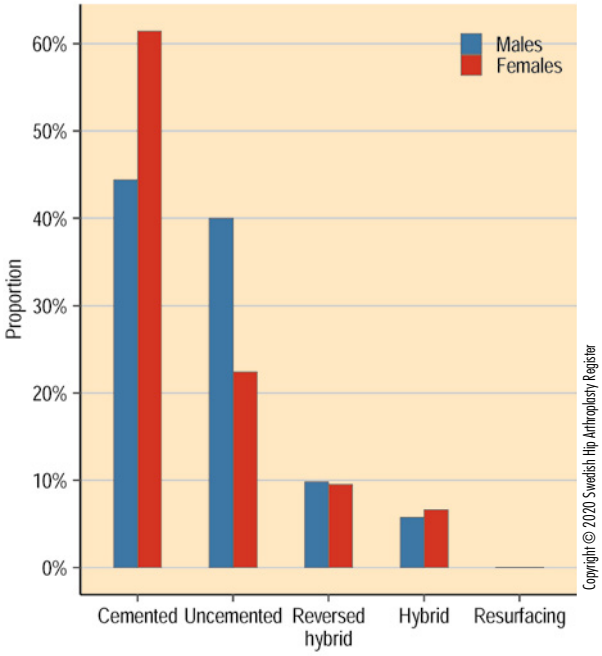

Figure 3.3.4. Percentages of fixation type, men compared with women during the period 2017–2019.

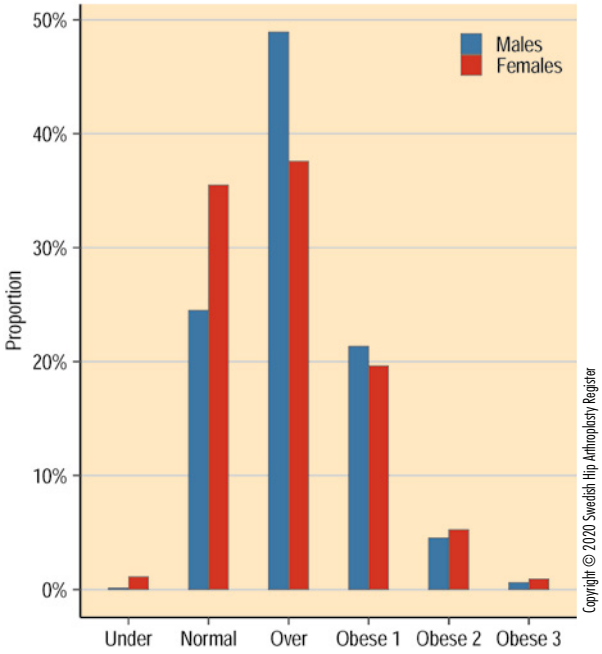

Figure 3.3.5. Percentage-distribution of BMI, men compared with women during the period 2017–2019. (Underweight is defined as BMI <18,5, normal weight as 18,5–24,9, overweight as 25,0–29,9, obesity 1 as 30,0–34,9, obesity 2 as 35,0–39,9 and obesity 3 as >40).

3.4 Duration of hospital stay-analysis for elective hip arthroplasty 2009–2018

Author: Urban Berg

Over the last decade the duration of hospital stay in conjunction with elective total hip arthroplasty has more than halved in Swedish hospitals (figure 3.4.1). In 2009, 2014 and 2017 the median duration of hospital stay was 5, 3 and 2 days respectively. The mean duration of hospital stay has stayed somewhat higher, but a decrease can be seen year after year and follows the same trend as the median duration of hospital stay. The duration of hospital stay is defined as the date of discharge minus the date of admission, which corresponds to the number of overnights. Individual regions and units have measured the duration of hospital stay in hours or half-days, but most have rounded-off to days. The implementation of the care concept fast-track during elective hip arthroplasty in Swedish hospitals has contributed to the shortened duration of hospital stay, but there has been a successive decrease of the duration of hospital stay regardless of the care program. One reason for this is that the lack of beds for elective care has forced an increased efficiency.

During the period 2011–2015, fast-track was implemented on a broad scale during elective hip and knee arthroplasty in Swedish hospitals. The proportion of hospitals that had implemented fast-track increased from 30% to 80%. Data on duration of hospital stay from this period, where operations with fast-track are compared to non-fast track, shows that the difference between duration of hospital stay with fast-track and without fast-track has decreased successively over time (figures 3.4.2 and 3.4.3).

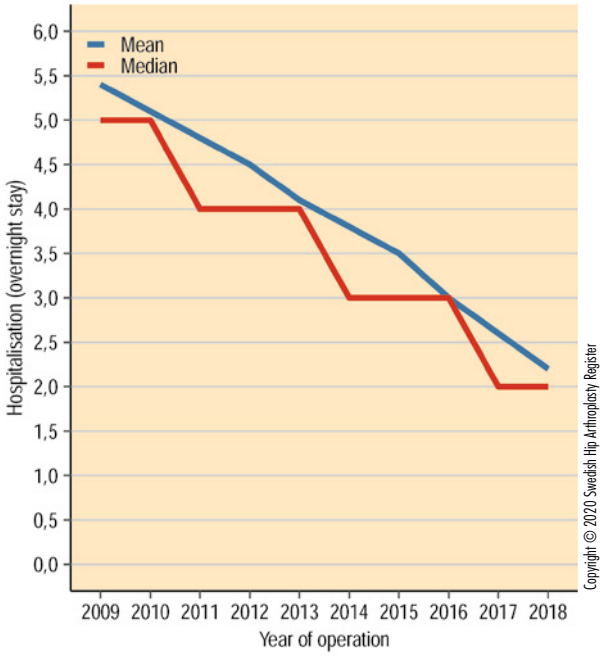

Figure 3.4.1. Duration of hospital stay during elective hip arthroplasty at Swedish hospitals 2009–2018.

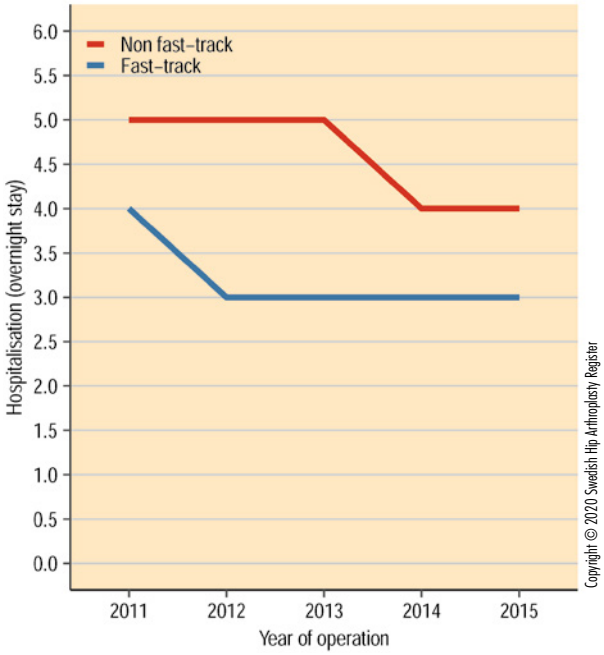

Figure 3.4.2. Median duration of hospital stays during elective hip arthroplasty at Swedish hospitals 2011–2015.

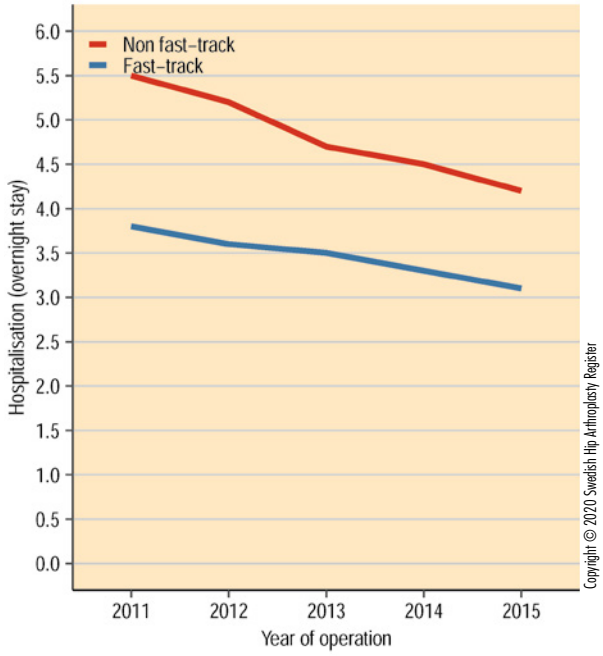

Figure 3.4.3. Mean duration of hospital stays during elective hip arthroplasty at Swedish hospitals 2011–2015.

4. Register development, improvement work and research

4.1 The Swedish Arthroplasty Register

Author: Ola Rolfson

Among the Swedish national quality registries there are 13 registries that cover care and treatment of the musculoskeletal diseases and injuries. Since a few years back, there is an ongoing collaboration-project between the musculoskeletal registries. In a parallel track, the Swedish Knee Arthroplasty Register and the Swedish Hip Arthroplasty Register have begun the work leading to the joining of the two registries and the formation of one register out of the two.

The Swedish Knee Arthroplasty Register (SKAR) started in 1975 and the Swedish Hip Arthroplasty Register in 1979. Together these two registries are the two oldest national quality registries in Sweden. In total, there are more than 700,000 arthroplasties registered. The registries resemble one another in many ways. Both collect information on the procedure and outcomes after operation, and on implants and patient-reported outcomes. Both registries are well-established and accepted within the profession with a high completeness rate (> 97 %) and the highest classification level according to the classification that is carried out by the Swedish Association of Local Authorities and Regions (SKR).

The formation a common register for hip and knee arthroplasties will bring many advantages. Above all it will become easier for users to register, find and use the information in the registries. The management of users will become uniform. All data and results will be presented in a uniform way. Furthermore, in the longer run there are economic advantages merging the registers. After the large drive on quality registries 2012–2016, the registries have received smaller fundings and the conditions to continue to run quality registries has changed. A changed economy in combination with generational change requires an increased collaboration between registries in order to be able continue to deliver the same high quality.

Since the 1st of January 2020, the Swedish Knee Arthroplasty Register and the Swedish Hip Arthroplasty Register have a common steering group. The registries have received an extra funding from the Swedish Association of Local Authorities and Regions in order to be able to complete the union. Moreover, Swedish Orthopaedic Association contributes financially. Now the work is underway to build a structure for the new register that will have a Central Data Controlling Responsibility within the Västra Götaland-region. The practical aspects such as IT platform and collaboration between the units will be dealt with as time progresses. The new register will be called the Swedish Arthroplasty Register (SAR). SAR will keep and administer data on the platforms and servers of the Västra Götaland-region.

SAR is expected to become fully operational in mid-2021. After more than 40 years as individual successful registries, a new era now dawns for arthroplasty in Sweden.

4.2 Collaboration between registries associated to musculoskeletal diseases

Authors: Johanna Vinblad, Ola Rolfson

Predecessors within quality registries

The musculoskeletal diseases and injuries together constitute the most common reason for healthcare in Sweden. The costs for healthcare and impaired working ability due to musculoskeletal diseases are enormous. Sweden has been a pioneer in establishing quality registries to evaluate healthcare and treatment within the musculoskeletal diseases. Today there are 13 national quality registries with an association to musculoskeletal diseases. Swedish national quality registries are funded nationally, and all registries are separate entities when it comes to funding, reporting and central data controller responsibility. Since each register is independent there is no explicit strategy when it comes to variables, IT platform, data management and expertise regarding research and quality work between registers. In order to exploit the registries full potential, the registries need to collaborate more in the future. During 2018, the county councils implemented a common national system for knowledge management within the healthcare system, national program areas (NPO). A strengthened collaboration between musculoskeletal registries falls well within the framework of this initiative.

An extended collaboration between the musculoskeletal registries

The implementation of a national system for knowledge management in combination with limited funding has contributed to an increased need for collaboration between national quality registries. In the beginning of 2019, representatives from all 13 musculoskeletal registries met for the first time to discuss an extended collaboration. As a result, representatives from all 13 registries are today part of a collaboration group. The group has identified several areas that would benefit from an increased collaboration, for example harmonization of variables and direct data transfer from healthcare information systems, as well as joint research. Additionally, by collaborating and sharing experience and knowledge, the hope is more efficient and smarter solutions for healthcare personnel.

Activities during 2019

Since many regions are in the process of digitize their medical records management system, this has been a prioritised area for the group during last year. The group have had discussions with representatives of five providers of digital healthcare information systems and have also had conversations with the Swedish PeriOperative Registry (SPOR) on potential collaborations regarding direct transfer of data. A common message from representatives from digital healthcare information systems is that quality registries can prepare for direct transfer of data from the new healthcare information systems through a good variable structure that follows the national and international guidelines of digital data gathering.

Joint research

Strengthened collaboration between the musculoskeletal registries and the establishment of a broad research infrastructure within the area will improve the healthcare for patients. The scientific evidence for treatments within musculoskeletal diseases area is generally low. Furthermore, quality and methods differ depending on geographical location in the country. A variation in treatment could be acceptable, but standardized methods to reduce unjustified variation are needed. Instead of developing new methods for presenting data and register-based research methods, this initiative will contribute to establishing more homogeneous methods.

4.3 Improved care of patients with an acute hip fracture and alternative surgical approach during hip arthroplasty in Södertälje

Authors: Ferenc Schneider, Erik Lind

In 2017, the clinical management in consultation with the arthroplasty section decided to implement a new work procedure for patients with femoral neck fractures who have undergone an arthroplasty. One reason for this was the high reoperation frequency as measured six months postoperatively (just over 11 %).

The focus has to a large degree been on ensuring that hip fracture patients who have undergone an arthroplasty get the same quality of treatment and follow-up as patients with hip osteoarthritis who have undergone an elective arthroplasty. Earlier, the follow-up was decided by the surgeon and therefore variation was inevitable. With the new work procedure, the follow-up is today very similar for fracture patients and osteoarthritis patients.

We have taught care personnel sterile wound dressing, both at the ward and, if applicable, at the rehabilitation unit. The rehabilitation unit is situated on our hospital grounds and the contact path to arthroplasty surgeons has been made more efficient – something that, for example, plays a pivotal part for the early discovery of delayed wound healing.

Even if reality sometimes puts limitations for what is possible to do (for example revisiting routines for institutional patients) the greater part of the fracture patients come to us at the orthopaedic ward for changing bandages, removing sutures after discharge, and to physiotherapist and surgeon for assessment two and six months postoperatively respectively. Before the patients leave the ward, they receive written information including a phone number to where they can turn 24/7 for questions regarding their hip arthroplasty.

We have chosen to prioritise the requisite that it is an arthroplasty surgeon who assesses the patient's radiographs, comorbidity and operability, and assists or performs the operation itself. This takes precedence over the demand that the operation should be carried out within 24 hours after arrival to the emergency unit. Normally, this is not a problem and the operation starts within 24 hours in more than 70 % of cases. This can be compared with hip fractures treated with internal fixation where more than 80 % are operated within 24 hours. The new generation of anticoagulants contributes to the delay of the operation-start for these patients as compared to patients with a hip fracture on the new generation of anticoagulants treated with internal fixation.

Fracture patients undergo a total hip arthroplasty to a greater extent today compared with before when the proportion of hemiarthroplasties was markedly larger. A contributing factor behind this is that the radiographs are scrutinised more thoroughly preoperatively today and conditions where a hemiarthroplasty would entail an increased risk for complications – for example dysplasia and risk for dislocation – are spotted more often.

The effort has meant that the scheduling considers the fact that an arthroplasty surgeon should be on call during all office hours of the year and that a preparedness should be in place also during weekends and holidays. That there is always a patient responsible doctor is an improvement work that we have been running in parallel and can be said to play an important role during deviant postoperative courses and in the handling of complications.

Today, we have decreased the risk for reoperation from more than 11 % to just under 3 %. Today, we meet the demands of all quality indicators for fracture patients (according to the value compass published in the Swedish Hip Arthroplasty Register annual report). We think that our patients of today are relatively well-informed and participate in the decision-making unless cognitive impairments are at hand – when next of kin are engaged in the decision-process.

Finally, something on surgical approach. Our arthroplasty team use two different surgical approaches: Hardinge and Watson-Jones, both modified compared with the original methods. Most orthopaedic surgeons in Sweden know about the Hardinge approach (one of the variants of direct lateral approach), but Watson-Jones is considerably more uncommon. In short, this approach is about establishing access to the joint through the intermuscular plane between gluteus medius and the tensor. In that way the tendon to gluteus medius does not have to be loosened. The operation takes place in a supine position, which the anaesthesiology personnel often think is advantageous.

When it comes to complications it is not possible to say if the surgical approach matters. The improvement we have achieved is rather due to the postoperative care.

Patient reported outcome measures from the Swedish Hip Arthroplasty Register indicate that those operated with a Watson-Jones approach have a greater degree of satisfaction with the operation than those operated with a Hardinge approach, something that matches the data in the register on osteoarthritic patients. Whether this results in clinically relevant differences we cannot say, more research is needed to be able to elucidate this.

The observations concerning the differences in early activity level we and the physiotherapists have made, between the two different approaches, within the first three months, make us suspect that there may be a certain advantage for those operated with the gluteus medius-saving approach, that is with the

Watson-Jones modified approach. The questionnaire follow-up of the register takes place after a year at the earliest why an early functional advantage is not captured in the register. Likewise, gluteus medius-insufficiency and Trendelenburg-limp are observed more often after a Hardinge approach. More research is needed in the area before anything of the above can be said with any certainty.

Södertälje hospital has been using the Hardinge approach since a long time back. In connection with a new recruitment in 2015, the Watson-Jones approach was introduced. A certain training of the operating personnel was needed but also introduction of single specific instruments. This adjustment was easy to make. More colleagues found the approach interesting and as a result the decision was made to let them learn the approach.

Our experience is that this approach puts higher demands on the handling of the soft tissue in order to optimise the access to the joint and prosthesis positioning. To teach this approach takes six months to a year depending on previous experience and the possibility of receiving a coherent education. Today, we are three specialists who operate with the Watson-Jones approach.

4.4 Summary of dissertation: Periprosthetic hip fractures after hip arthroplasty: incidence, risk factors and treatment

Author: Georgios Chatziagorou

Fracture around the stem of a hip prosthesis (PeriProsthetic Femoral Fracture – PPFF) is the third most common reason for reoperation after primary total hip arthroplasty in Sweden. The risk for this complication is the highest among older individuals. The fracture is associated with high mortality, entails high costs and often results in a low degree of patient satisfaction. The treatment is in most cases surgical and varies depending on fracture type. In my dissertation (defended at Göteborgs universitet in 2020-03-20) I investigated the incidence of surgically treated PPFFs in Sweden between the years 2001 and 2011, demography of the affected patients, risk factors and treatment. All four studies of the dissertation (I–IV) were observational and based on data from the Swedish Hip Arthroplasty Register and information from medical records reviews.

In study I, the registration of these fractures in Swedish Hip Arthroplasty Register was validated by linking data between Swedish Hip Arthroplasty Register and the Patient Register of the National Board of Health and Welfare. It turned out that Swedish Hip Arthroplasty Register had a high completeness rate for reoperations carried out with stem revision (97 %), while the completeness rate for fractures treated with another method than revision was poor (26 %). Fractures distally of a femoral stem (Vancouver type C) had the lowest degree of reporting of all in the Swedish Hip Arthroplasty Register (17 %). The inclusion of all non-registered cases resulted in a population with a lot more Vancouver C-fractures (37 % compared with 11 % before data linkage), a higher mean age during PPFF (77.5 years and 76.4 years respectively) and a higher proportion of women (60.1 % and 49.5 % respectively). The incidence of PPFF increased during the period 2001–2011 from around 1 ‰ to around 1.4 ‰.

Study II investigated if the type of cemented stem may be related to type of fracture (type B (fracture around the stem) or type C (fracture distally of a femoral stem)). The stems that were compared were the two most common stems that have been used in Sweden since 1992: Lubinus SP II and Exeter Polished. Exeter had a poorer survival and around ten times higher risk to cause a Vancouver B fracture compared to Lubinus (figure 4.4.1). Even though 74 % of all fractures around a Lubinus were type C, Cox regression has shown that stem design did not influence the risk for this type of fracture. Other factors that influenced the risk for PPFF (both B and C fractures) was aging and diagnosis of hip fracture or caput necrosis during primary total arthroplasty. Patients with inflammatory arthritis and women had a higher risk for fractures distally of the stem. Men on the other hand, had a higher risk for fractures around the stem. In a subgroup of patients, with a diagnosis of primary osteoarthritis, a posterior approach could be shown to have a 60 % increased risk for type B-fractures compared to a direct lateral approach; a finding that was difficult to interpret and has to be studied more.

In study III, the treatment of 1,381 Vancouver type B-fractures was studied. The majority of fractures around a fast stem (Vancouver type B1) were treated with only internal fixation (90.5 %) and had a significant higher proportion of re-reoperations compared with fractures around a loose stem (type B2 and B3), where stem change was the most common method (87.2 %). An interprosthetic fracture between a hip and a knee prosthesis (IPFF) had a higher risk for a poor outcome among individuals who had had a cemented stem inserted due to primary osteoarthritis during index surgery. Locking plates were not used prior to 2005 for treatment of B1-fractures and they had just as high percentage of re-reoperations as conventional plates. The three most common categories of revision stems that were used for the treatment of B2 and B3-fractures were cemented, uncemented mono-block, and uncemented modular stem. The re-reoperation frequency varied between around 13 % and 14 % (uncemented modular), without any statistically significant difference between the three categories.

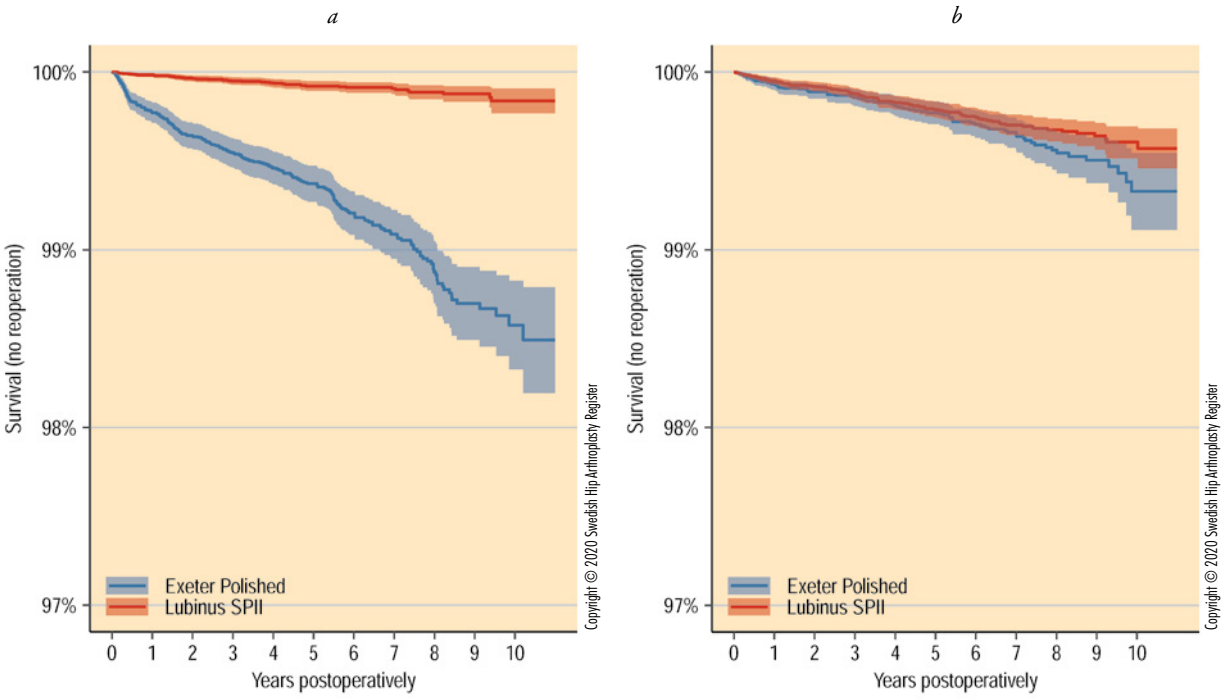

Figure 4.4.1. 10-year survival for reoperation due to Vancouver B (a) and Vancouver C (b) fracture respectively, Lubinus and Exeter stem (Kaplan-Meier).

Treatment of Vancouver type C-fractures was the theme in study IV. The four most common methods were fixation with an ordinary plate, a locking plate, with two plates, or with an intramedullary nail. Locking plates had a lower re-reoperation frequency within two years from PPFF compared with conventional plates, in patients without an ipsilateral knee prosthesis (figure 4.4.2). The re-reoperation frequency did not differ significantly between IPFF and non-IPFF. 24 % of the population with a Vancouver type C-fracture died within two years of the date of fracture. The re-reoperation frequency during the whole observational time-period for all B- and C-fractures was 17.3 % and 15.2 % respectively.

In conclusion, we found that periprosthetic fractures treated with another method than stem revision had a low degree of registration in the Swedish Hip Arthroplasty Register. The incidence of PPFF increased during the period 2001–2011. The polished Exeter stem had an almost tenfold higher risk for Vancouver type B-fractures compared with the Lubinus SP II-stem. A knee prosthesis on the fracture side entails an increased risk for a poor result during type B- but not during type C-fractures. The choice of locking plate or conventional plate did not affect the outcome during treatment of a B1-fracture. The choice of stem fixation also did not influence the treatment outcome during treatment of type B2- or B3-fracture. Locking plates had a better result than conventional plates during treatment of type C-fractures.

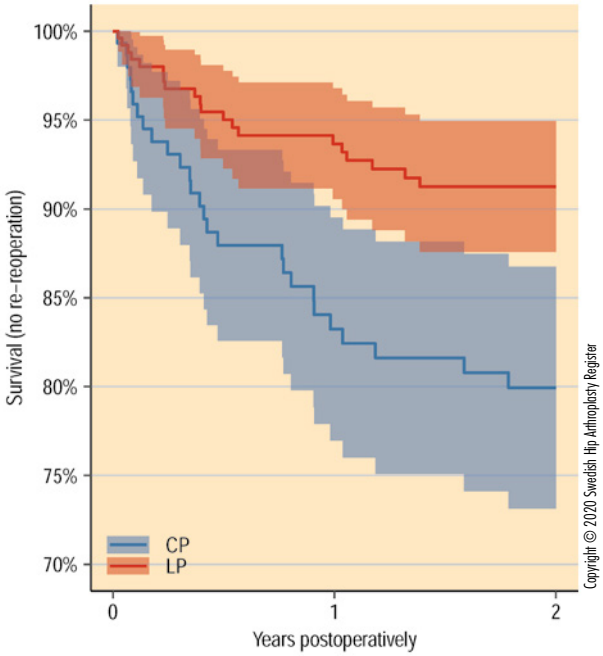

Figure 4.4.2 Survival for re-reoperation within two years after treatment of Vancouver type C fracture with either locking plate or conventional plate (Kaplan-Meier).

Studies included in the dissertation:

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II. Chatziagorou G, Lindahl H, Kärrholm J. The design of the cemented stem influences the risk of Vancouver type B fractures, but not of type C: an analysis of 82,837 Lubinus SPII and Exeter Polished stems. Acta Orthopaedica. 2019 April; 90(2): 135-142.

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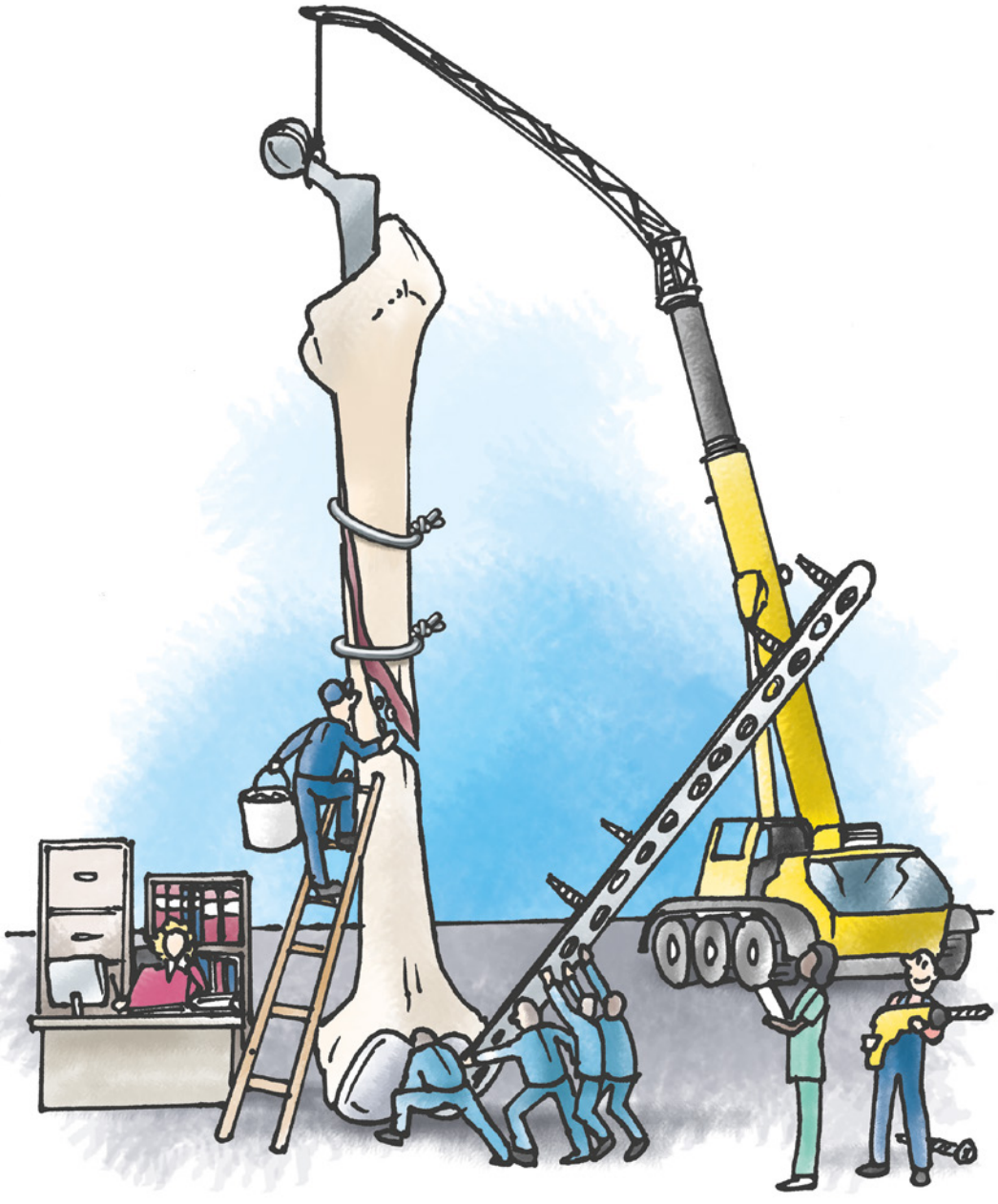

4.5 Summary of dissertation: Outcome after primary total hip arthroplasty with a focus on the role of the surgeon and the surgeons' view on feedback

Author: Per Jolbäck

The dissertation is based on four studies. In study I, we investigated if adverse events and death within 90 days after a primary hip arthroplasty due to osteoarthritis, was associated with the surgeon's annual operation volume. In study II, we investigated if differences in patient-reported outcomes was associated to the surgeon's experience (for how long one had been a specialist in orthopaedics or if one is a specialist doctor at the time of the operation). Study III was a qualitative study where we investigated what views there are among specialists in orthopaedics and specialist doctors in Sweden regarding individual feedback of operation results. In study IV, we investigated how many surgeons who have a deviating result when it comes to adverse events and the risk for reoperation within two years after primary total hip arthroplasty in Sweden. Studies I, II and IV were register-based studies with data from the Swedish Hip Arthroplasty Register, the regional care provider-database (VEGA) in the Västra Götaland-region (not used in study II), local hospital administrative systems and the National Board of Health and Welfare's register over licensed healthcare personnel. Study III was a qualitative interview study where all specialists in orthopaedics, and specialist doctors employed at any of the units that report to the Swedish Hip Arthroplasty Register, were invited to participate.

In study I, the surgeon's annual volume was calculated according to the formula; the number of primary total hip arthroplasties 365 days prior to the index operation. 12,100 primary total hip arthroplasties carried out at ten hospitals in the Västra Götaland-region between 2007 and 2016 were included in the analysis. In this study we used logistic regression (unadjusted and adjusted). We adjusted for demographical patient factors (age, gender, body mass index (BMI) and comorbidity), for operation factors (diagnostic indication for the operation, type of surgical approach and method of fixation), and for hospital and surgeon-specific factors (the hospital's annual volume and the surgeons' number of years as specialists in orthopaedics). The results of this study showed that if the surgeon's annual volume of primary total hip arthroplasties increased with ten operations, the risk for an adverse event decreased by 10 % (8 % after adjusting). In order to estimate the future risk of an adverse event within 90 days of the operation, we calculated a 95 % prediction interval (table 4.6.1). The mortality rates in the study were low (0.2 %). We found no association between death within 90 days and the surgeon's annual volume.

In study II, we investigated the association between the surgeon's experience and patient-reported outcome (EQ-5D index, EQ VAS, pain and satisfaction with the operation outcome) one year after primary total hip arthroplasty. This study includes operations carried out from 2007 to 2012 at the same ten hospitals in the Västra Götaland-region as in study I. 6,713 operations were included. The surgeon's experience was defined as the surgeon's number of years after obtaining proof of specialist status in orthopaedics or that the surgeon was a specialist doctor at the time of the operation (no proof of specialist status). Experience was thereafter categorised in four groups: 1) specialist doctor, 2) specialist with less than 8 years of experience since obtaining proof of specialist status, 3) specialist with 8 to 15 years of experience since obtaining proof of specialist status, specialist with more than 15 years of experience since obtaining proof of specialist status. Linear regression was used in this study (unadjusted and adjusted). We adjusted for age, gender, BMI, ASA class, diagnostic reason for the operation and one-year postoperative Charnley class. Specialists with more than 15 years of experience were the reference group. The results of this study showed that there exist statistically significant differences in patient demography and in choice of method of fixation between the different categories of experience. This difference in patient demography and choice of method of fixation was expected as specialist doctors in Sweden are taught the cemented fixation method first. The other methods of fixation are learnt later during the professional career of the orthopaedic surgeon. The linear regression model showed that there is no difference in the patient-reported outcome between specialists in orthopaedics, after adjustment. Patients operated on by specialist doctors (category 1) report the same health and pain gains as patients operated on by specialists with experience but with a lower degree of satisfaction with the result of the operation compared with the reference group. Differences remained after adjustment.

In study III, the aim was to investigate Swedish surgeons' views on receiving feedback on one's own results after primary total hip arthroplasty. This study was a phenomenographic qualitative study using individual interviews. We invited all specialists in orthopaedics and specialist doctors employed at the units that report to the Swedish Hip Arthroplasty Register to participate. In order to maximise the inclusion of the number of views, a strategic selection of informants was undertaken. This selection was based on certain assumptions that we in advance thought could affect how the phenomenon hospital level is perceived (private, local, county or university/regional hospital), the surgeon's experience (the number of years after proof of specialist status in orthopaedics or specialist doctor) and the surgeon's gender (man/woman). All in all, 19 interviews were conducted with specialists in orthopaedics or specialist doctors employed at 15 hospitals. The analysis showed that there are four views among the informants on receiving feedback on one's own results after primary total hip arthroplasty (figure 4.5.1).

In the last study (IV), the aim was to describe the frequency of surgeons that had a deviant result due to adverse events within 90 days after operation or reoperations within two years during

primary total hip arthroplasty in Sweden, and to investigate the effect of a standardisation regarding age, gender, ASA class, BMI and diagnostic reason. The inclusion criteria were the same as in study I, but the operations were undertaken 2011–2016. The analysis included 9,482 operations carried out by 208 surgeons. We used a funnel plot to visualise deviating observations. For each surgeon a standardised proportion of the "outcome" was calculated according to the formula: the number of adverse events/expected number of adverse events times the total number of events. We used multiple logistic regression to estimate the probability that an event happens. We used five potential covariates (patient age, gender, ASA class, BMI and diagnostic reason for the operation). The result of this study showed that the proportion of surgeons that had a deviant result was low both for adverse events within 90 days of the operation and for reoperations within two years (table 4.5.2a). We have also conducted a sub analysis that included only surgeons who have carried out more than 10 primary total hip arthroplasties during the year in question. The results of this sub analysis showed that all deviant results disappeared both for adverse events within 90 days and for reoperations within 2 years after standardisation (table 4.5.2b).

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A high annual volume of operations per surgeon is associated with a reduced risk of adverse events within 90 days. Patients can expect the same health-related benefits, pain relief and satisfaction one year after primary total hip arthroplasty regardless of the surgeon's number of years as specialist in orthopedics.

Swedish orthopedic specialists and specialist doctors perceive individual feedback of surgical results after primary total hip arthroplasty from a quality register in several different ways. It is perceived as a system that can contribute to individual improvements and development in the profession through that each surgeon becomes aware of its strengths and weaknesses. One concern, however, is that individual results can harm the surgeon if the data end up in the wrong hands or is misinterpreted. Feedback regarding surgical results are also perceived as something that can impair patient benefit or as unnecessary as all valuable information already comes to the operator's knowledge.

There is a low number of surgeons who would receive deviated results regarding adverse events within 90 days and reoperations within 2 years after primary total hip replacement surgery in a Swedish environment.

The annual volume of the surgeon, number	Mean risk, %	95 % prediction interval
0	8	7–10
10	8	6–9
20	7	5–9
30	6	5–8
40	6	4–7
50	5	4–7

Table 4.5.1. Predicted risk for adverse events within 90 days after index operation depending on the surgeon's annual volume.

Something that gives an opportunity for individual professional development	• Something that leads to professional development and increased patient good • As a replacement for earlier revisits • Something that visualises the need for new learning • Something that can lead to an improved accuracy and compliance with routines • Something that can force a changed working method
Something that may expose the surgeons to unwarranted critique	• Fear of media and the risk that the information will be misinterpreted • Risk for worsened well-being • Risk for discrimination • The surgeon is not the only factor that influences the result
Something that may lead to worsened patient safety	• Risk of deselecting patients from operation • Risk of making the surgeon a victim of the system
Does not contribute to improved feedback to the surgeons	• The surgeon is supplied with all the important information • A local feedback system is already providing the surgeon with personal feedback

Figure 4.5.1. Different ways of perceiving individual feedback of result of operation from a national quality register, formulated as description categories.

	2011 n=52	2012 n=41	2013 n=54	2014 n=54	2015 n=62	2016 n=51
Number of surgeons above the 95 % C.I. for adverse events within 90 days, observed, n	5	2	6	3	1	0
Number of surgeons above the 95 % C.I. for adverse events within 90 days, standardised*, n: *Age, gender, ASA-class, BMI and diagnosis reason	3	1	3	1	1	0
Number of surgeons above the 95 % C.I. for reoperations within 2 years, observed, n	0	0	0	1	1	1
Number of surgeons above the 95 % C.I. for reoperations within 2 years, standardised*, n: *Age, ASA-class and BMI	0	0	0	1	0	1

Table 4.5.2a. Number of surgeons (n) that end up above the upper limit in a 95 % confidence interval (C.I.) for adverse events within 90 days and reoperations within 2 years if all surgeons are included independently of annual volume during a calendar year.

	2011 n=52	2012 n=41	2013 n=54	2014 n=54	2015 n=62	2016 n=51
Number of surgeons above the 95 % C.I. for adverse events within 90 days, observed, n	1	0	1	1	0	0
Number of surgeons above the 95 % C.I. for adverse events within 90 days, standardised*, n: *Age, gender, ASA-class, BMI and diagnosis reason	0	0	0	0	0	0
Number of surgeons above the 95 % C.I. for reoperations within 2 years, observed, n	0	0	0	0	0	1
Number of surgeons above the 95 % C.I. for reoperations within 2 years, standardised*, n: *Age, ASA-class and BMI	0	0	0	0	0	0

Table 4.5.2b. Number of surgeons (n) that end up above the upper limit in a 95 % confidence interval (C.I.) for adverse events within 90 days and reoperations within 2 years if only surgeons that have carried out more than ten primary total hip arthroplasties during a calendar year.

4.6 Dissertation summary: Dislocation after fracture related hip arthroplasty – incidence, risk factors and prevention

Author: Ammar Jobory

17,000 swedes are annually afflicted by a hip fracture, of which half have a femoral neck fracture. Around 6,000 hip fractures are treated annually with an arthroplasty in Sweden. There are two types of arthroplasties, hemiarthroplasties (HA) and total arthroplasties (THA). Traditionally, THA has been the prosthesis that gives the best mobility in comparison with HA. So why are not all patients given a THA? The answer is that patients with a THA have a higher risk of dislocation in comparison with those with a HA. Dislocation is one of the more serious complications a patient with an arthroplasty can suffer from. It is painful, and often a light anaesthesia is required to put the joint back in place. Usually this is done through a closed procedure at the emergency unit. A doctor puts the joint back in place by exerting force from the exterior, without having to do surgery. It takes multiple repeated dislocations to warrant a reoperation.

When it comes to dislocation it is only the proportion of patients that have undergone open surgery due to a dislocation that are reported in the Swedish Hip Arthroplasty Register. Thus, we do not know how many patients that are really afflicted by a dislocation; only a smaller share needs open surgery. This is the background for study I and II of the dissertation. By using the Patient Register of the National Board of Health and Welfare, that registers codes for medical diseases and measures, we could request which measures the fracture patients in our studies have been subjected to. In study I of the dissertation, patients with THA were investigated and we found that more than eight percent were afflicted by a dislocation. In study II with HA patients, the corresponding share was just under five percent. These proportions are higher than we expected. Only one out of six patients with dislocation after THA went on to be revised, and one in three with dislocation after a hemiarthroplasty. Only measuring revision substantially underestimates the dislocation problem.

We analysed which risk factors that affect the risk for dislocation. In both studies the strongest risk factor was the surgical approach. Two surgical approaches dominate in Sweden, the posterior and the direct lateral. We could see that patients operated with the posterior approach had a significantly increased risk for dislocation compared with those who were operated with the lateral approach. For THA, the risk increased from 4.8 % to 13.4 % when a posterior approach was used. The corresponding proportions for HA were 2.7 % and 7.2 % respectively.

Most surgeons prescribe the patient mobility limitations after a hip arthroplasty, so called restrictions. Aids are also routinely being offered, for example sock aid and beanbag. All in order to reduce the risk of dislocation. In study III of the dissertation, we investigated how necessary these restrictions are in patients with HAs inserted with a lateral approach. At two of the four orthopaedic wards in Malmö we lifted all restrictions and offered no routine aids. At the other two wards we kept things as before. We followed the patients and were able to deduce that restrictions do not affect the risk for dislocation. These restrictions were lifted in Malmö, and at other hospitals, after this study.

In the dissertation's fourth study (IV), we looked at a special prosthesis type, dual mobility cups (DMCs), a THA with an additional movable part inside the cup. In order to gather enough patients, the study was conducted through a collaboration between the Nordic hip arthroplasty registries (the Nordic Arthroplasty Register Association, NARA). Here DMC was compared with standard THA. We could show that a DMC entails a lower risk for revision and above all a lower risk for revision due to dislocation for patients with a hip fracture.

In summary, we find that the risk for dislocation may be influenced by different measures such as choice of surgical approach and type of prosthesis. We think that focus on an individually adapted rehabilitation of the patient, and not routine restrictions, is a better way of managing the working hours of the rehabilitation personnel. Finally, we have given a clearer view of the DMC and its role in the future surgical treatment of hip fracture patients.

The dissertation was defended 2020-05-08 at the institution for clinical sciences, Malmö, Faculty of Medicine, Lund University.

With their choice of prosthesis and incision, the orthopedist can influence the risk of dislocation – 13 % of the fracture patients who are operated on with a total prosthesis via the posterior incision suffer from dislocation, compared with 3 % after a half prosthesis via a lateral incision!

4.7 Dissertation summary: Fast-track during elective hip and knee arthroplasty at Swedish hospitals – effect on patient safety, results and patients' experiences of the care process

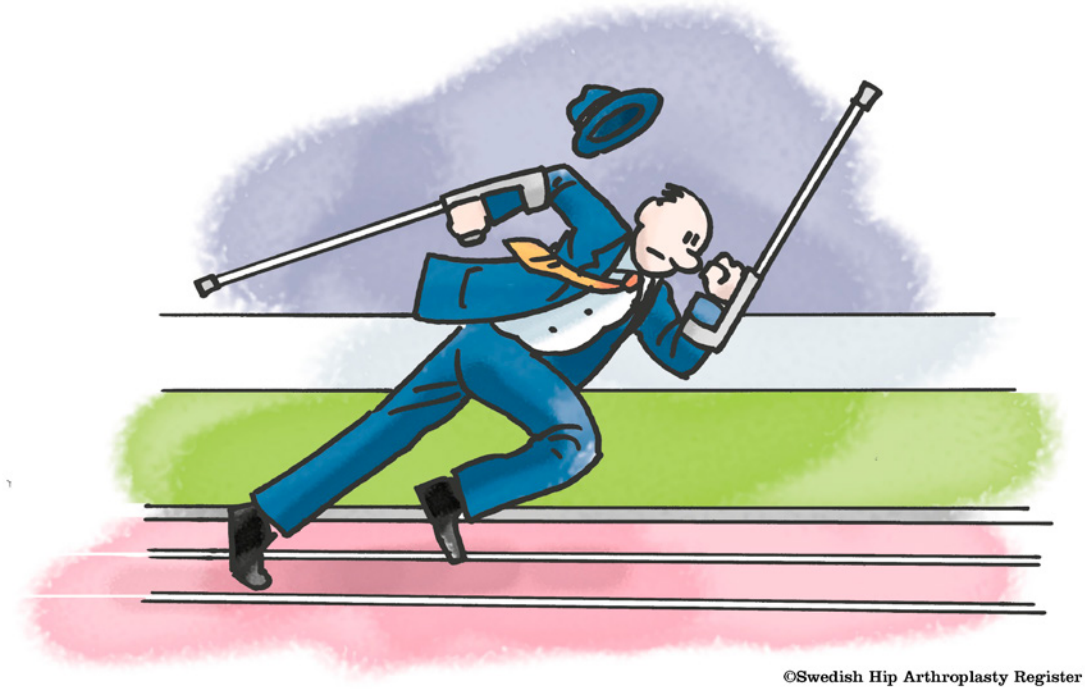
Author: Urban Berg

Fast-track is a care concept during elective operations, where the objective is to minimise both the physiological stress caused by the surgical procedure, as well as the mental stress during care measures and hospital stays. Through careful preparation and a good pain relief, that enables immediate mobilisation, the rehabilitation process is accelerated. This means that the duration of the hospital stay may be shortened. Over the last ten years, fast-track has been implemented as a model for the care process during elective hip and knee arthroplasties at most of the orthopaedic units in Sweden.

In a dissertation defended by Urban Berg at University of Gothenburg the 8th of May 2020, the effect of the care concept on patient safety, outcomes and patients' own experiences during elective total hip and knee arthroplasty at Swedish hospitals, was investigated through three observational and one qualitative study.

By sending a questionnaire to Swedish orthopaedic units, which have carried out elective hip and knee arthroplasties during the period 2011–2015, the care routines during these operations was surveyed. The aim with the questionnaire was to define if fast-track had been implemented as a care concept and at which point in time. With this as a background, operations carried out at hospitals applying fast-track were compared with operations where fast-track had not been applied. The risk for readmission and adverse events within three months (study I), difference in patient-reported outcomes (PROM) and satisfaction with the operation after one year (study II) and the risk for reoperation and death within two years (study III) have been calculated. In study I, that illustrates the implementation of fast-track at eight hospitals in the Västra Götaland-region, additional data from the regional care-database VEGA were retrieved. The other two register-based studies illustrate the effect of fast-track on hospitals all over the country.

The qualitative study (study IV), illustrates patients' experiences of the care process from decision to operate up to three months after the operation. Data were gathered through semi-structured individual interviews with in total 24 patients from three different hospitals. An inductive approach with open questions was used during the interviews and in the analysis process the content was coded and categorised, which led to the formulation of overarching themes.



The implementation of fast-track did not lead to any increased risk for readmission, for new care contacts or adverse events within three months according to the regional study (study I) that encompassed eight hospitals. The median duration of hospital stays decreased from 5 to 3 days. 10 %–15 % of the unidentified adverse events within three months after the operations were spotted during a first contact with the primary care. About half of the identified complications led to hospital readmission. Of all the readmissions within 90 days, half of them were due to an adverse event that could not be associated to the operation. The proportion of readmissions within 90 days associated to the performed operation was around 4 %, for both hip and knee arthroplasties, and any significant difference in risk between fast-track and non-fast track could not be demonstrated.

Study II investigated the effect of fast-track on the PROM-data of the national registries after one year. Patient-reported outcomes regarding pain, health related quality of life and satisfaction with the operation were in general better where fast-track had been in place, but the difference was small and the clinical relevance debatable.

Study III was based on register data up to two years after the operation and comprised the analysis of the risk for revision, and mortality. For patients who had undergone a hip arthroplasty where fast-track was in place 20 % had a higher risk of revision within two years compared to the conventional care process, mostly due to infections. Considering that the cohort for total hip arthroplasty with fast-track in place encompassed more than 35,000 operations, the confidence bands were relatively wide, and the robustness of the calculation was thereby low. In a sub analysis it could be shown that large differences in the revision frequency due to infection between different hospitals had been the case, and local conditions at single hospitals may be of greater importance when it comes to explaining the risk increase than the care program fast-track. For knee arthroplasties no increased risk with fast-track can be seen.

The risk of dying following hip or knee arthroplasty is low, and when fast-track is used the risk of dying for patients who have undergone knee arthroplasties within two years is lower than in a conventional care process. For patients who have undergone a hip arthroplasty any statistically significant difference between fast-track and other care process could not be demonstrated during the period 2011–2015. When it comes to mortality within 30 and 90 days, the results indicate an even greater risk reduction with fast-track, but since the mortality after elective hip and knee arthroplasties is so low, considerably more numerous cohorts are needed to demonstrate a statistically significant difference.

The qualitative study showed that there is a large variation when it comes to patients' need for information and participation. The rehabilitation phase seemed to be the weak link in the care chain. Patients describe an insecurity regarding their progress, and whether the course of rehabilitation was normal or not. Feedback and follow-up after hospital discharge was experienced as insufficient. The result indicates that the standardised care process that characterises fast-track needs to be complemented with a person-centred approach during the whole care path.

The fast-track concept during planned hip and knee replacement surgeries in Swedish routine healthcare is patient-safe and at least as good as a conventional care process regarding results and patient satisfaction. This is despite greatly shortened hospital care times. An observation is a confirmed increased risk for revision within two years after hip replacement surgery when fast-track is used. Further studies are needed to identify possible causes this. The qualitative study indicates that the care phase after discharge from the hospital can be improved, and that a person-centered approach is important whole the care process.

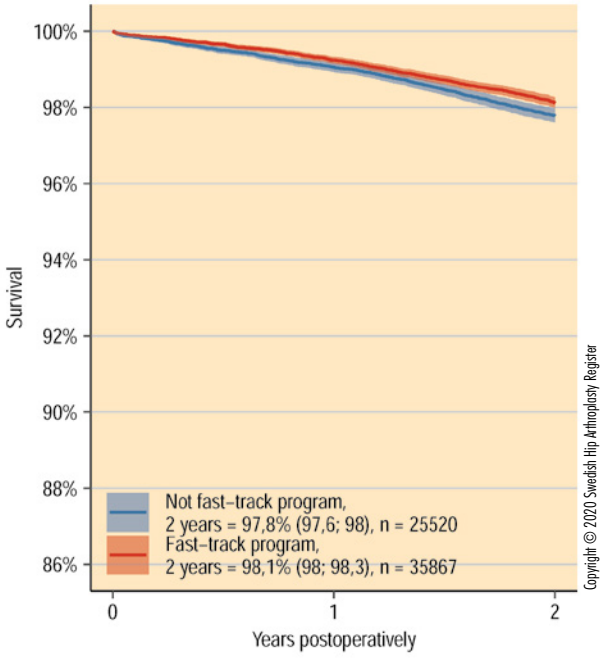


Figure 4.7.1. Kaplan–Meier curve for survival after elective total hip arthroplasty 2011–2015.

Variable (definition)	Not fast-track	Fast-track
Operations (number)	3,859	3,915
Median duration of hospital stays (days)	5	3
Mean duration of hospital stays (days)	5.8	3.7
Readmission with adverse event < 90 days, number of patients (%)	151 (3.9)	146 (3.7)
Patients with adverse event < 90 days, number (%)	308 (8.0)	317 (8.1)

Table 4.7.1. Duration of hospital stay, readmissions and adverse events after implementation of fast-track during elective total hip arthroplasty at eight hospitals 2011–2015.

	Preoperatively		One year postoperatively	
	Not fast-track	Fast-track	Not fast-track	Fast-track
Number of operations	19,237	27,615	19,237	27,615
EQ-5D index				
Mean (SD)	0.74 (0.11)	0.73 (0.11)	0.88 (0.11)	0.88 (0.11)
Improvement (SD)			0.14 (0.13)	0.15 (0.13)
EQ VAS				
Mean (SD)	57 (22)	58 (22)	76 (20)	78 (20)
Improvement (SD)			19 (26)	20 (26)
Pain VAS				
Mean (SD)	63 (15)	63 (15)	14 (18)	13 (17)
Improvement (SD)			-49 (22)	-50 (22)
Satisfaction VAS				
Mean (SD)			16 (20)	14 (20)

Table 4.7.2. Elective total hip arthroplasties 2011–2015 with complete PROM-data preoperatively and one-year postoperatively. SD = Standard deviation, VAS = Visual analogue scale.

Variable (definition)	Not fast-track	Fast-track
Operations, number	25,520	35,867
Revisions regardless of cause, number (%)	335 (1.3)	565 (1.6)
Revisions due to suspected or deep prosthesis infection, number (%)	174 (0.7)	300 (0.8)

Table 4.7.3. Revision within two years after elective total hip arthroplasty 2011–2015.

4.8 In Lidköping the registration works smoothly

Author: Charlotta Sjöstedt

To register in the Swedish Hip Arthroplasty Register is an extensive workload with many involved. At the orthopaedic unit at Skaraborg Hospital, Lidköping the process with all its steps is well-trimmed. Everyone knows exactly what to do and potential problems are dealt with fast.

Skaraborg Hospital consists of the hospitals in Lidköping, Skövde and Falköping. To a certain degree one is specialised when it comes to orthopaedics. In Lidköping, the focus is on arthroplasty. The goal is to do around 15 knee and hip arthroplasties per week. Sometimes fewer are made and during the corona pandemic there is of course no business as usual.

During admission, patients to undergo a hip arthroplasty answer questions in the preoperative PROM-questionnaire. This is taken care of by nurses at the ward and nurses Christina Ingemarsson and Kristin Kjäll are responsible for this part. The operation-questionnaire is completed by the operating surgeon on paper and then the data is transferred to the Swedish Hip Arthroplasty Register by Ann-Britt Berling, medical secretary. One of the operating surgeons is Mats Jolesjö and he is also the contact doctor, that is the doctor in charge of the contacts with the Swedish Hip Arthroplasty Register. Ann-Britt Berling has the corresponding role as a contact secretary. The next step in the process is that patients answer questionnaire questions one, six and ten years after the operation. Susanne Andersson is responsible for the mailing of the PROM-questionnaires and Britt-Marie Johansson is responsible for the registration of them. Both are medical secretaries.

The registration works well

Mats Jolesjö and Ann-Britt Berling agree on that the registration works well. The process is well-established, and problems are solved immediately.

– I think it runs very, very well. When I have questions to Mats if there is something I don't really understand in the operation-questionnaire, then I just ask him. And I'm answered quickly, says Ann-Britt Berling.

She is a leading figure in the work with the registration. She has worked for over 20 years as a contact secretary for the Swedish Hip Arthroplasty Register and she has deep knowledge of among other things diagnosis codes and measure codes. One thing that eases the registration is that she also writes most of the operative reports.

– In connection with that it might happen that I question if, for instance, the right code is used for the operation. Sometimes a incorrect diagnosis code or operation code is used, says Ann-Britt Berling.

Mats Jolesjö, M.D, Kristin Kjäll, nurse, Ann-Britt Berling, medical secretary, Britt-Marie Johansson, medical secretary, Susanne Andersson, medical secretary.

When the operative report is correct, things will also check out in the Swedish Hip Arthroplasty Register. According to Mats Jolesjö, it is Ann-Britt Berling who pulls the heaviest load when it comes to the registration.

– We have one of the best secretaries there is. Ann-Britt is very thorough, knowledgeable and experienced. She does not let anything slip; things get done in time. She knows this coding business better than us doctors, so when we make mistakes things turn out right in the end anyway, says Mats Jolesjö.

Quality work in several ways

The quality awareness is high at the orthopaedic unit in Lidköping. The doctors study Swedish Hip Arthroplasty Register annual report thoroughly when it arrives every year. Ann-Britt Berling also looks to see how they are holding up compared with others. They reach results that are on par with the national mean Mats Jolesjö thinks that the work effort the clinic puts in with the registration in the Swedish Hip Arthroplasty Register is meaningful.

– It is valuable to have such a good overview, get feedback on the job and be able to compare oneself with others. It's a good thing that all units report. One gets a confirmation on how one fares, says Mats Jolesjö.

The orthopaedic unit in Lidköping also works with quality with the help of their own follow-up systems. Here it is possible to quickly detect if changes in the medical prescription regime or changes of the routines during operation affect the frequency of complications and readmissions. The doctor Hans Forsberg leads a group that works with quality in the care process for arthroplasty and Ann-Britt Berling is one of the participants.

4.9 Machine learning models to predict outcomes for the musculoskeletal diseases

Author: Mikko Venäläinen

Models to predict risk are increasingly being used as a complement to clinical considerations and decision-making in modern medicine. Even if they are very popular within the cardiovascular field for example, there is a lack of validated and generally accepted prediction tools within the area of the musculoskeletal diseases. This project that is led by Dr Venäläinen and funded by the Academy of Finland, aims at filling this gap by using machine learning methods on high-quality data from national and international patient registries with the objective of providing new prediction tools for several orthopaedic procedures. A large part of the project deals with total hip arthroplasties and involves significant collaboration with the Swedish Hip Arthroplasty Register.

The NARA-study

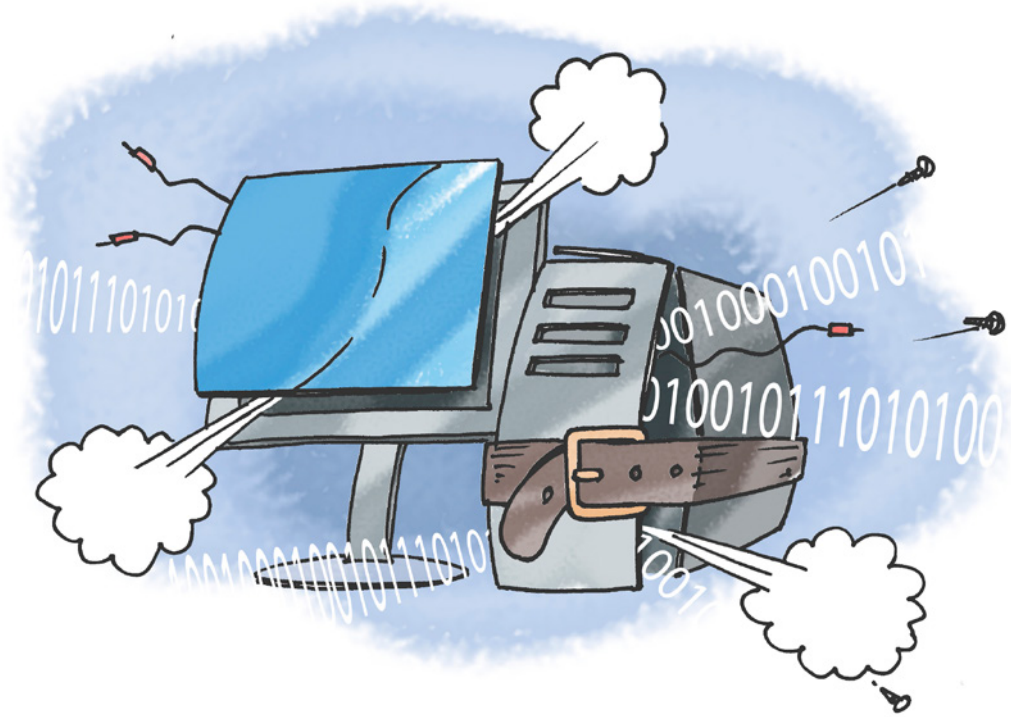
Despite excellent treatment results for total hip arthroplasties the related complications and the need for revision constitute a substantial problem within the healthcare system. This is a problem that is expected to increase with an aging population. At present, there is a need to identify patients that have a high risk for early reoperation or to tailor the procedures based on the needs of the individual patient. The goal is to reduce the number of revisions and to ensure a high proportion of non-revised primary total hip arthroplasties in the long run.

In 2019 the project was initiated with a study where a dataset available from the Nordic Arthroplasty Register Association (NARA) was used. The NARA-dataset contains data from the national arthroplasty registries in Norway, Sweden, Denmark and Finland. The main objective was to develop new models for risk prediction of revision due to deep infection, dislocation or periprosthetic fracture, and death occurring within one year after the primary operation. The study encompassed a cohort of 575 407 primary total hip arthroplasties carried out between 1995 and 2016. In order to predict the risk for the outcomes of interest, models were developed based on a number of machine learning methods such as gradient boosting machines, random forests and least absolute shrinkage and selection operator (LASSO) regression where a randomly selected training cohort (2/3 of the surgeries) was used and validated against the independent test cohort, which was not used to train the models (1/3 of the surgeries).

The main finding of the study was that all outcomes could be predicted with a moderate to excellent accuracy and that easy-to-use risk prediction tools suitable for clinical use could be developed based on the models.

Studies based on the Swedish and Finnish hip arthroplasty registries

The dataset from NARA only comprises variables that all member countries can deliver. This means that machine learning methods have limited possibilities to offer an improvement compared to the more traditional statistical methods. The advantages with the machine learning models should therefore be even more evident when they are applied on data from the



national quality registries, since these provide richer and more fine-grained data. At present two studies are under way, as part of this project, where more advanced risk prediction models are developed for similar outcomes as in the NARA-study but based on the more detailed data available in the Swedish Hip Arthroplasty Register and the Finnish Arthroplasty Register.

Other ongoing studies and future plans

In addition to provide new risk prediction models to support decision-making related to total hip arthroplasties, the project also aims at providing similar models also for total knee arthroplasties and the reconstruction of the rotator cuff. As far as it is possible, all the developed models will also be validated against external, completely independent data from different quality registries and healthcare environments, in order to verify the generalisability of the models. Thereafter easy-to-use prediction tools based on all models will be developed together with clinical collaborators and tested in the daily clinical practice. In the end, the project aims at decreasing the number of reoperations and the associated socioeconomic burden. This is of importance as the need of orthopaedic procedures is expected to increase in the future.

Visiting fellowship

In January, Mikko Venäläinen spent two weeks as a visiting research fellow at the Swedish Hip Arthroplasty Register to work on the project and to learn more about the register. He also participated and presented at the annual research meeting of the Swedish Hip Arthroplasty Register 2020, which had a focus on machine learning.

4.10 The effects of the covid-19 pandemic on hip arthroplasty surgery

Author: Ola Rolfson

When the covid-19 pandemic hit Sweden in the beginning of March 2020, large parts of the healthcare system were directed towards meeting the care needs, especially intensive care needs, which arose as a result of the pandemic. In addition, a comprehensive effort was made to protect people in the risk groups. This resulted in a drastic decrease of elective arthroplasties. This analysis illustrates how the production and different types of arthroplasty changed during the first four months of the year, differences between regions and mortality. We have compared the mean for the same time-period (January to April) with the mean for these months during 2017 to 2019. Data from 2020 are preliminary and are to be interpreted carefully since the reporting is lagging.

Production

During the first two months of the year there was an increase of the number of elective primary operations while arthroplasties due to fracture stayed at around the same levels as previous years. During March and April, the elective total arthroplasty production decreased by 23 % and 82 % respectively compared with 2017–2019. County hospitals accounted for the largest decrease of arthroplasties in April (96 %) while the decrease was 49 % at private hospitals. The number of reoperations also decreased during the first months of the pandemic. In April, only half as many (46 %) were carried out compared with the mean during April of the three last preceding years.

Mortality

During January and February, the 30-day mortality was somewhat lower among those operated due to hip fracture compared with previous years but increased during March and April by 27 % and 20 % respectively. For elective total arthroplasties, the 30-day mortality was 92 % higher in February but none of those operated electively in March and April 2020 died within 30 days. Among those reoperated in March and April, especially those who underwent revision, the mortality was higher. Those revised in April had a five-times higher 30-day mortality compared with the same month 2017–2019.

Differences between regions

There is no clear connection between how hard a region was hit by the covid-19 pandemic and the decrease in production. In the analysis, production per region for March–April 2020 is compared with the mean for these months the previous three years. In the regions Värmland and Blekinge, which had a relatively low incidence of covid-19, the production decreased by 74 % and 70 % respectively for elective total arthroplasties but only with 47 % in the Stockholm-region and 34 % in the Gävleborg-region where the incidence has been high.

Comments to the analysis

The analysis only comprises the first two months of the covid-19 pandemic. It is likely that the production fall has been just as large in May and during the summer as it was in April. This has of course affected those waiting for and in need of a hip arthroplasty. A higher mortality among fracture and revision patients is likely to have an association with the pandemic but at the same time it is reassuring that among those operated with an elective primary arthroplasty during March and April, the mortality was not increased. That the productivity decrease differs between regions is interesting and seems to mirror regional decision-making rather than the incidence of covid-19 in the different regions.

Number of operations (Jan–April)

		Total arthroplasty		Hemiarthroplasty		Elective total arthroplasty		Total arthroplasty fracture		All fractures	
		2017–2019 Number (mean)	2020 Number	2017–2019 Number (mean)	2020 Number	2017–2019 Number (mean)	2020 Number	2017–2019 Number (mean)	2020 Number	2017–2019 Number (mean)	2020 Number
Country	January	1,712	1,763	394	419	1,492	1,579	210	180	599	592
	February	1,701	1,831	316	358	1,505	1,630	190	198	500	554
	March	1,773	1,390	360	364	1,586	1,210	181	176	535	536
	April	1,713	426	336	368	1,533	278	172	142	504	508
Local hospital	January	661	708	55	73	609	666	51	42	106	115
	February	645	754	47	57	598	701	47	53	94	110
	March	677	533	57	48	638	487	37	45	94	93
	April	639	87	56	62	604	43	34	43	90	105
County hospital	January	494	494	220	205	383	388	105	104	324	304
	February	492	499	171	205	396	390	94	107	262	311
	March	513	351	200	202	413	259	97	92	296	292
	April	522	97	180	209	425	18	94	75	272	284
Private hospital	January	425	435	16	13	415	431	9	4	25	17
	February	428	437	11	10	421	433	6	4	17	14
	March	450	418	13	18	444	410	6	8	19	26
	April	414	214	15	10	408	209	6	5	20	15
University or regional hospital	January	133	126	102	128	85	94	44	30	144	156
	February	135	141	86	86	90	106	43	34	127	119
	March	133	88	90	96	90	54	40	31	126	125
	April	138	28	86	87	96	8	38	19	122	104

Table 4.10.1 Number of primary operations January to April divided between two types of operation and hospital type, 2020 compared with average 2017–2019.

Number of reoperations (Jan–April)

		Revisions		All reoperations	
		2017–2019 Number (mean)	2020 Number	2017–2019 Number (mean)	2020 Number
Country	January	190	186	226	206
	February	172	181	209	195
	March	186	177	216	206
	April	182	75	209	96
Local hospital	January	23	31	27	33
	February	21	33	25	36
	March	28	31	31	34
	April	26	8	28	9
County hospital	January	99	94	118	103
	February	92	86	110	92
	March	94	88	109	105
	April	93	33	106	44
Private hospital	January	13	5	16	8
	February	9	12	12	12
	March	8	6	11	8
	April	8	2	13	5
University or regional hospital	January	55	56	65	62
	February	50	50	61	55
	March	56	52	64	59
	April	55	32	63	38

Table 4.10.2 Number of revisions and reoperations January to April divided after hospital type, 2020 compared with mean 2017–2019.

Mortality (Jan–April)

		Total arthroplasty		Hemiarthroplasty		Elective total arthroplasty		Total arthroplasty fracture		All fractures	
Mortality within 30 days		2017–2019	2020	2017–2019	2020	2017–2019	2020	2017–2019	2020	2017–2019	2020
	Primary operation	Per mille	Per mille	Per mille	Per mille	Per mille	Per mille	Per mille	Per mille	Per mille	Per mille
Country	January	2.9	2.8	114.2	100.2	0.7	0.6	19	22.2	81.8	74.3
	February	3.5	4.4	104.4	97.8	1.3	2.5	21.1	20.2	72	68.6
	March	2.3	1.4	97.2	126.4	0.6	0	11	11.4	69.2	87.7
	April	2.3	11.7	86.3	97.8	0	0	23.3	28.2	65.5	78.7

Table 4.10.3 Mortality during primary operations January to April 2020 compared with mean 2017–2019.

Mortality reoperations (Jan–April)

Mortality within 30 days		Revision		All reoperations	
		2017–2019	2020	2017–2019	2020
	Primary operation	Per mille	Per mille	Per mille	Per mille
Country	January	31.6	21.5	31	34
	February	23.3	11	28.7	15.4
	March	10.8	22.6	27.8	29.1
	April	11	53.3	14.4	52.1

Table 4.10.4 Mortality during revisions and reoperations January to April 2020, compared with mean 2017–2019.

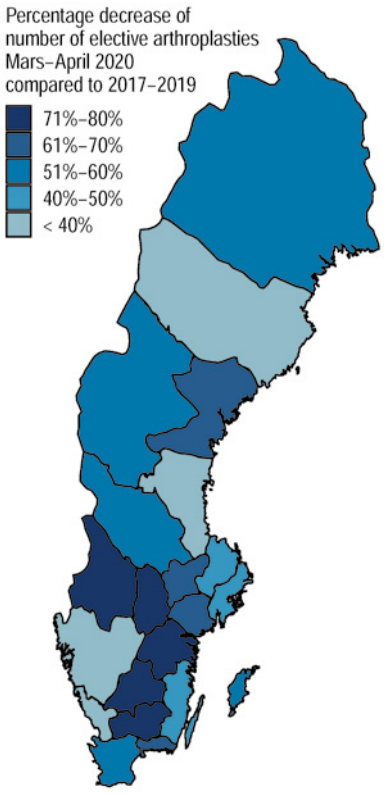


Figure 4.12.1 Geographical differences in the reduction of the production of elective total hip arthroplasties March to April 2020 compared with the mean for the same months 2017–2019.

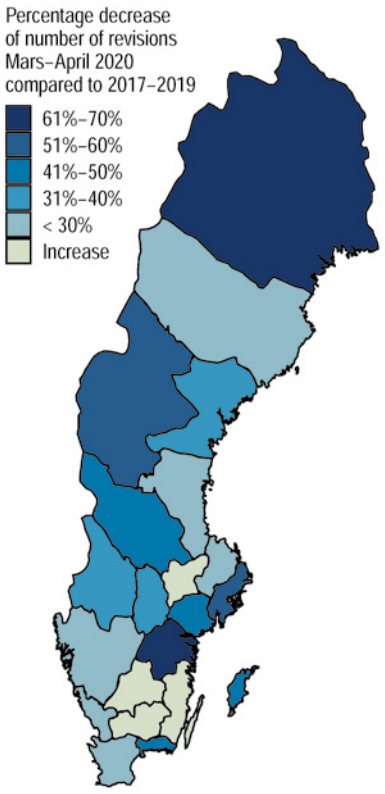


Figure 4.12.2 Geographical differences in the reduction of the production of revisions March-April 2020 compared with the mean for the same months 2017–2019.

5. International perspective on register work

Author: Maziar Mohaddes

5.1 International studies

The Swedish Hip Arthroplasty Register has continued to deepen its collaboration with other international registries during the preceding year. We have for example surveyed the use of and outcome after operation with hip arthroplasties where metal-on-metal articulations have been used in a collaboration with ten other European registries within the framework of the Network of Orthopaedic Registries of Europe (NORE). In total, 54 434 resurfacing prostheses and 58 498 stemmed hip arthroplasties with large metal-on-metal articulations were included. The study showed that the risk of revision five years after operation was more than doubled when using hip prostheses with metal-on-metal articulations compared with traditional hip prostheses. Moreover, the follow-up routine after hip arthroplasty with a resurfacing prosthesis differed between European countries.

The Swedish Hip Arthroplasty Register was represented during 2019 at several international meetings, which among others were organised by the American Academy of Orthopaedic Surgeons, The European Federation of National Associations of Orthopaedics and Traumatology, European Hip Society and International Society of Arthroplasty Registries. Researchers and register co-workers affiliated with the SHAR were represented at these meetings and contributed with research presentations. We think that the growing international collaboration over the last years has had a positive impact both on research and quality of the care.

Figure 5.1.1. Collaborations in the Nordic countries.

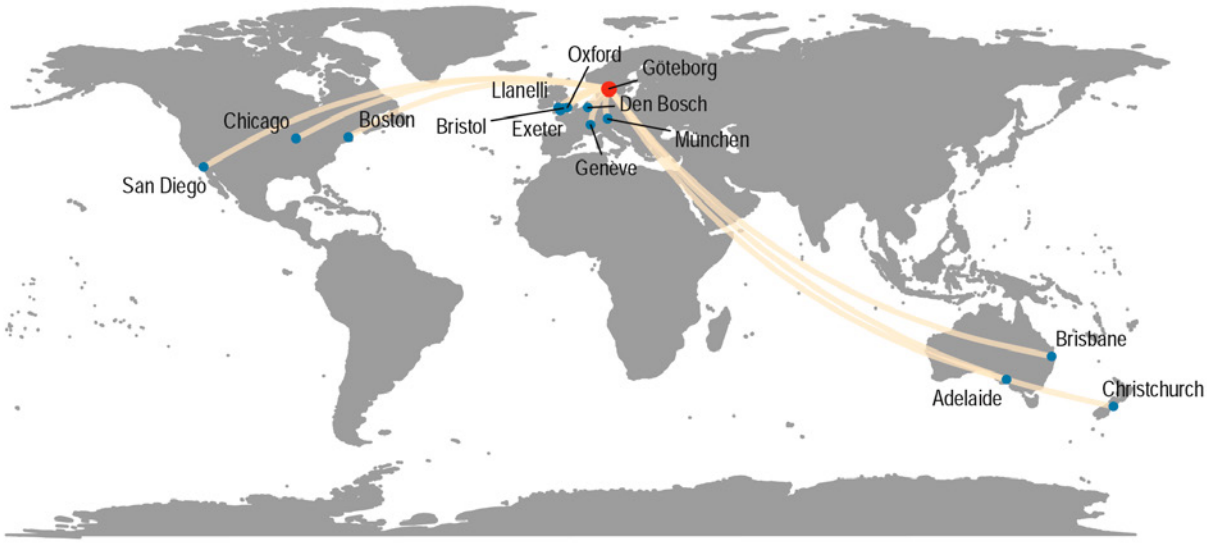


Figure 5.1.2. International collaborations.

6. Primary arthroplasty

Author: Maziar Mohaddes

The information in the primary arthroplasty chapter includes all primary total arthroplasties from year 2000. The register report is based on many analyses. In this year's report the results are mainly given as Kaplan-Meier survival analyses or regression analyses, usually Cox regression. The Kaplan-Meier statistic describes the number of patients who after a certain number of years have not had a reoperation. Data is presented as percentages including a 95-percentage confidence interval (abbreviated C.I.). Regression data is given using the risk ratio (hazard ratio, relative risk). The risk ratio describes the degree of increased or decreased risk of having the chosen outcome (usually revision) compared with a reference group. The risk of the reference group is routinely set to the value 1.0. If the risk ratio is 2.0 for having a revision this means that the risk is doubled for the group in question. The increased or decreased risk of an outcome should be related to the outcome of the reference group. The clinical significance of a doubled risk has a completely different meaning if the reference group is revised in one out of a thousand cases compared to if a hundred out of a thousand in the reference group have been revised. In the first case, a doubling means that two hips out of a thousand are expected to have a revision in the study group. In the second case, 200 hips are expected to be revised. The risk ratio is shortened with RR and is given with one decimal and with a 95-percentage C.I. The farther the upper and lower limits of the confidence interval are from 1.0 the higher is the statistical certainty that the risk differs from the comparison group.

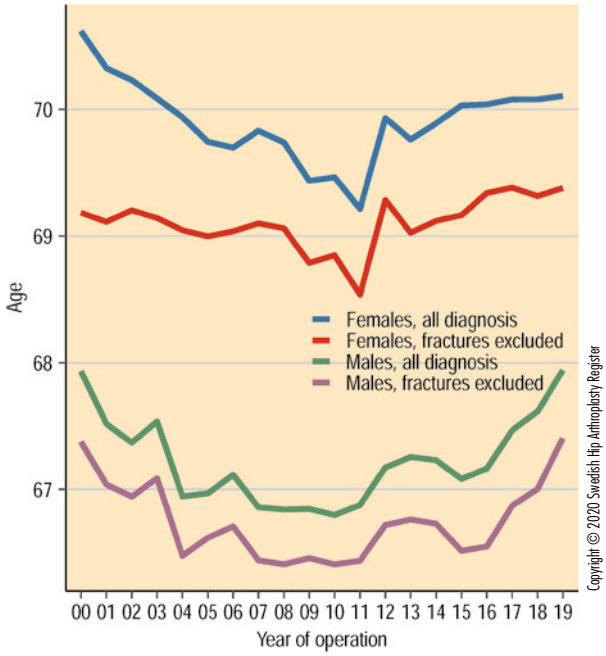


Figure 6.1.1 Trends for mean age.

6.1 Demography

The number of registered primary arthroplasties have increased continuously over the last years. In 2019, 19 692 primary arthroplasties were reported, an increase by around 6 % compared with the previous year. In 2019, the mean age during operation was 67.9 years for men and 70.1 years for women. Between the years 2000 and 2010 the mean age decreased for both genders. Thereafter there has been a successive increase of the mean age. The same trend can be seen also when the fracture diagnoses is excluded (figure 6.1.1).

6.2 Diagnosis

The most common reason for a hip arthroplasty is primary osteoarthritis. Since 2000, the proportion operated due to primary osteoarthritis has increased from 75 %, and in 2019 it was 82 %. Men dominate this diagnosis group while the relative proportion of women is higher in all the larger groups of secondary osteoarthritis. The proportion of patients with an inflammatory joint disease has decreased since 2000 and in 2019, 0.6 % were operated due to this diagnosis. In figure 6.2.1 the age distribution is illustrated for the most common diagnosis groups. In general, the mean age during a total hip arthroplasty is a little higher in women than in men. The only exception being the sequelae after hip disease during adolescence (sequelae after childhood disease), which is the diagnosis group where the mean age is relatively similar for both genders.

The proportion of patients undergoing surgery for primary osteoarthritis continues to increase. This increase is most likely real but may to a small extent also reflect declining resources and interest in making as accurate diagnosis as possible.

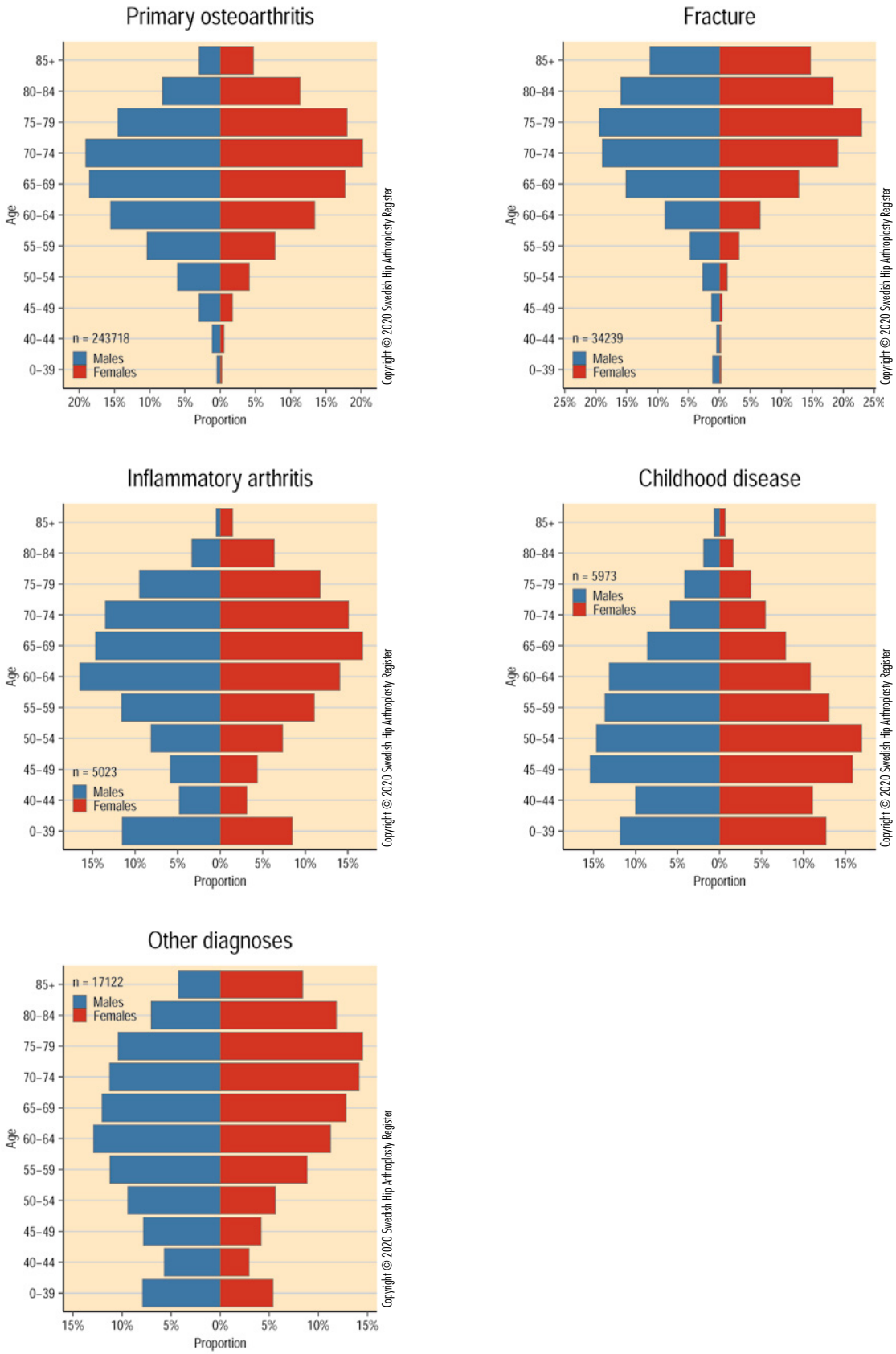


Figure 6.2.1. Age and gender distribution for different diagnosis groups.

Change of BMI and ASA-class selected years

2015–2019

	2015	2016	2017	2018	2019
BMI					
Existing observations/missing observations					
Men	16,633/599	17,269/579	18,153/541	18,638/683	19,692/389
Women	16,633/599	17,269/579	18,153/541	18,638/683	19,692/389
Mean – median					
Men	27.6 – 27.1	27.7 – 27.2	27.5 – 27.1	27.6 – 27.2	27.6 – 27.2
Women	26.7 – 26.1	26.7 – 26.1	26.8 – 26.2	26.8 – 26.2	26.8 – 26.1
Underweight < 18.5					
Men. %	0.5	0.3	0.3	0.3	0.5
Women. %	2	1.8	1.6	1.8	1.7
Normal weight 18.5–24.9					
Men. %	26.2	26.8	26.9	26.5	26.7
Women. %	38.2	38.2	37.5	37.7	37.2
Overweight 25–29.9					
Men. %	48.8	47.4	48.3	48.1	47.3
Women. %	36.7	36.9	36.8	36.4	36.8
Obesity degree I 30–34.9					
Men. %	19.7	20	19.5	20.2	20.9
Women. %	17	17.8	18.3	18.1	18.7
Obesity degree II–III 35+					
Men. %	4.80	5.3	4.7	4.9	4.5
Women. %	6	5.1	5.7	5.7	5.5
ASA-classification					
Existing observations/missing observations					
Men	16,633/233	17,269/189	18,153/184	18,638/327	19,692/135
Women	16,633/233	17,269/189	18,153/184	18,638/327	19,692/135
Healthy (I)					
Men. %	23.4	22.5	21.6	21.8	20
Women. %	19.9	19.4	18.8	19.3	17.8
Mild systemic disease (II)					
Men. %	55	55.6	55.6	55.6	56.5
Women. %	60.3	60.4	61.8	61.5	63
Serious/life-threatening systemic disease (III–V)					
Men. %	21.6	21.9	22.8	22.6	23.5
Women. %	19.8	20.2	19.4	19.2	19.2

Table 6.3.1

Percentages BMI och ASA-class

Selected diagnosis groups

	Primary osteo-arthritis, %	Acute trauma, hip fracture, %	Idiopathic necrosis, %	Complication or sequelae after fracture or other trauma, %	Sequelae after childhood hip disease, %	Other, %
BMI						
Underweight < 18,5	0,6	5,7	2,1	5,6	0,5	2,4
Normal weight 18,5–24,9	30,2	50,5	39,2	48,3	35,9	43,9
Overweight 25–29,9	42,6	33,4	35,4	32,5	37,3	33,7
Obesity degree I 30–34,9	21,1	8,8	16,3	10,9	19,6	15,4
Obesity degree II–III 35+	5,4	1,6	7	2,7	6,7	4,5
ASA-class						
Healthy (I)	19,8	9,5	12,2	6,5	37,8	18,1
Mild systemic disease (II)	62,3	52,2	53,1	45,1	51,7	51,6
Serious/life-threatening systemic disease (III–V)	18	38,3	34,7	48,4	10,5	30,3

Table 6.3.2

6.3 BMI and ASA class

The reporting of BMI (Body Mass Index) and ASA class (American Society of Anaesthesiology Physical Status Classification System) to the Swedish Hip Arthroplasty Register started in 2008. The first year there was data for 82 % and 90 % of cases regarding BMI and ASA class respectively and the reporting continues to improve. During 2019, BMI and ASA class had been reported in 98 % and 99 % of cases respectively. Over the last five years the mean for BMI has stayed relatively constant (table 6.3.1). The comparison of BMI between different diagnosis groups shows that obesity tends to be more common in the group with primary osteoarthritis and normal weight and underweight is more common in the fracture group (table 6.3.2).

Regarding ASA class, the proportion of those who have been reported healthy (class I) continues to decrease while the proportions of patients in classes III-V continue to increase (serious or life-threatening disease, table 6.3.1). The healthiest patients, assessed by their ASA class, are found in the group with sequelae after child disease and the most ill patients are found in the group that is operated due to fracture (table 6.3.2). The trend towards increasing ASA class over time could in part be explained by the fact that the proportion of patients with fracture increases, although other reasons can be surmised.

In summary, we find the highest BMI means in the group with primary osteoarthritis and the lowest in the fracture group. We find the highest proportion of patients with ASA class III/IV in the fracture group and the lowest proportion in the group with sequelae after childhood disease.

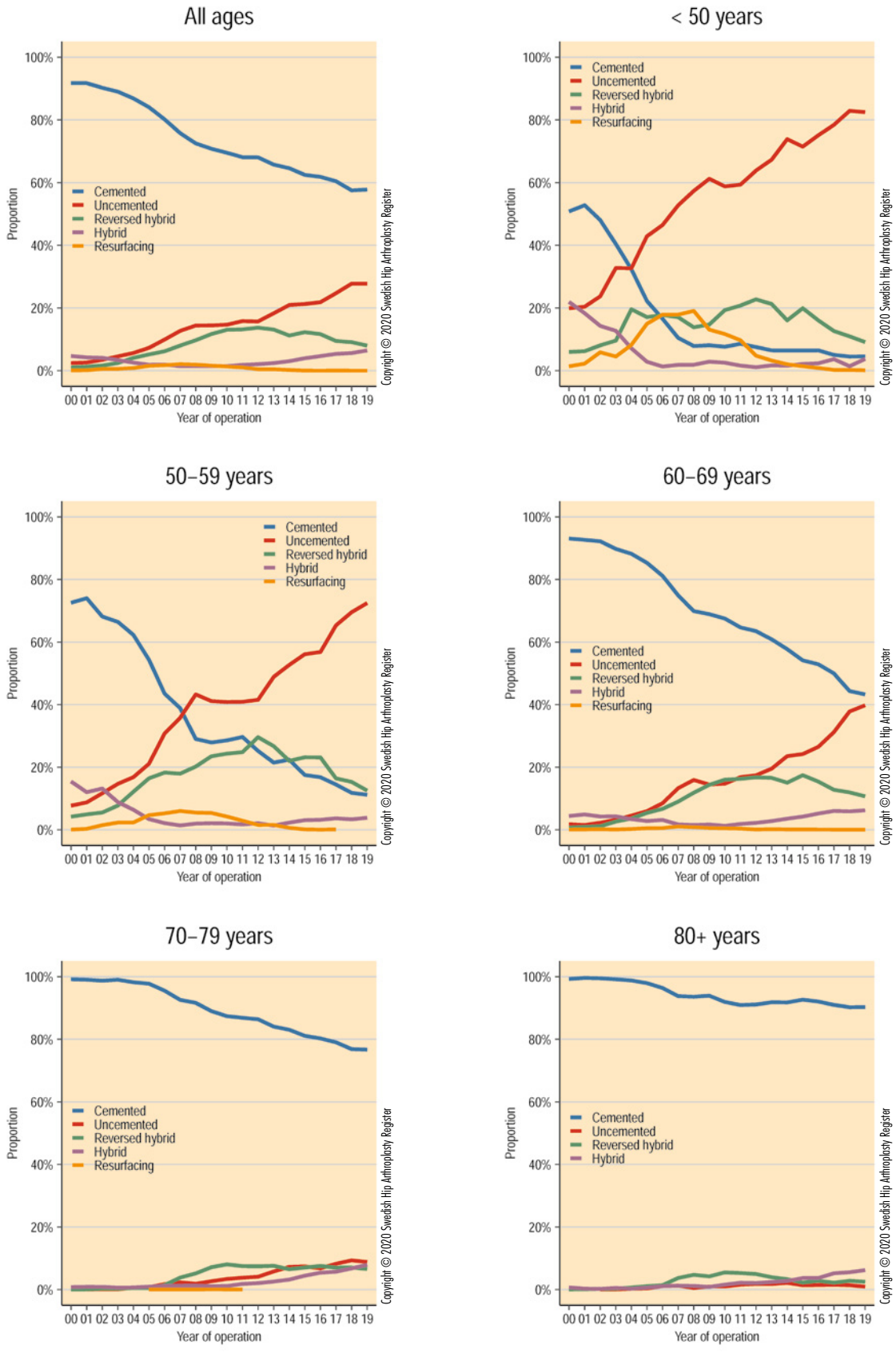


Figure 6.4.1 Trends for fixation method.

6.4 Choice of implants

In Sweden, cemented fixation is more often used than in any other Nordic country. Poor results with uncemented fixation during the 1990s resulted in an increase of the completely cemented fixation to a top level around 93 % at the turn of the millennium. After this cemented fixation has decreased each year (figure 6.4.1). During 2019, the proportion of cemented arthroplasties was 57.8 %. Completely uncemented fixation has instead become more common. In 2000, the completely uncemented arthroplasties accounted for 2.4 % of all reported operations. The corresponding proportion in 2019, was 27.8 %. The increase of uncemented fixation has mainly occurred in the age groups under 60 years, but also in patients 60 years and older. Since 2012, the proportion of reversed hybrids (cemented cup, uncemented stem) has decreased. The proportion of hybrid arthroplasties (uncemented cup, cemented stem) has been small during the last ten-year period and amounted to around 1.5 % during the years 2007–2010, thereafter there has been an increase to 6.5 % during 2019. The resurfacing prosthesis was used during 2 operations during 2019. The increased use of uncemented implants in Sweden, especially among patients aged 70 years or more, can be seen as something remarkable as existing data from several international registries does not support the use of uncemented fixation in patients older than 70 years

In the absence of data supporting the use of uncemented implants in elderly patients, the use of such implants in patients older than 70 years should be limited.

6.5 The most common implants

The 15 most used cups and stems are presented in tables 6.5.1 and 6.5.2. The five most commonly used cemented cups accounted for 91.1 % of the total number of cemented cups reported to the registry during 2019. On the stem side Lubinus SP II, Exeter and MS30 dominate. Together they account for 98.5 % of all cemented stems being reported. For the uncemented cups the variation is greater, the five most commonly used cups account for 69.7 % of all uncemented cups reported to the registry. A reduction in the proportion of trabecular cups can be seen during the last few years. We would once again like to call for a certain prudence when it comes to the use of trabecular cups, where indication is not necessarily the case, awaiting the publication of studies with longer follow-up. This is due to the insecurity that has arisen for the development of radiological zones around certain cups with a trabecular titanium coating and an increased risk for dislocation for trabecular tantalum cups in published studies. Regarding uncemented stems, the diversification is less pronounced than on the cup side. Since 2009, the Corail stem has been the most common uncemented stem. The Corail stem accounts for 39.4 % of all uncemented stems reported to the register during 2019.

6.6 Articulation

In uncemented cups, plastic inserts made of highly cross-linked polyethylene are almost exclusively used (97.9 % of all insertions in 2019). In cemented cups this type of plastic is used in 84.9 % of cases during 2019. The proportion of cups with extra cross-linked polyethylene (x-polyethylene) continues to increase (figure 6.6.1). During 2019, x-polyethylene was used in 89.3 % of all hip arthroplasties reported to the registry. The combination of ceramic femoral head-on-polyethylene is decreasing slightly, from 20.1 % in 2018 to 19.5 % during 2019. Femoral heads with a diameter of 32 mm are used more often. The proportion of femoral heads with a diameter of 36 mm was 11.1 % during 2019. Time trends regarding the choice of articulation and femoral head sizes are visualised in figures 6.6.1 and 6.6.2.

6.7 Implant combinations

The most common implant combinations are given in the tables 6.7.1–6.7.5 and onwards. In the cemented group, the combination Lubinus SP II stem with a Lubinus cup is the most commonly used. In the uncemented arthroplasties, the proportion of Corail-Pinnacle W/Gription 100 is increasing somewhat. Changes can also be noted for the group reversed hybrids and hybrids. For several of these combinations, implants from different manufacturers have been used. This mix and match method have been implied in Sweden, even though this is not recommended by most manufacturers. Long-term data is available for several mix and match combinations indicating good long-term results.

15 most common cups

Cup	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Lubinus x-link	8,683	4,563	5,349	5,260	5,308	5,665	26,145	28.9
Exeter Rim-fit	6,271	2,056	2,623	2,919	3,040	3,188	13,826	15.3
Marathon	12,032	1,777	1,730	1,624	1,289	1,197	7,617	8.4
Pinnacle W/Cripton 100	674	581	731	1,372	2,005	2,315	7,004	7.7
Lubinus	71,195	1,735	1,187	1,243	1,146	1,148	6,459	7.1
Trident hemi	2,028	656	737	787	766	944	3,890	4.3
Continuum	2,152	646	774	630	608	419	3,077	3.4
Avantage	1,230	363	478	615	630	598	2,684	3
Pinnacle 100	1,456	273	300	508	471	567	2,119	2.3
ZCA XLPE	13,361	951	388	239	259	183	2,020	2.2
Trilogy	9,967	384	312	334	333	382	1,745	1.9
IP Link	336	244	389	383	332	387	1,735	1.9
Pinnacle W/Gription Sector	68	103	131	278	347	400	1,259	1.4
Trilogy IT	555	309	283	215	228	205	1,240	1.4
Exceed ABT Ringlock	845	292	274	245	250	9	1,070	1.2
Other	84,837	1,700	1,583	1,501	1,626	2,085	8,495	9
Total	215,690	16,633	17,269	18,153	18,638	19,692	90,385	

Table 6.5.1

[1)] Refers to the number of carried out primary operations during the last five years.
[2)] Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common stems

Stem	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
SPII standard	90,680	6,539	6,874	7,093	7,086	7,402	34,994	38.7
Exeter standard	46,623	3,313	3,429	3,482	3,358	3,591	17,173	19
Corail standard	8,641	1,853	2,120	2,409	2,638	2,708	11,728	13
MS-30 polished	10,071	1,095	1,062	1,144	1,174	1,461	5,936	6.6
CLS	10,150	648	750	820	819	633	3,670	4.1
Corail high offset	2,578	533	534	648	934	846	3,495	3.9
Corail coxa vara	1,920	426	494	623	673	823	3,039	3.4
Bi-Metric X por HA NC	6,770	837	727	458	422	39	2,483	2.7
Accolade II	620	349	340	412	479	646	2,226	2.5
M/L Taper	521	254	218	128	149	291	1,040	1.2
Wagner Cone	1,335	168	134	203	191	155	851	0.9
ABG II HA	2,762	188	199	187	115	2	691	0.8
Echo Bi-Metric (FPP)		35	87	6	82	442	652	0.7
SP-CL	1	10	27	80	79	66	262	0.3
CPT	2,693	22	32	58	43	72	227	0.3
Other	30,325	363	242	402	396	515	1,918	1.8
Total	215,690	16,633	17,269	18,153	18,638	19,692	90,385	

Table 6.5.2

[1)] Refers to the number of carried out primary operations during the last five years.
[2)] Refers to the proportion of the total number of primary operations carried out during the last five years.

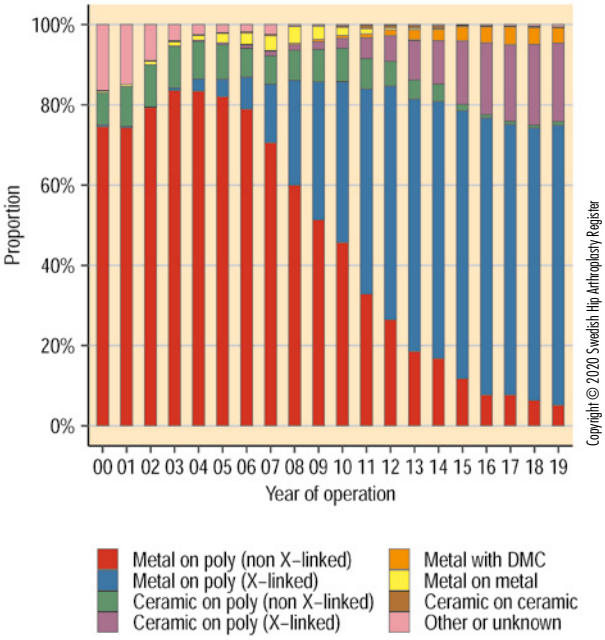


Figure 6.6.1 Trends for articulation.

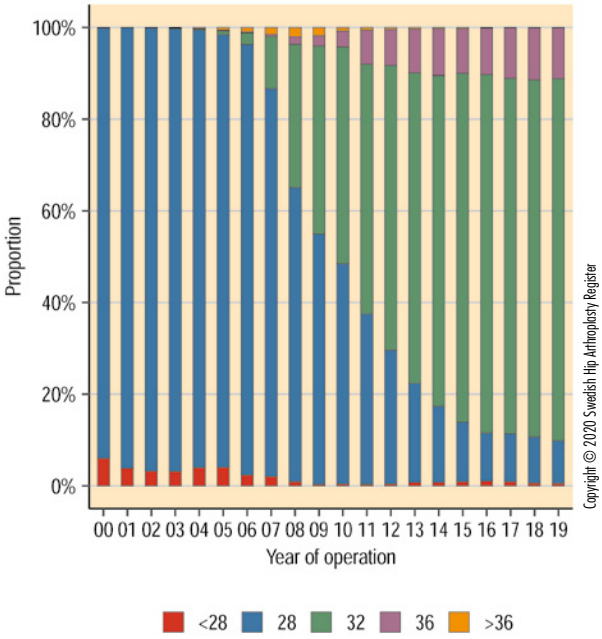


Figure 6.6.2 Trends for femoral head size.

15 most common implants

Cup (Stem)	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Lubinus x-link (SPII standard)	7,698	4,021	4,596	4,588	4,682	5,037	22,924	25.4
Exeter Rim-fit (Exeter standard)	4,982	1,651	1,647	1,534	1,630	1,768	8,230	9.1
Lubinus (SPII standard)	66,834	1,448	1,024	1,086	1,017	986	5,561	6.2
Marathon (Exeter standard)	6,805	1,002	937	945	796	822	4,502	5
Pinnacle W/Cripton 100 (Corail standard)	391	342	493	918	1,153	1,234	4,140	4.6
Exeter Rim-fit (MS-30 polished)	639	55	477	750	673	692	2,647	2.9
Trident hemi (Exeter standard)	471	273	408	505	484	610	2,280	2.5
Avantage (SPII standard)	823	297	378	479	519	451	2,124	2.3
Exeter Rim-fit (Corail standard)	308	205	330	395	470	415	1,815	2
ZCA XLPE (MS-30 polished)	7,552	740	358	235	258	181	1,772	2
IP Link (SPII standard)	288	222	351	364	319	365	1,621	1.8
Pinnacle W/Cripton 100 (Corail high offset)	189	137	124	266	525	553	1,605	1.8
Trilogy (CLS)	3,669	223	277	322	324	370	1,516	1.7
Pinnacle 100 (Corail standard)	978	177	149	289	240	292	1,147	1.3
Lubinus x-link (Corail standard)	340	132	257	211	214	260	1,074	1.2
Other	113,723	5,708	5,463	5,266	5,334	5,656	27,427	27.4
Total	215,690	16,633	17,269	18,153	18,638	19,692	90,385	NA

Table 6.7.1

[1)] Refers to the number of carried out primary operations during the last five years.
[2)] Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common cemented implants

Cup (Stem)	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Lubinus x-link (SPII standard)	7,698	4,021	4,596	4,541	4,682	5,031	22,871	42.4
Exeter Rim-fit (Exeter standard)	4,982	1,651	1,647	1,524	1,630	1,768	8,220	15.2
Lubinus (SPII standard)	66,832	1,448	1,024	1,082	1,016	984	5,554	10.3
Marathon (Exeter standard)	6,805	1,001	937	902	796	822	4,458	8.3
Exeter Rim-fit (MS-30 polished)	639	55	477	750	673	692	2,647	4.9
Avantage (SPII standard)	821	297	378	477	517	448	2,117	3.9
ZCA XLPE (MS-30 polished)	7,552	740	358	235	258	181	1,772	3.3
IP Link (SPII standard)	288	222	351	364	319	365	1,621	3
Marathon (SPII standard)	504	139	172	183	192	183	869	1.6
Contemporary Hooded Duration (Exeter standard)	6,089	147	127	200	104	16	594	1.1
ZCA (MS-30 polished)	618	216	118	56	39	27	456	0.8
Polar cup cemented (SPII standard)	260	87	81	95	89	101	453	0.8
Exceed ABT E-poly non-flanged (cem) (MS-30 polished)		8	2	2	56	330	398	0.7
Lubinus x-link (Exeter standard)	104	30	70	68	68	71	307	0.6
Avantage (MS-30 polished)	57	14	35	42	35	58	184	0.3
Other	62,417	304	292	271	244	290	1,401	2
Total	165,666	10,380	10,665	10,792	10,718	11,367	53,922	NA

Table 6.7.2

[1)] Refers to the number of carried out primary operations during the last five years.
[2)] Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common uncemented implants

Cup (Stem)	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Pinnacle W/Cripton 100 (Corail standard)	391	342	493	918	1,153	1,234	4,140	18.5
Pinnacle W/Cripton 100 (Corail high offset)	189	137	124	266	525	553	1,605	7.2
Trilogy (CLS)	3,669	223	277	322	324	369	1,515	6.8
Pinnacle 100 (Corail standard)	978	177	149	287	239	292	1,144	5.1
Continuum (CLS)	702	194	262	266	247	63	1,032	4.6
Pinnacle W/Cripton 100 (Corail coxa vara)	67	89	94	144	225	332	884	4
Trident hemi (Accolade II)	348	146	140	182	179	235	882	3.9
Exceed ABT Ringlock (Bi-Metric X por HA NC)	730	261	233	144	126		764	3.4
Trilogy IT (Bi-Metric X por HA NC)	331	181	167	127	129	20	624	2.8
Pinnacle W/Gription Sector (Corail standard)	42	59	77	140	156	171	603	2.7
Continuum (Wagner Cone)	268	110	78	143	124	71	526	2.4
Pinnacle 100 (Corail coxa vara)	143	35	78	105	133	174	525	2.3
Continuum (M/L Taper)	235	40	27	93	135	199	494	2.2
G7 PPS (Echo Bi-Metric (FPP))		20	55	4	49	330	458	2
Continuum (Corail standard)	284	152	196	47	22	15	432	1.9
Other	16,411	1,367	1,317	1,220	1,405	1,408	6,717	28.2
Total	24,788	3,533	3,767	4,408	5,171	5,466	22,345	NA

Table 6.7.3

[1)] Refers to the number of carried out primary operations during the last five years.
[2)] Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common hybrid implants

Cup (Stem)	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Trident hemi (Exeter standard)	471	273	408	505	484	610	2,280	48.1
Pinnacle sector (SPII standard)	6	36	57	62	48	65	268	5.7
Tritanium (Exeter standard)	77	31	30	41	62	48	212	4.5
Trident AD LW (Exeter standard)	46	17	29	46	39	37	168	3.5
Trilogy IT (SPII standard)	20	36	22	27	35	29	149	3.1
Pinnacle W/Gription Sector (Exeter standard)	9	13	18	26	40	51	148	3.1
Pinnacle W/Gription Sector (MS-30 polished)		2		25	53	53	133	2.8
Trilogy (SPII standard)	1,326	65	13	3	3		84	1.8
Pinnacle W/Cripton 100 (MS-30 polished)	3			6	26	47	79	1.7
Continuum (MS-30 polished)	90	22	45	6	1	3	77	1.6
Pinnacle 100 (SPII standard)	18	23	5	9	16	23	76	1.6
Pinnacle W/Cripton 100 (SPII standard)	6	6	8	17	16	29	76	1.6
Continuum (SPII standard)	47	8	12	15	25	14	74	1.6
Pinnacle W/Cripton 100 (Exeter standard)	8	5	9	12	22	24	72	1.5
TMT revision (SPII standard)	46	13	9	17	15	16	70	1.5
Other	3,120	109	137	140	164	221	771	15.5
Total	5,293	659	802	957	1,049	1,270	4,737	NA%

Table 6.7.4

[1)] Refers to the number of carried out primary operations during the last five years.
[2)] Refers to the proportion of the total number of primary operations carried out during the last five years.

15 most common reversed hybrid implants

Cup (Stem)	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Exeter Rim-fit (Corail standard)	308	205	328	375	470	415	1,793	19.9
Lubinus x-link (Corail standard)	340	132	257	211	213	260	1,073	11.9
Marathon (Corail standard)	1,498	228	232	94	120	51	725	8.1
Exeter Rim-fit (Corail high offset)	77	62	76	134	181	148	601	6.7
Marathon (ABG II HA)	535	141	152	133	71		497	5.5
Lubinus x-link (Corail coxa vara)	92	61	98	128	112	76	475	5.3
Lubinus (Corail standard)	1,622	136	91	69	69	89	454	5
Lubinus x-link (Bi-Metric X por HA NC)	224	117	84	74	52	7	334	3.7
Marathon (Corail high offset)	844	127	110	10	21	17	285	3.2
Lubinus x-link (M/L Taper)	80	96	85	21	13	20	235	2.6
Marathon (Bi-Metric X por HA NC)	786	77	75	49	23	1	225	2.5
Lubinus x-link (Corail high offset)	31	30	36	53	69	22	210	2.3
Lubinus x-link (Accolade II)	26	25	27	16	22	62	152	1.7
Lubinus x-link (CLS)	45	32	33	36	23	16	140	1.6
Exeter Rim-fit (Corail coxa vara)	53	10	17	15	21	51	114	1.3
Other	11,131	561	308	270	213	335	1,687	17.4
Total	17,692	2,040	2,009	1,688	1,693	1,570	9,000	NA

Table 6.7.5

[1)] Refers to the number of carried out primary operations during the last five years.
[2)] Refers to the proportion of the total number of primary operations carried out during the last five years.

6.8 Surgical approach

Posterior and direct lateral approach in supine or lateral position have dominated completely among the surgical approaches in Sweden since 2005. During 2019, one of these approaches was used in 99.1 % of the total arthroplasties reported to the register. The posterior approach is still the most common (57 %). Direct lateral approach in lateral position was used in 35.7 % of all operations and the proportion of direct lateral approach in supine position was 6.4 %. Mini approach, Watson-Jones approach and direct lateral/posterior approach combined with a trochanteric osteotomy were used only sporadically. The distribution between the three most used approaches do not show any greater variation during the last five years (figure 6.8.1). In table 6.8.1 the proportion of reoperations within two years related to used approach is shown. Reoperation within two years has been used as endpoint rather than revision. This is done to include open reductions and potential fractures that only have been treated with internal fixation, where the implant and its parts are not changed. The highest proportion of reoperations were in the two groups that have been operated with a mini approach. In both these groups the proportion of uncemented implants is high, which probably affects the risk for reoperation (table 6.8.1). The somewhat higher risk for reoperation within two years in the group direct lateral approach could be explained by an increasing proportion of patients with a secondary osteoarthritis and especially with a hip fracture, are operated with a direct lateral approach. The relationship between patient demography, comorbidity, implant choice and choice of surgical approach are complex. The data presented should therefore be viewed mainly as descriptive.

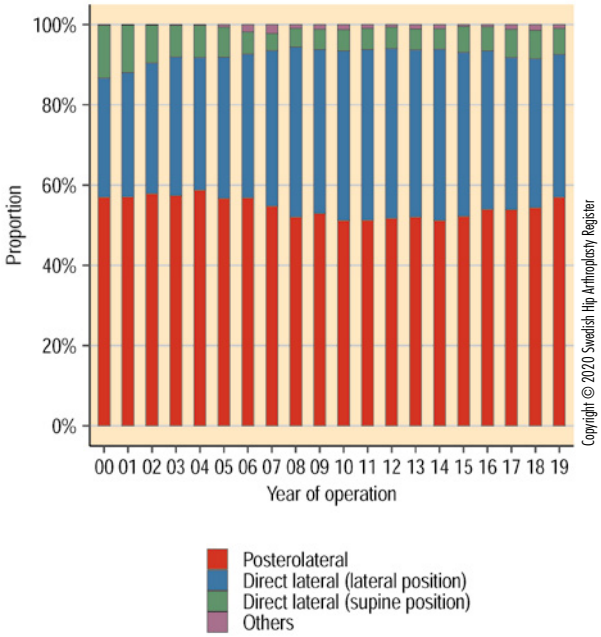


Figure 6.8.1 Trends for surgical approach.

93% of all total arthroplasties are performed with either a posterior approach or a lateral approach in lateral position. The risk of early reoperation does not seems to be affected by the choice of these two approaches, when all reoperations are included. On the other hand, the choice of surgical approach may differ in different subgroups and mirror different risk profiles, something that we have reproted earlier for operations of patients with a fracture diagnosis.

Demography, method of fixation and proportion of reoperated patients in relation to surgical approach

2000–2019

Surgical approach	Number	Proportion of women, %	Proportion of primary osteoarthritis, %	Proportion of operations with an uncemented cup, %	Proportion of operations with an uncemented stem, %	Proportion of reoperated, %
Posterior approach in lateral position (Moore)	164,629	57.5	81.7	19.6	22.9	2.1
Direct lateral approach						
Lateral position (Gammer)	115,959	59.6	77.8	21.1	25.2	2.3
Supine position (Hardinge)	19,970	63.4	77.9	4.5	26.3	2.1
Mini approach						
MIS/1-approach, posterior	537	55.1	79.1	49.3	59	2
MIS/1-approach, anterior	811	62.5	85.8	68.6	65.2	3.5
MIS/2-approach	46	47.8	82.6	54.3	60.9	6.5
Watson-Jones (original)	739	54.9	75.2	42.9	54.7	2.5
Trochanteric osteotomy						
Direct lateral	463	61.6	65	25.9	31.1	3.5
OCM-approach	54	31.5	92.6	87	90.7	1.9
Not available	2,867	60.1	67.8	16.7	11.5	2.7

Table 6.8.1

Number of primary total hip arthroplasties per unit and year

Unit	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Aleris Specialistvård Bollnäs	820	306	279	278	338	270	1 471	1.6
Aleris Specialistvård Elisabethsjukhuset	1,211	0	0	0	0	0	0	0
Aleris Specialistvård Motala	2,315	580	585	635	609	132	2,541	2.8
Aleris Specialistvård Nacka	839	218	244	234	243	263	1,202	1.3
Aleris Specialistvård Sabbatsberg	2,186	24	0	0	0	0	24	0
Aleris Specialistvård Ängelholm	98	131	91	62	65	232	581	0.6
Alingsås	2,676	198	194	207	191	193	983	1.1
Art Clinic Göteborg	1	25	45	75	109	96	350	0.4
Art Clinic Jönköping	30	20	36	71	137	190	454	0.5
Arvika	1,802	195	196	208	216	232	1,047	1.2
Bollnäs	2,839	0	0	0	0	57	57	0.1
Borås	2,722	158	133	121	161	182	755	0.8
Capio Artro Clinic	0	0	0	259	358	395	1,012	1.1
Capio Movement	1,738	304	339	328	367	327	1,665	1.8
Capio Ortopedi Motala	0	0	0	0	0	329	329	0.4
Capio Ortopediska Huset	4,695	477	467	610	635	687	2,876	3.2
Capio S:t Göran	6,509	508	578	596	559	638	2,879	3.2
Carlanderska	1,243	145	172	208	265	393	1,183	1.3
Danderyd	5,175	331	325	312	256	244	1,468	1.6
Eksjö	2,815	243	233	203	253	242	1,174	1.3
Enköping	3,173	347	354	413	442	424	1,980	2.2
Eskilstuna	1,534	109	108	129	135	98	579	0.6
Falköping	2,459	0	0	0	0	107	107	0.1
Falun	4,279	254	254	250	175	164	1,097	1.2
Frölunda Specialistsjukhus	853	83	0	0	0	0	83	0.1
Frölundaortopeden	0	0	4	8	13	11	36	0
GHP Ortho Center Göteborg	874	127	164	179	235	307	1,012	1.1
Gothenburg Medical Center	121	0	0	0	0	0	0	0
Gällivare	1,488	93	91	92	119	104	499	0.6
Gävle	2,745	253	252	210	183	219	1,117	1.2
Halmstad	3,259	236	206	199	206	234	1,081	1.2
Helsingborg	1,431	182	124	92	46	47	491	0.5
Hermelinen Specialistvård	15	12	11	23	20	27	93	0.1
Hudiksvall	2,077	138	138	98	96	145	615	0.7
Hässleholm	10,088	776	789	782	768	868	3,983	4.4
Jönköping	2,885	160	129	208	261	198	956	1.1

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Number of primary total hip arthroplasties per unit and year, continued

Unit	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Kalix	385	0	0	0	0	0	0	0
Kalmar	2,693	174	173	173	179	180	879	1
Karlshamn	2,757	259	241	235	284	309	1,328	1.5
Karlskoga	1,948	186	139	45	31	18	419	0.5
Karlskrona	580	31	35	40	34	44	184	0.2
Karlstad	3,422	219	199	192	179	159	948	1
Karolinska/Huddinge	3,459	241	189	194	183	233	1,040	1.2
Karolinska/Solna	3,182	196	113	120	107	57	593	0.7
Katrineholm	3,147	221	193	248	260	328	1,250	1.4
Kristianstad	215	31	40	49	49	19	188	0.2
Kristinehamn	61	0	0	0	0	0	0	0
Kungälv	2,688	185	202	196	175	211	969	1.1
Köping	1,690	0	0	0	0	0	0	0
Landskrona	1,382	0	0	0	0	0	0	0
Lidköping	2,288	280	307	292	199	264	1,342	1.5
Lindesberg	2,482	214	426	613	690	621	2 ,564	2.8
Linköping	1,474	70	63	39	82	88	342	0.4
Linköping Medical Center	27	0	0	0	0	0	0	0
Ljungby	2,045	152	165	195	198	187	897	1
Lycksele	3,681	334	324	323	318	250	1,549	1.7
Mora	2,642	241	278	253	269	271	1,312	1.5
Motala	2,732	0	0	0	0	0	0	0
Norrköping	3,159	248	266	272	245	254	1,285	1.4
Norrtälje	1,608	128	159	153	169	190	799	0.9
Nyköping	2,163	148	138	196	188	165	835	0.9
NÄL	0	2	47	39	36	43	167	0.2
Ortho Center Stockholm	4,164	495	535	623	732	796	3,181	3.5
Oskarshamn	2,774	289	308	294	289	397	1,577	1.7
Piteå	3,869	329	374	401	444	538	2,086	2.3
Simrishamn	786	0	0	0	0	0	0	0
Skellefteå	1,717	126	128	148	148	128	678	0.8
Skene	1,403	125	118	155	173	184	755	0.8
Skövde	2,280	162	207	146	105	82	702	0.8
Sollefteå	1,792	139	194	325	317	308	1,283	1.4
Sophiahemmet	3,143	219	221	267	267	267	1,241	1.4
Specialistcenter Scandinavia	0	0	0	0	0	5	5	0

(the table continues on the next page)

Number of primary total hip arthroplasties per unit and year, continued

Unit	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Spenshult	1,326	0	0	0	0	0	0	0
SU/Mölndal	3,959	601	603	614	586	620	3,024	3.3
SU/Sahlgrenska	1,394	5	2	3	2	1	13	0
SU/Östra	1,191	0	0	0	0	0	0	0
Sunderby	1,166	40	36	27	35	52	190	0.2
Sundsvall	2,617	84	49	42	40	50	265	0.3
SUS/Lund	1,701	180	207	134	120	111	752	0.8
SUS/Malmö	1,606	22	29	37	50	32	170	0.2
Säffle	338	0	0	0	0	0	0	0
Södersjukhuset	5,133	391	412	358	275	329	1,765	2
Södertälje	1,780	119	130	174	182	198	803	0.9
SöS Sab	64	0	0	0	0	0	0	0
Torsby	1,387	118	129	138	120	114	619	0.7
Trelleborg	6,823	664	724	679	697	683	3,447	3.8
Uddevalla	4,749	374	402	372	376	378	1,902	2.1
Umeå	1,159	103	97	79	78	131	488	0.5
Uppsala	4,194	237	258	262	222	184	1,163	1.3
Varberg	3,198	187	273	242	291	249	1,242	1.4
Visby	1,589	136	136	129	138	152	691	0.8
Värnamo	1,940	133	176	131	154	157	751	0.8
Västervik	1,664	97	128	131	147	159	662	0.7
Västerås	4,018	377	422	522	502	569	2,392	2.6
Växjö	1,835	148	133	116	131	187	715	0.8
Ystad	652	0	0	1	3	0	4	0
Ängelholm	1,613	0	64	157	173	205	599	0.7
Örebro	2,469	74	62	45	56	34	271	0.3
Örnsköldsvik	2,160	203	183	166	134	154	840	0.9
Östersund	3,132	263	291	278	315	292	1,439	1.6
Total	215,690	16,633	17,269	18,153	18,638	19,692	90,385	NA

[1)] Refers to the number of primary total hip arthroplasty carried out the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties carried out during the last five years.

Number of primary total hip arthroplasties per diagnosis and year

2000–2019

Diagnosis	2000–2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Primary osteoarthritis	170,310	13,443	13,999	14,769	15,112	16,085	73,408	81.2
Acute trauma, hip fracture	15,007	1,526	1,617	1,645	1,793	1,722	8,303	9.2
Idiopathic necrosis	3,731	360	391	425	446	535	2,157	2.4
Complication or sequelae after fracture or other trauma	8,913	419	403	431	375	388	2,016	2.2
Other secondary osteoarthritis	6,522	308	305	311	307	347	1,578	1.7
Sequelae after childhood disease in the hip	4,417	282	281	290	328	375	1,556	1.7
Inflammatory joint disease	4,383	152	132	128	118	110	640	0.7
Tumour	1,287	85	81	80	88	69	403	0.4
Other acute trauma	402	36	35	42	48	48	209	0.2
Other	192	8	7	27	22	11	75	0.1
Missing	526	14	18	5	1	2	40	0
Total	215,690	16,633	17,269	18,153	18,638	19,692	90,385	NA

[1)] Refers to the number of primary total hip arthroplasty carried out the last five years.
[2)] Refers to the proportion of the total number of primary total hip arthroplasties carried out during the last five years.

Number of primary total hip arthroplasties per diagnosis and age group

2000–2019

Diagnosis	< 50 years		50–59 years		60–75 years		> 75 years		Total	Proportion, %
	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %		
Primary osteoarthritis	8,371	56	33,831	81.8	136,286	84	65,230	74.5	243,718	79.6
Acute trauma, hip fracture	120	0.8	810	2	10,982	6.8	11,398	13	23,310	7.6
Complication or sequelae after fracture or other trauma	412	2.8	1,033	2.5	4,095	2.5	5,389	6.2	10,929	3.6
Other secondary osteoarthritis	1,766	11.8	1,677	4.1	3,122	1.9	1,535	1.8	8,100	2.6
Sequelae after childhood disease in the hip	2,319	15.5	1,757	4.2	1,583	1	314	0.4	5,973	2
Idiopathic necrosis	834	5.6	892	2.2	2,412	1.5	1,750	2	5,888	1.9
Inflammatory joint disease	892	6	945	2.3	2,428	1.5	758	0.9	5,023	1.6
Tumour	161	1.1	285	0.7	824	0.5	420	0.5	1,690	0.6
Other acute trauma	21	0.1	41	0.1	219	0.1	330	0.4	611	0.2
Other	44	0.3	40	0.1	91	0.1	92	0.1	267	0.1
Missing	20	0.1	32	0.1	163	0.1	351	0.4	566	0.2
Total	14,960	100.0	41,343	100.0	162,205	100.0	87,567	100.0	306,075	

Number of primary total hip arthroplasties per diagnosis and age uncemented

2000–2019

Diagnosis	< 50 years		50–59 years		60–75 years		> 75 years		Total	Proportion, %
	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %		
Primary osteoarthritis	4,928	57	14,612	85.9	18,252	91	1,191	83.6	38,983	82.7
Sequelae after childhood disease in the hip	1,479	17.1	862	5.1	359	1.8	23	1.6	2,723	5.8
Other secondary osteoarthritis	1,083	12.5	711	4.2	563	2.8	34	2.4	2,391	5.1
Idiopathic necrosis	531	6.1	338	2	276	1.4	30	2.1	1,175	2.5
Inflammatory joint disease	349	4	167	1	181	0.9	17	1.2	714	1.5
Complication or sequelae after fracture or other trauma	201	2.3	212	1.2	192	1	70	4.9	675	1.4
Acute trauma, hip fracture	23	0.3	70	0.4	199	1	41	2.9	333	0.7
Other	20	0.2	11	0.1	8	0	2	0.1	41	0.1
Other acute trauma	7	0.1	8	0	17	0.1	7	0.5	39	0.1
Tumour	11	0.1%	10	0.1	5	0	2	0.1	28	0.1
Missing	10	0.1	6	0	7	0	8	0.6	31	0.1
Total	8,642	100.0	17,007	100.0	20,059	100.0	1,425	100.0	47,133	

Number of primary total hip arthroplasties per diagnosis and age cemented

2000–2019

Diagnosis	< 50 years		50–59 years		60–75 years		> 75 years		Total	Proportion, %
	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %		
Primary osteoarthritis	935	40.8	10,574	74.2	100,342	82.4	60,350	74.3	172,201	78.4
Acute trauma, hip fracture	72	3.1	652	4.6	10,113	8.3	10,848	13.4	21,685	9.9
Complication or sequelae after fracture or other trauma	125	5.5	647	4.5	3,563	2.9	5,016	6.2	9,351	4.3
Other secondary osteoarthritis	268	11.7	591	4.1	2,068	1.7	1,394	1.7	4,321	2
Inflammatory joint disease	149	6.5	365	2.6	1,737	1.4	1,573	1.9	3,824	1.7
Idiopathic necrosis	320	14	630	4.4	2,008	1.6	706	0.9	3,664	1.7
Sequelae after childhood disease in the hip	263	11.5	447	3.1	872	0.7	253	0.3	1,835	0.8
Tumour	136	5.9	265	1.9	771	0.6	405	0.5	1,577	0.7
Other acute trauma	10	0.4%	29	0.2	172	0.1	283	0.3	494	0.2
Other	8	0.3	26	0.2	68	0.1	83	0.1	185	0.1
Missing	5	0.2	18	0.1	128	0.1	300	0.4	451	0.2
Total	2,291	100.0	14,244	100.0	121,842	100.0	81,211	100.0	219,588	

Number of primary total hip arthroplasties per type of fixation and age

2000–2019

Fixation type	< 50 years		50–59 years		60–75 years		> 75 years		Total	Proportion, %
	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %		
Cemented	2,291	15.3	14,244	34.5	121,842	75.1	81,211	92.7	219,588	71.7
Uncemented	8,642	57.8	17,007	41.1	20,059	12.4	1,425	1.6	47,133	15.4
Reverse hybrid	2,289	15.3	7,351	17.8	14,357	8.9	2,695	3.1	26,692	8.7
Hybrid	684	4.6	1,808	4.4	5,418	3.3	2,120	2.4	10,030	3.3
Resurfacing	1,003	6.7	881	2.1	259	0.2	2	0	2,145	0.7
Missing	51	0.3	52	0.1	270	0.2	114	0.1	487	0.2
Total	14,960	100.0	41,343	100.0	162,205	100.0	87,567	100.0	306,075	

Number of primary total hip arthroplasties per type of surgical approach and year

2000–2019

Type of surgical approach	2000–2014	2015	2016	2017	2018	2019	Total	Proportion, %
Posterior approach in lateral position (Moore)	115,508	8,681	9,312	9,776	10,132	11,220	49,121	54.3
Direct lateral approach in lateral position (Gammer)	81,487	6,805	6,825	6,899	6,920	7,023	34,472	38.1
Direct lateral approach in supine position (Hardinge)	14,009	1,074	1,025	1,270	1,324	1,268	5,961	6.6
Other	1,868	71	95	192	249	175	782	0.9
Missing	2,818	2	12	16	13	6	49	0.1
Total	215,690	16,633	17,269	18,153	18,638	19,692	90,385	

Number of primary total hip arthroplasties per type of cement and year

2000–2019

Type of cement	2000–2014	2015	2016	2017	2018	2019	Total	Proportion, %
Refobacin Bone Cement	48,430	5,943	6,378	5,838	5,870	845	24,874	27.6
Palacos R+G	46,128	4,207	4,108	4,694	4,328	468	17,805	19.8
4711500396-3 Optipac 60 Refobacin® Bone Cement R	1	0	0	0	0	3,913	3,913	4.3
66044274 PALACOS R+G PRO 75	2	0	1	1	32	2,586	2,620	2.9
CMW med Gentamycin	433	73	91	118	290	18	590	0.7
66017569 PALACOS R+G 2x40 NE	1	0	0	0	0	572	572	0.6
Other	70,671	157	87	141	198	2,965	3,548	3.9
(wholly or partly cementless)	49,905	6,235	6,579	7,058	7,915	8,308	36,095	40.1
Total	215,571	16,615	17,244	17,850	18,633	19,675	90,017	

7. Primary arthroplasty – in-depth analyses

7.1 Risk for reoperation – changes between 1999 and 2019

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When total arthroplasty was introduced in Sweden 50 years ago, the biggest problem was infection. This problem was mainly addressed by improved ventilation in the operating room, pre- and per operative antibiotics prophylaxis and the use of antibiotics in cement. At the end of the 1970s and in the beginning of the 1980s it was instead loosening that was the problem and the results of revision surgery were even less encouraging than today. In Sweden, loosening and osteolysis were successfully addressed with improved surgical technique where feedback from data from the Swedish Hip Arthroplasty Register contributed to the fact that the new cementation technology quickly spread over the country. In several other countries one tried to address the loosening problem by switching to uncemented fixation, which initially was met with considerably less success. As time has gone by, the results of cemented and uncemented fixation have started to converge, not least due to the development of improved implant technology better selection of implants and materials with clinically well-documented results. Today, both cemented and uncemented fixation work well in general and especially if one considers the differences in indication.

The results of hip arthroplasty have successively improved in Sweden up to the 1990s. Hip arthroplasties that were carried out during the years 1992 and 1993 showed a ten-year survival rate of 88.4 %, measured as no reoperation regardless of cause. For hip arthroplasties carried out ten years later (2002 and 2003), the corresponding survival rate was 93.7 %, a substantial improvement.

Changes in arthroplasty over the last two decades

During the last two decades, additional changes with the goal of improving the results have taken place. Examples are increased use of larger femoral heads and dual mobility cups in order to reduce the risk for dislocation and the introduction of highly crosslinked polyethylene with the aim of reducing wear, osteolysis and loosening. Metal-on-metal articulations were also introduced to enable the use of larger femoral heads, reduce the wear and the risk for dislocation. Although they to some extent had these effects, they brought other problems with them (see section 7.5, Swedish version of Annual Report). In Sweden, this type of articulation was however seldom used (around 1 % of all arthroplasties between the years 2002 and 2011). Another factor that may have influenced the outcome during the period from 1999 to today, is a more active attitude to treat cases with obvious or suspected deep infection with Debridement, Antibiotics and Implant Retention (DAIR).

The aim of this in-depth analysis

Against this background it is of interest to evaluate if any changes in demography, the choice of surgical technique and implants have influenced the outcome during the last two decades, measured as prevention of a reoperation. In other evaluations we have shown that the patient-reported outcome has improved during the latter part of this period, but here process-related factors are likely of the greatest importance.

Method and overall result

In the analysis at hand, the period between 1999 and 2019 has been divided into three intervals; 1999–2005, 2006–2012 and 2013–2019 in order to make the duration of follow-up equally long. In a first analysis, we find that the procedural survival rate measured as absence of reoperation regardless of cause during the first seven years after the primary operation is relatively equal between the periods (1999–2005: 95.6 ± 0.2 %; 2006–2012: 95.7 ± 0.1 %; 2013–2019: 96.3 ± 0.2 %). If one excludes patients with a tumour diagnosis, metal-on-metal articulations, seldom used femoral head sizes and operations where information on factors necessary for a deeper analysis are missing, the total number of operations during the whole period is reduced from 316 648 to 290 348 total hip arthroplasties (figure 7.1.1). These exclusions only have a marginal effect on the result. The survival rate in the first group increases by 0.3 % to 95.9 %, in the second group it increases by 0.2 % to 95.9 % and in the last operated group it is not affected but stays at 96.3 % (figure 7.1.2).

Survival analysis (figure 7.1.2) shows that hip arthroplasties carried out during the two last periods were affected by more early reoperations than those who were operated during the first period. Moreover, it is clear that the curve that describes hip arthroplasties carried out between 2013 and 2019, and to some degree also those who were operated between 2006 and 2012, tends to level-off faster than in the group who were operated between 1999 and 2005 (the curves cross each other). In a separate analysis of reoperations carried two to seven years after the primary operation this becomes more obvious (figure 7.1.3). It can therefore be stated that early reoperations, up to two years after the primary operation have become more common with time and later reoperations two to seven years after the primary operation have become less common. Table 7.1.1 lists the distribution of selected variables that define factors related to demography, choice of surgical technique and distribution of implant characteristics during the time-periods. In order to simplify the interpretation of the analysis the operations have in some cases been split depending on method of cup fixation. In those cases when proportionality is not the case during the whole observational period, the evaluation has been divided into two periods, from date of surgery until two years and a later period from more than two to seven years after the primary operation.

Table 7.1.1 shows that the distribution of reasons for reoperation varies depending on the time-period during which the operation was carried out. Reoperation due to loosening/osteo-

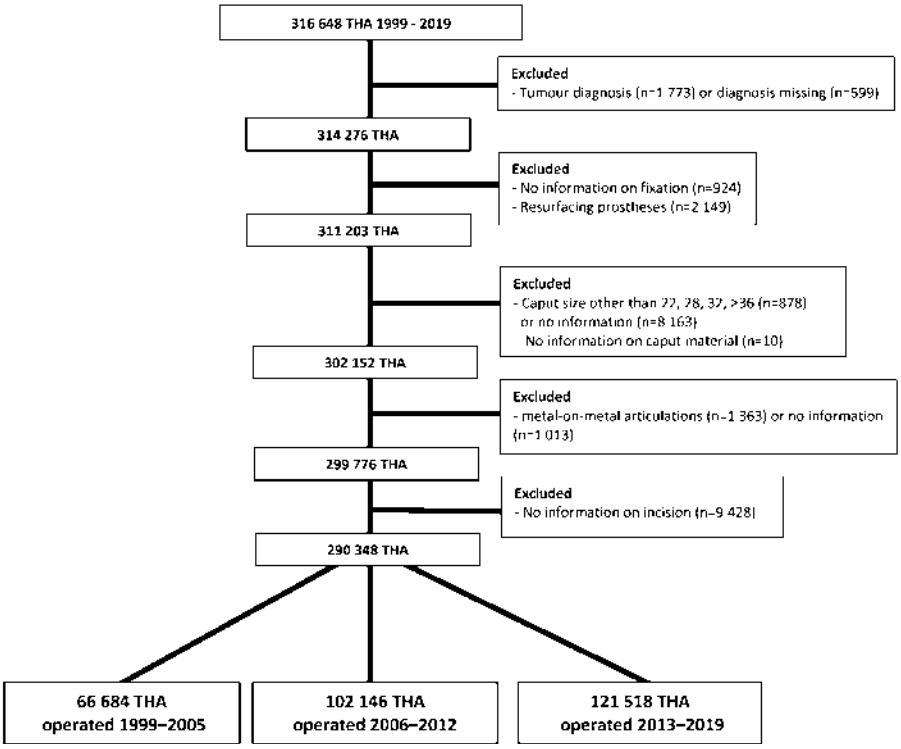

Figure 7.1.1. Flow-chart illustrating the selection of hip arthroplasties described closer in table 7.1.1.

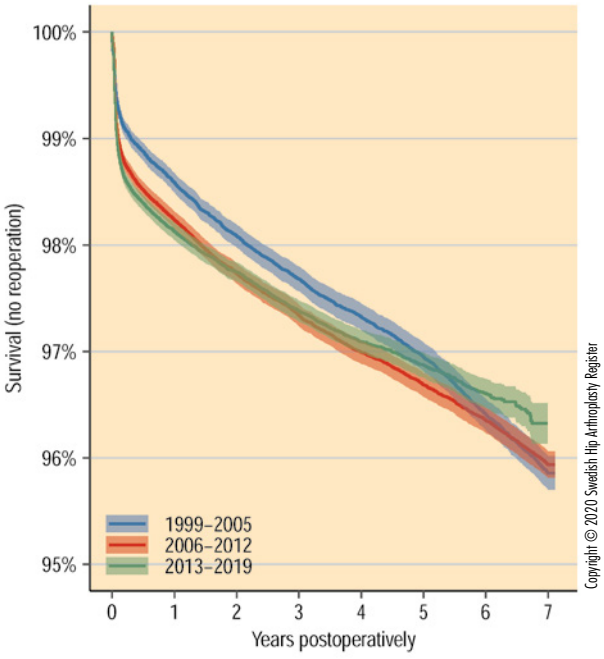

Figure 7.1.2 Survival diagram based on the absence of reoperation regardless of cause for hip arthroplasties carried out 1999–2005, 2006–2012 and 2013–2019.

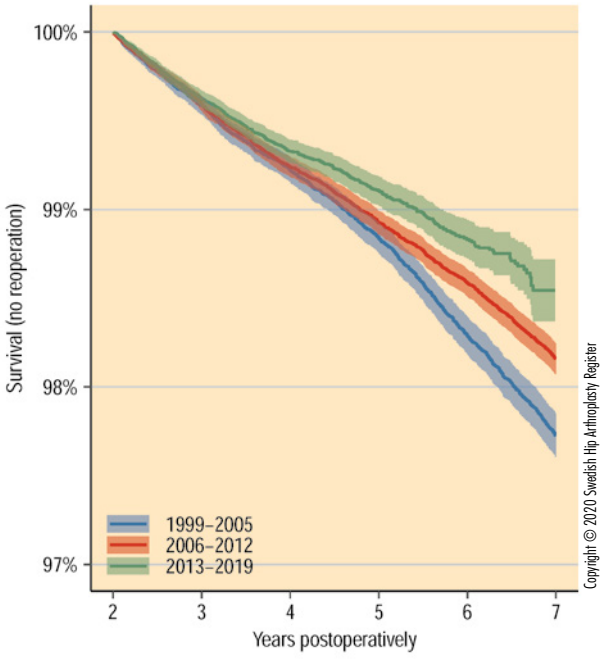

Figure 7.1.3. Survival diagram based on the absence of reoperation regardless of cause for hip arthroplasties carried out 1999–2005, 2006–2012 and 2013–2019. Note that the analysis starts at two years and only comprises the hip arthroplasties that have been followed-up during at least two years without a reoperation.

lysis and dislocation decreases for each time-period closer to the present that is studied, the proportion of reoperations due to periprosthetic fracture is equal during the first two periods but is more than halved during the last period and the proportion of reoperations due to infection increases, especially between the period 1999 to 2005 and the period just after, and the increase continues although less pronounced during the last period.

A separate analysis of the most common reasons for reoperation has been carried out, at first without any correction for covariation to describe the change that has been observed in the clinic. Hereafter, potential covariation has been studied for each variable separately and finally grouped to investigate to what extent single variables may have influenced the outcome. Due to lack of space and to simplify, only selected results are shown.

Reoperation – all causes

The risk of having a reoperation during the interval from zero to two years after primary operation has increased if one compares the period 1999 to 2005 with the period 2013 to 2019 (table 7.1.2). A comparison between the last two periods shows no clear difference. During the following interval, two to seven years after primary operation, the tendency is the opposite. The risk of having a reoperation later than two years after the primary operation is higher if a patient was operated during the periods 1999 to 2005 and 2006 to 2012 compared with the period 2013 to 2019. Adjustment for demographical factors and surgical approach, where the changes over time have been relatively small and for the choice of fixation, where the changes have been rather large, changes the results only marginally. Thus, we will have to look for other factors that have influenced the risk for reoperation over time and possibly explain the changes over time that we observe. To track down possible factors the analyses have been split and reoperation due to loosening, infection and dislocation have been studied separately.

Loosening/osteolysis

The risk of having a reoperation due to loosening and osteolysis is higher for the primary operations that were carried out during the first two periods. During the first period, 1999 to 2005 it was approximately 40 % higher (HR = 1.41, table 7.1.2) and during the middle period it was 16 % higher compared with the period 2013 to 2019 regardless of choice of cup fixation. If adjustment is made for choice of articulating material (cups with cemented fixation: older polyethylene/highly cross-linked polyethylene; uncemented fixation: type of polyethylene, ceramic liner or not; femoral head: ceramics or metal regardless of cup fixation) the differences decrease and become insignificant. Additional adjustments for the rest of the possible covariates in table 7.1.1 do not affect the result in a significant way. The same tendency, that is reduced differences between the periods after adjustment for articulating material, can be noted if one separates between cemented and uncemented cup fixation. The trend is however not as evident then. This can in part be explained by interference with other factors such as choice of femoral head size when using uncemented fixation and demographical differences within the uncemented cohort, but this analysis is not presented here due to high complexity and some degree of uncertainty. We can however observe that the increased use of above all highly cross-linked polyethylene and also ceramic in the articulation affects the outcome in a positive direction and is most likely one of the most important reasons, that we can measure, behind the decrease of the risk for reoperation due to loosening/osteolysis during the last two decades.

Infection

As is shown in table 7.1.1, an increasing proportion of hip arthroplasties are being reoperated due to infection. In total, 3 268 first time reoperations due to infection have been carried out during the whole period 1999 to 2019. During the earliest period, 0.7 % were reoperated and during the last period this proportion has risen to 1.3 %. The majority (2 791, 85.4 %) occurred during the first one to two years after primary operation, which is shown in figure 7.1.4 where the lines become more parallel after this period. During the period 1999 to 2005, the relative risk of being reoperated due to infection is reduced by 50 % and during the succeeding period reduced by 18 % (table 7.1.2) compared with the latest period. If the follow-up period is divided into two intervals, zero to two and more than two to seven years, it can be shown that the relative risk for the interval more than two to seven years approaches one when comparing between the three seven-year periods both before and after adjustment covariation without any significant difference between the groups (data not shown). In summary, the risk of being reoperated due to infection within two years has successively increased over time, apparently without any certain influence of the factors that in some cases have changed considerably over time and that we can adjust for.

Dislocation

As opposed to the risk of having a reoperation due to infection, the risk of having this complication decreases over time. The evaluation is made more difficult because the type of dislocation protection varies depending on the choice of cup fixation. When using a cemented cup, the only option is the use of a dual mobility cup, which is registered in 4 641 cases in total (2 %) during the whole period from 1999 to 2019. When it comes to uncemented cups, there are 376 operations with DMC cups (0.7 %). The majority of the uncemented cups have however been fitted with some sort of liner with an inbuilt protection against dislocation in the form of an acetabular wedge augment, an angled opening or something similar. In total, this accounts for 33 658 operations (61.2 %). Furthermore, it must be taken into consideration that we do not know the outer femoral head size during use of dual mobility cups.

For cemented cups it is evident that the risk for reoperation has decreased successively over time (figure 7.1.5a). During the first period it was twice as high as during the last period (relative risk 2.41, table 7.1.1) and during the middle period the risk-increase was 68 %. Adjustment for femoral head size decreases the difference between the periods. If the variable dual

Descriptive data for hip arthroplasty during three different seven-year periods starting in 1999

	Period for primary operation *year*		
	1999–2005	*2006–2012*	*2013–2019*
Number	75,950	102,264	121,562
Proportion of women %	59.7	59.4	58.1
Age mean *SD*	69.1 *10.8*	69.0 *10.4*	68.9 *10.7*
Diagnosis *%*			
Primary osteoarthritis	77.3	80.8	81.6
Inflammatory joint disease	3.0	1.7	0.8
Sequelae after childhood disease in the hip	2.2	1.9	1.8
Idiopathic necrosis	1..5	1.8	2.4
Acute trauma. hip fracture	6.3	7.4	9.0
Complication after fracture/trauma	6.1	3.2	2.4
Other secondary osteoarthritis	3.7	3.3	2.1
Surgical approach *%*			
Lateral *supine or lateral position*	59.4	52.4	53.7
Posterior	40.4	46.4	45.4
Other	0.3	1.2	0.9
Cemented cup *%*	92.1	85.9	70.3
Articulating material cup			
Older type of polyethylene*	97.9	61.2	13.8
Polyethylene with extra crosslinks	1.8	38.3	85.9
Ceramics	0.2	0.4	0.3
Diagnosis during primary operation			
Older type of polyethylene*	97.9	61.2	13.8
Polyethylene with extra crosslinks	1.8	38.3	85.9
Ceramics	0.2	0.4	0.3
Cup with dislocation protection *%*			
All types# including DMC¤	6.4	11.7	18.5
Proportion with DMC¤	<0.1	0.7	3.5
Femoral head diameter *%*			
22 mm	3.3	0.9	0.7
28 mm	96.4	58.0	12.6
32 mm	0.2	37.4	76
≥36 mm	0.04	3.6	10.7
Ceramic femoral head *%*	11.1	11.1	18.9
Cemented stem *%*	92.6	75.5	65.8
Reoperation within 7 years *%*			
Loosening/osteolysis	1.0	0.8	0.3
Infection	0.7	1.2	1.3
Periprosthetic fracture	0.7	0.7	0.3
Dislocation	1.1	0.8	0.4
Other causes	0.3	0.3	0.2
Not reoperated	96.2	96.2	97.5

Table 7.1.1 Demographical data. choice of surgical approach. fixation and articulation and reason of reoperation during the first seven years during hip arthroplasty carried out during three different seven-year periods starting in 1999, 2006 or 2013.

** gas-plasma. ethylene oxide or gamma-sterilised with less than 5 MRad (50 kGy)*
 # angled liner opening. liner with acetabular wedge augment. liner constraining the femoral head. dual mobility cups (DMC)
¤ DMC = Dual mobility cup

Risk of having a reoperation regardless of cause and due to three specific causes

	Year of operation *risk ratio 95 % C.I.*		
Reason for reoperation	*1999–2005*	*2006–2012*	*2013–2019*
All causes *0–2 years*			
Unadjusted	0.84 *0.78–0.89*	0.99 *0.94–1.05*	1 *(reference)*
Adjusted *for age, gender, diagnosis, surgical approach, fixation*	0.92 *0.85–0.98*	1.04 *0.98–1.10*	1 *(reference)*
All causes *>2–7 years*			
Unadjusted	1.42 *1.29–1.57*	1.16 *1.05–1.28*	1 *(reference)*
Adjusted *for age, gender, diagnosis, surgical approach, fixation*	1.38 *1.24–1.53*	1.14 *1.04–1.26*	1 *(reference)*
Loosening/osteolysis *0–7 years*			
Regardless of cup fixation			
Unadjusted	1.41 *1.24–1.61*	1.16 *1.02–1.32*	1 *(reference)*
Adjusted *only articulating material cup+femoral head*[2]	1.07 *0.91–1.26*	0.98 *0.86–1.13*	1 *(reference)*
Adjusted *for all variables in table 7.1.1*[1,2]	1.05 *0.86–1.28*	0.89 *0.76–1.05*	1 *(reference)*
Cemented cup			
Unadjusted	1.39 *1.20–1.61*	1.12 *0.97–1.30*	1 *(reference)*
Adjusted *only articulating material cup+femoral head*[2]	1.02 *0.85–1.21*	0.91 *0.77–1.07*	1 *(reference)*
Adjusted *for all variables*[1] *in table 7.1.1 except cup fixation*	0.91 *0.76–1.10*	0.84 *0.71–0.99*	1 *(reference)*
Uncemented cup			
Unadjusted	1.71 1.22–2.38	1.55 1.19–2.02	1 *(reference)*
Adjusted *only articulating material cup+femoral head*	0.78 0.49–1.22	1.29 0.98–1.69	1 *(reference)*
Adjusted *for all variables*[1] *in table 7.1.1 except cup fixation*	0.61 0.38–0.99	1.12 0.83–1.51	1 *(reference)*
Infection *0–7 years*			
Unadjusted	0.50 *0.45–0.55*	0.82 *0.76–0.88*	1 *(reference)*
Adjusted *for all variables*[1] *in table 7.1.1 except femoral head size*	0.49 *0.43–0.56*	0.82 *0.75–0.89*	1 *(reference)*
Dislocation *0–7 years*			
Unadjusted *all types of fixation*	1.91 *1.70–2.14*	1.34 *1.20–1.519*	1 *(reference)*
Cemented cup			
Unadjusted	2.41 *2.10–2.77*	1.68 *1.46–1.93*	1 *(reference)*
Adjusted *only femoral head size*	1.73 *1.45–2.07*	1.39 *1.19–1.63*	1 *(reference)*
Adjusted *for all variables*[1] *in table 7.1.1 except DA cup*	1.67 *1.38–2.02*	1.41 *1.20–1.66*	1 *(reference)*
Uncemented cup			
Unadjusted	1.16 *0.86–1.56*	0.91 *0.72–1.14*	1 *(reference)*
Adjusted *only femoral head size*	0.56 *0.38–0.83*	0.68 *0.53–0.89*	1 *(reference)*
Adjusted *only dislocation-protected liner or DA cup*	1.29 *0.96–1.75*	0.99 *0.79–1.25*	1 *(reference)*
Adjusted *for all variables*[1] *in table 7.1.1 excl. DA cup*	0.72 *0.48–1.08*	0.83 *0.63–1.09*	1 *(reference)*

Table 7.1.2 Risk ratio (relative risk) having a reoperation regardless of cause and due to loosening/osteolysis, infection and dislocation for hip arthroplasties carried out during three different time-intervals between 1999 and 2019.

[1] *Age, gender, diagnosis, surgical approach, fixation, femoral head size, articulating material (ceramics, older polyethylene, polyethylene with extra crosslinks), cup with dislocation protection (yes, no).*

[2] *Cemented cups with a ceramic articulating surface has not been used in Sweden, why this group has been excluded here but not in the sub analysis of uncemented cups.*

mobility cup (yes/no) is added the difference between the periods increases but only marginally (see chapter 7.4 for a deeper analysis). In conclusion, an increased use of larger femoral head sizes could partly but not completely explain the reduced frequency of reoperation due to dislocation that we have observed over time.

The risk of reoperation due to dislocation with use of an uncemented cup has not changed much during the last two decades. The survival curve (figure 7.1.5b) shows that hip arthroplasties carried out during the middle period are positioned somewhat above the other two periods without any statistically significant difference (log rank test: p = 0.3), which also can be verified in an unadjusted regression analysis (table 7.1.2). During the period it becomes more common with a diameter of 32 or 36 mm, which decreases the risk of being reoperated due to dislocation. Despite this, the risk over time in the adjusted analysis is not decreasing, which could support the idea that other as yet unknown factors play a part, such as choice of implants and surgical technique, factors that are not taken into consideration or are not completely covered in this analysis.

The use of liners with a dislocation protection has decreased during the periods under study. During the period 1999 to 2005, such a liner was used in 78 % of cases, during the middle period in 74 % of cases and during the last period in 54 % of cases. If this relationship is adjusted for, the relative risk increases for the first two periods, but still does not differ significantly compared with the same period. In summary, we find that the risk of reoperation due to dislocation when using an uncemented cup has not changed during the last 21 years.

The analyses above must be viewed on as preliminary since register data cannot be used to assess cause and effect, the observational time is relatively short especially regarding the outcome loosening and important parameters such as for example BMI and ASA are missing. They do however offer a unique view over how the result in the medium-term perspective has varied over the last 21 years and could be the basis of future in-depth and hopefully more prospective studies.

The risk of reoperation within two years has in general tended to increase and was lower during the period 1999 to 2005 compared with the period 2013 to 2019. A comparison between the periods 2006 to 2012 and 2013 to 2019 shows no clear difference. For those hips that have been followed-up during more than two years and still have their primary prosthesis, the risk of having a reoperation during the succeeding five years is higher if the primary operation was carried out during the two first periods.

– **loosening:** the risk of reoperation has decreased over time. A successive increased use of highly cross-linked polyethylene and a ceramic articulating surface is probably the most likely reason.

– **infection:** the risk of reoperation within two years has increased successively. After two years of observation there is a levelling between the three periods studied. The reason for this increase over time may be a change in indication and a real increase of the number of infections. It cannot really be explained by the factors studied here.

– **dislocation:** when using cemented fixation of the cup the risk of reoperation has decreased over time, in part because of the use of increased femoral head sizes. During uncemented fixation the risk has been relatively constant despite the increased use of larger femoral head sizes.

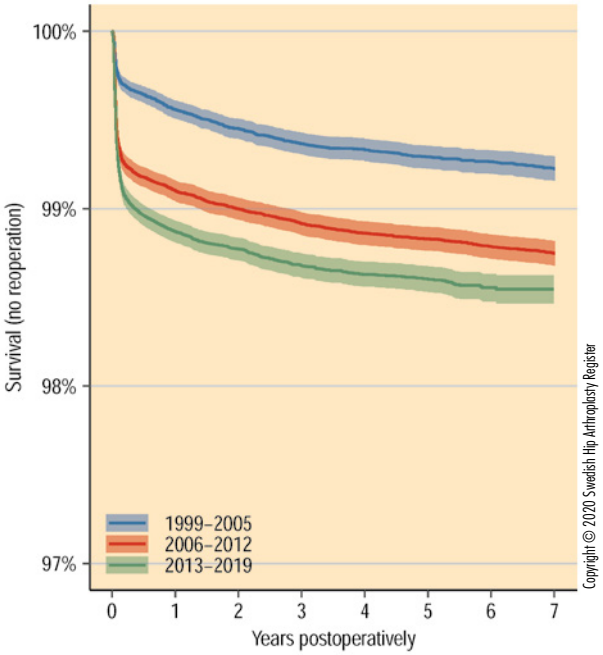

Figure 7.1.4 Survival diagram based on absence of reoperation due to infection for prosthesis operated 1999–2005, 2006–2012 and 2013–2019. The difference between the curves is mainly caused by more reoperations during the first six to 12 months after primary operations in the groups that have been operated 2006–2012 and 2013–2019.

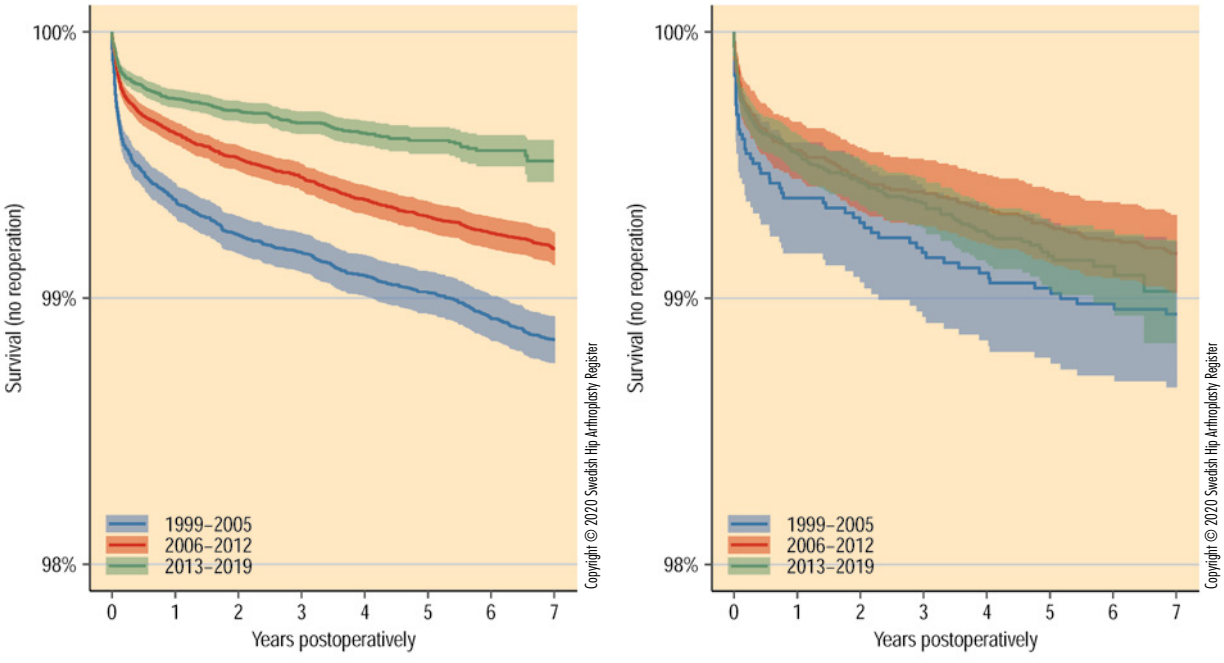

Figure 7.1.5 Survival diagram based on absence of reoperation due to dislocation for prostheses operated 1999–2005, 2006–2012 and 2013–2019. Hip arthroplasty with cemented cup to the left (a) and with cemented cup and with uncemented cup to the right (b).

7.2 Dual mobility cups

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In several annual reports we have drawn attention to the increased use of dual mobility cups (DMCs) in Sweden. During the last analysis in the annual report for the operational year 2017, any advantage could not be shown with certainty but rather an increased revision risk for dual mobility cups compared with standard cups. The main reason for the difference was that dual mobility cups more often were revised due to infection. Any dislocation preventive effect could not be shown with certainty. Internationally, this result is unexpected, not least since studies within the Nordic collaboration (Nordic Arthroplasty Register Association, NARA) has shown that dual mobility cups protect against dislocation both in cases with primary osteoarthritis, as well as those patients receiving a THR due to hip fracture. The reason behind these diverging results may be the fact that the results from the NARA-studies mainly are based on operations carried out with a posterior surgical approach. Studies based on the Swedish register of first-time revisions due to dislocation, support the results from the NARA-group. The studies showed that the risk for a second revision due to dislocation is reduced if one uses a dual mobility cup. Against this background and an increasing interest in the results after operation with dual mobility cups, we present a follow-up of DMCs also in this year's annual report. The follow-up is based on primary arthroplasties, however without any specific selection of diagnoses because the number of observations is still rather limited.

Fixation and demography

Since the mid-2010s the number of reported DMCs increased successively up to 2018 when 856 operations were registered. During the following years the number decreased marginally to 826. Between 2003 and 2019 there are 5 575 DMCs registered in total, of which the majority is cemented (n = 5 178; 92,9 %, figure 7.2.1, table 7.2.1). Not unexpectedly, the uncemented ones were used for somewhat younger patients, relatively more men and more seldom for patients who are operated due to hip fracture or due to complication after hip fracture (table 7.2.2). Both groups have a relatively large proportion of patients with an ASA class of III and infection is the most common reason for revision in both groups.

Even though almost 93 % of all DMCs are inserted with cement only five variants of cemented DMCs have yet been used. In the uncemented group the variation is larger (despite that the group is considerably smaller) maybe because uncemented fixation offers a larger flexibility. In some cases, a standard cup may be provided with DMC-function or a DMC that in the first place aimed for cemented fixation against bone is cemented into the metal casing of an uncemented cup.

Against the background of the different compositions of the fixation groups, it is not surprising that the survival computed on all revision causes and measures is different for cemented and uncemented fixation (figure 7.2.2). Few observations and a complicated background picture mean that a deeper analysis of the uncemented group is not meaningful.

The cemented DMCs

To try to assess the pros and cons regarding the risk for revision, three of the most used cemented DMCs have been chosen for the analysis based on at least 200 reported cases (Avantage, Polarcup, ADES dual mobility, table 7.2.1). Operations from 2008 have been included in order to enable inclusion of ASA class and BMI, variables collected from this year. After exclusion of cases where the register lacks data for certain variables, 4 088 operations with a cemented DMC remain. As the control group we have chosen the five most used cemented cups of conventional design used during the period 2008 to 2019, that is the same time-period as for the DMC-group. The control group encompasses 87 832 arthroplasties. This group comprises the Exeter Rim-fit, Lubinus with older polyethylene, Lubinus x-link, Marathon and ZCA XLPE-cup with an inner diameter of 32 mm (93.9 %) or 36 mm (6.1 %). We have shown in several earlier annual reports that DMCs are used to an increasing degree for patients with hip fracture and high comorbidity. It is therefore expected that the implant survival based on revision, regardless of cause and measure, is poorer in the group with the group with DMCs than in the control group (figure 7.2.4).

To get comparable groups, we have matched[1] hip operations in the control group with operations in the DMC-group based on age, gender, diagnosis, ASA class, BMI and stem fixation. After the matching the background variables became almost equally distributed, except that the DMC-group still had a preponderance of fracture patients and relatively fewer patients with other secondary osteoarthritis (table 7.2.3). The choice of surgical approach was not part of the matching, but was relatively equally distributed between the groups, around 53 % in each group were operated with a posterior approach. 46 % and 43 % in the DMC and the control group respectively were operated with a direct lateral approach and the rest was distributed on less common approaches. In 6 cases (4 in the DMC group and 2 in the control group) information on approach was missing.

165 (4.0 %) hips were revised in the DMC-group and 126 (3.1 %) in the control group, which was equivalent to about one percent lower implant survival rate in the DMC-group after nine years (table 7.2.4, $p < 0.001$, log-rank test). The difference is mainly due to high number of revisions due to infec-

[1] Propensity score matching, nearest neighbor.

tion in the DMC-group. This also explains why the differences increase if the outcome cup and/or liner revision is used as outcome, which gives higher influence of for DAIR procedures. If one as outcome only use complete cup revision or extraction the difference of one percentage point stays however. The DMCs show a risk increase of 50 % (HR 1.5, 95 percentage confidence interval, C.I.: 1.2–1.9). If one adjusts for diagnosis, the risk increase for the DMC group decreases to 1.4 (95 % C.I.: 1.1–1.8). If one includes only the first operated hip, the result is not affected in a significant way (HR = 1.5, 95 % C.I. 1.2–1.9 prior to and 1.4 (95 % C.I.: 1.1–1.8) after adjustment for diagnosis.

27 hips in the DMC group and 30 hips in the control group were revised due to dislocation. Just under half of the DMCs (13 out of 27), which had been revised due to this reason had been operated with a direct lateral approach. In the control group, 8 out of 30 revisions due to dislocation had been primarily operated with the same approach. The other revisions due to dislocation (14 in the DMC group and 22 in the control group) had been operated with a posterior approach. The risk of revision due to dislocation was equally large in the two groups (HR = 1.0: 95 % C.I.: 0.6–1.7 before and after adjustment for diagnosis). The mortality was relatively high in both groups and the highest in the group that received a DMC. At the end of the observation time (median 2.7; max 12 years), 28.5 % had died in the DMC group (906 out of 3 377 patients) and 26.5 % in the control group (1 027 out of 3 602). Patients with bilateral arthroplasties have been grouped according to the first arthroplasty they underwent.

In this year's analysis we cannot, despite the addition of more observations and attempts to conduct as fair comparison as possible, show that the risk of revision is reduced with use of DMC. The number of cases revised due to dislocation were equally many in the two groups. However, this does not mean that DMCs do not protect against dislocation since we do not register closed reductions. The DMC-group is furthermore at a disadvantage since reduction often is not possible to carry out without opening the joint. On the other hand, this fact can also be a disadvantage for the DMC-construction. In the analysis we have tried to compensate for comorbidity and deviating BMI with use of matching (propensity score matching). This is likely not enough against the background that infection frequency and mortality still are higher in the DMC group.

In summary, we can show that the risk of revision above all due to infection is increased if a DMC is inserted during the primary operation, based on data Swedish register-data. The reason behind this is not known but we think that factors indicating the degree of "patient frailty" where we are missing an impartial registration play a role. In total, we cannot show any reduced risk for re-revision due to dislocation in the DMC-group. Maybe the absence of dislocation preventive effect could depend on the in-built construction of the cup, which makes treatment with closed reduction impossible. In addition, hidden and unfavourable patient selection also may have affected this outcome.

The findings of this analysis are strong incitements for the conduction of randomised studies in order to reduce the risks of patient selection as much as possible. We therefore encourage participation in the national multicentre study (DUALITY) to obtain more evidence-based knowledge in this field.

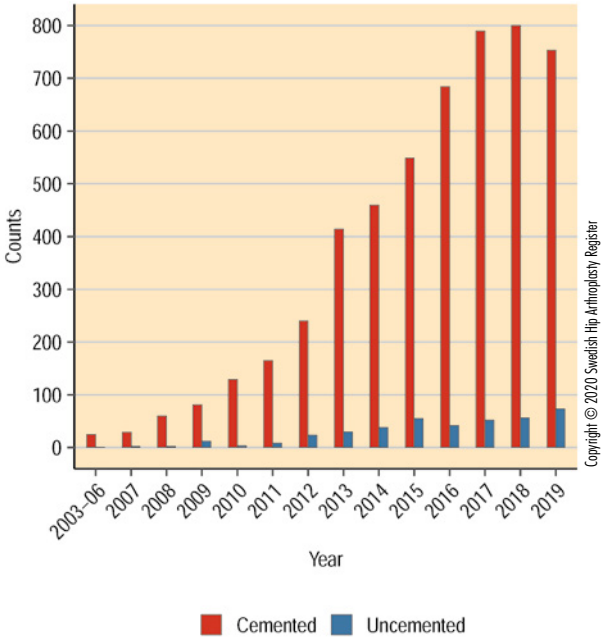

Figure 7.2.1. The number of reported primary hip arthroplasties where a dual mobility cup is used.

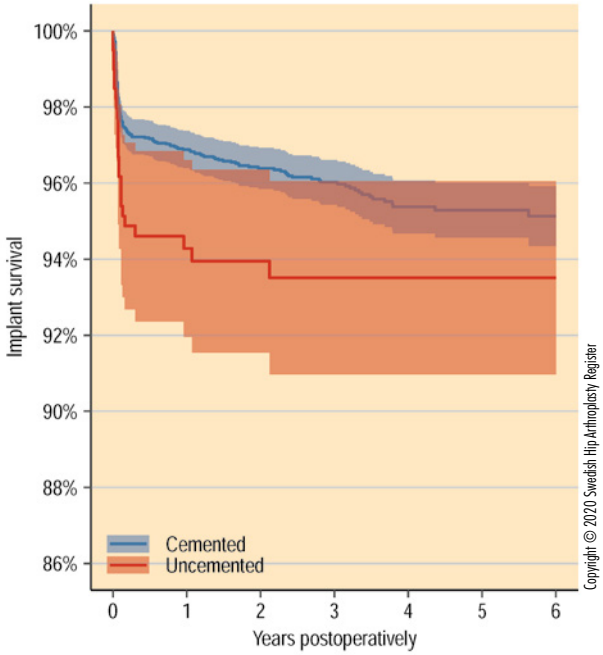

Figure 7.2.2. Implant survival of cemented and uncemented dual mobility cups based on revision regardless of measure and cause. After 6 years, 49 observations remain in the smallest group (uncemented fixation). "Blue" line = cemented fixation, "Red" line = uncemented fixation.

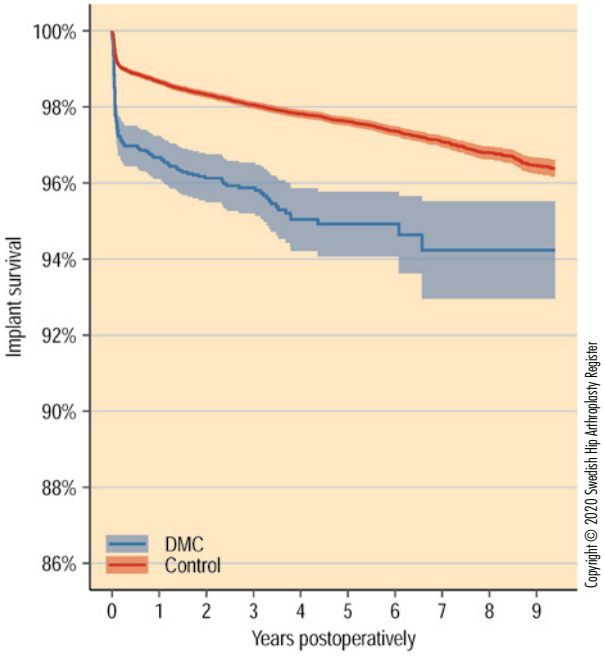

Figure 7.2.4. Survival diagram of study and control group after selection but before matching. After nine years, 59 observations remain in the smallest group (DMC). "Red" line = control group (n = 87 732 hip arthroplasties), "Blue" line = Study group (n = 4 088). Outcome is any type of revision.

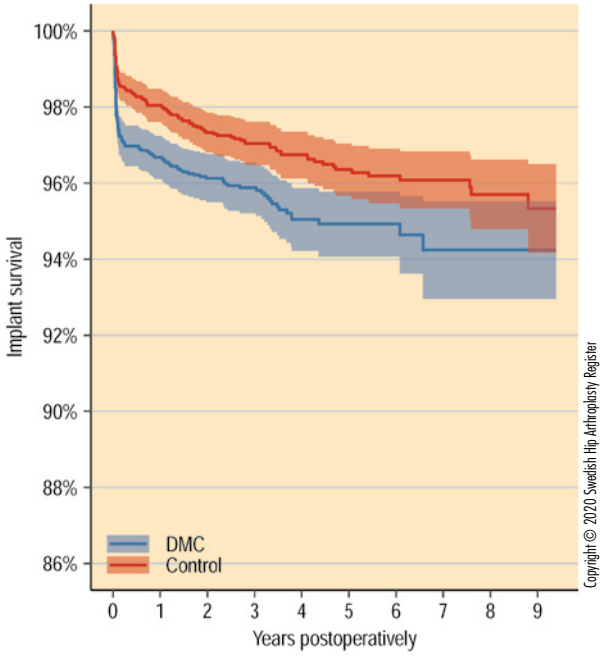

Figure 7.2.5. Survival diagram of study and control groups after matching. After nine years, 59 observations remain in the smallest group (DMC). "Red" line =control group (n = 87 732 hip arthroplasties), "Blue" line = Study group (n = 4 088). Outcome is any type of revision.

Dual mobility cups inserted 2003–2019

Dual mobility cups inserted 2003–2019	Number
Cemented	
Avantage	3,897
Polar cup	912
ADES dual mobility	248
Saturne	92
BiMobile casing	28
Undefined design	1
All cemented	**5,178**
Uncemented	
Avantage Reload	138
ADES dual mobility	118
Stafit	32
Delta-TT	29
TMT revision	22
Delta-One-TT	19
Avantage	17
G7 PPS	6
Materialise (custom-made)	5
Other (8 different)	11
All uncemented	**397**

Tabell 7.2.1. The number of reported operations with dual mobility cups during the period 2003 to 2019. 92 uncemented cups that are normally used with standard lines are included. In these cases, a metal casing has been inserted and thereafter either a DMC or a DMC has been cemented into the metal casing instead of using a conventional plastic insert.

Cemented and uncemented dual mobility cup inserted 2003–2019

	Cemented *Number = 5 178*	**Uncemented** *Number= 397*
Duration of follow-up *mean SD*	2.7 *2.3*	3.0 *2.5* *Cemented DA cup*
Age *mean SD*	75.8 *10.4*	68.4 *14.5*
Gender		
Proportion women %	63.0	57.9
BMI		
Number, *% of primary selection*	4,229 *81.7*	353 *88.9*
Mean SD	24.9 *4.8*	26.0 *5.0*
ASA-class		
Number, *% of primary selection*	4,927 *95.2*	386 *97.2*
I %	3.5	7.5
II %	43.3	47.9
III– %	53.2	44.6
Diagnosis *number, percentage*		
Primary osteoarthritis	1,017 *19.6*	137 *34.5*
Acute trauma, hip fracture	2,541 *49.1*	86 *21.7*
Sequelae after fracture/trauma	952 *18.4*	58 *14.6*
Other secondary osteoarthritis	668 *12.9*	116 *29.2*
Type of stem		
Cemented	4,694 *90.7*	207 *52.1*
Uncemented	480 *9.3*	189 *47.7*
Reason for revision *number %*		
Loosening/osteolysis	16 *0.3*	7 *1.8*
Infection	119 *2.3*	10 *2.5*
Periprosthetic fracture	21 *0.4*	3 *0.8*
Dislocation	32 *0.6*	4 *1.0*
Other causes	9 *1.0*	0 *1.2*
Non-reoperated	4,981 *96.2*	373 *94.0*

Table 7.2.2. Duration of follow-up, demography and the reason for revision during use of cemented and uncemented DMC respectively.

Operations with dual mobility cups and control cups operated 2008–2019 after matching

	Dual mobility cup *Number = 4,088*	**Control cup** *Number = 4,088*
Duration of follow-up *mean SD*	2.6 *2.2*	3.7 *2.8*
Age *mean SD*	*75.2 10.4*	*75.0 9.2*
Gender		
Proportion women %	62.7	62.5
BMI		
Mean SD	24.9 *4.8*	24.9 *4.2*
ASA-class		
I %	3.5	3.1
II %	44.0	42.9
III– %	52.5	54.0
Diagnosis number, *%*		
Primary osteoarthritis	935 *22.9*	1,607 *39.3*
Acute trauma, hip fracture	1,751 *42.8*	1,011 *24.7*
Sequelae after fracture/trauma	811 *19.8*	357 *8.7*
Other secondary osteoarthritis	591 *14.5*	1,113 *27.2*
Type of stem number, *%*		
Cemented	3,698 *90.5*	3,744 *91.6*
Uncemented	390 *9.5*	344 *8.4*
Surgical approach number, *% (is not included in the matching)*		
Posterior approach	2,155 *52.7*	2,158 *52.8*
Direct lateral in lateral position	1,877 *45.9*	1,748 *42.8*
Other approaches	52 *1.3*	180 *4.4*
No information	4 *0.1*	2 *0.04*

Table 7.2.3. Duration of follow-up, demography and choice of surgical approach in study and control group. The included cup types are given in figure 7.2.3 and in the text.

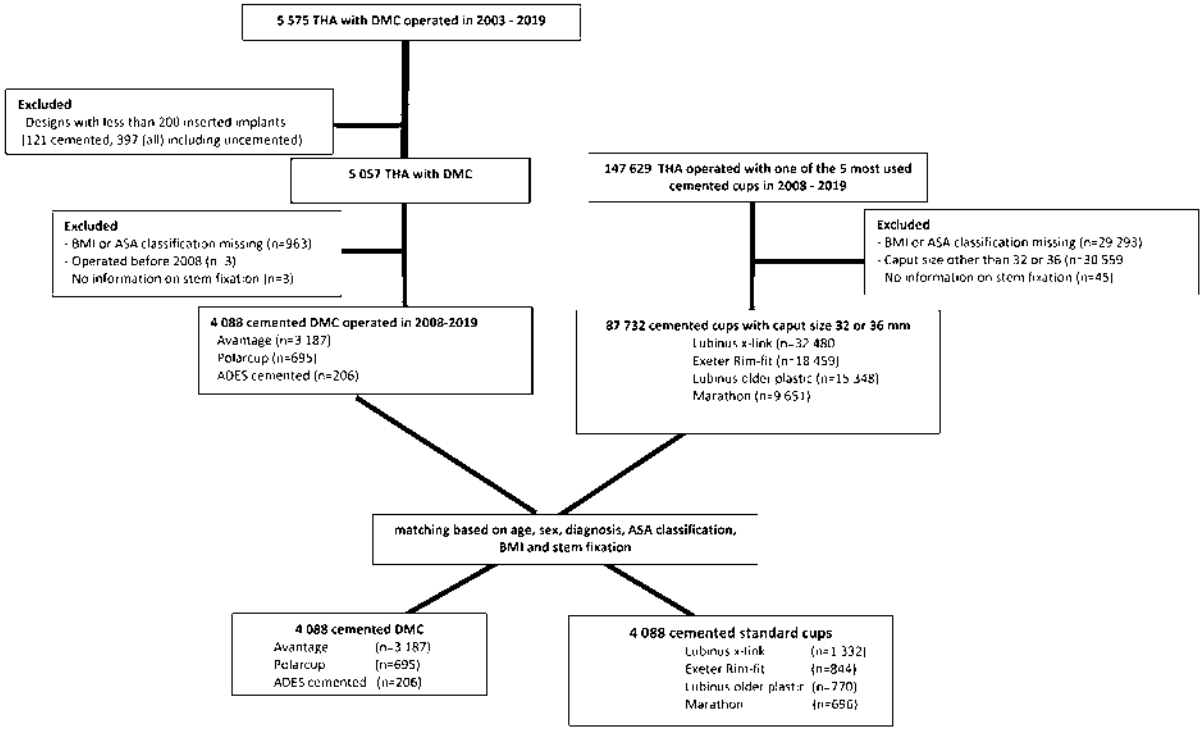

Figure 7.2.3. Flow-chart illustrating the selection process in the study and control groups respectively.

Reason for revision, implant and patient survival

	Dual mobility cup *Number of hips = 4,088*	**Control cup** *Number of hips = 4,088*
Reason for revision *number %*		
Loosening/osteolysis	10 *0.2*	18 *0.4*
Infection	105 *2.6*	57 *1.4*
Periprosthetic fracture	16 *0.4*	16 *0.4*
Dislocation	27 *0.7*	30 *0.7*
Other causes	7 *0.2*	4 *0.1*
Non-reoperated	3 923 *96.0*	3 963 *96.9*
Implantat survival[#] *9 years*		
Change/extraction regardless of part	94.2±*1.2*	95.3±*1.2*
Change/extraction cup/liner	94.6±*1.2*	97.5±*1.1*
Change/extraction cup	98.6±*0.6*	97.5±*1.1*
	Dual mobility cup *Number of patients =3 377*	**Control cup** *Number of patients =3 602*
Patient survival[#] *9 years*		
Mortality only until eventual revision	33.2±*4.6*	49.3±*3.1*
Mortality after eventual revision included	35.1±*4.7*	50.6±*3.2*

[#]*given with a 95 % confidence interval*

Table 7.2.4. Distribution of reasons for revision in matched groups of hip arthroplasties and patient survival of each group respectively with cemented dual mobility and cemented conventional cup respectively.

7.3 Primary arthroplasties with incomplete documentation in Sweden

Author: Johan Kärrholm

During the 1980s, the Swedish Hip Arthroplasty Register won international recognition for the possibility of being able to track-down deviant results both on a unit and on an implant level. This enabled a continuous improvement work with a stricter selection of implants and a more streamlined process around the operation. This contributed to a successive decrease of the risk of revision until it was among the lowest in the world. In the annual report of the previous year, we changed the headline "new implants" to "implants with an unsatisfactory documentation in Sweden" since parts of the implants may have been documented in other registries or studies where the reference population is not the same or even is missing.

Evaluation of implants in other registries

The possibility for a well-functioning register to systematically define deviating results has been developed in several countries. In Great Britain, an expert group, "the Orthopaedic Data Evaluation Panel" (ODEP) was formed to design guidelines for the assessment of new implants. The criteria that have been given much international attention. A similar organisation exists also in the Australian and Dutch arthroplasty registries. In ODEP, the degree of evidence is divided into several classes. The highest level in this grading is currently 13A*, which means that at least 500 hip arthroplasties carried out at more than three centres, or of more than three surgeons that have been involved in the development of the prosthesis, are to have been followed-up for at least 13 years. The upper limit in a 95 % confidence interval in a reversed Kaplan-Meier curve (1 – implant survival) should be lower than 6.5 %. The indications for revision and the number of deceased shall be known. Up to 20 % missing observations ("lost to follow up") is accepted (for more information visit www.odep.org.uk). The system has to a certain extent been criticised by the ISAR (International Society of Arthroplasty Registers) from a methodological viewpoint, which has meant that the methodology in part has changed and likely has improved.

A similar system exists within the Australian arthroplasty register where the evaluation is divided into three steps. The first step consists of an automated screening. Here, prostheses that compared with all others within the same group have an at least doubled risk of revision are identified. In step two, these implants are scrutinised regarding possible reasons for worse outcomes as for example deviant patient selection. Detailed statistical analyses are also carried out. If need be, an expert panel can make additional analyses and assessments before presentation in the annual report of the register (for details see Acta Orthop 2013; 84 (4): 348-352).

A new regulatory framework within the EU for implants (MDR)

For the approval of the marketing of a prosthesis in Sweden, a prerequisite has so far been a CE-marking of the implant. CE stands for Conformité Européenne (rough translation: European compliance). The legal framework for CE-marking is described in the now around 27 years old "Medical Device Directive" (MDD). So called notified bodies have had the right to issue a CE-marking, organisations that among other things monitor that the producers produce and introduce products on the market that fulfil the EU legal framework. This certification has not been enough for health technology products, especially not for those that belong to class III as hip implants do. Several prostheses have been introduced on the market that have not met the expected standards. This has caused severe complications in some cases. Due to these shortcomings, the legal framework will now be updated, after several years of preparatory work. The abbreviation MDD has changed to MDR (Medical Device Regulation), which reflects the fact that MDR will become a European law. The law was expected to become effective during 2020 and after the 26th of May no new MDD-certificates were to become effective according to the older directive. The situation in Europe has however changed considerably due to the covid-19 pandemic, why the transition to the new directive has been postponed one year.

The new framework is extensive and also encompasses clinical utility, risks and traceability. It not only includes completely new implants but also modifications of existing implants such as the introduction of a new prosthesis size. An important thing in the new framework is that the manufacturer of the implant in question must demonstrate a clear clinical patient good and low risk for complications. In practice this means that clinical use without limitations are not allowed until a sufficiently large patient population has been followed-up for a time period judged to be sufficiently long. Furthermore, the clinical result based on patient-reported data must adhere to today's standard and at the same time the risk of complications must be low. What the detailed framework will look like and how new implants that already exist on the market will be treated is not entirely clear at present. The concept also comprises the construction of a data bank (European Databank on Medical Devices, EUDAMED) where all information on a prosthesis is to be gathered and to which complications can be reported. This new framework is welcome as the potential benefit for the patient is large by the heightening of the security level and the reduction of the risk of future implant-related problems. This framework also means that it will become more complicated, time-consuming and probably also more expensive to launch new implants and innovations. On the other hand, the need for well-designed clinical studies will also increase. It is likely that the prices also will be affected, but to what extent is not yet clear.

The situation in Sweden

In Sweden we have had a restrictive stance towards change of standard implants during a long time. This stance has proven successful since the clinical results for most of the new implants that now are introduced on the market is at best on par with already existing ones. Several new implants are even worse than existing ones. In single cases, this prudent attitude will mean that implants with better properties than current standard will be introduced late to Swedish healthcare. This drawback is easily outweighed against the background of the good results that have been noted for the most used prosthesis types in Sweden, and the catastrophic consequences that sometimes can be the outcome when a new and unknown implant is inserted in a large number of patients.

Today, there are no preclinical tests that can safely answer the question if a new prosthesis works better or worse than the already existing ones. Since the prostheses we use today in Sweden have a very high standard it is mainly among selected patient groups additional implant development can be proven to make a difference. A change of a standard implant also entails a certain risk taking since new routines must be learned. Against this background it seems self-evident that a change of implant only is to be carried out in those cases where a clinical need is at hand and where the replacement implant has documented advantages. Service and price also play a role, even if the price often only accounts for a small part of the total cost.

The choice of control group in our analysis

The procedure around implant evaluation is not that simple. Most registries use the outcome revision, regardless of reason and regardless of which component that is revised. Some registries multiply the number of observed components with the number of observational years, which means that the fact that the reasons for revision vary over time is not considered. To the extent a comparison with other prostheses is made, the comparative group may be all other implants, all other implants in the same product category or a selected reference group. Sometimes a fixed limit is used corresponding to 95 % implant survival after 10 years for example. So far, there has not been any established standard. Such a standard is also not that easy to bring about since the conditions vary greatly among different registries regarding the total number of observations, the number of different implants that are used within the uptake area of the register, the length of the duration of follow-up and the extent of the data acquisition of the individual register. Moreover, exact quality limits are a constructed limit based on what is deemed acceptable at a certain point in time. Today's acceptable standard does not have to be that of 10 to 20 years later by necessity.

Control group – choice of outcomes

In this year's follow-up of reviewed implants, we have by and large used the same selection criteria for the reference group that were introduced in the annual report for the operational year 2015. Last year an adjustment was made so that the observational time in the control group was prolonged with one year. For this year's report this means that the observational time starts in 2008 and continues up until 2019. The reference values in the control groups are thus based on a window of time corresponding to 12 years that is moved one year ahead for each new annual report. The reason behind including only the last years is to try to make the analysis as representative as possible of today's operations. The outcomes are based on cup or stem revision. During evaluation of cups, the outcome is change of cup and/or liner or extraction regardless if the stem has been changed or not. The same principle applies during evaluation of stems. Revisions due to infection are excluded as this outcome mainly reflects care process and case-mix. It is possible that the surface structure of the implant or other properties may influence the risk for infection. As long as this remains unclear, we have however chosen to exclude revision due to infection.

Control group – definitions

In order for an implant to qualify to be part of the control group there are three basic requisites: the implant survival after 10 years based on cup or stem revision (all causes excluding infection), should exceed 95 % based on at least 50 observations at the end of the observational time. Requisite number two is that 50 prostheses should have been inserted during the last two years and requisite number three is that at least one of these should have been inserted during the previous year (at present during 2019). In general, the results tend to improve, and it can be discussed if the limit at a 95 % implant survival at ten years should be adjusted upwardly somewhat in the future.

Control group – included implants

The implants that are included in each control group are given in table 7.3.1. Compared with the previous annual report, ZCA with an older type of polyethylene has been excluded due to lack of observations. Since the observational interval has been moved one year ahead, the number of observations has also changed. In total, only four types of cemented cups are thus included: Contemporary Hooded Duration, Lubinus older polyethylene type, ZCA XLPE and Marathon XLPE. As a group, the ten-year survival rate with non-infectious cup revision or extraction as outcome is at 98.1 ± 0.1 % (± 95 % confidence interval), where the Marathon XLPE-cup has the highest and the Contemporary hooded duration-cup the lowest value within the group.

Seven cups are part of the uncemented control group. Compared with the analysis of the previous year, Pinnacle 100 has been added and no cup has had to be excluded. The ten-year survival rate is somewhat higher here than in the cemented group (98.9 ± 0.2 %), possibly since all cups have highly cross-linked polyethylene. (In this year's annual report highly cross-linked polyethylene means polyethylene that has been irradiated with more than 5 MRad). The variation within the group is also somewhat smaller, between 97.25 % (Pinnacle 100) and 99.2 % (Trilogy with or without hydroxy apatite/tricalcium phosphate coating). Despite the very low incidence of revisions,

the use of the Trilogy cup has decreased from 2010 up to 2016, thereafter a relatively modest increase can be noted (figure 7.3.1).

The group with a cemented stem is dominated by Lubinus SP II followed by the Exeter stem. In both cases only stems with a standard length are included. Exact stem length is missing in the register for a majority of the MS30- and CPT-stems why the same selection has not been possible when it comes to these implants. The ten-year survival rate in the group is at 98.7 ± 0.1 % based on the outcome non-infectious stem revision, where MS 30 has the highest (99.0 ± 0.1 %) and CPT has the lowest values (96.0 ± 1.6 %). The CPT-stem has been used only sparingly during the last years. Since 2016, there has however been a slight increase, from 22 reported cases in 2016 up to 72 reported cases in 2019.

The control group for uncemented stems comprises six main groups, of which two (Corail and Bi-Metric) consist of several variants. In both these groups there has been what seems like implant specific problems. Regarding Bi-Metric, there has been corrosion around the cone of the prosthesis (see annual report in 2017) and regarding the Corail-stem there has been loosening of the proximal part of the stem. These problems have however been very rare and therefore have not affected the stem survival other than marginally. ABG II HA has a stem survival rate in this year's report of just above the 95-percent limit and has therefore been moved to the reference group. Its use has decreased. During 2019, only two cases were reported, and the stem has been replaced by the ANATO-stem in some units. The uncemented control group for stems has a ten-year survival rate of 98.4 ± 0.4 % where the CLS-stem has the highest value (98.9 ± 0.2 %) and the ABG II HA-stem has the lowest value (95.2 ± 1.2 %). It should however be pointed out that small changes within a group in the table should not be attached with importance since these likely can be explained by other factors than the choice of implant. This also applies to comparisons between cemented and uncemented fixation.

Definition and use of implants with insufficient documentation in Sweden

Those implants that are accounted for has in most cases been introduced from 2007 and onwards. In all cases, fewer than 50 implants have passed the ten-year follow-up even though the observational window is moved one year forward this year, that is it starts in 2008. Prostheses that have been reported with fewer cases than 50 during the last two years, or not at all during 2019, thus have exited. The starting year is given for the year when more than ten implants were registered, except for the Avantage cup where 19 and 29 respectively were reported for 2006 and 2007 respectively. In the control group the starting year has been set to 2008 in order to make the time-periods that are compared as equal as possible.

We would like to add that the screening carried out here mostly touches on early complications. This can be disadvantageous for an implant that is associated with an increased risk of revi-

Composition of the control groups

Type of component *period of analysis*	Number	Implant survival at 10 years, *2 SEM* [1]
Cemented cup *2008–2019*		
Contemporary hooded duration	6,669	95.9 *0.7*
Lubinus older polyethylene	37,995	97.6 *0.2*
Marathon XLPE	31,459	99.3 *0.3*
ZCA XLPE	24,631	98.6 *0.2*
All	**100,754**	**98.1 *0.1***
Uncemented cup *2008–2019*		
Allofit	1,421	98.8 *0.7*
Pinnacle sector	2,348	98.1 *1.6*
Pinnacle 100	5,346	97.3 *1.3*
Trident hemi	10,042	98.3 *0.9*
Trident AD LW	1,841	97.8 *1.4*
Trident AD WHA	2,192	98.4 *0.8*
Trilogy±HA	13,005	99.2 *0.2*
All	**36,195**	**98.9 *0.2***
Cemented stem *2008–2019*		
CPT (CoCr alloy)	1,006	96.0 *1.6*
Exeter 150 mm	30,110	98.2 *0.3*
Lubinus SPII 150 mm	75,335	98. 8 *0.2*
MS-30	24,260	99.0 *0.1*
All	**130,602**	**98.7 *0.1***
Uncemented stem *2008–2019*		
ABG II HA	2,555	95.2 *1.2*
Accolade Straight	2,963	98.2 *0.7*
Bi-Metric[2]	10,812	98.5 *0.3*
CLS	15,826	98.9 *0.2*
Corail[3]	47,987	98.5 *0.3*
Wagner Cone	1,843	98.1 *0.8*
All	**81,986**	**98.4 *0.2***

Table 7.3.1. Implants in the control groups during analysis of reviewed implants in tables 7.3.2 to 7.3.4. For cups only cup revisions, and for stems only stem revisions, have been included. All reasons for revision except infection are included.

[1] Cup and stem survival respectively excluding revision due to infection.

[2] Several variants are included (X por HA NC, por HA and HA FMRL).

[3] Several variants are included (standard, high offset, coxa vara).

sion due to dislocation, an early complication, but that has a reduced risk of revision due to loosening and wear. On the other hand, it is the total picture that counts. In general, the implant survival rate is high today, with small differences in risk for revision between the most used implants.

When "new" implants are introduced on the Swedish market, this should take place according to a well-established plan. It always takes some time before the use of new instruments has been learnt and the insertion technique may vary. Furthermore, the first cases should be followed-up in a structured way. Among the ten uncemented cups presented in table 7.3.2, we find however that ten units only have inserted six to nine each, and as many as 35 units only have inserted one to five implants per unit during the last two years (figure 7.3.2). In some cases, this can be explained by the fact that the cup in question is a variation of a base concept, as for example Pinnacle or Trident. In other cases, a large experience of revision surgery may exist, for example for the TMT cup or that a prosthesis is on its way out. Even if there may be several highly plausible explanations for this picture there is however a notable large number of units that use implants with an uncertain documentation only during single occasions. If we compare with the previous annual report, the number of units that during a two-year period only have reported one to five used implants decreased by seven, a trend we hope will continue.

Cemented cups

The cemented cups analysed this year are the same as last year, except that the ADES-cup has been excluded due to lack of observations (table 7.3.2). Two cups (Exeter X3 RimFit, Lubinus X-link) have a somewhat higher implant survival rate than the control group. The distinctly low revision frequency for these cups is interesting. It is however yet not clear if these implants follow the time trend with a tendency towards fewer revisions due to non-infectious causes or if design factors, alternatively the choice of polyethylene with extra crosslinks, affect the result. The manufacturing processes for high molecular polyethylene varies between different producers, but we have not yet been able to find any evident and clinically relevant differences between the different new polyethylene materials.

As before, the Avantage-cup has a poorer outcome compared with the control group. The ten-year survival rate is at 94.3 ± 4.5 % based on 39 cases at the end of the observation period. If operations carried out the year before (2007) are included, these data are only marginally affected (ten-year survival = 94.6 ± 4.0 % based on 46 observations). Why the Avantage-cup is revised more often is not known but patient selection probably plays a large and maybe completely decisive role. The distribution of reason for revision between the Avantage-cup and the control group that is presented in table 7.3.4 shows a larger proportion of revisions due to loosening in the control group. There is also an increased proportion of revisions due to

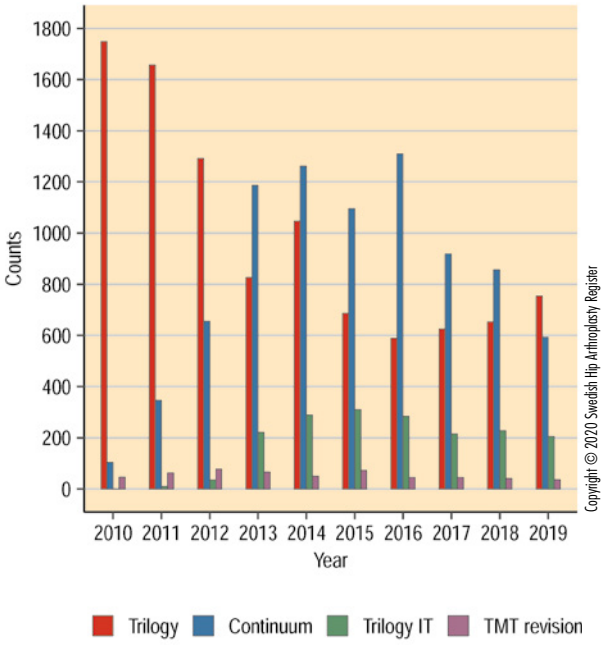

Figure 7.3.1. The number of reported operations where the Trilogy-cup and later generations of this cup have been used during the period 2010–2019. None of the successors reach the same result as the Trilogy-cup (see preceding annual report).

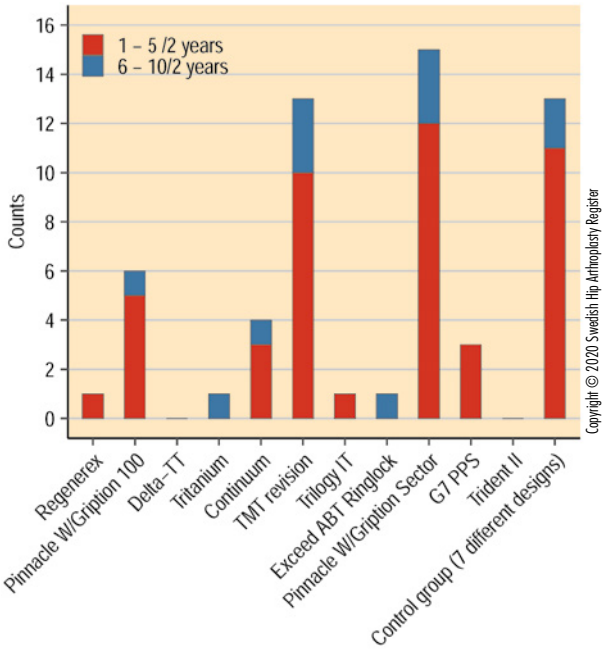

Figure 7.3.2. Units that have reported insertion of one to five and six to nine uncemented cups of the types given in table 7.3.2 respectively during the last two years (2018–2019).

dislocation in both the group operated with Avantage and the group operated with the Polar cup. The reason for this is unknown but the differences can likely be explained by different patient demographics and degree of comorbidity. A more in-depth analysis based on register data where we have tried to compensate for these factors as much as possible, shows no obvious advantages with dual mobility cups. It is thus not possible to completely answer the question on the role of the dual mobility cups based on available register data (see section 7.2 for more detailed information). The reason for the poorer outcome of the Avantage-cup therefore remains unclear. As is evident from table 7.3.4, both the Avantage-cup and the Polar cup are more often selected for older patients with a hip fracture compared with the control group. Interestingly enough, the Polar cup does not differ from the control group, but so far the number of observations are too few to be able to decide if the apparently lower revision frequency of the Polar cup is just a random fluctuation.

Reviewed cups, number of revisions and implant survival

	Starting year	Number		Duration of follow-up, years	Cuprevisions[1)] number, %		Implant survival[1), 2)] cup/liner, *2 SEM*	
		total	followed 2 years	mean, *max*	total	≤ 2 years	2 years	5 år
Cup cemented								
Avantage Cemented	2008[6]	3,843	2,014	2.6 *11.8*	58 *1.5*	43 *1.1*	98.6 *0.4*	97.8[3] *0.7*
Exceed ABT E-poly non-flanged	2014	794	390	4.4 *7.8*	4 *0.5*	1 *0.1*	99.6 *0.6*	99.1 *1.0*
Exeter X3 RimFit	2010	34,796	23,149	3.5 *9.8*	81 *0.2*	49 *0.1*	99.8 *0.1*	99.7[4] *0.1*
Lubinus X-linked	2010	52,406	34,400	3.2 *9.8*	166 *0.3*	109 *0.2*	99.7 *0.2*	99.6[4] *0.1*
Koncentrisk X-linked IP	2011	2,791	1,657	2.7 *8.8*	13 *0.5*	8 *0.3*	99.4 *0.4*	99.1 *0.6*
Polar cup	2010	912	530	3.0 *9.9*	8 *0.9*	7 *0.8*	99.1 *0.6*	98.9 *0.8*
Control group[5]	2008	100,754	88,788	6.2 *12.0*	1 138 *1.4*	373 *0.4*	99.6 *0.0*	99.3 *0.1*
Cup uncemented								
Continuum	2010	8,329	6,567	4.2 *10.2*	88 *1.1*	65 *0.8*	99.1 *0.2*	98.8[3] *0.3*
Delta TT	2012	636	465	3.4 *8.1*	4 *0.6*	4 *0.6*	99.3 *0.7*	99.3 *0.7*
Exceed ABT Ringloc	2011	1,914	1,382	4.5 *9.3*	9 *0.5*	7 *0.4*	99.6 *0.3*	99.5 *0.43*
G7 PPS	2015	696	102	1.1 *4.8*	5 *0.7*	5 *0.7*	98.3 *2.0*[7]	–
Pinnacle W/Gription 100	2011	12,443	5,312	2.1 *8.3*	58 *0.5*	47 *0.4*	99.5 *0.2*	99.2[7] *0.2*
Pinnacle W/Gription sector	2014	2,004	810	1.9 *9.2*	7 *0.3*	7 *0.3*	99.6 *0.3*	99.6 *0.3*
Regenerex	2008	943	860	5.6 *11.4*	9 *1.0*	2 *0.2*	99.5 *0.4*	98.9 *0.8*
TM revision	2008	574	446	5.0 *11.8*	18 *3.1*	14 *2.4*	97.4 *1.4*	96.8[3] *1.6*
Trilogy IT	2011	1,794	1,264	2.9 *7.2*	41 *2.3*	32 *1.8*	98.0 *0.7*	97.4[3] *0.8*
Tritanium	2010	929	683	4.7 *10.1*	12 *1.3*	3 *0.3*	99.5 *0.5*	98.6[7] *1.0*
Trident II	2018	56	0	0.7 *1.2*	0	0	-	-
Control group[5]	2008	36,195	27,426	5.5 *12.0*	216 *0.6*	90 *0.2*	99.7 *0.1*	99.5 *0.1*

Table 7.3.2. Cups without information on 10-year survival, used in more than 50 cases during the last two years including 2019. Bold name indicates lower survival than in the control group (log-rank test).

[1)] All reasons except infection.
[2)] Survival data presented only if number of observations exceeds 49.
[3)] Poorer survival compared with control group. p < 0,0005, log-rank test.
[4)] Better survival compared with control group. p < 0,0005, log-rank test.
[5)] See table 7.3.1.
[5)] 54 Avantage-cups inserted 2003–2007 excluded.
[7)] Poorer survival compared with control group, p<=0,002, log-rank test.

Uncemented cups

In the group uncemented cups the ADES-cup and Pinnacle 100-cup have been excluded. In the first case due to decreased use as fewer than 50 operations with the ADES-cup have been reported the last two years. Pinnacle 100 has been transferred to the control group due to a better than 95 % ten-year survival rate regarding the outcome non-infectious cup revision and more than 50 observations at 10 years. Trident II has been added with just over 50 implants inserted during the last two years. Just as in several earlier analyses from the register, the Continuum-, Trilogy IT- and TMT Revision-cups have a poorer outcome ($p < 0.0005$, log-rank test). In all cases, dislocation is the most common reason for revision. In the previous annual report, we found that the high revision rate for the Continuum-cup was even worse than that of the Trilogy-cup, probably because it was more often used with a liner of the standard type without modification in the form of an acetabular wedge augment, a dual mobility insert or the like in order to prevent dislocation. In this year's report we therefore present the proportion of the operations where a liner was chosen for each single design with some form of in-built dislocation protection.

Three additional cups: G7 PPS, Pinnacle W/Gription 100 and Tritanium also have a two- and five-year survival rate that is somewhat lower than expected. The difference compared with the control group is small and it is not clear if it is of any clinical relevance. Table 7.1.4 shows that the most common reason for cup revision for the Pinnacle W/Gription 100-cup is dislocation and here only 13 % of cases have been operated with a standard liner, while the corresponding proportion in the control group is much higher and at 79 %. The most common reason for revision of the Tritanium-cup is surprisingly enough loosening, but the number of observations is still low, why a random variation cannot be ruled out. This can be said of the G7 PPS-cup to an even higher degree, which furthermore shows an even distribution between the most common reasons of revision.

We have not been able to show that any of the cups that have a trabecular metal surface on the Swedish market have a higher implant survival rate compared with their predecessors with a porous or blasted metal surface. Some of them instead tend to be revised more often due to dislocation but in one instance apparently due to loosening. Even though register data cannot decide if the somewhat poorer survival rate for cups with a trabecular metal surface is implant-related or not, their use is hard to motivate against the background of that they are more expensive in general.

Choice of liner with a dislocation protection seems to have an advantageous effect on the early outcome by reducing the risk for revision for at least some types of cups (annual report 2017). If this advantageous effect remains over time is not clear, especially since one cannot rule out secondary effects due to a collision between the neck of the prosthesis and the elevated rim of the cup.

Cemented stems

During the last years no completely new type of cemented stem that fulfils the criteria for scrutiny have been introduced. Nonetheless, also this year we have conducted an analysis of the Lubinus SP II-stem of 130 mm length and of the short Exeter stem (125 mm). The reason for the follow-up of the SP II-stem is that the question has arisen if a stem length of 150 mm can be changed to 130 mm without an increase of the risk of revision. A potential advantage with the shorter variant would be that an eventual future revision is facilitated. Theoretically, the load transfer to the femur would become more advantageous, but any firm data based on clinical material is missing, and it is not clear if a potential difference of this kind has any clinical significance.

Since 1999, the first year the register could separate prosthesis components at a more detailed level, 2 326 SP II stems with a length of 130 mm have been reported, most of which were inserted starting with the year 2014. This year's analysis, that begins in 2008 comprises 2 249 operations. The number of Lubinus SP II with a short stem are thus relatively few. From 2018 to 2019, the number of reported operations rose from 397 to 625 and during the years 2008–2019 they accounted for 2.9 % of all SP II-stems used during primary operations. The duration of follow-up within the time-period in question is still short and the survival rate due to non-infectious mechanical reasons for stem revision is about the same as in the control group.

An Exeter-stem of 125 mm length was used in more than 100 cases during 2010 and has increased successively up to 367 cases reported during 2019. The short Exeter-stem is used about as often in relative terms as the 150 mm-stem for patients with primary osteoarthritis (125 mm: 82 % of cases, 150 mm: 77 % of cases). Theoretically, this stem with its smaller contact surface against cement, could have a deviant result. Since 2008, 2 697 stems are reported, corresponding to 6.6 % of all Exeter-stems inserted during the period 2008-2019. The stem survival rate at five years is somewhat lower than for the control group (99.0 ± 0.4 % compared with 99.5 ± 0.05 %) and is also marginally lower than for the Exeter-stem with length 150 mm (99.2 ± 0.1 %).

New uncemented stems

Since the annual report of the previous year, the ABG II-stem has returned to the control group due to a somewhat better result for operations carried out from 2008 to 2019. As suggested above, only two stems were reported in 2019, which means that the model likely is excluded in the analysis in the annual report of next year. Overall, the risk of stem revision due to non-infectious reasons is low for the newly introduced stems from 2008 and onwards. Two of them even have a somewhat better five-year survival rate compared with the control group (Accolade II and M/L Taper).

Most of the implants that have been introduced on the Swedish market since 2008 show good or acceptable results, but some of them are not on par with today's standards. The reason for this may be disadvantageous patient selection or other reasons that are not evident in a register analysis.

The Avantage-cup still has an increased risk of being revised. At present, it is not clear if this is due to poor patient selection. Future comparisons with other cemented cups of the same type could prove more elucidating.

None of the cups with a trabecular metal surface in Sweden have had a better result compared with corresponding older implants with a porous metal surface. Some of them have a lower implant survival rate above all due to revision caused by dislocation and in one case there is a weak tendency towards an increased risk due to loosening. Register-data can however not be used to safely say if poorer results for a specific design are due to implant properties, patient selection or surgical technique.

The introduction of highly cross-linked cups in cemented cups has so far been associated with similar or slightly better survival than for cemented cups made of older types of polyethylene.

Reviewed stems, number of revisions and implant survival

	Starting year	Number		Duration of follow-up mean *max value*	Stem revisions[1], number, %		Implant survival[1, 2] stem, *2 SEM*	
		total	followed 2 years	years	total	≤ 2 years	2 years	5 years
Stem cemented								
Exeter 125 mm	2008	2,697	1,892	4.1 *11.9*	23 *0.9*	17 *0.6*	99.2 *0.4*	99.0[3] *0.4*
Lubinus SP II 130 mm	2008	2,249	1,158	2.2 *11.6*	11 *0.5*	3 *0.1*	99.9 *0.2*	-
Control group[5]	2008	130,062	101,503	5.2 *12.0*	785 *0.6*	268 *0.2*	99.8 *0.03*	99.5 *0.05*
Stem uncemented								
Accolade II	2012	4,394	2,820	3.2 *7.9*	11 *0.3*	11 *0.3*	99.7 *0.2*	99.7[4] *0.2*
Echo Bi-Metric	2013	864	228	1.5 *7.0*	6 *0.7*	6 *0.7*	98.9 *0.1*	-
M/L Taper	2012	2,050	1,421	3.3 *6.8*	4 *0.3*	3 *0.2*	99.8 *0.2*	99.7[4] *0.2*
SP-CL,	2015	263	116	1.8 *4.8*	2 *0.8*	1 *0.4*	99.6 *0.6*	-
ANATO	2016	102	44	2.2 *5.2*	0	0	-	-
Control group[5]	2008	81,986	62,167	5.0 *12.0*	701 *0.9*	421 *0.5*	99.4 *0.1*	99.2 *0.1*

Table 7.3.3. Stems introduced on the Swedish market from 2008 (or earlier if less than 10 cases per year) and that have been used in more than 50 hip arthroplasties during the last two years including 2019. Bold name indicates lower survival than in control group.

[1] All causes except infection.
[2] Data is given only for at least 50 observations.
[3] Poorer survival compared with control group (p = 0.004, log-rank test).
[4] Better survival compared with control group Accolade II: p = 0,002, M/L Taper: p = 0.02, log-rank test.
[5] See table 7.1.1.

Demography and reason for revision for implants that deviate from the control group and other implants chosen for comparison[#)]

Type of implant	Age	Gender	Diagnosis, %	Dislocation protection[1)]	Reason for revision number, % of all[2), 4)]			
	Mean, *SD*	Women, %	Primary osteoarthritis/ acute fracture/ other secondary osteoarthritis	% of all	Loosening/ osteolysis	Dislocation	Peripros-thetic fracture	Other[2)]
Cemented cup								
Avantage Cemented	75.7 *10.7*	62.9	21/48/31	-	12 *(0.3)*	27 *(0.7)*	17 *(0.4)*	8 *(0.2)*
Polarcup[3]	76.3 *9.1*	63.0	14/56/31	-	1 *(0.1)*	5 *(0.6)*	4 *(0.3)*	0
Control group	71.2 *9.1*	62.2	84/7/9	-	863 *(0.9)*	626 *(0.6)*	440 *(0.4)*	127 *(0.1)*
Uncemented cup								
Continuum	60.4 *10.4*	47.7	86/1/13	24	48 *(0.6)*	108 *(1.3)*	22 *(0.3)*	17 *(0.2)*
G7 PPS	60.4 *9.1*	41.4	94/0/42	76	2 (*0.3)*	2 *(0.3)*	2 *(0.3)*	1 *(0.1)*
Pinnacle W/Gription 100	59.8 *9.2*	42.8	92/0/8	13	29 *(0.2)*	68 *(0.5)*	18 *(0.1)*	14 *(0.1)*
TM revision	60.7 *14.1*	44.6	49/2/49	96[5]	3 *(0.5)*	19 *(3.3)*	2 *(0.3)*	2 *(0.3)*
Trilogy IT	62.3 *11.1*	43.0	83/1/16	75	2 *(0.1)*	35 *(2.0)*	18 *(1.0)*	4 *(0.2)*
Tritanium	59.2 *11.5*	47.4	75/0/25	54	9 *(1.0)*	3 *(0.3)*	3 *(0.3)*	0 *(0.0)*
Control group	60.3 *11.0*	46.6	84/1/15	79	225 *(0.6)*	161 *(0.4)*	164 *(0.5)*	83 *(0.2)*
Cemented stem								
Exeter 125 mm	73.1 *8.3*	61.2	76/12/12	-	140 *(0.5)*	105 *(0.3)*	171 *(0.6)*	21 *(0.1)*
Lubinus SP II 130 mm[3]	73.4 *8.0*	70.6	84/10/6	-	16 *(0.7)*	12 *(0.5)*	1 *(0.0)*	1 *(0.0)*
Control group	72.9 *8.1*	62.3	80/11/9	-	641 *(0.5)*	739 *(0.6)*	319 *(0.2)*	120 *(0.1)*

Table 7.3.4. Demographical data and reason for revision for the cups and stems that have been analysed in tables 7.3.2 and 7.3.3 and differ significantly through a poorer implant survival. A dual mobility cup (Polar cup) and Lubinus SP II-stem 130 mm do not differ significantly but have been included for comparison. The distribution of reason for revision should be contrasted with the duration of the observational period (see previous tables) since the distribution of causes varies with time.

#) Year of operation and the number of operated patients according to tables 7.1.2 and 7.1.3.
1) All types of acetabular wedge augments, angled or constrained liner and cup/liner with dual mobility.
2) Excluding infection.
3) Implant survival within the expected interval, data is presented for comparison.
4) During analysis of cups only cup/liner-revisions are included and during analysis of stems only stem revisions are included.
5) Metal-casing with cemented conventional cup are excluded.

7.4 Prostheses with metal-on-metal articulation

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Metal-on-metal articulation was introduced already at the end of the 1930s by Philip Wiles and was developed further during the 1950s and 1960s of among others Peter Ring and George Kenneth McKee. Watson-Farrar contributed by designing a narrower neck on the McKee prosthesis, and the modified prosthesis became McKee-Farrar. This prosthesis became relatively popular in Sweden and between 1967 and 1984, 2 508 McKee-Farrar prostheses were inserted in Sweden (data from Lennart Ahnfeldt's dissertation). Metal-on-metal articulations were however phased out, probably due to the introduction of the Charnley prosthesis and other prosthesis types with metal-on-plastic articulation. There were also early reports on granuloma around prostheses with metal-on-metal articulation, concern for toxic effects of released cobalt ions and uncertainty regarding carcinogenic effects in the longer perspective.

The first prototypes of resurfacing prostheses appeared during the 1940s and 1950s, but their more extensive use would wait until prostheses with a metal femoral head and cups made from polyethylene were launched during the 1970s. The results were however poor, mainly due to a high plastic wear and loosening of the cup.

During the 1990s several pilot studies were initiated once again of hip prostheses with metal-on-metal articulation. Through an improved manufacturing technique, an apparent perfect match between the femoral head and the cup could be achieved so that a thin liquid layer between the articulating surfaces would minimise wear and the release of metal. Despite a lack of evidence, the use of metal-on-metal articulations increased substantially in several countries during the early 2000s.

Resurfacing prostheses 1999–2019

Cup	Inserted, number *% of all resurfacing prostheses*	Revised, number *% of specific model*[1]
BHR *Standard*	1,260 *58.6*	121 *9.6*
BHR *Dysplasia*	17 *0.8*	3
ASR	397 *18.5*	62 *15.6*
Durom *Coarsely granulated surface on the cup*	362 *16.8*	54 *14.9*
Durom *Finely granulated surface on the cup*	15 *0.7*	6
Adept	75 *3.5*	2 *2.7*
ReCap	12 *0.6*	1
Cormet 2000	7 *0.3*	5
Zimmer MMC	4 *0.2*	0
Total	2,149 *100*	254 *11.8*
Stam		
BHR *Standard*	906 *42.2*	106 *11.7*
BHR	325 *15.1*	16 *4.9*
BMHR-stam VS	42 *2.0*	1
BMHR coated	5 *0.2*	1
ASR	396 *18.4*	62 *15.6*
Durom	381 *17.7*	60 *15.7*
Adept	75 *3.5*	2 *2.7*
ReCap	12 *0.6*	1
Cormet	7 *0.3*	5
Total	2,149 *100*	254 *11.8*

Table 7.4.1. Number and percentage of resurfacing prostheses and reported revisions 1999–2019.

[1] *Percentages are only presented if number of observations exceed 49.*

Administrative statistics in the US, shows that during the years 2005 and 2006 the proportion of metal-on-metal articulations reached 35 %. Between 2004 and 2006 almost every other patient in Great Britain, aged 55 years or younger, underwent hip arthroplasty with a resurfacing prosthesis. In Sweden, the incidence peaked in 2008 when 4.2 % of all total hip replacements performed received a metal-on-metal articulation. In patients 55 years or younger 13,4% were operated with a metal-on-metal resurfacing prosthesis that same year.

The risk of serious complications, especially in the form of metal granuloma (international terms: Aseptic Lymphocytic-Dominated Vasculitis Associated Lesions – ALVAL, Adverse Reaction to Metal Debris – ARMD, Adverse Local Tissue Reaction – ALTR), toxic effects of cobalt ions in particular and unclarities when it comes to long-term carcinogenic effects have made these implants to more or less disappear in Sweden.

There is however still an interest among a limited number of patients that are operated abroad in private praxis. From several perspectives it is therefore of interest to get an overview of how hip prostheses with metal-on-metal articulation have been used in Sweden and how the results in question look in a register-perspective. In this in-depth analysis we describe how prostheses where both the articulating surfaces are made of metal have been used in Sweden since 1999 and provide a short summary of the results regarding the risk of revision.

Prostheses with both articulating surfaces made of metal

During the period 1999 to 2019, 3 620 hip prostheses in total were registered with a metal-on-metal articulation. 2 149 of those were complete resurfacing prostheses (table 7.4.1), in 675 a cup of the resurfacing type together with a stem with a large femoral head were inserted and 796 hips are conventional prostheses with a metal femoral head that articulates against a metal liner or a metal insert in a cemented cup. During the use of the combination resurfacing cup with conventional stem, almost all stems were uncemented (780 of a total of 796). Usually, some sort of Bi-Metric-stem (n = 230) or CLS-stem (n = 223) were used. In the group prostheses of conventional type, the three most common cups were M2a (n = 320), Weber (n = 163) or Pinnacle (n = 160). Also, this group is dominated by the Bi-Metric stem (n = 338), followed by Corail (n = 155) and the CLS-stem (n = 120).

Cup	Number *%*
ReCap	228 *33.8*
ASR	167 *24.7*
Durom *coarsely granulated surface*	160 *23.7*
BHR Standard	105 *15.6*
BHR Dysplasia	4 *0.6*
Adept	8 *1.2*
Zimmer MMC	3 *0.4*
Total	675 *100*

Table 7.4.2. Resurfacing cups used with conventional stem 1999–2019.

Beginning in 1999, the number of metal-on-metal articulated prostheses increased successively to reach a top in 2008, when 605 were registered. Thereafter, there has been a successive decrease up to 2014 when 37 prostheses were registered. Between 2015 and 2019, 1 to 5 prostheses have been reported per year (figure 7.4.1).

As of the 31st of December 2019, the mean duration of follow-up in the two groups that have at least one prosthesis part of the resurfacing type was just under 11 years. In the group with a conventional prosthesis with metal-on-metal articulation, it was somewhat longer, 12.5 years (table 7.4.3). The proportion of women is the lowest in the group with a complete resurfacing prosthesis, where the patients also are a little younger, have primary osteoarthritis to a greater extent and have the lowest degree of comorbidity measured as ASA class. (Data on ASA class and BMI were not registered in the register before 2008.) The proportion of revised is the highest in the group with a resurfacing cup combined with a conventional stem while the two other groups show the same proportion of revised prostheses. It should however be noted that the duration of follow-up in the group with a conventional prosthesis is somewhat longer.

After 12 years, when at least 100 observations remain in each group, the implant survival is 87.5 ± 1.6 (mean ± 95 % confidence intervals) for resurfacing prostheses, 78.5 ± 1.6 % in the group with resurfacing cup and standard stem and 89.1 ± 1.7 % for the group with metal-on-metal articulation and a prostheses of the standard type (figure 7.4.2). During a simple comparison between the groups, one finds that the group with resurfacing cup combined with a standard stem differs from the other two (log rank-test: $p \leq 0.0005$), while any firm difference between resurfacing prostheses and conventional prostheses with metal-on-metal articulation cannot be seen (log-rank test $p = 0.15$). The reason for revision also differs. For resurfacing prostheses and resurfacing cup with a standard stem, loosening and pseudotumor or high concentrations of metal ions dominate where 46 % of all revisions in the last group are caused by pseudotumor/high metal ion concentrations (9.2 % of all cases). In the group conventional prostheses, loosening/osteolysis is the most common reason for revision.

Resurfacing prosthesis or conventional prosthesis?

Resurfacing prostheses were recommended for younger patients against a background of a presumed higher tolerance for wear and simpler types of revision. In order to be able to assess the result after this operation a comparison should be made with a group of patients with about the same age, gender and diagnosis distribution, and the same degree of comorbidity. The

Three patient groups where both the articulating surfaces are made of metal operated 1999–2019

	Three prosthesis types with metal-on-metal articulation		
	Resurfacing prosthesis	*Resurfacing cup/ Conventional stem*	*Conventional prosthesis*
Duration of follow-up *mean SD*	10.8 *3.7*	10.9 *3.0*	12.5 *4.0*
Age *mean SD*	49.8 *8.7*	51.6 *10.5*	51.4 *10.1*
Gender			
Proportion of women %	22.3	30.8	45.9
BMI			
Number, *% of primary selection*	1 036 *48.2*	*444 65.7*	218 *27.3*
Mean SD	26.9 *3.5*	27.4 *4.8*	26.6 *4.4*
ASA-class			
Number, *% of primary selection*	1 062 *49.4*	450 *66.6*	218 *27.3*
I %	69.0	56.9	65.1
II %	28.8	38.4	33.5
III– %	2.2	4.6	1.4
Diagnosis number, *%*			
Primary osteoarthritis	1 848 *86.0*	403 *59.7*	608 *76.4*
Acute trauma, hip fracture	0	4 *0.6*	0
Other secondary osteoarthritis	301 *14.0*	268 *39.7*	188 *23.6*
Reason for revision number, *%*			
Loosening/osteolysis	*76 3.5*	35 *5.2*	44 *5.5*
Infection	8 *0.4*	14 *2.1*	15 *1.9*
Periprosthetic fracture	*62 2.9*	9 *1.3*	1 *0.1*
Dislocation	3 *0.1*	2 *0.3*	6 *0.8*
Only pain	9 *0.4*	5 *0.7*	5 *0.6*
Pseudotumor/"cyst"/high metal ion concentration	*73 3.4*	*62 9.2*	13 *1.6*
Other causes	23 *1.0*	8 *1.2*	8 *1.0*
Non-reoperated	1 895 *88.2*	540 *80.0*	*704 88.4*

Table 7.4.3. Duration of follow-up, demography and reason for revision in three patient groups with both articulating surfaces made of metal operated 1999–2019.

mean age during insertion of a resurfacing prosthesis is just under 50 years in the Swedish Hip Arthroplasty Register and none of the patients are older than 79 years of age. No one of these patients has been operated due to an acute fracture or a tumour. To make a control group clinically relevant considering the existing prostheses that today are chosen for the younger, these control patients have been chosen among the patients that have the five most commonly used cemented and uncemented implants during the last five years. Regarding cemented stems the selection has been limited to three since these three stem types (MS30, Exeter standard and Lubinus SP II) completely dominate the Swedish market. Furthermore, only prostheses with a femoral head made of metal or ceramics, which articulates against highly crosslinked polyethylene or ceramics, have been chosen as controls (table 7.4.4). Matching[1] has been carried out so that each patient with a resurfacing prosthesis has been matched to a control patient with a standard prosthesis based on age, gender, diagnosis and year of operation. The last variable entails that the distribution of the different selected prostheses in the control group differs from the distribution that is the case today, since the duration of follow-up in the two groups otherwise will differ. Otherwise we think that the control group relatively well mirrors the prosthesis types and prosthesis materials we choose today for younger patients with a not too deviant skeletal anatomy.

Prostheses in the control group

Cup *cemented*	**Number** *%*
Lubinus x-link	33 *1.5*
Exeter Rim-fit	26 *1.2*
Marathon	148 *6.9*
ZCA XLPE	266 12.4
IP Link	0 *0.0*
CUP *uncemented*	
Pinnacle Gription	*31 1.4*
Pinnacle	140 *6.5*
Trilogy	1241 *57.3*
Trident	229 *10.7*
Continuum	35 *1.6*
STAM *cemented*	
SP II standard	124 *5.8*
Exeter standard	64 *3.0*
MS 30 polished	99 *4.6*
STAM *uncemented*	
Corail	430 *20.0*
CLS	977 *45.5*
Accolade	208 *9.7*
Bi-Metric	239 *11.1*
M/L Taper	8 *0.4*

Table 7.4.4. Prosthesis in the control group. The number refers to after matching against resurfacing prosthesis.

The composition of the study group with resurfacing prosthesis and the control group is shown in table 7.4.5. ASA-class and BMI could not be used during the matching since the registration of these variables did not start until 2008, but they are part of the table anyway for information. It should also be noted that the analysis is based on the number of operations, which means that patients with a bilateral prosthesis of the same type can have a theoretical effect on the reliability of the results. In this case we have however prioritised to account for all reported operations.

During the duration of the follow-up we find that hips with a resurfacing prosthesis are revised more often and especially due to loosening, pseudotumor and periprosthetic fracture. After 15 years, the implant survival rate in the control group is 94.0 ± 1.6 % and in the group with resurfacing prosthesis around 9 percentage points lower (84.9 ± 2.1 %). In general, the risk for revision of a resurfacing prosthesis is 2.5 times that of the control group (Hazard Ratio, HR; 95 % confidence interval = 2.0–3.2). As expected, adjustment for gender, age and diagnosis does not affect this risk since gender, age and diagnosis became relatively equally distributed between the groups as a result of the matching. A separate analysis of men and women shows that the risk is increased for both genders, even if the difference is much greater for women (HR = 7.0; 4.3–11.3) than for men (HR = 1.6; 1.2–2.1, unadjusted data for both sexes). Out of the resurfacing prostheses that have been inserted during more than 100 operations (stem component BHR, BHR Upgrade, Durom and ASR), we find that the proportion of revised prostheses varies between 4.9 % and 15.7 % (table 7.4.1). BHR Upgrade has the lowest proportion of revised prostheses and almost three years shorter duration of follow-up compared with BHR Standard. ASR and Durom have the highest proportions of revised prostheses.

[1] Propensity score matching, nearest neighbor.

In a fifteen-year perspective we find that the risk of revision during use of a resurfacing prosthesis is increased by 70 percent for men and by 700 percent for women. In the light of these data it is not motivated to use this type of prosthesis. Available data also indicate that other types of metal-on-metal articulating prostheses that are used in Sweden show similar or worse results as resurfacing prostheses even if a more in-depth analysis has not been carried out in this annual report. The high proportion of revisions due to problems related to the release of metal ions from prostheses with both articulating surfaces made of metal supports Swedish Hip and Knee Society's recommendations regarding continuous follow-up of patients with these types of hip prosthesis.

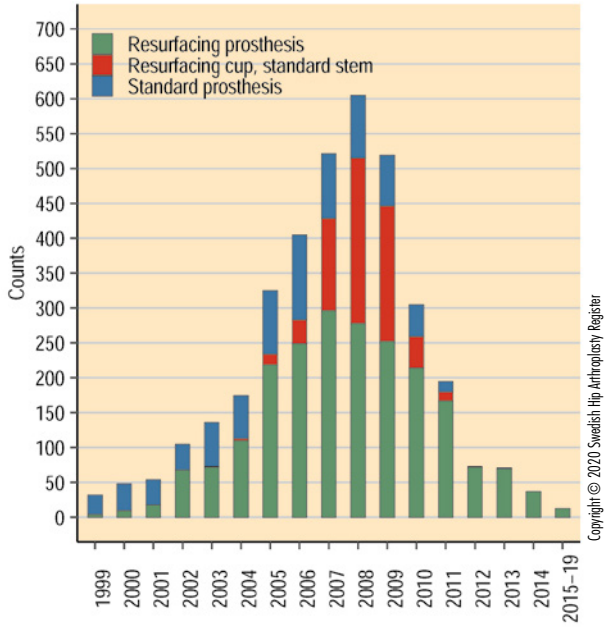

Figure 7.4.1. Distribution of prostheses with both articulating surfaces made of metal, based on year of operation.

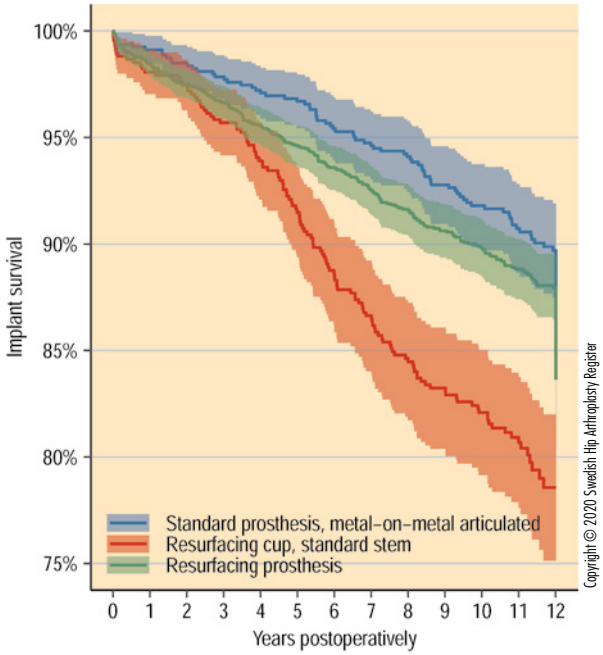

Figure 7.4.2. Survival diagram for prostheses with both articulating surfaces made of metal. (Blue, n = 796) Conventional prosthesis type. (Green, n = 2 149) Resurfacing prosthesis. (Red, n = 675) Resurfacing cup and conventional stem.

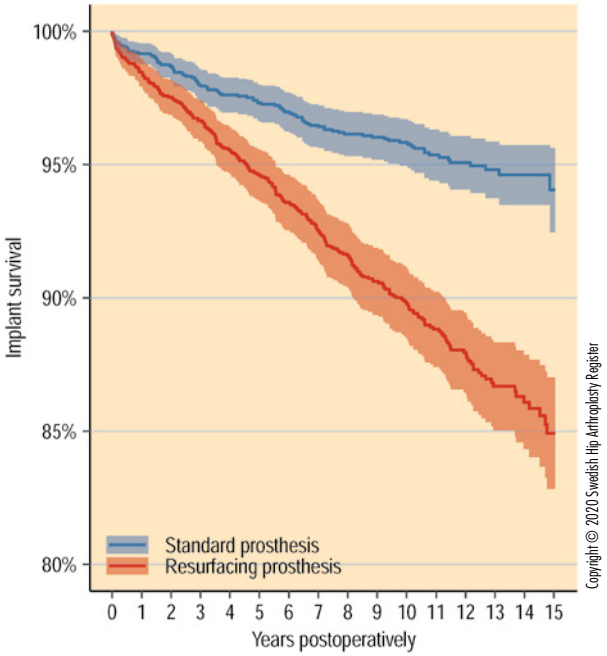

Figure 7.4.3. Survival diagram for resurfacing prostheses (red, n = 2 149) and concurrent conventional prostheses (blue, n = 2 149) with femoral head made of metal or ceramics articulating against crosslinked polyethylene or ceramics where gender, age, diagnosis and year of operation have been used in order to make the groups as similar as possible.

Duration of follow-up, demography and reason for revision for resurfacing prostheses and standard prostheses after matching

	Prosthesis type	
	Resurfacing prosthesis	*Standard prosthesis*
Number of operated hips *patients*	2,149 *1,836*	2,149 *2,028*
Duration of follow-up *mean SD*	10.8 *3.7*	10.6 *3.3*
Age *mean SD*	49.9 *8.7*	50.0 *9.8*
Gender		
Proportion women %	22.3	22.8
BMI-class number, *% with data*	1,036 *48.2*	1,097 *48.2*
<25	325 *31.2*	281 *13.1*
25–34	681 *31.7*	735 *34.2*
35–	30 *1.3*	81 *3.8*
ASA-class number, *% with data*	1,062 *49.4*	1,111 *51.7*
I %	733 *34.1*	582 *27.1*
II %	306 *14.2*	448 *20.8*
III– %	23 *1.1*	81 *3.8*
Diagnosis number, *%*		
Primary osteoarthritis	1,848 *86.0*	1,729 *80.5*
Sequelae after trauma	6 *0.3*	3 *0.1*
Other secondary osteoarthritis	295 *13.7*	417 *19.4*
Reason for revision number, *%*		
Loosening/osteolysis	76 *3.5*	23 *1.1*
Infection	8 *0.4*	34 *1.6*
Periprosthetic fracture	62 *2.9*	9 *0.4*
Dislocation	3 *0.1*	22 *1.0*
Only pain	9 *0.4*	2 *0.1*
Pseudotumor/"cyst"/high metal ion concentration	73 *3.4*	2 *0.1*
Other causes	23 *1.0*	6 *0.2*
Non-reoperated	1,895 *88.2*	2,051 *95.4*

Table 7.4.5. Duration of follow-up, demography and reason for revision for resurfacing arthroplasties and standard arthroplasties after matching.

7.5 Restrictions after hip arthroplasty

Author: Kiril Gromov

Dislocation is one of the most common complications after a total hip arthroplasty and affects 0.5–3 % of all patients who have undergone such an operation. Swedish Hip Arthroplasty Register annual report from 2019 shows that 15 % of the revisions within two years after a primary total hip arthroplasty are due to dislocation, which makes it the second most common reason for revision. It can be shown that the risk for dislocation may be affected by factors associated to the surgical execution of the operation and to the patient. These encompass surgical approach, type of implant, femoral head size, age, gender, spine malformation and cognitive functions.

Traditionally, many surgeons have used postoperative restrictions or precautionary measures to try to minimise the risk of dislocation, and the use of restrictions is included in several national guidelines for postoperative care after a primary total hip arthroplasty. The arguments behind postoperative restrictions have however been questioned by more novel research findings regardless of surgical approach. This has been summarised in a systematic review, which established that a more liberal attitude when it comes to lifestyle and precautions did not increase the frequency of dislocations after total hip arthroplasty (van der Weegen et al. 2016). Several studies have confirmed these findings, where centres in both Europe (Peters et al. 2019) and in the United States (Tetreault et al. 2020) have reported that no increase of the dislocation risk can be seen when minimal or no restrictions have been applied, regardless of surgical approach. One possible explanation for the limited effect of postoperative restrictions may be the use of larger femoral heads, which may be protecting against dislocation. Another possible explanation is that the patients simply do not adhere to the restrictions, which renders these obsolete. A survey study, which was carried out in a collaboration between the Nordic hip arthroplasty registers, shows that all hospitals that responded in Sweden, Norway, Denmark and Finland have changed their mobilisation procedures within the last five years. All but two hospitals changed to a less strict application (Gromov et al. 2019). 38 % of the hospitals in Sweden did not use any postoperative restrictions, compared with 50 %, 41 % and 19 % in the hospitals in Denmark, Finland and Norway respectively.

An argument for the abandonment of the restrictions, beyond them not having any effect on the risk for dislocations, is the potential negative effect on both physical and mental early patient recovery (van der Weegen et al. 2016, Lightfoot et al. 2020). It is important to stress that the available evidence regarding the lifting or reduction of postoperative restrictions only is applicable on primary total hip arthroplasties and that there are no studies today that looks into the effect restrictions have after revised total hip arthroplasties or hip arthroplasties that take place due to femoral neck fracture.

Evidence-based treatment is a central aspect of the fast-track concept, which is well-established in all Nordic countries and has led to a decrease of the duration of hospital stay without giving up on the patient safety (Berg et al. 2018). This challenges the hip arthroplasty surgeon to think beyond the implants and consider the surrounding multidisciplinary care that plays an equally important role when it comes to the outcome after total hip arthroplasty. Our study concerning the use of restrictions in the Nordic countries shows the potential of register-collaboration, not just as a way of evaluating implant outcome, but also to study the impact of the surrounding care on an international level. Additional studies should embrace such a collaboration and beyond implant survival also consider patient outcome data.

Berg U, Bülow E, Sundberg M, Rolfson O. No increase in readmissions or adverse events after implementation of fast-track program in total hip and knee replacement at 8 Swedish hospitals: An observational before-and-after study of 14,148 total joint replacements 2011–2015. Acta Orthop. Taylor and Francis Ltd; 2018;89(5):522–7.

Gromov K, Troelsen A, Modaddes M, Rolfson O, Furnes O, Hallan G, Eskelinen A, Neuvonen P, Husted H. Varying but reduced use of postoperative mobilization restrictions after primary total hip arthroplasty in Nordic countries: a questionnaire-based study. Acta Orthop. Taylor and Francis Ltd; 2019; 90(2):143–7.

Lightfoot CJ, Coole C, Sehat KR, Drummond AER. Hip precautions after total hip replacement and their discontinuation from practice: patient perceptions and experiences. Disabil Rehabil. Taylor and Francis Ltd; 2020;

Peters A, ter Weele K, Manning F, Tijink M, Pakvis D, Huis in het Veld R. Less Postoperative Restrictions Following Total Hip Arthroplasty With Use of a Posterolateral Approach: A Prospective, Randomized, Noninferiority Trial. J Arthroplasty. Churchill Livingstone Inc.; 2019;34(10):2415–9.

Tetreault MW, Akram F, Li J, Nam D, Gerlinger TL, Della Valle CJ, Levine BR. Are Postoperative Hip Precautions Necessary After Primary Total Hip Arthroplasty Using a Posterior Approach? Preliminary Results of a Prospective Randomized Trial. J Arthroplasty. Churchill Livingstone Inc.; 2020;

van der Weegen W, Kornuijt A, Das D. Do lifestyle restrictions and precautions prevent dislocation after total hip arthroplasty? A systematic review and meta-analysis of the literature. Clin Rehabil. 2016;30(4):329–39.

van der Weegen W, Kornuijt A, Das D, Vos R, Sijbesma T. It is safe to use minimal restrictions following posterior approach total hip arthroplasty: results from a large cohort study. HIP Int. SAGE Publications Ltd; 2019;29(6):572–7.

8. Reoperation

8.1 Definition and trends

Author: Johan Kärrholm

Reoperation includes all types of surgical procedures that can be related directly to an earlier inserted hip prosthesis, regardless if the prosthesis or any of its parts have been changed, extracted or left untouched. The proportion of reoperations (regardless if the hip is reoperated earlier or not) related to the annual production of primary arthroplasties and reoperations has decreased successively. Between 1993 and 1995, the reoperations accounted for 14.5 % and have thereafter decreased to 10.6 % of the total during the period 2017 to 2019 (figure 8.1.1). The absolute number of reoperations increased successively to a plateau around 2 400 per year between 2009 and 2015, to decrease thereafter. During 2019, the number had decreased to 2 123 reported operations (figure 8.1.2). The reason for this decrease is not known, it could be real, but it could also be due to underreporting. Earlier, we have found that the reporting of reoperations without change or extraction of at least one prosthesis part is inadequate. Such procedures also comprise DAIR procedures without any component change and internal fixation of a periprosthetic fracture. Regarding periprosthetic fractures, they are nowadays linked automatically to the Swedish Hip Arthroplasty Register from the Swedish Fracture Register, which should entail that the earlier noticed problems with underreporting would have been reduced considerably.

The relation between reoperations and primary operations gives some indication of to what extent reoperations occupy healthcare resources dedicated to hip arthroplasty in one country or within a region. It is however not a suitable measure due to its sensitivity for fluctuations of the number of performed primary operations. The ratio is also affected by many other factors such as patient flow between hospital areas, the attitude of the medical profession towards carrying out reoperations and of the time-period during which hip arthroplasty has been carried out within a defined region or country. The reporting of reoperations is inferior compared to reporting of primary operations. This seems to be true especially for reoperations where the implant is left untouched. The reason for this is not known. It could be that these reoperations commonly are carried out by orthopaedic surgeons without a special profiling towards arthroplasty. The lack of knowledge that reoperations are to be reported to the register, even though the prosthesis itself has not been changed or extracted, is another explanation. Insufficient penetration of information left by the Register Management may also have contributed. We hope however that the awareness within the profession regarding the importance of reporting also these procedures will improve. The possibility to link data with the Patient Register is tested but is sometimes made difficult due to too unspecific procedure codes.

Distribution of reoperations between hospitals

From 2005 and onwards, most of the reoperations were carried out at county hospitals (between 1 089 and 1 291 per year and unit), followed by university hospitals (between 618 and 836 per year and unit). Local hospitals accounted for between 215 and 301 reoperations per year and unit, and private hospitals accounted for between 78 and 204 per year and unit (figure 8.1.3A–D). During 2019, reoperations were carried out at 63 units in Sweden, of which half took place at 12 units. These 12 units performed between 69 (Gävle) and 160 reoperations (SU/Mölndal). 23 units performed only a few procedures during 2019, between one and ten reoperations.

Demography

The demography for patients undergoing reoperation has changed over time. Changes that have taken place since 1981 were described in the annual report of 2015. We found that the mean age has increased by around three years between the periods 1981–1995 and 2011–2015 and that the proportion of patients over 85 years old has risen from 3.1 % to 11.4 %.

This year's report compares three periods (2008–2010, 2012–2014, 2017–2019). Furthermore, demographic data over primary arthroplasties carried out during the last three-year period are shown. Table 8.1.1 shows that the mean age has continued to increase over the last period to become more than 3 years higher than the mean age of patients who undergo primary hip arthroplasty. The proportion of men that is reoperated is higher than the proportion operated with a primary arthroplasty, since men in general are reoperated more often than women.

The proportion of reoperated patients who have a BMI of 35 or more, has increased and is somewhat higher than observed for patients operated with primary arthroplasty. This is well in agreement with the observation that this patient group has a higher risk of being afflicted by prosthesis-related complications. The same applies to patients with ASA class II and above, and even more pronounced. Patients undergoing reoperation more commonly have a high degree of comorbidity than those operated with a primary arthroplasty and the differences between the groups tend to increase.

In summary, men are more likely to undergo reoperation than expected based on the gender distribution in the group operated with primary arthroplasty. Patients who undergo reoperation also tend to be a little older, have a somewhat higher BMI and a higher degree of comorbidity compared with the situation at primary arthroplasty. Furthermore, the degree of comorbidity, and to a lesser extent reported BMI and age, tend to have increased in this group during the last decade.

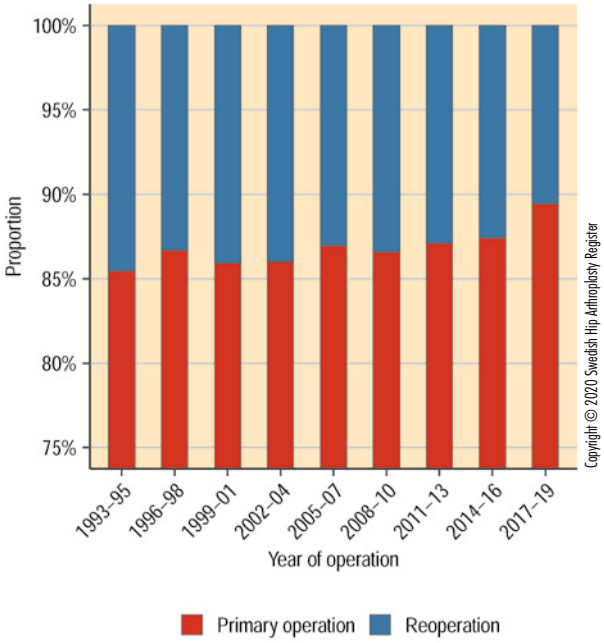

Figure 8.1.1. Distribution between reoperations (revision + other reoperation) and primary hip arthroplasties during the period 1993–2019 divided into three-year periods. The scale of the y-axis is adjusted and starts at 75 %. The proportion of reoperations of the total number of hip arthroplasties has decreased from 14.5 % during the period 1993–1995 to 10,6 % during the last three-year period.

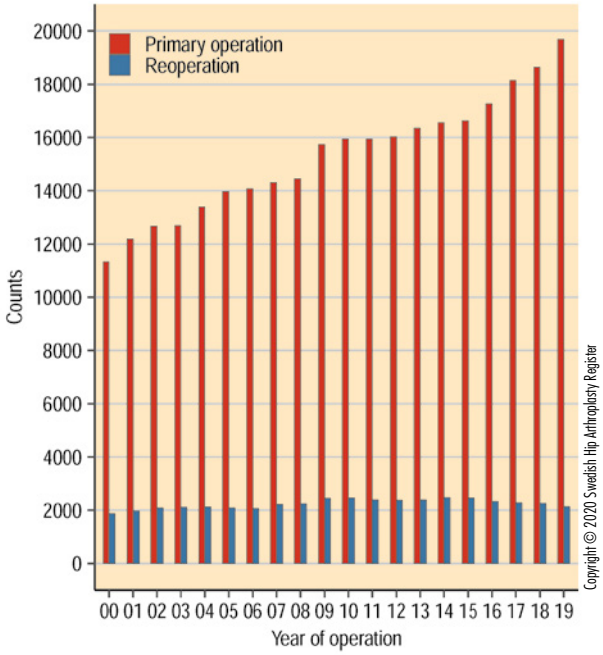

Figure 8.1.2. The number of primary operations and reoperations annually during the period 2000–2019.

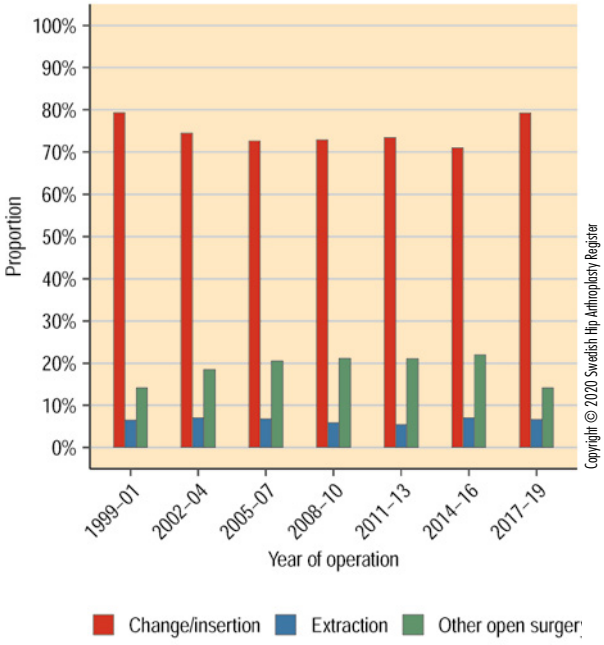

Figure 8.1.4. Distribution of the main measures change/insertion, extraction and other measures where the implant is not affected during three-year periods 1999–2019.

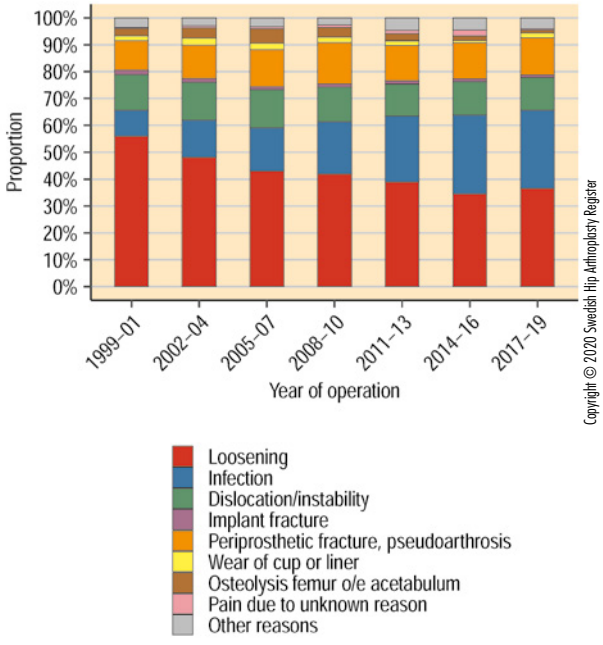

Figure 8.1.5. The eight most common reasons of reoperation during three-year periods 1999–2019.

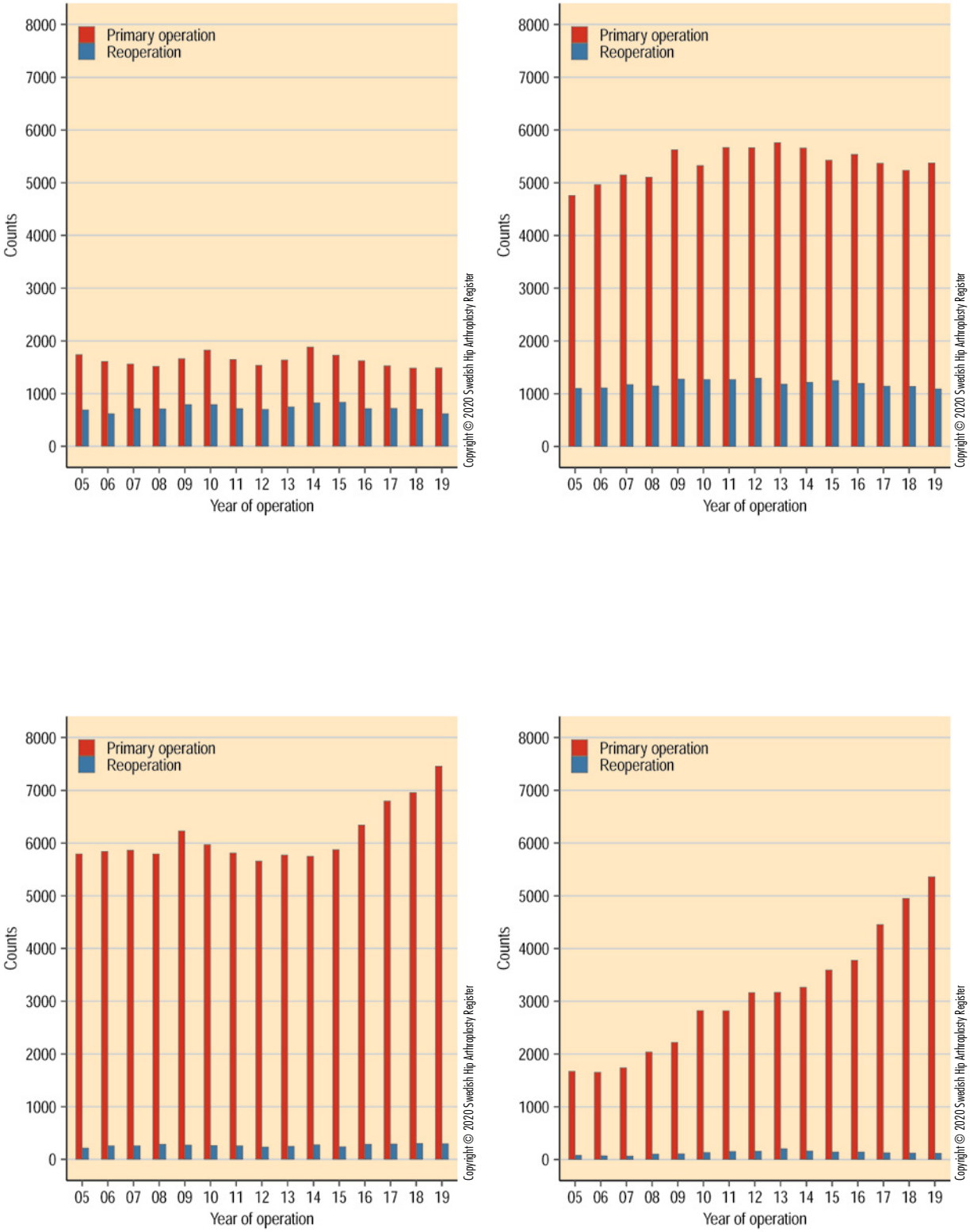

Figure 8.1.3 A–D. Distribution of reoperations and primary hip arthroplasties between different types of hospitals during the period 2005–2019. As a group the county hospitals account for most reoperations but counted per hospital many of the relatively fewer university hospitals are among the top producers. A=University/regional hospital, B=County hospital, C=Local hospital, D=Private hospital.

Reason for reoperation

At the reorganisation of the Swedish Hip Arthroplasty Register database, the number of reasons for reoperation were reduced from over 200 to around 30. In the new database, the number of predefined causes has been reduced to around 30, moreover, an extra variable has been added in those cases when an additional cause needs to be registered. Table 8.1.2 presents reason for reoperation in detail for the first two decades of the 2000s divided into first time reoperations and reoperations that have been preceded by at least one earlier reoperation. Reasons defined in the old database have as far as possible been reclassified to fit into the new subdivision. Also, in table 8.1.2 there has been a certain simplification. All osteolysis cases have for example been grouped together regardless of location. It should also be pointed out that in the majority of the analyses that the Swedish Hip Arthroplasty Register presents classification of reasons has been simplified. The causes wear, osteolysis and loosening are for example often grouped under the heading loosening. Data in table 8.1.2 may be used to study time-trends in broad terms but may also be of help for the interested reader to review the possibilities to carry out more in-depth analyses of less common reasons for reoperation.

Figure 8.1.5 presents the most common reasons for reoperation. Since the period 1999−2001 the proportion of reoperations due to loosening has been reduced successively and the proportion of reoperations due to infection have increased. During the last six years this trend has been broken and if one compares the period 2014–2016 with the three-year period thereafter up to 2019, the proportion of loosenings has increased somewhat and the proportion of infection has been relatively constant. In both figures 8.1.6 and 8.1.1 the proportion of reoperations compared to the total volume of arthroplasty operations is shown with the difference that the most common reasons for reoperation also are given. The reason for the decrease of the relative proportion of reoperations is not entirely clear but it is reasonable to think an increased quality of the primary arthroplasty including implant selection and the addition of improved articulating materials ought to have had an effect. If one studies the proportion of reoperated within ten years one also sees an even more dramatic reduction of the proportion of reoperated due to loosening (figure 8.1.7) compared with data in figure 8.1.6, where all reoperations regardless of point in time of the primary operation and regardless if is a first-time reoperation or not, are illustrated. Despite the marked decrease of first-time reoperations within ten years from 17.2 % for primary operations carried out 1992–1994 to 6.1 % for primary operations carried out 2007−2009, reoperation due to infection has increased from 0.8 % to 1.3 % between these time-periods.

Reoperation without change/extraction of implants

Reoperations without change or extraction of implant parts are often due to infection or fracture. In the beginning of the 2000s, dislocation was another dominant cause but it has decreased in frequency, probably due to the fact that it has become increasingly more unusual to only carry out an open reduction without changing liner and femoral head or perform a more extensive procedure such as cup and maybe also a stem revision (figure 8.1.8).

The measures where the implant is left in situ are dominated by irrigation/synovectomy especially during the more recent half of the twenty-year period, something that can be seen as remarkable as analysis in annual reports of previous years indicate that this measure results in a poorer degree of healing compared to if the femoral head and eventual liner are changed at the same time. Another common reoperation without implant change/extraction is fracture reconstruction, of type C-fractures in the first place but also of type B-fractures, predominantly in those cases when the stem is deemed fixated (B1). Operation with an acetabular wedge augment (as open reduction, which has been pointed out above) has decreased heavily and almost disappeared at the end of the period. This development is motivated against the background that other measures such as cup revision are considerably more effective in hindering relapsing dislocation demanding surgical intervention.

The number of reoperations compared with the total number of arthroplasties has decreased during the last two decades to just under 11 % in the period 2017−2019, mainly because reoperation due to loosening has decreased.

Reoperation due to infection has increased. It is not clear if this is because of a more active stance towards surgical treatment of an infected hip prosthesis or if it corresponds to a real increase of the number of infections, but both factors have likely contributed to this development.

Men have more reoperations than expected based on the gender distribution during primary operation.

Patients undergoing reoperation are older, have a higher BMI and a higher degree of comorbidity than those patients that undergo a primary operation.

During the last decade, the degree of comorbidity and to some extent observed BMI and age has increased among patients undergoing reoperation.

Be thorough and report all reoperations, also those where no implant part is changed. The reoperation frequency is one of our most important benchmarks for quality.

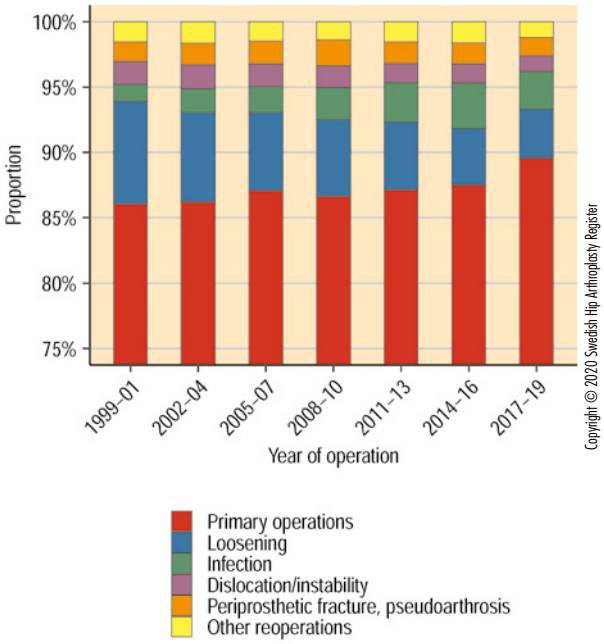

Figure 8.1.6 The distribution between reoperations and primary hip arthroplasties during the period 1999–2019 divided into three-year periods. The y-axis scale is adjusted and starts at 75 %. The proportion of reoperations has decreased, mainly due to the more than halving of the reason of reoperation-group aseptic loosening, while the proportion of reoperations due to infection has increased and accounted for around 3 % of all hip arthroplasty-related activity during 2017–2019.

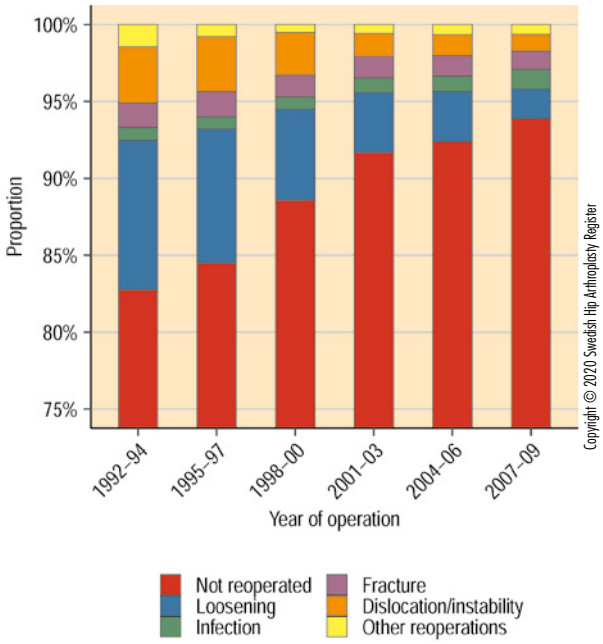

Figure 8.1.7 Distribution of reasons of reoperation within ten years after primary operation with total hip arthroplasty during three-year periods 1992–2009. For all six periods, reoperations after ten years have been excluded to facilitate comparison.

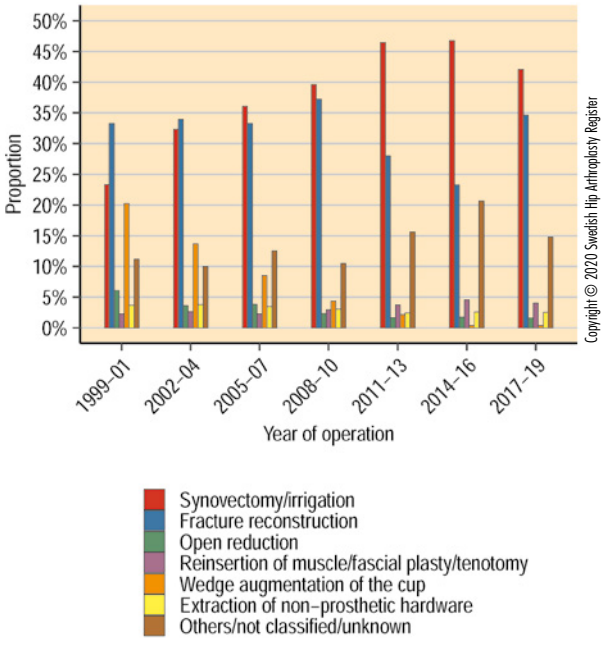

Figure 8.1.8 Distribution of reoperations without change/extraction of implants during three-year periods from 1999 to 2019.

Demography during reoperation since first year of BMI and ASA registration. Primary operations carried out during the last period 2017–2019 for comparison.

	Reoperation			Primary operation
	2008–2010	2012–2014	2017–2019	2017–2019
Number	7,153	7,239	6,663	63,127
Age				
Mean, SD	71.9 *11.3*	71.5 *11.4*	72.4 *11.0*	69.4 *10.8*
< 55 years, %	7.4	7.8	6.4	9.8
55–69 years, %	30.8	31.6	27.7	34.9
70–84 years, %	50.0	49.5	53.6	49.4
>= 85 years, %	11.8	11.1	12.3	5.9
Gender				
Proportion of women, %	53.7	50.2	50.9	57.5
BMI				
Number with reported data, *%*	5,098 *71.5*	6,262 *86.5*	6,196 *93.0*	61,085 *96.7*
Mean, SD	27.1 *5.7*	27.3 *5.6*	27.5 *5.0*	27.1 *4.6*
< 18.5 %	2.0	1.8	1.3	1.1
18.5–24.9 %	34.2	32.0	32.2	32.9
25–29.9 %	39.7	41.8	38.9	41.1
30–34.9 %	18.1	17.1	19.5	19.2
> 35 %	6.0	7.4	8.1	5.7
ASA-class				
Number with reported data, *%*	6,028 *83.3*	6,785 *93.7*	6,585 *96.1*	62,272 *98.6*
I, %	13.2	11.0	7.3	18.4
II, %	52.6	50.9	50.2	58.6
III–, %	34.2	38.1	42.5	23.1
Diagnosis during primary operation				
Primary osteoarthritis	70.4	72.1	75.8	80.8
Fracture/trauma including sequelae	10.0	10.9	9.2	11.0
Inflammatory joint disease	6.7	5.5	3.4	0.9
Sequelae after childhood disease	4.4	3.6	3.1	1.9
Idiopathic necrosis	1.7	1.9	2.6	2.5
Other secondary osteoarthritis	3.0	3.5	4.8	2.8
Not available	3.8	2.5	1.1	0.1

Table 8.1.1. Distribution of gender, age, BMI and ASA-class during all types of reoperation during three periods 2008–2019. Data for primary operated patients 2017–2019 is shown for comparison. Diagnosis data may differ from previous year partly due to a new classification of ICD-codes.

Detailed reason for reoperation during the last ten-year periods#

Cause number %	2000–2009		2010–2019	
	First reoperation	At least one earlier reoperation	First reoperation	At least one earlier reoperation
Loosening	7,421 *52.5*	1,921 *32.2*	6,659 *43.6*	1,669 *23.6*
Fracture femur	1,938 *13.7*	695 *11.7*	2,370 *15.5*	692 *9.8*
Dislocation, instability	1,772 *9.2*	997 *16.7*	1,789 *11.7*	938 *13.3*
Infection	1,295 *9.2*	1,731 *29.0*	2,789 *18.3*	3,181 *45.0*
Osteolysis acetabulum and/or femur	709 *5.0*	114 *1.9*	390 *2.6*	48 *0.7*
Cup/liner wear	416 *2.9*	56 *0.9*	297 *1.9*	35 *1.0*
Implant rupture incl. plate rupture	180 *1.3*	91 *1.5*	158 *1.0*	87 *1.2*
Unclear pain	89 *0.6*	45 *0.8*	192 *1.3*	89 *1.3*
Faulty inserted implant	45 *0.3*	20 *0.3*	40 *0.3*	11 *0.2*
Trochanteric problems, limp	37 *0.3*	23 *0.4*	109 *0.7*	19 *0.3*
Loose implant part	34 *0.2*	18 *0.3*	8 *0.1*	7 *0.1*
Heterotopic bone formation	30 *0.2*	11 *0.2*	42 *0.3*	18 *0.3*
Bleeding, hematoma	27 *0.2*	31 *0.5*	39 *0.3*	54 *0.8*
Material left behind (not cement)	25 *0.2*	51 *0.9*	14 *0.1*	20 *0.3*
Wound complication (rupture, granuloma)	23 *0.2*	13 *0.2*	21 *0.1*	20 *0.3*
Difference in bone length	21 *0.1*	6 *0.1*	14 *0.1*	7 *0.1*
Inadequate cementation/loose piece of cement	19 *0.1*	8 *0.1*	32 *0.2*	7 *0.1*
Dislocation/fracture of spacer		34 *0.6*		35 *0.5*
Delayed fracture healing	10 *0.1*	83 *1.4*	11 *0.1*	69 *1.0*
Heightened metal ion concentrations	8 *0.1*	1 *0.01*	66 *0.4*	8 *0.1*
Malignant or benign tumour	5 *0.04*	1 *0.02*	9 *0.1*	4 *0.1*
Fracture under resurfacing prosthesis	4 *0.03*		25 *0.2*	2 *0.03*
Cyst/bursa	3 *0.02*	1 *0.02*	11 *0.1*	2 *0.03*
ALVAL/pseudotumor	1 *0.01*		118 *0.8*	23 *0.3*
Fracture acetabulum	1 *0.01*	1 *0.02*	13 *0.1*	7 *0.1*
Allergy		1 *0.02*	2 *0.01*	3 *0.03*
Per operative fracture (previous op.)			2 *0.01*	2 *0.03*
Nerve or vascular injury			2 *0.01*	1 *0.01*
Other causes	25 *0.2*	8 *0.1*	42 *0.3*	17 *0.2*
Not available	7 *0.05*	2 *0.03*	1 *0.01*	
Total number	**14,145**	**5,963**	**15,265**	**7,074**

 # In two-stage operations only the reason for the first intervention is provided. If more than one reason is given only the main reason is included.

Table 8.1.2. Distribution of reasons for reoperation on a detailed level during the last 20 years divided into ten-year periods for first time procedures and procedures in hips previously reoperated at least one time earlier. The table gives the number followed by the proportion in percentages in italics. Numbers over 100 in bold.

8.2 Reoperation within two years

Author: Maziar Mohaddes

Reoperation within two years is used as a quality indicator for primary hip arthroplasties. The background for this is that the most common causes for early reoperation are infection and dislocation. The distribution of reason for early reoperation has varied, especially during the first year after primary operation (figure 8.2.1). In the beginning of the 2000s, dislocation and deep infection were about just as common. The proportion of reoperations due to dislocation has however decreased while the proportion of reoperations due to infection has increased. This could mirror that Swedish surgeons have become better at identifying and taking measures to prevent dislocation. The increasing proportion of infections may also indicate that surgeons have a more active attitude towards surgical treatment after infection. Another explanation may be an increased awareness that reoperations without implant change also should be reported. If an increased incidence of infections also is the case is not verified, but of course it cannot be ruled out. The proportion of reoperations within two years has varied between 1.6 % and 2.4 % since 2010.

It should however be noted that all the patients who were operated during 2018 and 2019 had not reached the two-year limit when data from the annual report was analysed and for these two years the proportion of reoperation within two years will increase. Reoperation within two years thus refers to all forms of additional surgery after a total hip arthroplasty. This outcome measure mainly reflects early and serious complications. This indicator is therefore quickly available and easier to use for clinical improvement work compared with ten-year survival rate, which is an important but slow and to some extent historical outcome measure. 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 following total hip arthroplasty. The indicator is most probably one of the most important and most influenceable outcome measures that the Swedish Hip Arthroplasty Register reports.

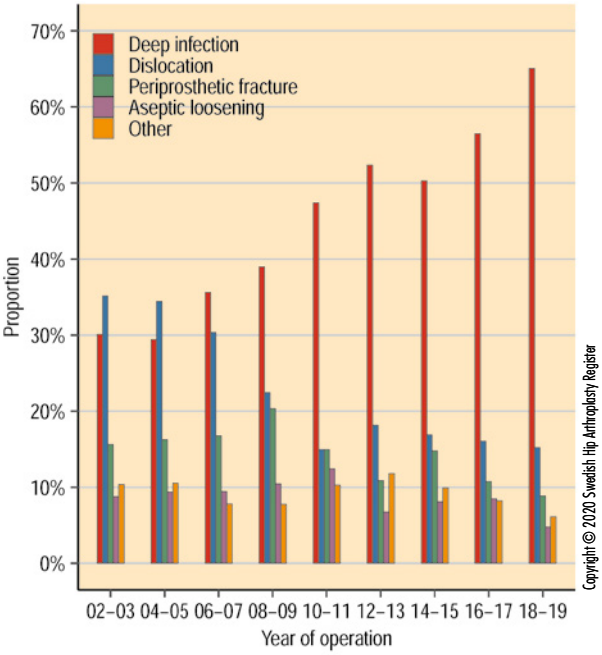

Figure 8.2.1. The distribution of the reasons for reoperation within two years after the primary operation divided into six time-periods between 2002 and 2019

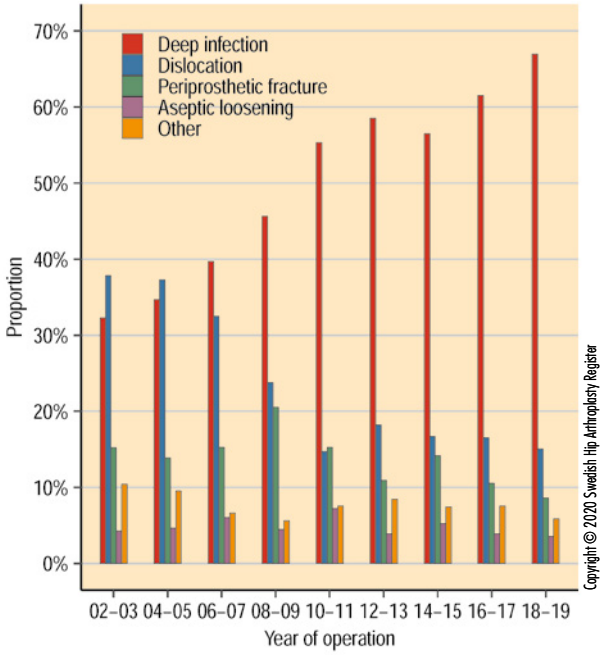

Figure 8.2.2. The distribution of the most common reasons for reoperation during the first year after primary operation divided into different time-periods between 2002 and 2019.

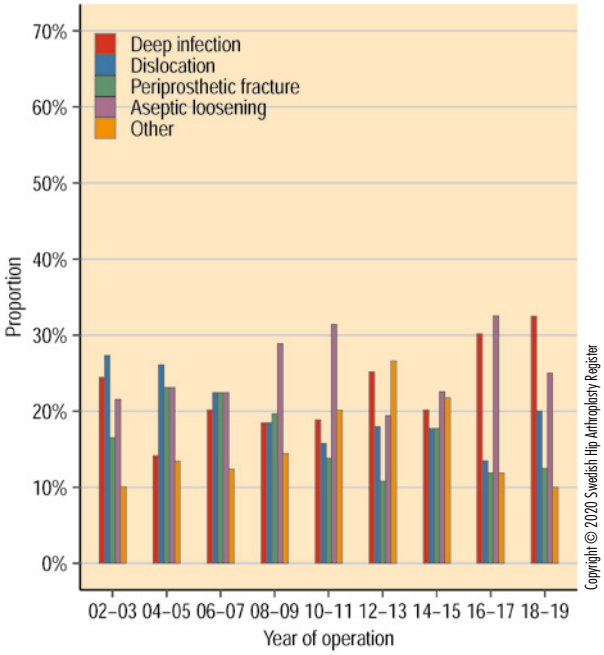

Figure 8.2.3. Distribution of the most common reasons of reoperation during the second year after primary operation divided into different time-periods between 2002 and 2019.

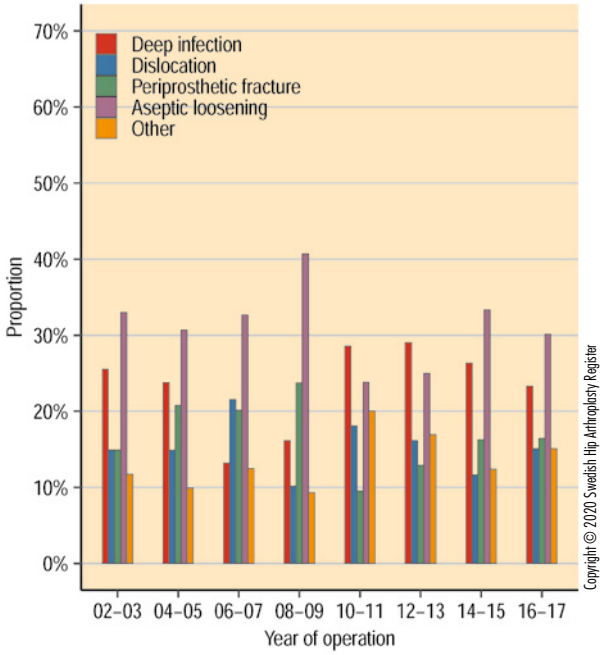

Figure 8.2.4. The distribution of the most common reasons of reoperation during the third year after primary operation divided into different time-periods between 2002 and 2017.

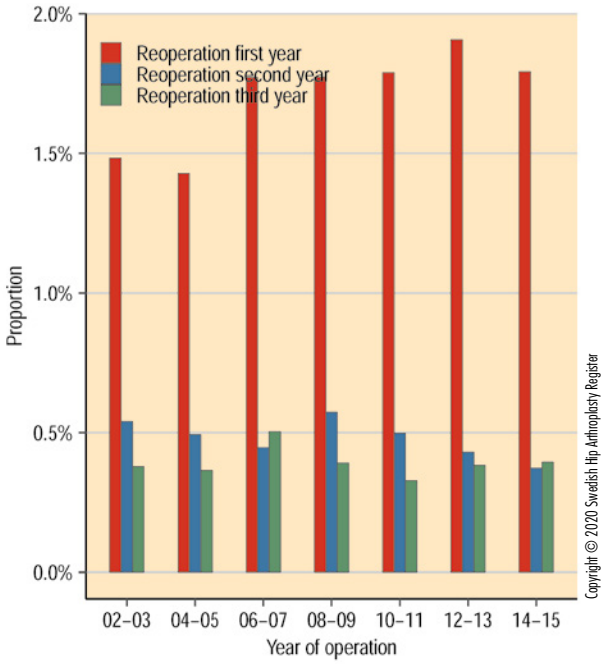

Figure 8.2.5. The proportion of reoperations during the first to the third year after primary operation related to year of primary operation. Years of primary operation where the observational time has not yet been attained have been excluded.

Reoperations within two years per unit, primary operation

2016–2019

	Primary op.	Reoperation[1]		Deep infection		Dislocation		Fracture		Other	
Unit	**Number**	**Number**	**Proportion, %[2]**	**Number**	**Proportion, %**	**Number**	**Proportion, %**	**Number**	**Proportion, %**	**Number**	**Proportion, %**
University or regional hospital											
Karolinska/Huddinge	799	21	3.1	11	1.5	3	0.5	3	0.5	4	0.6
Karolinska/Solna	397	22	5.9	12	3.1	3	0.8	2	0.5	4	1.1
Linköping	272	9	3.6	3	1.1	6	2.4	0	0	0	0
SU/Mölndal	2,423	64	3	43	2	12	0.6	4	0.2	5	0.2
SUS/Lund	572	12	2.4	6	1.2	3	0.5	2	0.5	1	0.2
SUS/Malmö	148	3	2.3	0	0	2	1.5	0	0	1	0.9
Umeå	385	9	2.6	7	1.8	1	0.3	1	0.5	0	0
Uppsala	926	28	3.3	18	2.1	4	0.4	2	0.2	4	0.5
Örebro	197	6	3.2	2	1.1	1	0.5	2	1.1	1	0.5
County hospital											
Borås	597	10	1.9	7	1.2	1	0.2	2	0.5	0	0
Danderyd	1,137	43	4	22	2	11	1	8	0.7	2	0.2
Eksjö	931	37	4.2	33	3.7	1	0.1	2	0.3	1	0.1
Eskilstuna	470	13	2.9	11	2.4	0	0	1	0.3	1	0.2
Falun	843	32	4.3	12	1.5	0	0	3	0.4	17	2.4
Gävle	864	14	1.8	8	1	2	0.2	0	0	4	0.6
Halmstad	845	23	2.9	15	1.9	5	0.7	1	0.1	0	0
Helsingborg	309	14	4.7	9	3	4	1.3	1	0.3	0	0
Hässleholm	3,207	48	1.7	34	1.1	1	0	9	0.3	4	0.1
Jönköping	796	22	3.1	14	1.9	2	0.3	1	0.1	5	0.8
Kalmar	705	8	1.2	3	0.5	1	0.1	1	0.1	3	0.5
Karlskrona	153	4	2.6	1	0.7	3	2	0	0	0	0
Karlstad	729	33	5	27	3.8	1	0.1	3	0.6	2	0.5
Kristianstad	157	1	0.7	1	0.7	0	0	0	0	0	0
Norrköping	1,037	11	1.3	6	0.7	0	0	0	0	5	0.6
NÄL	165	3	2.5	2	1.4	0	0	0	0	1	1.1
Skövde	540	28	5.3	23	4.3	1	0.2	3	0.6	1	0.2
Sunderby	150	2	2	1	1.3	1	0.7	0	0	0	0
Sundsvall	181	5	2.8	1	0.6	2	1.1	0	0	2	1.1
Södersjukhuset	1,374	34	2.7	19	1.4	5	0.4	8	0.7	2	0.2
Uddevalla	1,528	32	2.3	27	1.9	2	0.1	1	0.1	2	0.2
Varberg	1,055	12	1.3	5	0.5	2	0.2	2	0.2	3	0.3
Västerås	2,015	59	3.2	35	1.9	15	0.8	3	0.2	3	0.2
Växjö	567	24	4.8	18	3.4	3	0.7	0	0	3	0.8
Östersund	1,176	37	3.3	21	1.9	5	0.4	6	0.5	4	0.4

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Reoperations within two years per unit, primary operation, continued.

2016–2019

	Primary op.	Reoperation[1]		Deep infection		Dislocation		Fracture		Other	
Unit	**Number**	**Number**	**Proportion, %[2]**	**Number**	**Proportion, %**	**Number**	**Proportion, %**	**Number**	**Proportion, %**	**Number**	**Proportion, %**
Local hospitals											
Alingsås	785	15	2	15	2	0	0	0	0	0	0
Arvika	852	35	4.6	24	2.9	1	0.2	6	0.8	4	0.6
Enköping	1,633	30	2.2	10	0.7	6	0.4	3	0.2	11	0.9
Falköping	107	2	2	2	2	0	0	0	0	0	0
Gällivare	406	3	0.7	3	0.7	0	0	0	0	0	0
Hudiksvall	477	8	1.8	6	1.4	0	0	1	0.2	1	0.2
Karlshamn	1,069	24	2.6	10	1	9	0.9	1	0.1	4	0.6
Karlskoga	233	9	3.9	7	3.1	0	0	2	0.9	0	0
Katrineholm	1,029	39	4.3	27	2.8	4	0.4	1	0.1	7	1
Kungälv	784	28	3.9	24	3.3	0	0	1	0.1	3	0.4
Lidköping	1,062	25	2.5	8	0.8	11	1.1	1	0.1	5	0.5
Lindesberg	2,350	34	1.6	14	0.6	8	0.4	4	0.2	5	0.3
Ljungby	745	15	2.2	10	1.4	3	0.4	1	0.1	1	0.2
Lycksele	1,215	23	2.2	11	1	3	0.3	4	0.3	5	0.6
Mora	1,071	10	1	8	0.8	2	0.2	0	0	0	0
Norrtälje	671	15	2.5	6	1	4	0.6	1	0.2	4	0.8
Nyköping	687	22	3.3	18	2.7	0	0	0	0	3	0.4
Oskarshamn	1,288	13	1.3	11	1	1	0.1	0	0	1	0.2
Piteå	1,757	12	0.9	0	0	6	0.4	0	0	4	0.4
Skellefteå	552	10	2	4	0.8	2	0.4	1	0.2	3	0.7
Skene	630	7	1.3	4	0.8	1	0.2	0	0	2	0.4
Sollefteå	1,144	17	1.7	8	0.7	4	0.4	2	0.2	3	0.4
Södertälje	684	18	2.8	12	1.8	0	0	3	0.5	3	0.5
Torsby	501	13	2.7	10	2.1	2	0.4	0	0	0	0
Trelleborg	2,783	39	1.6	16	0.6	9	0.4	10	0.4	3	0.2
Visby	555	10	2	3	0.5	2	0.4	1	0.2	4	0.8
Värnamo	618	10	1.7	8	1.3	1	0.2	0	0	0	0
Västervik	565	12	2.2	10	1.8	1	0.2	1	0.2	0	0
Ängelholm	599	7	1.2	6	1	0	0	1	0.2	0	0
Örnsköldsvik	637	6	1.1	3	0.5	2	0.4	0	0%	1	0.2

(the table continues on the next page)

Reoperations within two years per unit, primary operation, continued.

2016–2019

	Primary op.	Reoperation[1]		Deep infection		Dislocation		Fracture		Other	
Unit	Number	Number	Proportion, %[2]	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %
Aleris Specialistvård Bollnäs	1,165	10	1.1	5	0.5	3	0.3	0	0	2	0.3
Aleris Specialistvård Motala	1,961	34	1.8	16	0.8	5	0.3	0	0	12	0.7
Aleris Specialistvård Nacka	984	16	1.8	6	0.6	4	0.5	4	0.5	2	0.2
Aleris Specialistvård Ängelholm	450	6	1.4	4	0.9	2	0.5	0	0	0	0
Art Clinic Göteborg	325	3	1	1	0.3	0	0	1	0.3	0	0
Art Clinic Jönköping	434	2	0.8	1	0.4	1	0.4	0	0	0	0
Capio Artro Clinic	1,012	21	2.8	14	1.9	2	0.2	1	0.1	3	0.4
Capio Movement	1,361	24	2	15	1.2	4	0.4	1	0.1	4	0.3
Capio Ortopedi Motala	329	8	3.8	8	3.8	0	0	0	0	0	0
Capio Ortopediska Huset	2,399	21	1.1	10	0.5	2	0.1	1	0	7	0.4
Capio S:t Göran	2,371	43	2	15	0.7	6	0.3	11	0.5	7	0.4
Carlanderska	1,038	8	0.9	6	0.7	1	0.1	0	0	0	0
Frölundaortopeden	36	1	3.8	1	3.8	0	0	0	0	0	0
GHP Ortho Center Göteborg	885	10	1.5	8	1.2	0	0	1	0.1	1	0.2
Hermelinen Specialistvård	81	0	0	0	0	0	0	0	0	0	0
Ortho Center Stockholm	2,686	38	1.7	19	0.9	12	0.6	4	0.2	3	0.1
Sophiahemmet	1,022	21	2.1	10	1	3	0.3	6	0.6	2	0.2
Country	73,747	1,506	2.3	896	1.3	232	0.4	146	0.2	207	0.4

Table 8.2.1. Units with fewer than 20 primary operations during the time-period are excluded.

[1] Refers to the number of patients with short-term complication, which can differ from the sum of the number of complications as each patient may have more than one type of complication.

[2] All proportions are calculated using competing risk-analysis at two-year follow-up.

8.3 Revision

Author: Johan Kärrholm

Revision of a hip arthroplasty means that a patient who has undergone an earlier hip arthroplasty undergoes an additional operation where the whole or parts of the prosthesis are changed or extracted. During a two-stage procedure these two procedures as seen as one (if not otherwise stated). If for example a primary prosthesis is revised in two stages, the extraction date will become the point in time for the revision of the primary operation, while the insertion date will be the starting point for continued observation of a first-time revision. If the prosthesis is extracted and no later prosthesis insertion is registered (at the latest observation date, 2019-12-31 in this report), the operation is classified as a permanent prosthesis extraction. The lack of a reported prosthesis insertion thus decides if the extraction will be counted as permanent or not. This means that some extractions that have taken place during the latter part of 2019, will be wrongfully classified as permanent.

Since 1979, revisions (and other reoperations) have been reported on an individual level. This entails a possibility to extract more complete data starting with this year, as opposed to registration of primary operations where data was linked to the personal identity number for the first time in 1992. Up to 1991, primary operations were only reported as aggregated data per unit.

Since 1999, both the number of primary operations and the number of revisions have increased, but the increase of the number of primary operations has been greater. During the period 1999–2001, 11 362 primary hip arthroplasties were reported per year. The number of revisions were on mean 1 530 per year (11.9 %) during the same period. The majority of these (9.3 percentage points), were first-time revisions and the rest (2.5 percentage points) were multiple revisions. Around 20 years later (2017–2019), the corresponding number of primary hip arthroplasties was 18 827 (91.3 % of all primary operations + revisions) and the number of revisions was 1 812 per year, of which 6.9 % were first-time revisions and 1.9 % had been revised at least one time earlier (figures 8.3.1a and b).

As the proportion of elderlies, and the number of hip prosthesis-bearing individuals, increases in the population, we may expect that the number of hips that will have been revised multiple times also will increase. Since 1999, the multiple revisions have on mean comprised around 22 % of all revisions with a variation between around 19 % and 24 % without any clear time-trend (figure 8.3.1c). The number of first-time revisions has increased from 3 605 in the period 1999–2001 to 4 247 during the last three-year period. The number of second-time revisions has fluctuated between 753 and 919 per three-year period (annual mean: 251 to 306) and the corresponding number of revisions with at least two earlier revisions has varied between 213 and 363 (annual mean: 71 to 121, figure 8.3.1d). Up to around 2009, the number of revisions thus has increased somewhat to stay at a relatively even level thereafter, despite the successive increase of the number of primary arthroplasties.

Patients undergoing revision differ demographically (as do those who undergo reoperation) from the patients that only undergo a primary arthroplasty. The revised patients are in general older, more often men and more often have a secondary osteoarthritis and a higher degree of comorbidity (table 8.3.1). The proportion of patients with secondary osteoarthritis and a high degree of comorbidity increases even more among patients that undergo multiple revisions. Among the patients who have at least one revision the degree of comorbidity is even more increased (here measured as ASA class) and an even higher proportion have initially been operated due to secondary osteoarthritis. The mean BMI is relatively similar between the groups. In the group of patients that have at least two revisions the proportion of patients with a BMI of 30 or more is somewhat higher.

During 2019, primary hip arthroplasties were carried out at 84 units in Sweden. 60 of those units also carried out revisions and at 48 of those, patients who had undergone at least one earlier revision were operated again. In table 8.3.2, the units carrying out revisions have been grouped after the number of carried out revisions per year for 2018 and 2019. Figure 8.3.2 shows a simpler overview over reported volumes during 2019. The number of primary arthroplasties based on the same grouping is shown for comparison. During 2019, 14 units reached a revision level of at least 50 revisions, 13 carried out 10 to 24 revisions and as many as 20 units reported fewer than 10 revisions. Some of these units have a problem with underreporting, but in most cases the reported number should be correct. These units have reported 71 revisions taken together, most of these were due to infection (n = 26), loosening (n = 18) or dislocation (n = 12). Change of cup, femoral head and/or liner were the most common measures (n = 50). In the other cases, the stem was changed or extracted with or without change/extraction of the cup.

Since the annual report of 2014, we have followed the distribution of revisions per unit, initially divided into three-year periods, later to transition into one-year periods. Over the last ten years, the distribution between units that carry out fewer than 25, between 25 and 49 and 50 or more revisions per year, has been relatively constant (figure 8.3.3). We think that it is an advantage to have a certain volume of revisions, not least as choice of correct indications and surgical technique may be difficult, and peroperative complications and unexpected findings and events during revision surgery are common. In these cases, experienced and specially trained personnel should be available, as well as special instruments, a bone bank and a large enough assortment of implants.

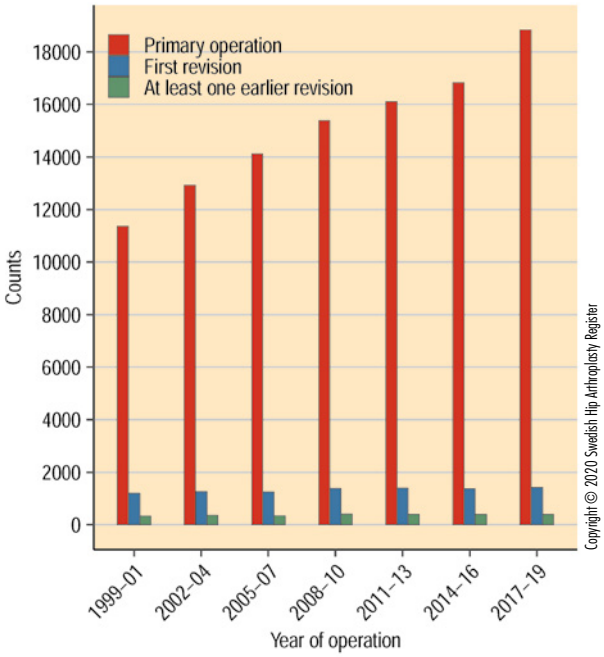


Figure 8.3.1a. Number of primary arthroplasties, first-time revisions and multiply revised hips during years 1999–2019. The mean number of operations per three-year period is given for improved overview. The increase of the number of primary operations is greater than the increase of the number of revisions.

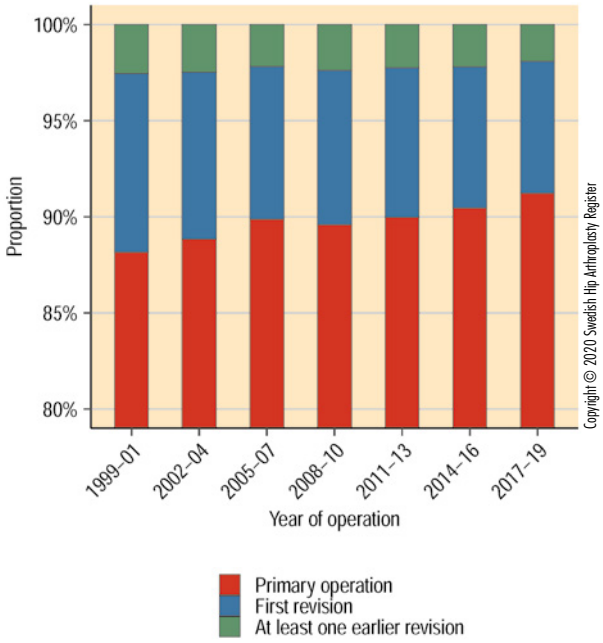


Figure 8.3.1b. Percentages of primary hip arthroplasties, first-time revisions and multiply revised hips during the years 1999–2019. During the period, the proportion of revisions decreased from 11.8 % during 1999–2001 to 8.8 % during 2017–2019.

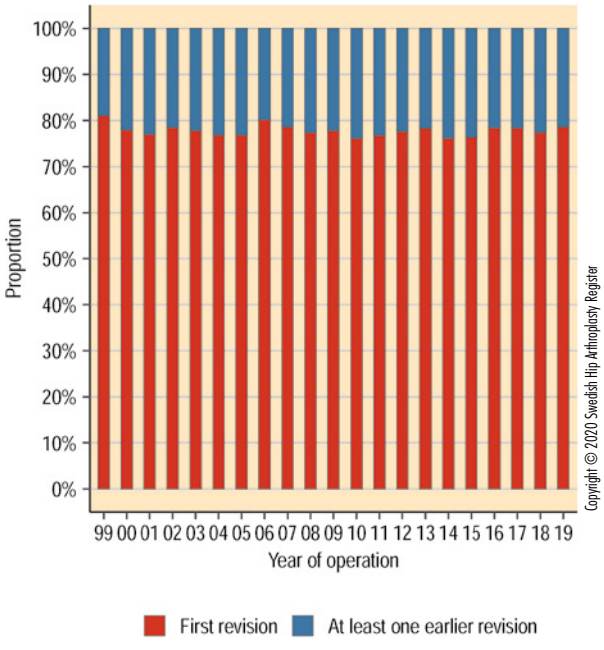


Figure 8.3.1c. Percentages of first-time and multiple-revisions 1999–2019. The proportion of multiple revisions has varied between 76.2 % and 81.1 % without any clear change over time.

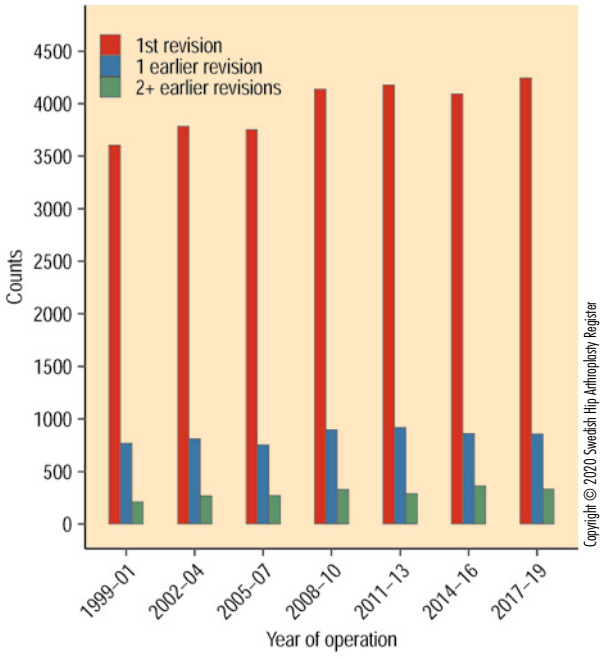


Figure 8.3.1 d. The number of revisions that were preceded by no, one or at least 2 earlier revisions during 1999–2019. The distribution between these types of operations is relatively constant over time without any apparent tendency of increase of multiple revisions.

Demography for primary THRs, first- and second-time revisions and cases previously revised at least two times earlier 2010–2019*

	Number of earlier revisions			Primary operation
	None	1	≥2	
Number	13,928	2,958	1,105	171,224
Age				
Mean, *SD*	71.8 *11.0*	72.0 *10.9*	71.3 *11.1*	68.8 *10.7*
< 55 years %	7.2	7.0	9.0	10.1
55–69 years %	29.7	29.5	30.0	38.6
70–84 years %	52.4	52.6	51.0	46.2
≥ 85 years %	10.6	10.9	10.1	5.1
Gender				
Proportion of women, %	51.6	48.2	52.4	58.1
BMI				
Number, *% of all in the interval*	12,620 *91.9*	2,677 *90.5*	987 *89.3*	163,587 *95.5*
Mean, *SD*	27.3 5.5	27.3 5.8	27.2 5.1	27.1 4.5
< 18.5 %	1.3	1.5	2.3	1.2
18.5–24.9 %	32.8	33.5	32.3	33.2
25–29.9 %	41.1	40.0	37.9	41.7
30–34.9 %	18.0	17.8	19.0	18.4
35–39.9 %	5.3	5.2	6.4	4.6
≥ 40 %	1.5	1.9	2.0	0.9
ASA-class				
Number, *% of all in the interval*	13,475 *96.7*	2,846 *96.2*	1,056 *95.6*	168,027 *98.1*
I, %	11.0	8.9	5.8	21.5
II, %	53.2	48.8	45.3	58.7
III–V %	35.8	42.3	49	19.9
Diagnosis during primary operation				
Primary osteoarthritis	76.4	70.6	61.6	80.9
Fracture including sequelae	8.1	7.9	11.7	11.1
Inflammatory joint disease	4.4	7.4	10.4	0.9
Sequelae childhood disease	3.3	5.2	5.8	1.8
Idiopathic necrosis	2.2	2.0	1.8	2.3
Other secondary osteoarthritis	3.7	3.8	5.1	2.8
Missing	1.8	3.2	3.6	0.1

Table 8.3.1. Gender and age distribution during first, second and multiple revision starting in 2010. Data for primary operated patients is shown for comparison.

** Here, 2-stage procedure is counted as one revision.*

Volume of primary and revision surgery during 2018 and 2019 per operating unit

	Primary prosthesis	Revision		
		First revision	≥ 1 earlier revision(s)	Regardless of earlier number of revisions
Number per unit and year	**Number of operating units per category in 2018 and 2019**			
1–9	2/2	22/21	25/20	19/20
10–24	2/3	14/18	16/17	11/13
25–49	7/6	15/12	3/8	17/12
50–99	6/8	8/9	0/3	9/11
100–149	13/8	–	–	2/3
150–199	15/18	–	–	–
200–299	18/18	–	–	–
300–499	10/12	–	–	–
500–999	9/9	–	–	–
	Total number of operating units in the country			
	81/84	59/60	44/48	59/60

Table 8.3.2. The number of units that carry out first and multiple revisions presented grouped for the years 2018 and 2019 separated with a slash. 2-stage procedures are counted as one operation.

Reason for revision

Between the years 1999 and 2019, aseptic loosening (56.0 %), infection (14.8 %), dislocation (13.7 %) and periprosthetic fracture (9.2 %) have been the most common reasons for revision regardless of an earlier revision or not. The distribution of causes has however changed over time (figures 8.3.4a and b). During first-time revision, 71.5 % of the operations carried out during 1999–2001 were caused by loosening, osteolysis and/or wear. Dislocation was second place (9.3 %), followed by periprosthetic fracture (7.3 %) and infection (5.5 %). During multiple revision the order was reversed for infection and periprosthetic fracture (loosening: 59.2 %, dislocation: 14.4 %, infection: 11.8 % and periprosthetic fracture: 9.2 %).

Up to the period 2017–2019, this distribution has gradually changed so that loosening still dominates, but has been reduced to 47.5 %, followed by infection (22.5 %), dislocation (12.6 %) and periprosthetic fracture (11.2 %). In cases previously revised, deep infection was the most common cause (37.8 %), followed by loosening (31.7 %), dislocation (18.3 %) and periprosthetic fracture (7.5 %). The total number of revisions due to loosening, regardless if it is a first-time revision or multiple revision, has decreased from just above 1 000 per year at the turn of the millennium, to 783 per year during the last three-year period. The corresponding increase of the number of revisions due to infection increases from around 103 to 460 per year between the periods 1999–2001 and 2017–2019. For dislocation and periprosthetic fracture, the increase is not that pronounced. Revision due to dislocation increased from 156 to 243 per year and due to periprosthetic fracture from 116 to 184 per year.

In general, the distribution of the four most common groups of causes loosening/osteolysis/wear, infection, dislocation and periprosthetic fracture differs between first-time and multiple revisions. There is also a gender-related difference (figure 8.3.5a to d). Data in these bar charts are from the period 2008–2019, in order to mirror a more recent period but still encompassing a reasonably large number of observations. During first-time revision, aseptic loosening is the predominant revision cause in men in the age group 71 to 80 years old (57.8 % of all causes). In women, the distribution between the age groups is smoother with a somewhat lower proportion in the age groups 51–50 and 80+. In men, the proportion of first-time revisions due to infection increases with age. In women, the proportion of revisions due to infection is at its lowest among the youngest (50 years or younger) and in the group 80 years old.

Regardless of gender, the proportion of periprosthetic fractures increases with age, as does the proportion revised due to dislocation, even though the increase is much more prominent among female patients. In multiple revisions, a smoother age distribution for men with loosening is noted, compared with first-time revision. During both first-time and multiple revi-

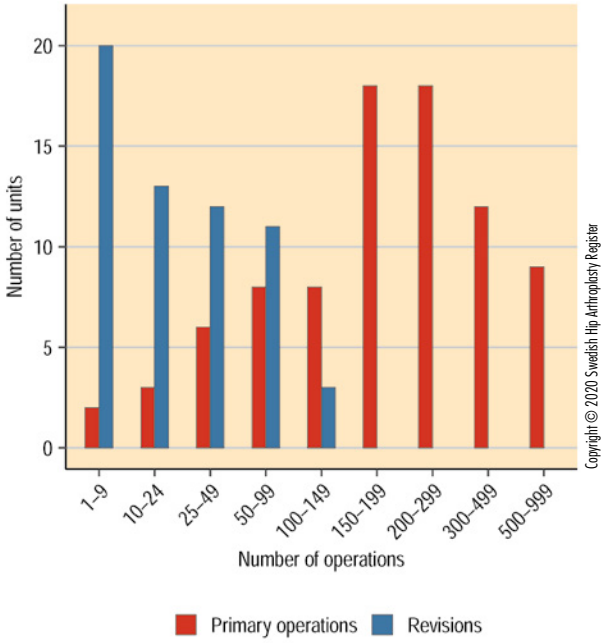


Figure 8.3.2. Primary prostheses and revisions grouped according to number carried out per unit (x-axis) and number of units for each cathegory (y-axes) related to annual volume of primary and revision operations, respectively.

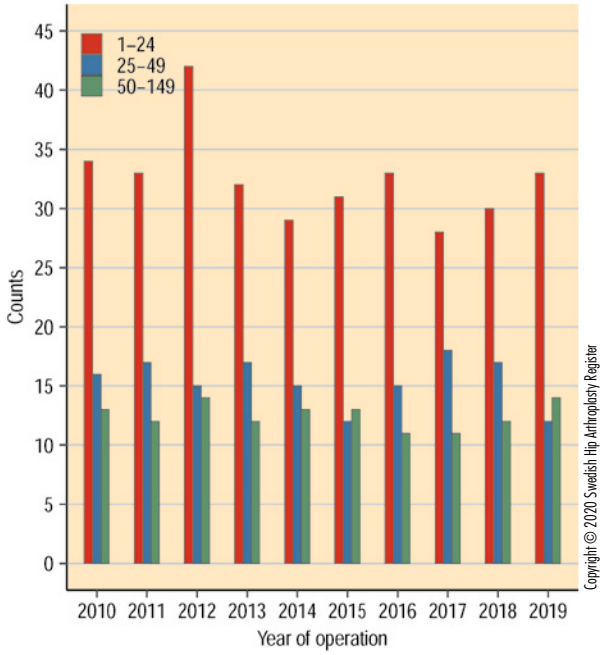


Figure 8.3.3. Distribution of units that carry out fewer than 25, 25 to 49 or 50 or more revisions per year 2010–2019. The proportion of low-volume units has been relatively constant during the last ten years.

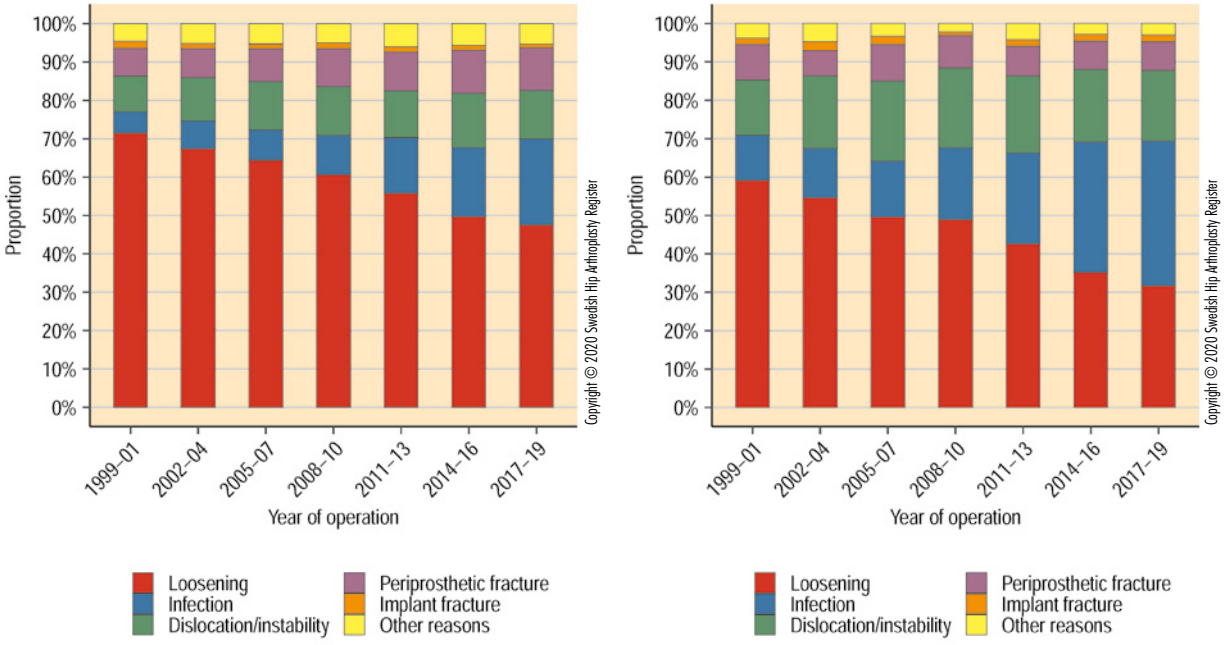


Figure 8.3.4. Distribution of reason for revision at first (a) and multiple revisions (b) in three-year periods 1999–2019 regardless of gender.

sions, the proportion of patients with infection decreases with age. Instead, the revision causes periprosthetic fracture and dislocation increase among the older men. The same increase, although perhaps even more pronounced, is seen also in women, especially when it comes to the cause dislocation. In women, the reason infection, as during first-time revision, is more evenly distributed age-wise compared with in men.

In the group other reasons for revision, several different diagnoses and measures are hiding. Several of them are also treated surgically without change of implant or extraction, why sections 8.1 and 8.2 (Reoperation) and the chapter "Unusual reasons for reoperation" in chapter 8.5 in the annual report of 2018, offer a better overview.

Stem fracture

Stem fracture is an unusual complication. The register has a category revision due to implant failure. Exact information on what components that have been affected are however missing. In table 8.3.3 those operations where a primary operation has been revised or a revision has been re-revised, and where the reason is given as implant failure combined with revision of the stem are identified.

The table presents the total number of reported stems of a specific design, the number that have been revised due to implant failure divided into revised primary and re-revised revision cases, and the proportion of stem fractures as a percentage of the total number. In the rightmost column we have tried to identify how many of the implant failures that affect the smallest stem size that is registered in the Swedish Hip Arthroplasty Register. In some cases, the information is however missing for some or all implants, why this information is missing or is uncertain (for example SP dysplasia).

Seven stems have a fracture frequency of one percent or more. Three of them (MP custom-made, Reef and ZMR) have only been used in a few cases, why any conclusions cannot be drawn. Regarding the remaining four, the observed number is still very low pertaining to SP II dysplasia (n = 65) and Corail Revision (n = 208). Ten out of 868 reported Exeter stems of the variant "short revision stem" (1.15 % with implant failure) and 7 out of 1 057 Revitan stems (0.66 %) have been revised due to implant fracture. This should be more reliable infomation since the number of observed cases is considerably higher than for the other five stems. The incidence in the whole material in table 8.3.3 only includes those stems where an implant failure resulting in a revision has been registered at least once. If those stem types where no fracture has been reported in any of the cases are added, the incidence decreases from 0.09 % to 0.08 %. For the Exeter short revision stem and for Revitan this would however not mean anything more than a slight downward adjustment.

The SP II-stem has an incidence of 0.08 %, which means that the number of implant failures is average. If one instead relates the result to stem size, 92 out of the 113 implant failures were a size 01, ten were a size one, nine a size two and the other two were even thicker implants. This means that the incidence for size 01 is 8–9 times higher than the mean, for size one it is less than half of the mean and for size two, four times lower.

In general, thin stems of certain models should be avoided for younger active patients with a narrow medullary cavity. We hope that this review can be of some help, at least regarding designs that should be avoided if possible. Regarding the best choice, specific recommendations are not possible to offer except that well-documented stems of a size and model that have the lowest frequency as reported in table 8.3.3, or that are not found there, should be used. That being said, stem fracture is still not always a completely preventable complication and the more often a stem is used, the higher the probability that at least some stem fractures will occur. When assessing stems not found in the list, the number of used stems and the observation time for the stem in question must be considered.

Reason of re-revision related to reason of previous revision

The reason of the first-time revision affects the reason profile during a potential second-time revision (table 8.3.4). A patient who undergoes a first-time revision due to loosening/osteolysis, infection or dislocation has a high probability of being revised due to the same cause during a potential second revision. The same can be said of patients affected by a second revision. An exception is patients that undergo a first-time revision due to a periprosthetic fracture. In these cases, the most common reason for a possible later revision is dislocation followed by loosening and infection, both after first and second revisions. This year, primary operations and revisions carried out between 2001 and 2019 are presented. As in the previous annual report, complete and partial prosthesis extractions where a second procedure (stage 2) has not been registered, are presented. In these cases, it is safe to say that a prosthesis insertion is not imminent, based on the date for the prosthesis extraction. On the other hand, it can be assumed that insertion of a new prosthesis will take place in 2020 in most of those cases where the prosthesis was extracted during the last 3–6 months of 2019. Of the 948 "definitive" partial or complete prosthesis extractions that are reported starting in 2001, 41 (4.3 %) were carried out during the period from July to December 2019. Most of these will become stage 2 procedures with an overwhelming probability during 2020 and can therefore be misclassified in table 8.3.4. Since they make up a small part of all extractions, this entails only a minor downward adjustment of the proportion of "definitive" extractions in the table.

Prosthesis extraction without subsequent insertion of a new prosthesis

The proportion of patients who have undergone a complete or partial prosthesis extraction without subsequent insertion varies between 0.5 % and 8.4 % during first-time revision and between 0.9 % and 13.6 % during second-time revision. Not unexpectedly, the most common reason is infection followed

Stems inserted 1999–2019 that have been revised due to implant fracture (n=288)

	Numbers inserted 1999–2019[1]	Fracture of primary/revision prosthesis	Proportion with implant fracture *percentage#*	Smallest size/ other stem sizes* *number with fracture*
Cemented				
Cenator	275	1/0	0.4	0/1
Charnley	6,113	4/0	0.07	-
CPT	3,950	2/5	0.17	0/7
Durom	381	1/0	0.26	-
Elite Plus	1,723	3/0	0.17	2/3
Exter short revision stem	868	1/9	1.15	-
Exter long	1,497	1/3	0.27	0/4
Exeter standard	69,408	44/13	0.10	22/57
MP custom-made	3	0/1	33	-
MS-30 polished	16,391	8/2	0.06	2/10
Müller straight	985	2/0	0.20	-
Spectron EF Primary	10,176	10/1	0.11	8/11
SP II Dysplasia	65	2/1	4.6	≥1/3
SP II standard	133,031	96/17	0.08	92/113
Uncemented				
Bi-Metric X por HA NC	9,422	5/0	0.05	0/5
CFP	464	1/0	0.22	1/1
CLS	13,999	5/0	0.05	0/5
Corail high offset	6,112	1/0	0.02	0/1
Corail Revision	208	1/1	0.96	≥0/2
Corail standard	20,528	4/1	0.02	0/5
MP	3,353	0/3	0.09	≥1/3
Reef	24	0/1	4	1/1
Restoration	1,305	0/1	0.08	0/1
Revitan	1,057	0/7	0.66	1/7
Wagner Cone	2,318	2/0	0.08	0/2
Wagner SL Revision	809	0/1	0.12	-
ZMR Taper	10	0/1	10	0/1
Not available	-	0/27	-	-
All with data on type of stem	**304,475**	**193/68**	**0.09**	**-**

Table 8.3.3. Stems that have been revised due to implant fracture after primary operation or revision (regardless of the number of earlier revisions) 1999–2019.

[1] Primary prostheses + revisions.
** The smallest of the registered sizes or diameters in the Swedish Hip Arthroplasty Register.*
 # Primary and revision prostheses.
- Data on stem size is completely missing or in part or is not relevant. Many of the groups include different stem lengths.

Reason for second and third revision respectively grouped after preceding cause

	Primary operation 2001–2019 *n = 294,746*				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other/not available**
First revision, %	**1.6**	1.0	0.5	0.8	0.3
No revision	95.9				
	First revision 2000–2018 *n = 25,139*				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other/not available**
Extraction, %					
No registered insertion	**0.4**	**8.4**	**1.8**	**3.6**	**0.5**
Reason next revision *(1- or 2-stage) %*					
New revision					
Loosening	**5.8**	2.0	3.1	2.1	**5.7**
Infection	1.9	**13.6**	2.8	5.2	2.7
Periprosthetic fracture	1.2	0.5	1.0	0.9	1.4
Dislocation	2.2	2.0	**3.8**	**7.9**	3.5
Other/not available	1.3	0.5	0.8	0.4	1.9
Extraction without registered insertion (yet)	0.4	8.4	1.8	3.6	0.5
Sum *revision/extraction %*	12.8	26.9	13.3	20.1	15.7
No re-revision	87.2	73.1	86.7	79.9	84.3
	Second revision 2001–2019 *n = 5,374*				
	Loosening	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other/not available**
Extraction, %					
No registered insertion	1.0	13.6	2.0	5.8	0.9
Reason next revision *(1- or 2-stage) %*					
Loosening	**7.8**	1.4	5.4	3.0	**7.6**
Infection	2.8	**14.9**	2.9	5.6	3.7
Periprosthetic fracture	1.2	0.5	0.4	1.3	0.6
Dislocation	3.2	3.4	**6.8**	**10.2**	4.0
Other/not available	0.8	0.3	1.4	1.0	2.1
Sum *revision/extraction %*	16.8	34.1	18.9	26.9	18.9
No re-revision	83.2	65.9	81.1	73.1	81.1

Table 8.3.4. Distribution of reason for second and third revision in percentages grouped after preceding cause. Patients that have been primary operated or revised during the period 2001–2019 are included. Osteolysis and wear are part of the group loosening. During two-stage procedures the reason that was present during stage one (extraction) is given. Prosthesis extractions not followed by a subsequent insertion are presented separately. For a smaller part of these, insertion of prosthesis may be planned during 2020. The percentage for the most common reason for re-revision is given in bold.

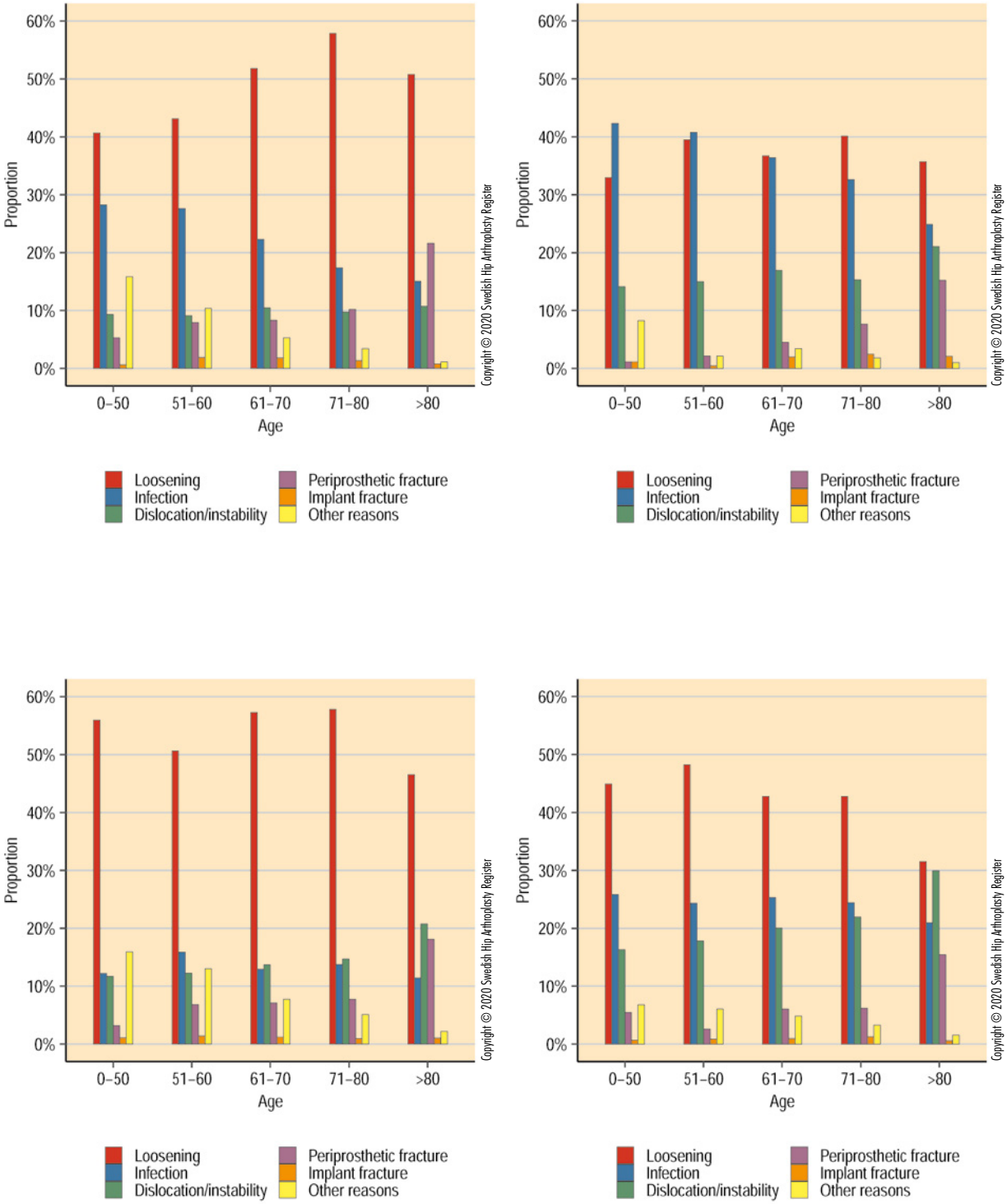


Figure 8.3.5. Distribution of reasons for men at first (a) and multiple revisions (b) and for women during first (c) and multiple revisions (d) related to age. Data is based on the period 2008–2019. 8,032 first-time revisions and 2,419 multiple revisions on men, and 8,615 first-time revisions and 2,387 multiple revisions on women are included.

The five most used cups and stems during revision surgery in 2009, 2018 and 2019

2009		2018		2019	
Cup during revision %					
Cemented, number	685		472		448
Lubinus (older polyethylene)	20.3	Avantage	39.6	Avantage	36.8
Contemporary Hooded Duration	15.6	Exeter X3 RimFit	19.5	Exeter X3 RimFit	19.9
Avantage	11.2	Lubinus X-linked	15.0	Lubinus X-linked	15.2
Elite Ogee	11.2	Marathon XLPE	9.7	Marathon XLPE	13.2
ZCA XLPE	9.9	ADES DMC	4.2	Polar cup	6.7
Other	31.7	Other	11.9	Other	8.3
Uncemented number	633		628		551
TMT modular/revision	46.0	TMT revision	30.6	TMT revision	27.7
Trilogy ±HA	25.0	Tritanium revision	13.1	Tritanium Revision	18.5
Trident hemi +AD (LW+WHA)	14.6	Continuum	11.9	Continuum	11.7
Mallory Head	6.2	Pinnacle W/Gription (100+Sector)	9.7	Pinnacle W/Gription (100+Sector)	10.2
Tritanium revision	1.7	Delta-One-TT	6.1	Trilogy IT	5.5
Other	6.5	Other	28.6	Other	26.4
Stem during revision, %					
Cemented number	540		480		447
Lubinus SP II*	34,5	Exeter*	42,1	Exeter*	41,6
Exeter*	32,9	Lubinus SP II*	32,7	Lubinus SP II*	32,2
CPT long rev. stem	12,0	Exeter long	6,9	Exeter short rev-stem	8,3
Spectron EF long	8,1	Exeter short rev. stem	5,8	Exeter long	6,9
Exeter short rev. stem	5,9	CPT	5,4	CPT	4,3
Other	6,6	Other	7,1	Other	6,7
Uncemented number	341		420		418
MP	41,7	MP	37,9	MP	37,1
Restoration	17,3	Restoration	20,7	Restoration	28,2
Revitan	16,4	Revitan	12,0	Corail Revision	15,2
Wagner SL Revision	7,1	Corail revision	8,3	Revitan	6,2
Corail revision	3,4	Corail standard 3 variants	4,3	Arcos	2,6
Other	14,1	Other	16,8	Other	10,7

Table 8.3.5. The five most used cemented and uncemented cups and stems inserted at revision surgery given as percentages of the total reported number during 2009, 2018 and 2019. Both first and multiple revisions are included. In the cases where data is not available (0 %–6,7 % depending on group) these have been included in the group "Other".

** varying lengths*

by dislocation and periprosthetic fracture, regardless if it is a first or second revision. Between 1999 and 2019, 1 043 partial or complete prosthesis extractions were carried out where no subsequent insertion is registered. Twelve patients had undergone a bilateral prosthesis extraction. The number has varied between 131 and 163 per three-year period (figure 8.3.6), equivalent to 44 to 54 cases annually. The mortality among these patients during the immediate years after the operation is high, which is to be expected against the background that they almost exclusively are cases with hard-to-treat infections, periprosthetic fracture or dislocation and furthermore have a high degree of comorbidity. Half of the patients who have been operated since 1990 live without a hip prosthesis in just under three years (median 2.9 years) and 80 % of them under a maximum 7.6 years. 151 of the total number (n = 1 031 patients) live or have lived with an extracted prosthesis for more than 10 years (figure 8.3.7).

Surgical procedures

In general, the changes over time regarding the choice of procedure has been relatively the same for first-time and multiple revisions. Change of both cup and stem has been the most common measure during both first-time and multiple revisions since 1999 (figures 8.3.8a and b). The incidence of this type of procedure has however tended to decrease during first-time revision and also during multiple revision up to the period 2014–2016, after which there is a small increase. Change of femoral head and/or liner, and change of stem and liner, have increased during the whole period, probably as an effect of an increasing number of DAIRs (Debridement Antibiotics Implant Retentions) and an increasing number of revisions of uncemented implants respectively. That extraction without registered subsequent insertion forms a considerably larger part of the multiple revisions than of the first-time revisions, is also not that unexpected. The permanent prosthesis extractions as measured in absolute numbers are however somewhat more numerous during first-time revision compared with multiple revision (figures 8.3.9a and b).

Choice of procedure related to reason for revision

Depending on the reason of the revision, the type of measure varies. Here, as in other parts of this section, the header change/insertion means that the patient may have undergone a 2-stage operation. Extractions followed by a registered insertion have thus been excluded. In figures 8.3.10a and b the relative distribution of surgical procedures related to reason for revision for first-time and multiple revisions carried out from 2015 to 2019, are illustrated. During aseptic loosening and first-time revision, cup/liner change combined with stem change dominates, closely followed by cup/liner changes. During multiple revision,

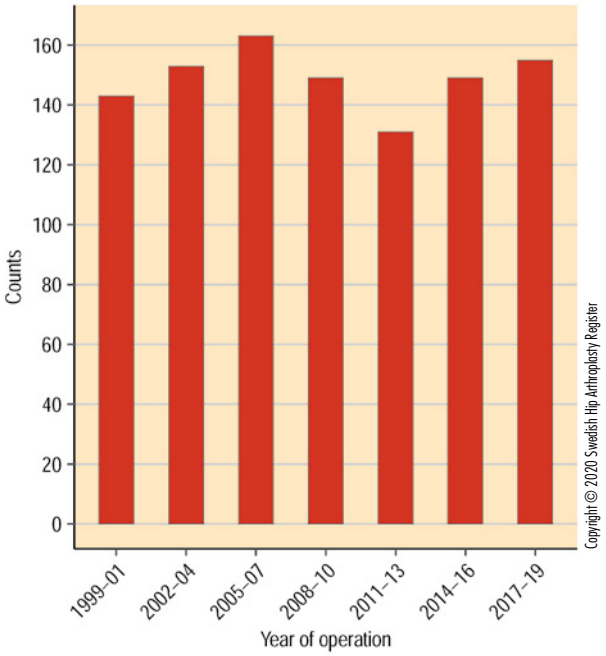


Figure 8.3.6. Number of patients who have undergone a prosthesis extraction without registered subsequent insertion of a new prosthesis per three-year period.

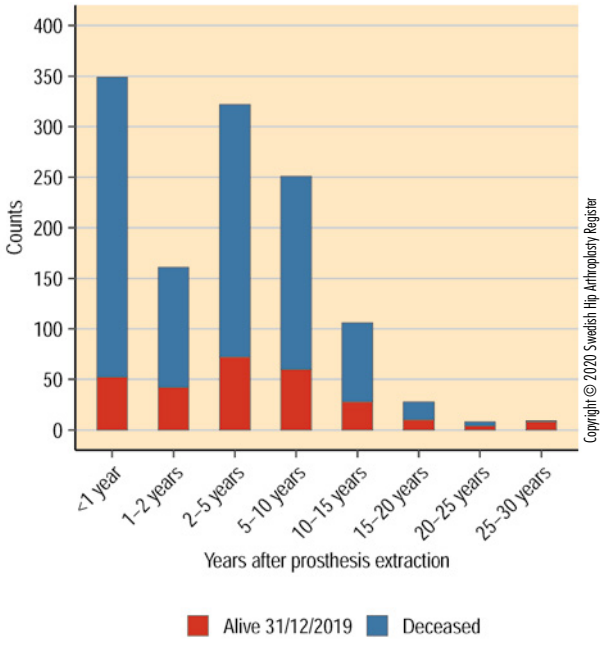
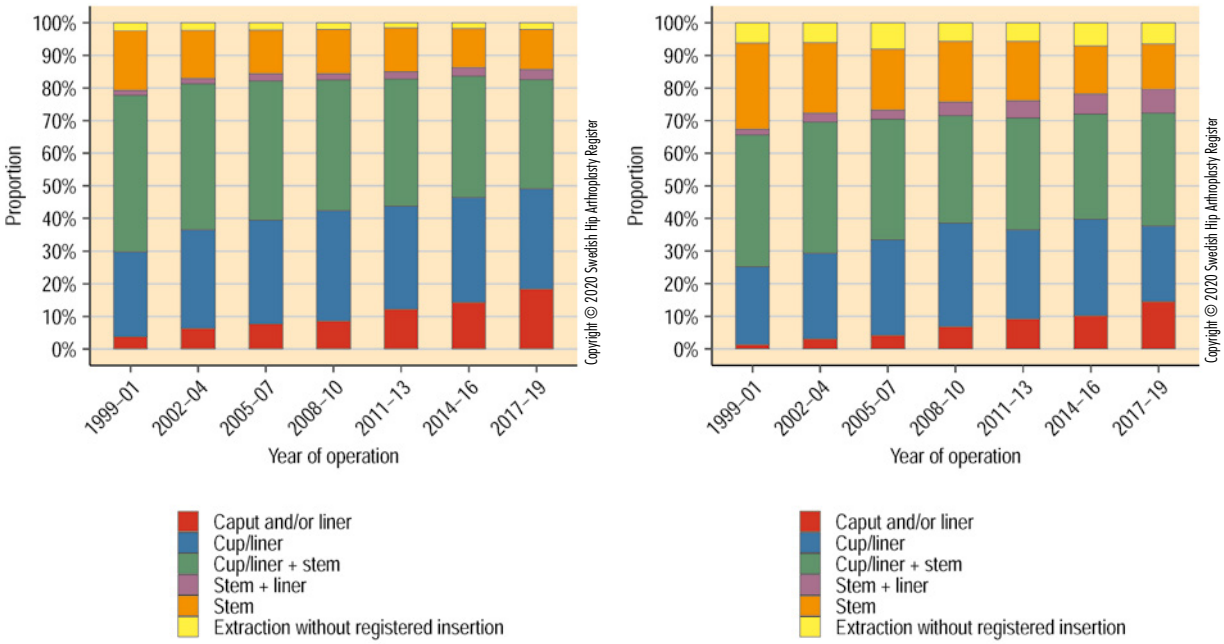


Figure 8.3.7. The number of individuals related to time for prosthesis extraction, who live or have lived with an extracted prosthesis since 1990. As of the last December 2019, 251 patients had for example lived 5–10 years after the removal of the prosthesis, of which 191 had died during the period and 60 were alive. For patients afflicted by bilateral prosthesis extraction (n = 12), the first operated hip is included.



Figur 8.3.8 Relative distribution of measure during first (a) and multiple revision (b) per three-year periods 1999–2019.

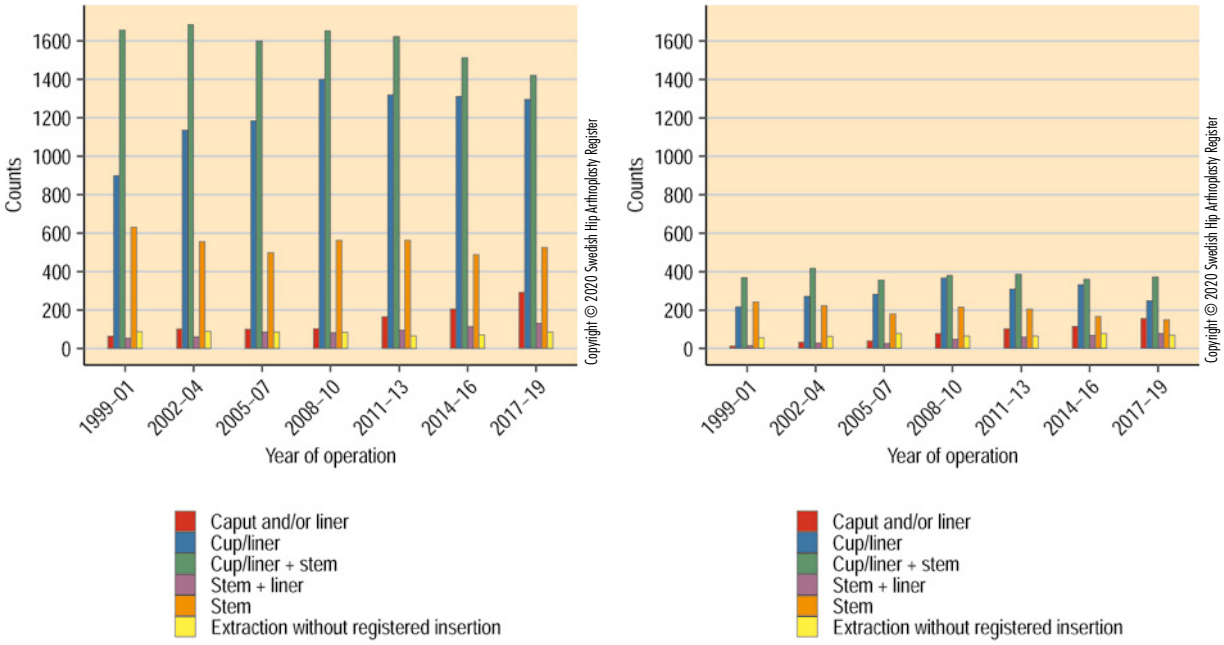


Figure 8.3.9 The number of measures per three-year period at first (a) and multiple revisions (b) per three-year period 1999–2019.

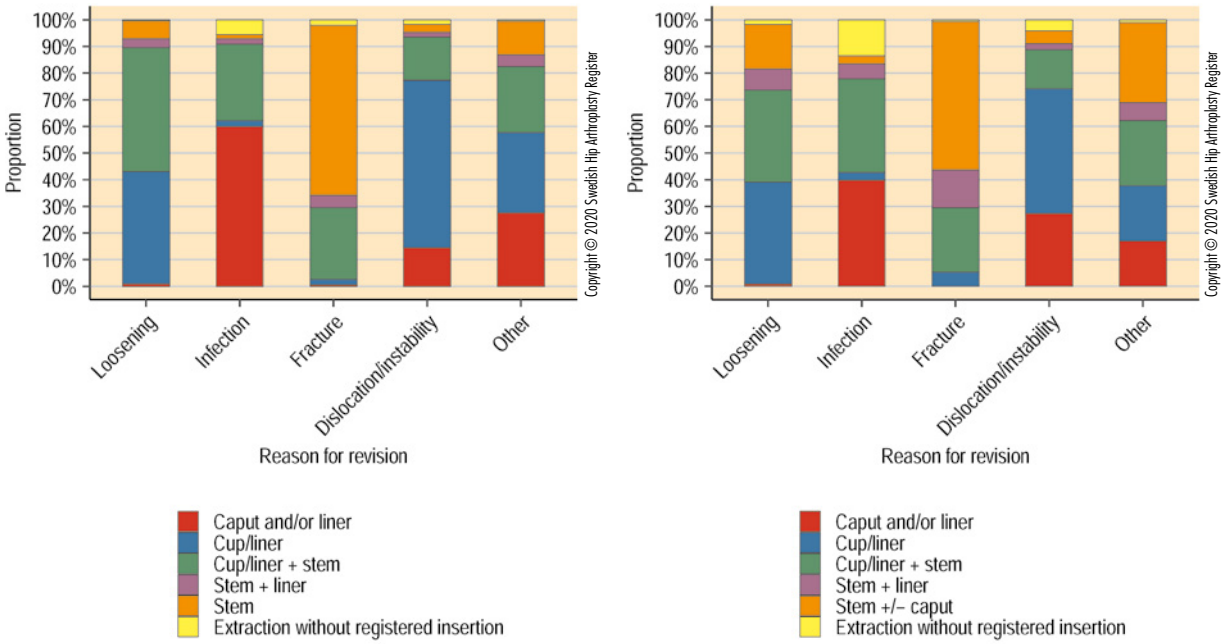


Figure 8.3.10. Type of procedure at first (a) and multiple revisions (b) related to reason of revision. 6,939 first revisions and 1,964 multiple revisions carried out 2015–2019 are included in the analysis. During 2-stage procedure, the first stage (prosthesis extraction) has been excluded.

it is relatively more common that only one of the components is revised. During deep infection, caput and/or liner change dominates during both first-time and multiple revisions, and as expected the relative proportion of the one and two stage changes, as well as prosthesis extraction increase if the hip has been revised at least one time before. Most of the periprosthetic fractures are revised with stem exchange, just as expected. Concurrent cup change takes place in about a fourth of cases, and somewhat more seldom during multiple revision. The most common measure during first-time revision due to dislocation is cup change (62.8 %). During multiple revision this proportion decreases to 46.8 %, mainly due to more changes of femoral heads and liners.

Choice of fixation

Just as during primary operations, the number of operations with uncemented cup has increased among revision cases. This increase has however been greater on the revision side, which has meant that an uncemented cup has become more common than a cemented one during the last three years, regardless of the number of earlier revisions (figures 8.3.11a and b). On the stem side, there has also been a gradual change towards uncemented fixation. However, just not as pronounced that the number of uncemented stems outnumber the number of cemented ones during first-time revision. This goes for all three-year periods except the last one, during which we observe a break of the trend with a small increase of cemented stem fixation (figure 8.3.12a). During multiple revision, the picture is different and more resembles the pattern during cup revision. Uncemented stem fixation became the most used alternative during multiple revision almost ten years earlier.

In revision surgery, the notions completely cemented, completely uncemented, hybrid and reversed hybrid become harder to uphold, since it is more common that parts of the prosthesis are changed, not the whole prosthesis. This means that a prosthesis that for example is classified as a hybrid after revision, can consist of everything from none to three "original parts" from the preceding operation; original parts that were the components of a prosthesis that maybe was a hybrid also before revision, but also could have been a completely cemented or completely uncemented prosthesis, where some part from a preceding prosthesis remains. (If a hybrid is converted to a reversed hybrid, one must assume that all the parts have been changed). Nonetheless, all prosthesis parts were changed during several revisions. During the period 1999 to 2019, this pertained to 40.4 % of all first-time revisions and 33.6 % of all multiple revisions if stage 2-operations are included (figures 8.3.13a and b).

Around 2000, both components were cemented in most cases. Thereafter, there was a gradual increase of combinations where at least one component was fixated without cement. The greatest increase is seen for completely uncemented fixation, apart

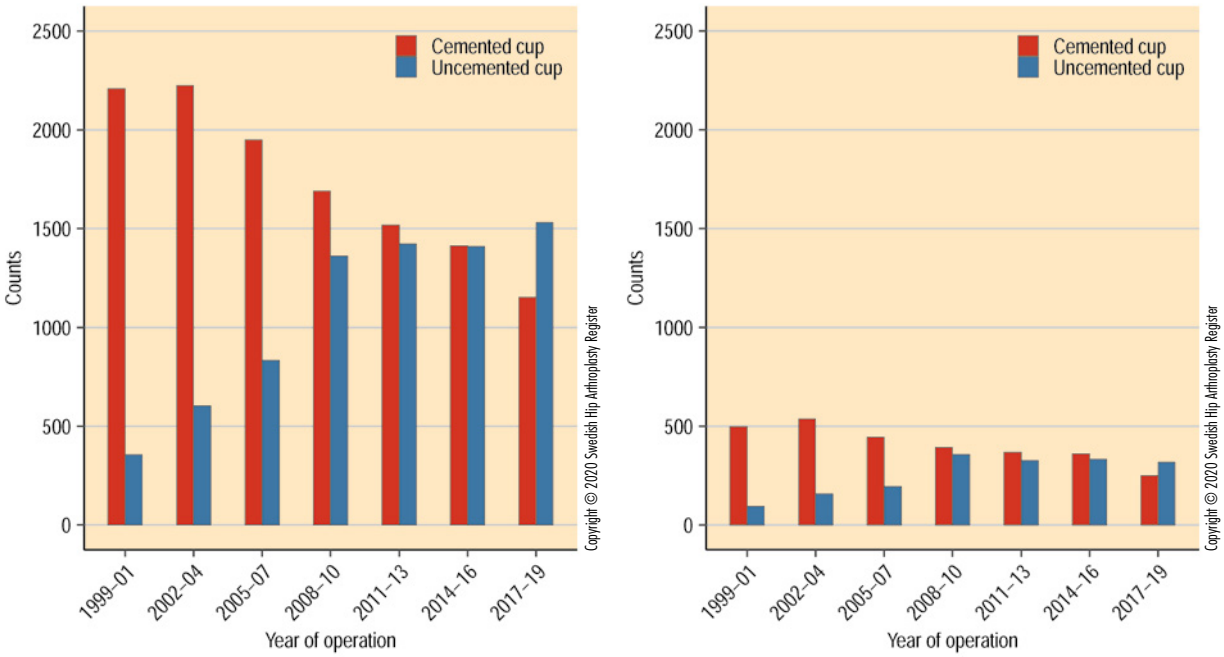


Figure 8.3.11. Distribution of cemented and uncemented fixation of the cup respectively at first-time (a) and multiple revisions (b) 1999–2019.

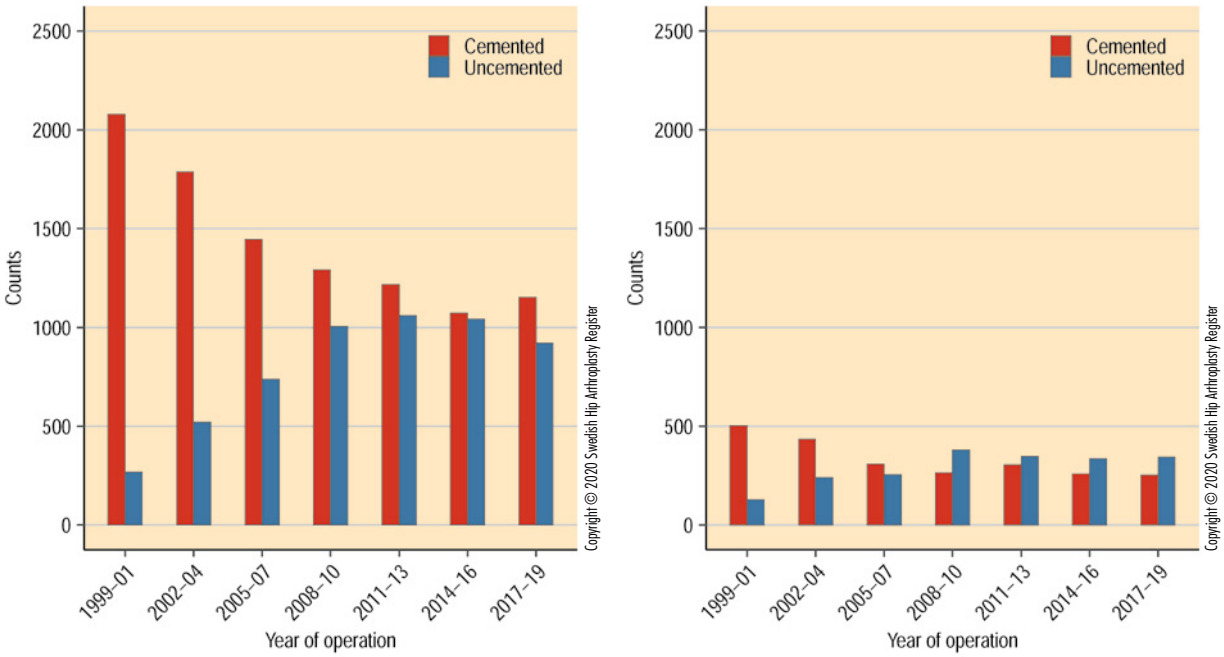


Figure 8.3.12. Distribution of cemented and uncemented fixation of the stem respectively at first-time (a) and multiple revisions (b) 1999–2019.

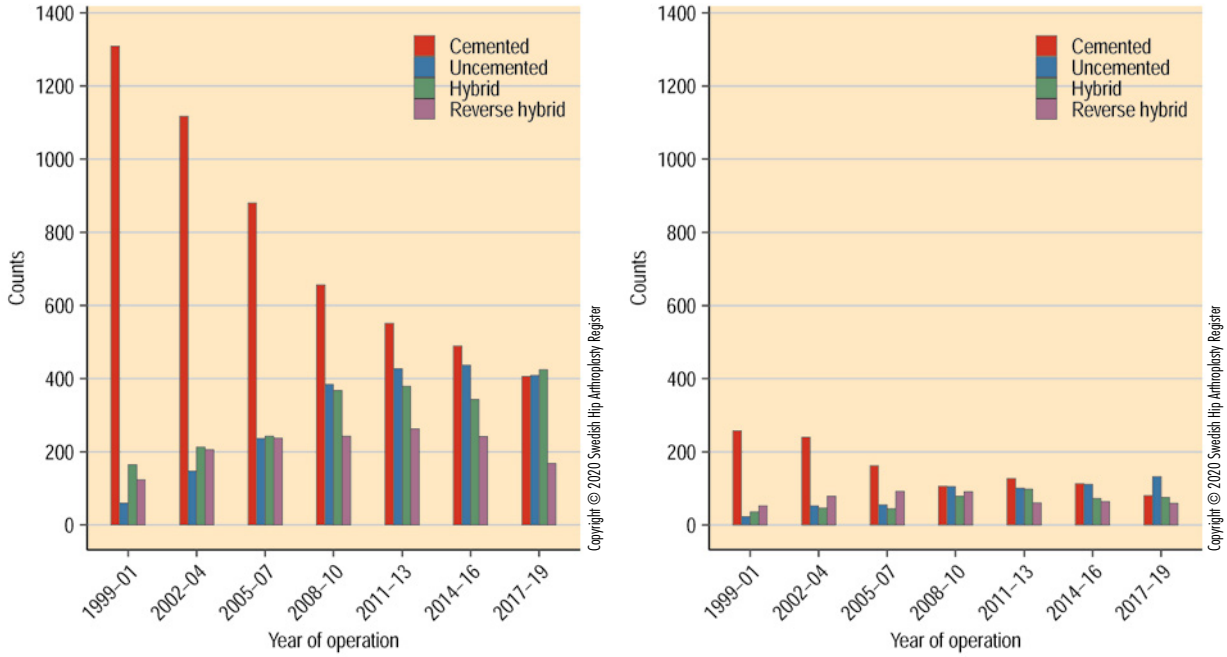


Figure 8.3.13. Distribution of completely cemented, completely uncemented, hybrid and reversed hybrid fixation in the cases where all prosthesis parts are changed at first-time (a) and multiple revisions (b) 1999–2019.

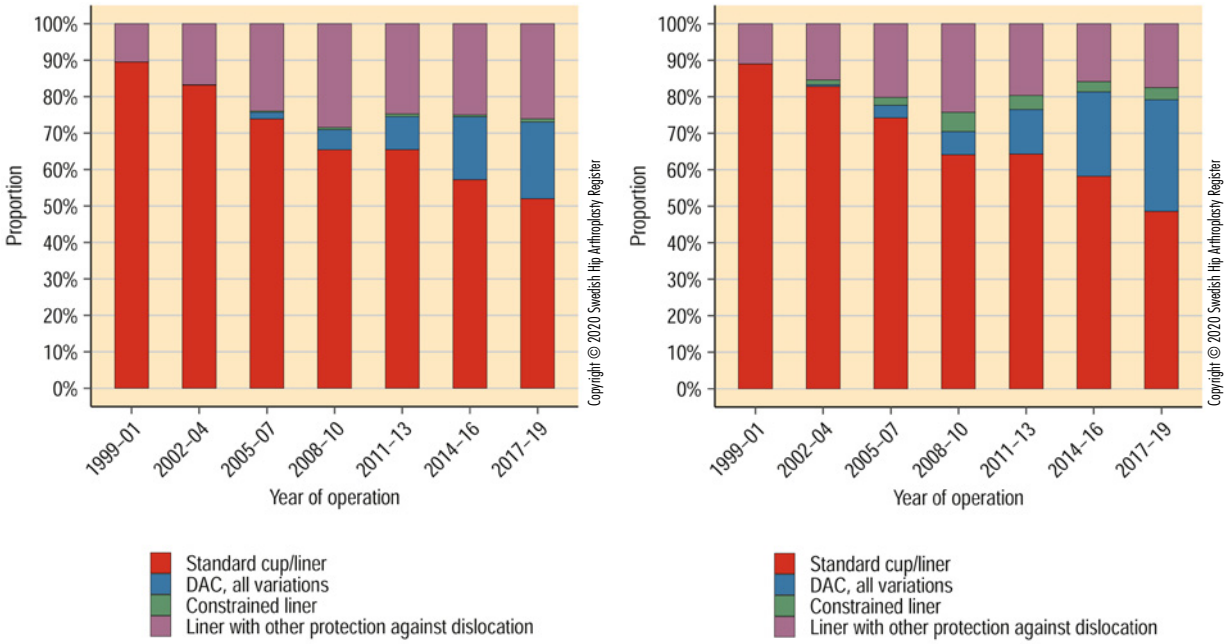


Figure 8.3.14. The use of cup or liner with some sort of protection against dislocation at first-time (a) and multiple revisions (b) 1999–2019. Both cemented and uncemented fixation. In the group dual mobility cups (DMCs) cases where a conventional cup has been converted to a DMC by inserting an inner metal casing with a polished inner surface and cases where a DMC intended for cemented fixation against bone, has been cemented into a metal casing of a conventional uncemented cup are included.

from during the last three-year period when hybrid fixation became the most common during first-time revision, while the completely uncemented prosthesis remained the most common during multiple revision.

Choice of cup

Since the turn of the millennium, it has become increasingly more common to use some form of cup or liner that is supposed to reduce the risk of dislocation (figures 8.3.14a and b). During the period 1999 to 2001, this pertained only to liners with an acetabular wedge augment or a partially elevated rim, increased inclination or similar modification. During the following period, polyethylene inserts that tie up the femoral head, "constrained liners" and during multiple revision, dual mobility cups, were added, and the use of the latter thereafter increased the most during both first-time and multiple revisions. During the period 2017 to 2019, just under a half of all first-time revisions (48.0 %) and more than a half (51.4 %) of all multiple revisions were fitted with a cup that had some form of in-built protection against dislocation. DMCs were used during a fifth of the first-time revisions (21 %) and during under a third (30.6 %) of the multiple revisions. During the same period, 42.3 % of all DMCs, regardless of earlier revision or not, were fixated without cement. This included the cases where a DMC-insert was used in an uncemented cup of the conventional type or was cemented into an uncemented metal shell.

Choice of femoral head

Femoral heads are routinely changed during practically all revisions. Since 1999, there is data on inserted femoral head in 88.5 % of all first-time revisions and 86.1 % of all multiple revisions. In other cases, the femoral head has not been changed or an eventual change has not been reported. If DMCs where the size of the inner femoral head does not affect the stability of the joint in the same way, also are excluded, 81 % remain during first-time revision (n = 22,335) and 75.2 % during multiple revision (n = 5,921). Figure 8.3.15 illustrates how the choice of femoral head size has changed over time during first-time revision (figure 8.3.15a) and during multiple revision (figure 8.3.15b). The change over time is approximately the same as during primary operation without any tangible difference between first-time and multiple revisions. During the last three-year period, a decrease in the use of femoral head size 36 mm and larger can be noted, a corresponding change is not visible during primary operation even if the increase of the use of 36 mm femoral heads seems to have levelled-off also here during the last three years.

Choice of stem

Since 1999, the stem has been changed during revision in more than half of cases. The trend, however, is that this procedure is getting relatively less common. This is in part due to the increasing number of DAIRs where the stem is not affec-

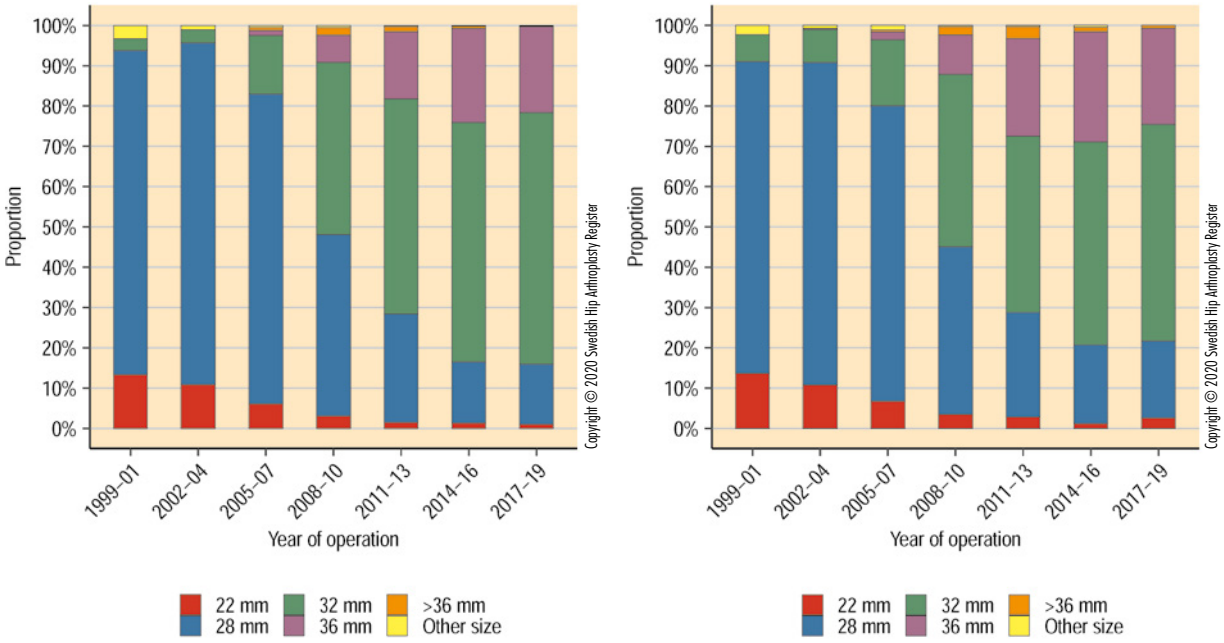


Figure 8.3.15. Choice of femoral head size at first-time (a) and multiple revisions (b) 1999–2019 where a change of femoral head is registered (see text). Prostheses with dual mobility cup have been excluded.

ted. During the three-year period 1999–2001, the stem was changed in 65 % of cases, a proportion that has successively decreased to 48.2 % 2017–2019.

During first-time revision, cemented fixation has dominated, but has decreased successively up to the period 2014 to 2016, and thereafter there apparently is a break of the trend as the proportion of cemented stems increases somewhat, from 50.7 % to 56.4 %. During cemented fixation, stems of standard type dominate and during uncemented fixation stems with separate distal and proximal parts, two-part stems, dominate. During the period 2017 to 2019, the use of this stem type has decreased a little, benefitting cemented fixation (figure 8.3.16a). During first-time revision, it is reported that bone transplantation with an allograft is carried out in 30.6 % of cases, which would be a minimum due to underreporting. The corresponding proportion during uncemented fixation is 3.9 %. Probably, most of these cases have been operated with impaction grafting of the femur, but this cannot be firmly established using only register-data.

During multiple revision, cemented fixation was the most common technique up to the period 2005 to 2008 (figure 8.3.16b). Thereafter, the increase of uncemented fixation has continued and accounted for 56.4 % during the last three-year period. Here, the proportion of two-part stems has been relatively constant, around 48 % to 49 % ever since the period 2008 to 2010. Bone transplantation of the femur with allograft is reported in around 35.4 % of cases during cemented, and in 6.3 % of cases during uncemented fixation, for multiple revisions.

Choice of specific implant

In table 8.3.5, the most used cemented and uncemented cups and stems during 2018 and 2019 are presented, and during 2009 to illustrate changes over time. This is a rolling schedule that is updated annually. Since data on stem length is not complete, all SP II-stems and Exeter-stems in their standard design, have been joined in one group each. Exeter short revision-stem is accounted for separately since its result regarding risk for stem fracture differs from other stems in the same family.

The cemented Avantage-cup began to be used during revisions in Sweden in 2004 when four implants were reported. Thereafter, its use increased up to 2016 (201 operations), where after there is a small decrease, in part benefitting other designs, above all the Polar cup and the ADES-cup. Since 2014 however, the total number of cemented DMCs has hovered between 188 to 249 per year without any obvious trend from 2014 to 2019 (figure 8.3.17). During 2018 and 2019, the cemented Avantage-cup was the most used revision cup in Sweden, followed by Exeter X3 RimFit and Lubinus X-linked. The four most used uncemented cups were the same in 2018 and 2019. The TMT cup was also the most used revision cup in 2009. Uncemented DMCs are used only sparingly in Sweden, not just in primary prostheses but also during revision (figure 8.3.17). Some uncemented cups can be converted to a DMC-function by fixing a metal insert with a polished inner surface to the metal shell that is fixed to the bone. This possibility has above all been used during operation with different variants of the Delta cup (113 out of 123 registered operations).

Another possibility is to cement a DMC, originally intended for cemented fixation against bone, in a metal shell that is fixated without cement. This possibility has above all been used during insertion of TM cup and custom-made Materialise cup respectively (figure 8.3.18). Also, in these cases, one has used the Avantage-cup in most cases (95.5 %) and in the rest of cases a Polar or an ADES-cup. In table 8.3.5 however, the cups are named after the metal shell that has been fixated to the bone tissue.

Different versions of the Exeter- and Lubinus SP II-stems dominate during choice of cemented fixation under the whole period. During the years in question (2009, 2018 and 2019), 61.9 % of the Exeter-stems were of standard length (15 cm), 14.7 % were shorter and 2.4 % were longer (Exeter long- and Exeter short revision-stem excluded). In 21.1 % of cases, stem length is missing. The large proportion of short stems can be explained by the fact that in just under half of the cases where data is available (78 %, 426 out of 546), a cement-in-cement revision was carried out. Regarding Lubinus SP II, data on stem length is more complete. In 54.8 % of cases, a 13 or a 15 cm stem was used and in the other cases stem lengths between 17 and 30 cm. During 108 out of 342 operations where data is available (72.9 % of all), cement-in-cement revision was carried out.

Among uncemented revision stems, three modular stems (MP, Restoration and Revitan) dominated during 2009 and 2018. During 2019, Revitan, which had occupied third place in earlier years, was replaced by Corail Revision. Two-part stems have many advantages. It is for example easier to adjust bone length and the version of the femoral neck. Disadvantages include risk of loosening between the two modular components and corrosion. Moreover, this stem type is based on distal fixation. During revision surgery many different types of bone defects are experienced and, in some cases, a periprosthetic fracture may be the case. In other cases, it can be an advantage to use stems of standard type to reduce proximal bone atrophy. Furthermore, the possibility to use cemented fixation with or without bone transplantation, is added, methods that in the short or mid-term perspective seem to give equal or better results than uncemented fixation. The choice of prosthesis also depends on the surgeon's personal experiences. In order to master the majority of the more or less complex situations that can occur during revisional surgery, it is however important to master several basic types of implants and surgical techniques.

Just as during primary operation, the conformity in Sweden regarding choice of implant is at its maximum during choice of cemented fixation. The size of the group "other" for each fixation group respectively, gives a certain, albeit limited, estimate of how diversified the choice of implant is, since the way of

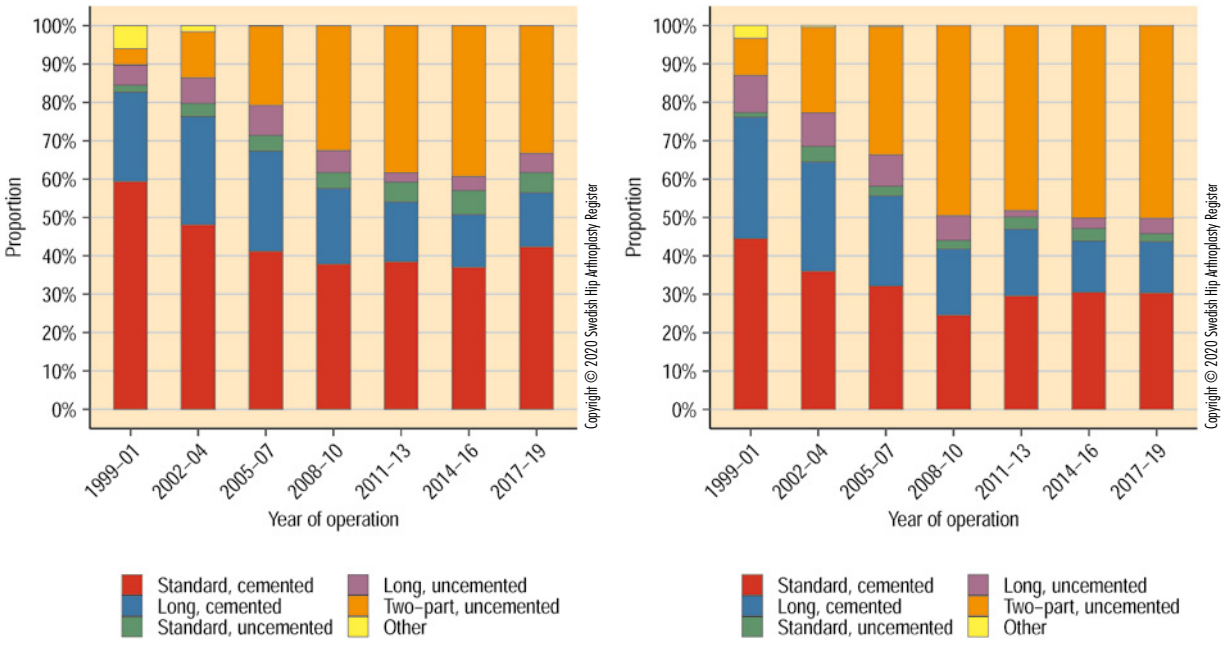


Figure 8.3.16. Distribution of cemented and uncemented stem types respectively at first-time (a) and multiple revisions (b) 1999–2019. The stem has been classified as long if its length is 165 mm or longer. The group Other is dominated by older monoblock-stems.

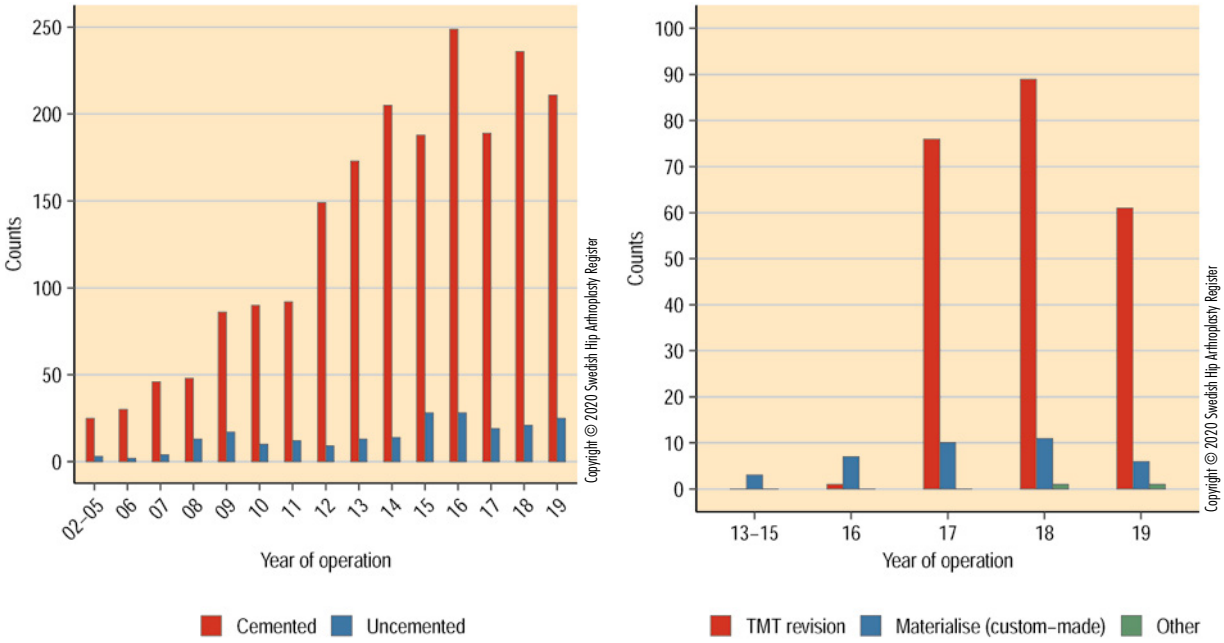


Figure 8.3.17. Number of cemented and uncemented dual mobility cups inserted during revisions 2002–2005 and thereafter annually up to and including 2019.

Figure 8.3.18. Number of cups related to year of operation that have been converted to dual mobility cups by cementing a whole cup in a metal casing that is attached to the bone without cement.

classifying implants to some extent influences how large the group "others" will become. During 2019, the proportion of "other" cemented revision cups was 8.3 %, while 26.5 % of the uncemented cups ended up in the group "other" uncemented cups. On the stem side, the difference was less pronounced: 6.7 % for cemented stems and 10.7 % for uncemented stems.

Results

Of the primary operations that were carried out between 1999 and 2019, 4.6 % had been revised after 15 years. The corresponding proportion for first-time revisions carried out during the same time-period was 15.1 %, for second-time revisions 19.8 % and for the hips that had been revised at least twice before 26.0 %. The implant survival after 15 years, when 115 observations remained in the latter and smallest group, was 91.2 ± 0.2 % in the primary operation-group and 76.4 ± 0.8 %, 72.4 ± 1.8 % and 63.9 ± 3.4 % in the revision groups respectively (figure 8.3.19). Figure 8.3.20a and b show the implant survival rate for men and women respectively during the same period and with the same groupings. During the last observational years, data is however less reliable since only 52 observations remain at 15 years in the smallest group (two or more previous revisions). The groupings are the same as in figure 8.3.14. The implant survival for men is worse in three of the groups (primary operation, first and second revisions).

The prognosis measured as risk for re-revision is thus getting worse for each revision that is carried out. Evaluation after 15 years with the use of Cox regression analysis and with adjustment for age at index operation, gender and primary diagnosis shows that the risk (Hazard Ratio) for re-revision is around 3.8 times higher (95 % confidence interval: 3.6–3.9) after first-time revision compared with primary operation, 5.3 (5.0–5.6) higher if the patient is revised a second time and 7.7 (7.0–8.4) if the hip has been revised at least twice before.

In general, men have an around 30 percent increased risk for revision or re-revision (Hazard Ratio (HR) 1.33; 1.30–1.37). If the operations that have been preceded by at least two revisions are excluded and only the first and second revisions are analysed, this risk is affected only marginally (HR 1.36: 1.32–1.40), probably because the group that has been excluded is so small. A separate analysis of those that have been revised at least twice (1 941 operations), however shows that the risk for men in this group is reduced (HR 0.7; 0.6–0.9). These data should however be evaluated more thoroughly, and it must also be considered to what extent these patients are reoperated without implant touch, as these often are infection cases.

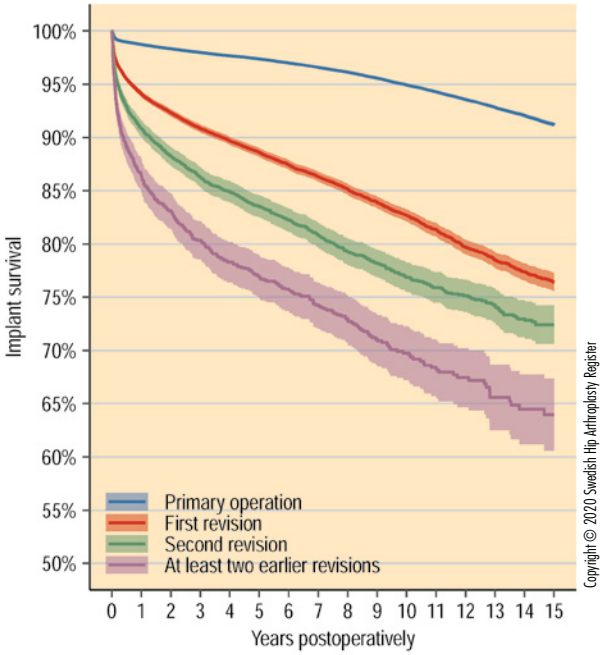


Figure 8.3.19. Implant survival up to 15 years regardless of gender and based on revision as outcome regardless of cause and measure for first- and second-time revisions of hip arthroplasties that earlier have undergone at least two revisions. Revisions carried out in 1999 at the earliest, are included.

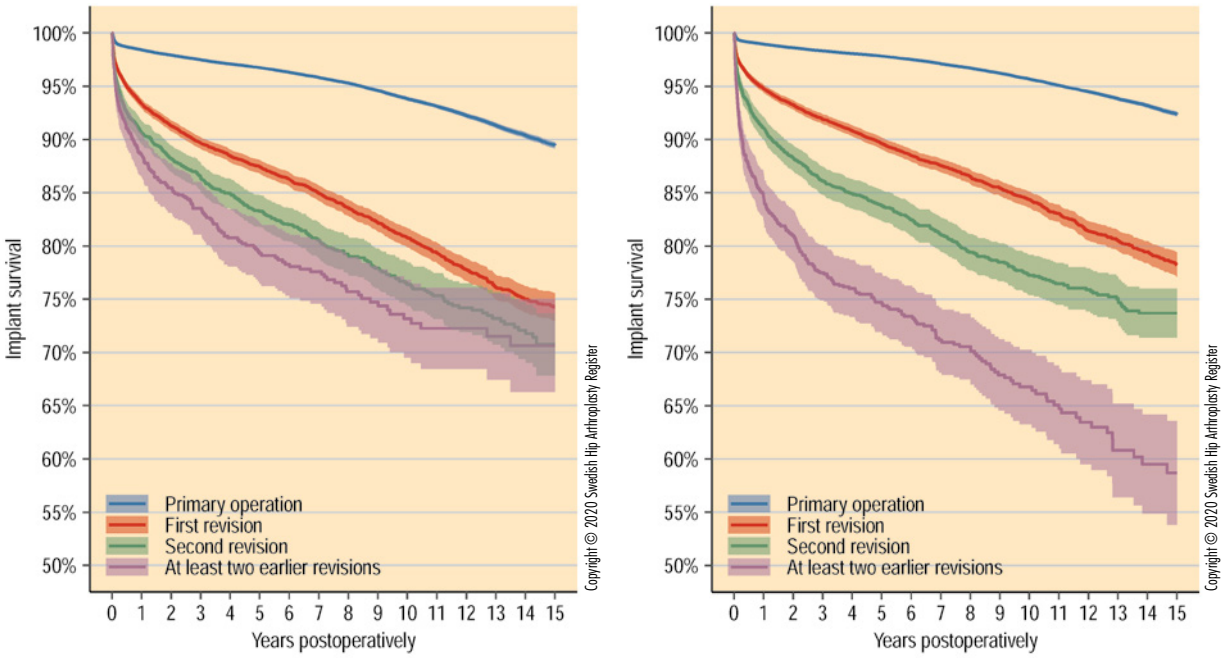


Figure 8.3.20. Implant survival up to 15 years for men (a) and women (b) based on outcome of revision regardless of cause and measure for first- and second-time revisions and for revisions of hip arthroplasties that have undergone at least two earlier revisions. Revisions carried out in 1999 at the earliest, are included.

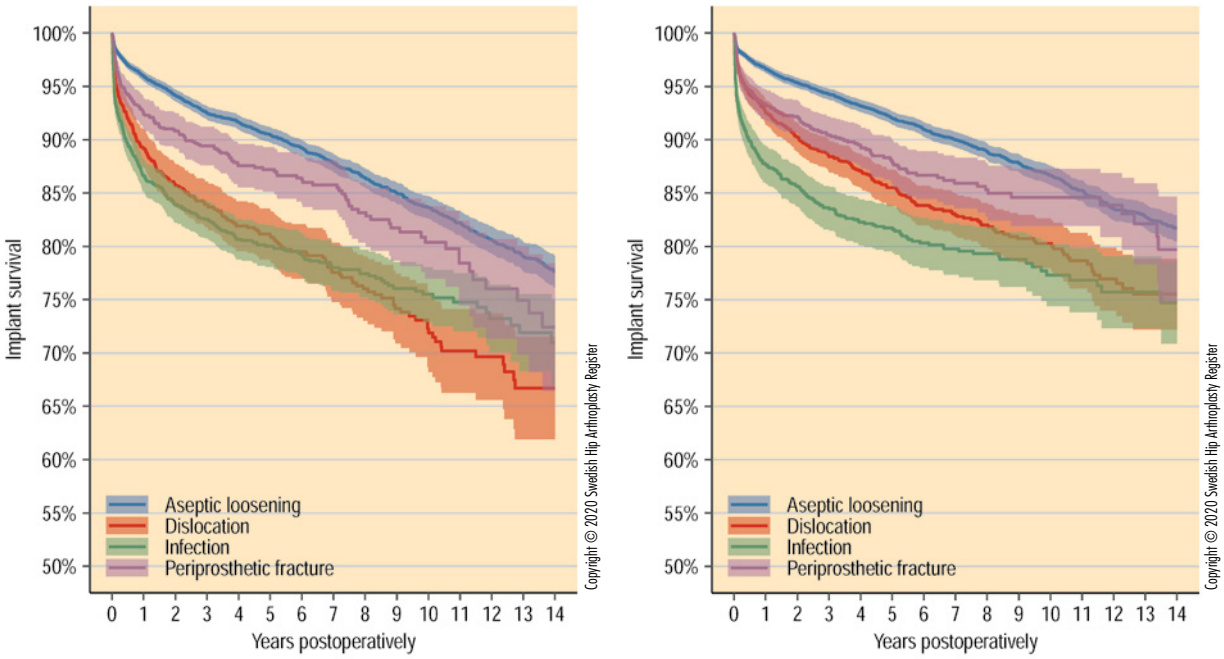


Figure 8.3.21. Implant survival for men (a) and women (b) up to 14 years divided after reason for revision and based on outcome of revision regardless of cause and measure for first- and second-time revisions and for revisions of hip arthroplasties that have undergone at least two earlier revisions. Revisions carried out in 1999 at the earliest, are included.

The risk of having additional revisions varies depending on reason for the preceding revision, which is illustrated in this section (table 8.3.4). An analysis of implant survival grouped after reason for revision shows that the risk of re-revision is the greatest if the reason is infection or dislocation. We also see that re-revisions, if they occur, occur relatively early. This holds especially if the reason of the revision was infection or dislocation. This is illustrated in the survival diagrams by the fact that the slope of the curves is steeper early after the index operation and thereafter levels-off somewhat (figures 8.3.21a and b). The duration of the follow-up for first-time revisions is 14 years here, when 51 observations remain in the smallest group (men revised due to infection). After four to five years in the male group, and some years later among the women, the parallelism of the curves in the survival diagrams disappears (some of the curves that describe implant survival cross each other), probably partly because the survival probability varies depending on reason for revision (see annual report 2016 and regarding reoperations this year's report and Cnudde et al. Acta Orthop. 2019; 90(3): 226–230).

A revision of a hip arthroplasty entails that a patient who has undergone an earlier hip arthroplasty undergoes an additional operation where the whole or parts of the prosthesis are changed or extracted.

Since 1999, the proportion of revisions related to the total number of primary and revision operations has decreased from 11.5 % to 8.8 %. The absolute number of revisions has however increased from an mean of 1 530 annually during the period 1999–2001, to on mean 1 812 annually during the period 2017–2019.

Since 2000, loosening has been the dominating reason for first-time and multiple revisions, but its relative share has gradually decreased, while above all the proportion of revisions due to infection has increased.

Patients that are revised are in general older, more often men and more often have a secondary osteoarthritis and a higher degree of comorbidity, than those operated with a primary prosthesis.

The number of low volume-units has been relatively constant in Sweden over the last ten years. During 2019, 33 operating units carried out fewer than 25 revisions and 20 out of these fewer than 10 revisions.

Between 2017 and 2019, aseptic loosening was the most common reason for revision during first-time revision and infection was the most common reason during multiple revision.

The risk of undergoing additional revisions increases with an increasing number of revisions. The prognosis is worst after revision due to infection, followed by revision due to dislocation. The importance of optimizing the primary operations is therefore crucial.

8.4 Implant survival after total hip arthroplasty within five and ten years

Author: Maziar Mohaddes

Implant survival within five and ten years after total arthroplasty is presented per unit with so called forest plots. All operations at a unit regardless of diagnosis during primary operation and all revisions regardless of cause are included in the analysis. Implant survival after five and ten years are Kaplan-Meier estimates. The grey line represents the national mean. Green indicates a statistically significant better implant survival and red a statistically significant poorer implant survival. It is important to note that very wide confidence intervals indicate few events being recorded in that specific centre. For the five-year survival, we have chosen to exclude units that have operated fewer than 30 patients and for the ten-year survival to exclude units that have operated fewer than 60 patients during the specified time-period. Those units that did not have any operations during 2009 or that have not registered any operations during 2018 and 2019 have also been excluded. The implant survival is based on revisions carried out on hip arthroplasties during the last five to ten years. This means that the observational time reaches the nine- and ten-year interval only for the patients that were operated the first observational year. Since more and more hip arthroplasties have been carried out during the latter part of the interval 2009–2019, the mean observation time becomes shorter than five years.

The national mean for implant survival at five and ten years is over 97 % and 95 % respectively. There is a quite considerable variation between units. The five-year survival varies between 94 % to 99 % at five years and between 90 % to 98 % at 10 years.

The outcome measure is a valuable quality indicator, especially for the units that have had a relative intact organisation and have not made any larger changes of the operational process, including choice of standard prosthesis during the last ten years. The outcomes dislocation and infection reflect both the unit's case-mix and the quality of care. The frequency of revision due to loosening provides relative illuminating information on how choice of prosthesis and surgical technique affect the outcome. For those units that have been through organisational changes during the last ten years or that have changed standard prosthesis, the implant survival rate after ten years may become more difficult to interpret since it reflects current organisation and choice of prosthesis to a lesser extent. Therefore, we have added the five-year survival that to some extent reflects current organisation. Here, it is possible to get an indication of potential problems a little earlier.

The implant survival for the most common combinations of stem and cup are presented in the Swedish web version of the annual report available at www.shpr.se.

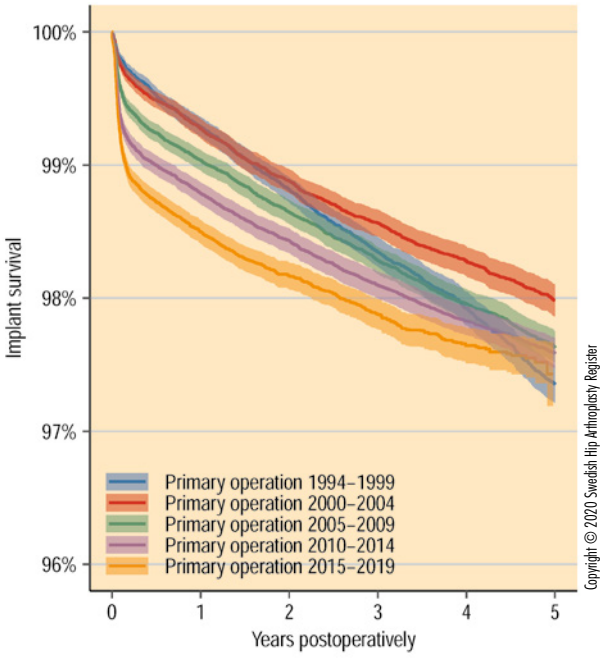


Figure 8.4.1. Implant survival for different periods up to 5 years.

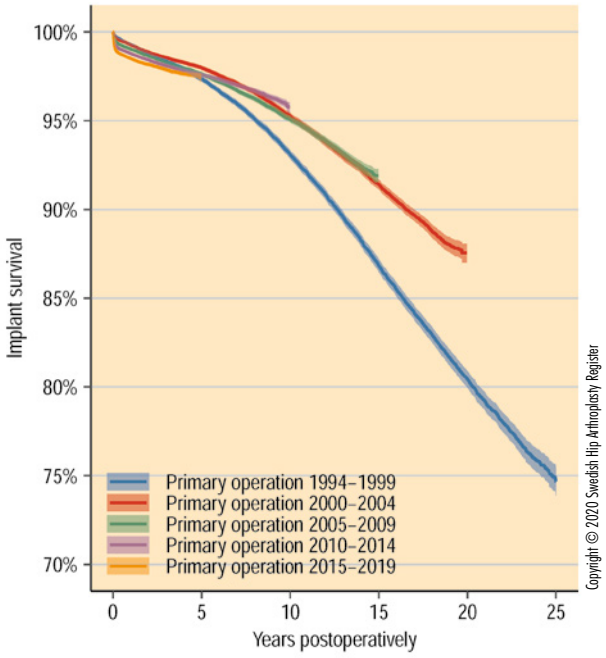
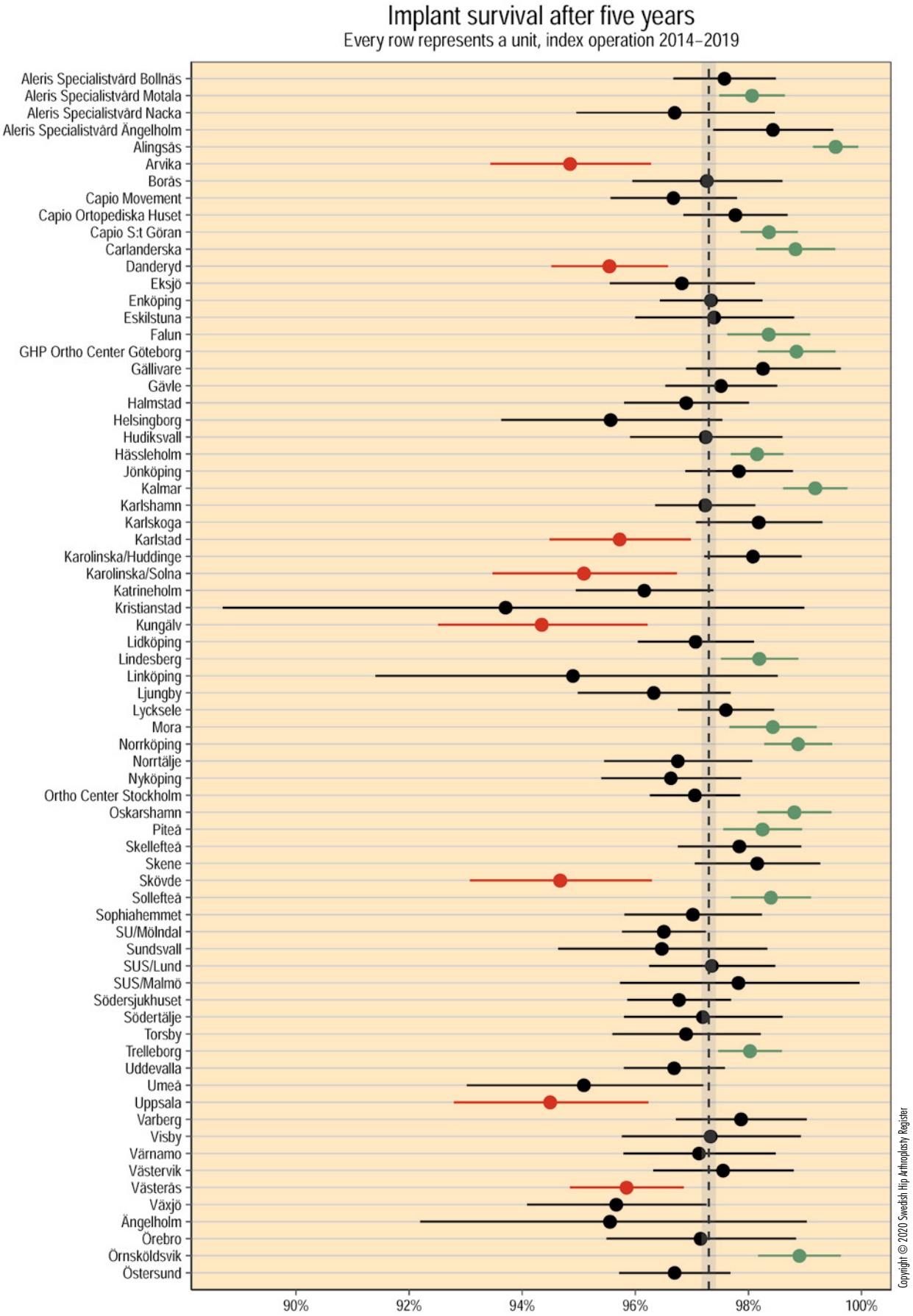
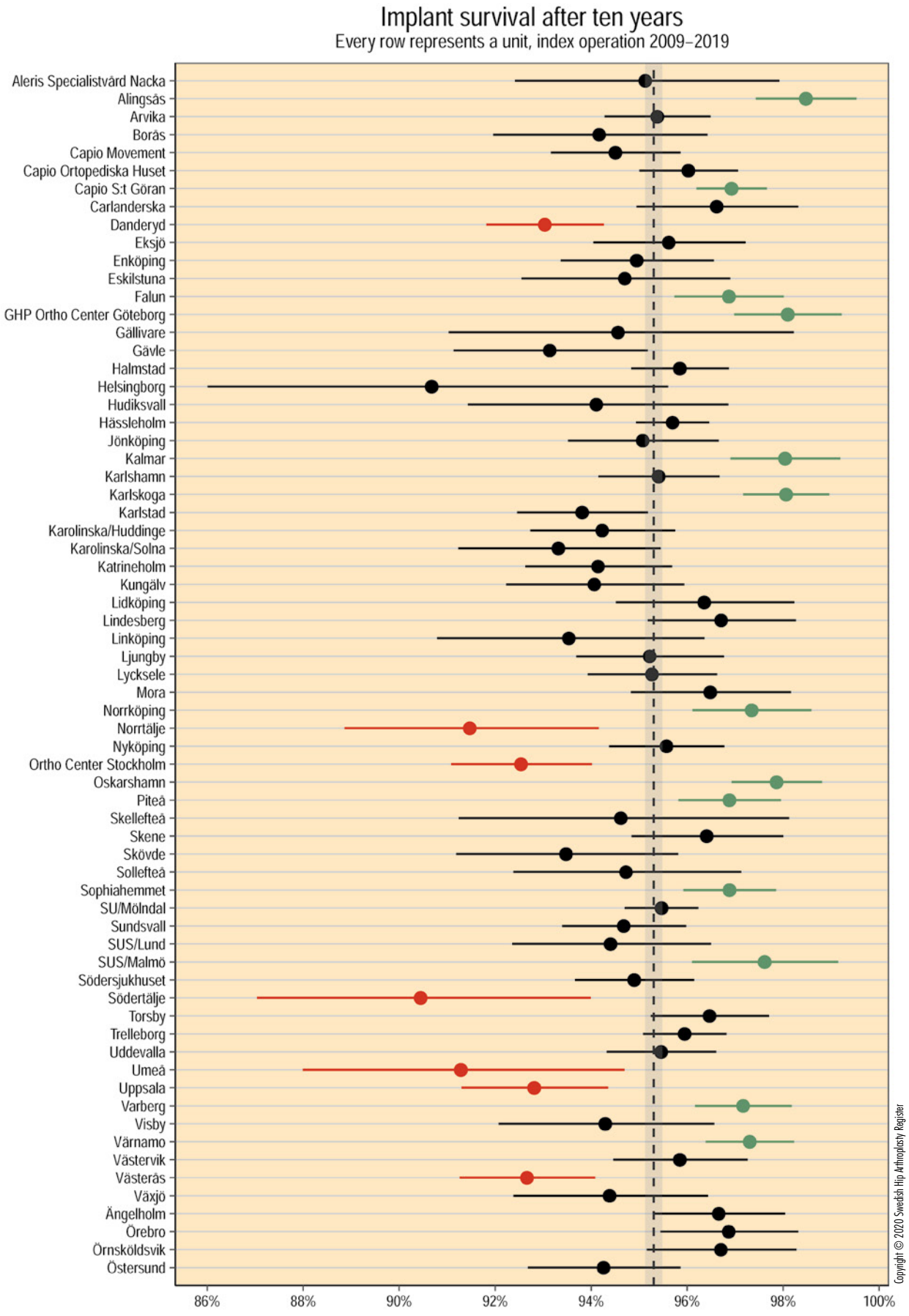


Figure 8.4.2. Implant survival for different periods up to 25 years.



8.4.3. 5-year implant survival with confidence interval per unit. Units with fewer than 20 observations "at risk" at the end of the analysis-period have been excluded.



8.4.4. 10-year implant survival with confidence interval per unit. Units with fewer than 20 observations "at risk" at the end of the analysis-period have been excluded.

8.5 Relative survival after reoperation

Author: Johan Kärrholm

Knowledge of mortality after reoperation of a hip arthroplasty is one out of several important factors in the decision-making process before performance of a reoperation. In the annual report for 2016, data on mortality divided into reason for reoperation for patients with primary osteoarthritis were presented for the first time. A more detailed analysis based on computation of relative patient survival was presented in 2019. The study included patients who had undergone a primary operation 1999 to 2017 and focused on 9 862 patients who had undergone one or two reoperations (Cnudde and co-workers Acta Orthop. 2019:90 (3): 226-230).

The computation of relative patient survival is based on knowledge of the survival among the Swedish population. These data are available and published by the Human Mortality database (http://www.mortality.org) and are based on data from Statistics Sweden when it comes to the Swedish population.

By matching the survival of a defined patient group against the expected survival of the whole population, with regard to age, gender and calendar year, it is possible to calculate for a given point in time if the proportion of deceased patients corresponds to the expected proportion or not. The relative survival is then defined as the observed survival in a patient group divided by the expected survival in the population. A relative survival above one, indicates that more patients survive compared with what is expected, and values below one indicates that there is an over mortality in the patient group (for details see Cnudde and co-workers Clin. Orthop. Relat. Res. (2018) 476: 1166-1175).

In this year's report we present the relative survival for patients who have undergone a reoperation for the first (n = 24 591) or for the second time (n = 7 146), during the period 1999 to 2018, without taking the year of the primary operation into account. The patients have been grouped according to the most common reasons for reoperation (table 8.5.1). By including all reoperations carried out for the first or second time during the period, the number of observations becomes higher than in earlier analyses. Furthermore, data will be closer to the clinical every day practice.

Table 8.5.1 shows that the mean age during reoperation for the first and second time respectively does not differ markedly between the reason for reoperation-groups loosening/osteolysis, infection, periprosthetic fracture and dislocation. In the reason for reoperation-group "other" the mean age however is more than four times higher during the second reoperation – compared with during the first reoperation. The highest mean age is seen for the patients who are reoperated due to periprosthetic fracture, both during first and second reoperation. During first-time reoperation the proportion of women is the highest among those that are reoperated due to dislocation. During reoperation for the same reason but for the second time, the proportion of women is still high but not as high as in the group that is afflicted by a periprosthetic fracture. During calculation of relative survival these differences are compensated for, which facilitates comparison between the groups and makes it more just.

In the groups that are reoperated for the first time due to loosening/osteolysis and due to other causes, the patient survival is higher than expected during the first 10 years. For patients reoperated due to infection, dislocation and periprosthetic fracture, we find the opposite relationship. As in the analyses that have been performed earlier and that are presented above, the over mortality tends to be the highest in patients that are reoperated due to periprosthetic fracture, followed by the causes dislocation and infection.

After the second reoperation the patient survival is lower in the group "other causes" than after first reoperation and does not differ from the expected after 10 years (table 8.5.2). In the group loosening/osteolysis it is marginally worse, just as in the groups infection and dislocation, even if the confidence intervals for first and second reoperation overlap after ten years. In the group that is reoperated due to periprosthetic fracture, the patient survival after 10 years is higher after second reoperation compared with after first reoperation. The number of observations during second reoperation are however few and the confidence intervals after each type of index operation respectively are wide and almost completely overlapping, which speaks against a real difference.

The background for the variations that we observe between the different reason for reoperation-groups are not known and presumed causes remain speculative. Bleeding and other medical complications in connection with the reoperation certainly affect the postoperative mortality but the difference in relative patient survival, especially between the reason for reoperation-groups loosening/osteolysis and infection/dislocation/periprosthetic fracture suggests that also other selection factors play a part. Patients who are reoperated due to loosening/osteolysis may be expected to be more active and in general be healthier. Symptoms due to loosening/osteolysis, if they exist at all, often progress slowly. Surgical treatment is not always necessary and when it is called for, the operation normally does not have to be carried out acutely or half-acutely, which means that the patient can be optimised medically prior to the intervention.

Infection, dislocation and periprosthetic fracture are conditions that must be addressed expediently and the time for patient optimisation is limited. Many of these patients may also be expected to have a higher degree of comorbidity. In the latter two reason for reoperation-groups there are probably also a higher proportion with an increased predisposition for fall and memory disorders than in the normal population, factors that are associated with increased mortality.

Patients operated for the first or second time due to loosening/osteolysis after primary hip arthroplasty have a higher patient survival than expected up to ten years after the operation. The patient survival after corresponding reoperations due to infection, dislocation and periprosthetic fracture is lower than expected. The reason behind these differences is unknown, but patient selection and comorbidity are probably important factors.

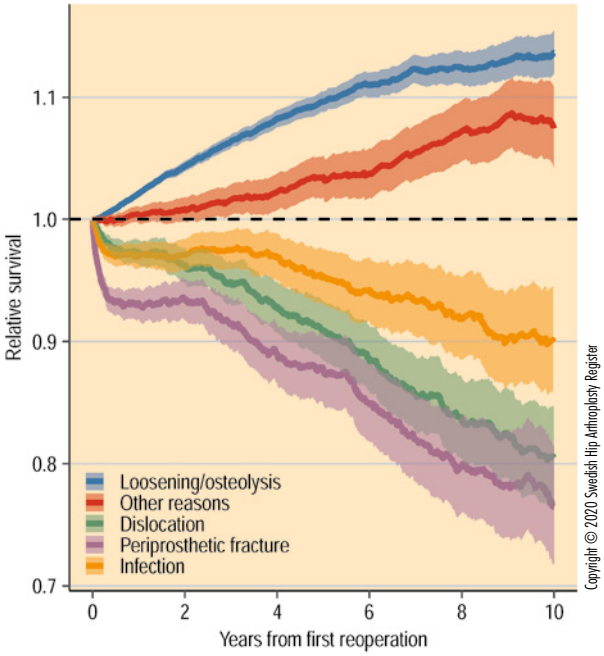


Figure 8.5.1. Relative patient survival up to 10 years after operation ±95 % confidence interval for first-time reoperations related to reason of reoperation.

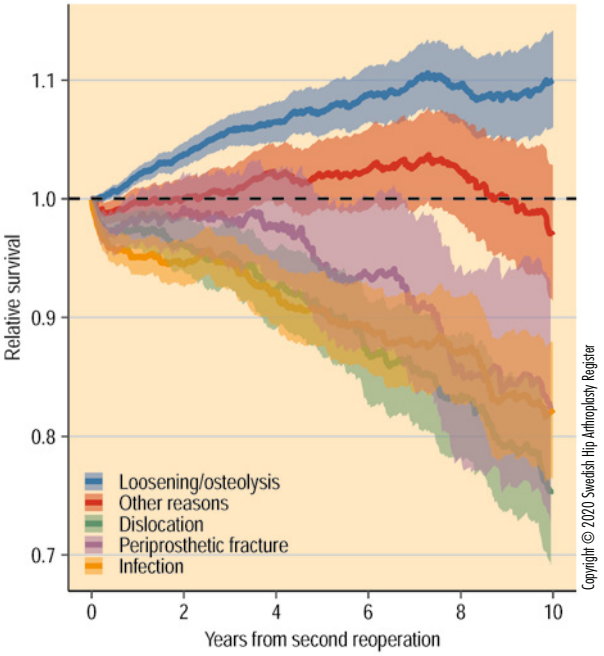


Figure 8.5.2. Relative patient survival up to 10 years after operation ±95 % confidence interval for second-time reoperations related to reason of reoperation.

Demographical data and diagnosis divided into reason of reoperation-groups for patients reoperated 1999 to 2018

	Reason of reoperation				
	Loosening/ osteolysis	**Infection**	**Periprosthetic fracture**	**Dislocation**	**Other causes**
First reoperation					
Number	12,938	2,944	3,513	3,148	2,048
Age during reoperation mean SD	71.5 *10.7*	70.3 *11.3*	77.6 *11.3*	73.6 *11.0*	65.6 *12.0*
Women number %	6,789 *52.5*	1,294 *44.0*	2,001 *57.0*	1,974 *62.7*	1,163 *56.8*
Diagnosis number %					
Primary osteoarthritis	9,832 *76.0*	2,004 *68.1*	2,317 *66.0*	2,026 *64.4*	1,456 *71.1*
Hip fracture acute	168 *1.3*	271 *9.2*	226 *6.4*	349 *11.1*	53 *2.6*
Fracture *sequelae/complication*	592 *4.6*	257 *8.7*	405 *11.5*	322 *10.2*	92 *4.5*
Inflammatory joint disease	829 *6.4*	96 *3.3*	188 *5.4*	117 *3.7*	95 *4.6*
Sequelae after childhood disease	528 *4.1*	65 *2.2*	60 *1.7*	60 *1.9*	137 *6.7*
Other secondary osteoarthritis	479 *3.7*	216 *7.3*	206 *5.9*	205 *6.5*	118 *5.7*
Not available	510 *3.9*	35 *1.2*	111 *3.2*	69 *2.2*	97 *4.7*
Second reoperation					
Number	2,330	1,585	816	1,251	1,164
Age during reoperation mean SD	71.4 *11.2*	70.6 *11.4*	78.2 *10.5*	74.7 *11.0*	69.8 11.6
Women number %	1,196 *51.3*	675 *42.6*	488 *59.8*	733 *58.6*	534 45.9
Diagnosis number %					
Primary osteoarthritis	1,587 *68.1*	1,048 *66.1*	561 *68.8*	814 *65.1*	805 69.2
Hip fracture acute	20 *0.9*	135 *8.5*	23 *2.8*	76 *6.1*	44 3.8
Fracture *sequelae/complication*	118 *5.1*	127 *8.0*	94 *11.5*	143 *11.4*	86 7.4
Inflammatory joint disease	240 *10.3*	76 *4.8*	61 *7.5*	62 *5.0*	72 6.2
Sequelae after childhood disease	167 *7.2*	37 *2.3*	25 *3.1*	24 *1.9*	61 5.2
Other secondary osteoarthritis	94 *4.0*	129 *8.1*	30 *3.7*	69 *5.5*	61 5.2
Not available	104 *4.5*	33 *2.1*	22 *2.7*	63 *5.0*	35 3.0

Table 8.5.1. Demographical data and diagnosis divided into reason of reoperation-groups for patients reoperated the first and the second time between 1999 to 2018.

Patients at risk, deceased within 10 years after first and second reoperation (regardless of side) and relative survival after 10 years

	Number at start	Number alive after 10 years #	Number of deceased after 10 years	Cumulative proportion (%) deceased after 10 years	Relative survival after 10 years
Reason of reoperation					
Loosening/osteolysis					
First reoperation	12,938	4,403	1,883	35.9 *34.9–36.8*	1.14 *1.12–1.15*
Second reoperation	2,330	770	330	37.0 *34.6–39.3*	1.10 *1.06–1.14*
Deep infection					
First reoperation	2,944	490	551	47.1 *44.5–49.5*	0.90 *0.86–0.94*
Second reoperation	1,585	267	181	51.9 *48.4–55.2*	0.82 *0.76–0.88*
Dislocation					
First reoperation	3,148	697	536	58.6 *56.5–50.5*	0.80 *0.77–0.85*
Second reoperation	1,251	297	265	62.9 *59.7–65.8*	0.75 *0.69–0.82*
Periprosthetic fracture					
First reoperation	3,513	440	551	70.0 *68.1–71.9*	0.76 *0.72–0.81*
Second reoperation	816	129	145	67.2 *63.0–71.0*	0.83 *0.73–0.93*
Other causes					
First reoperation	2,048	722	158	24.3 *22.0–26.6*	1.07 *1.04–1.11*
Second reoperation	1,164	348	164	40.6 *37.1–44.0*	0.97 *0.91–1.03*

Table 8.5.2. Patients who have undergone a reoperation as first or second measure 1999 to 2018, number of patients alive and number and cumulative proportion of deceased patients after 10 years related to reason of reoperation.

 # regardless of additional reoperations

8.6 Change of cup or stem or both during first-time revision due to loosening

Author: Johan Kärrholm

The choice of surgical procedure when performing a revision is decided by several factors. During prosthesis loosening with or without osteolysis, it is often obvious which components that should be changed. Sometimes, however, the question arises if it suffices to change only one of the components. The assessment may be aggravated by difficult-to-interpret subjective symptoms, radiographs that are hard to interpret and unexpected findings during the operation itself. Firm evidence of loosening may be at hand regarding one of the components, while the conditions regarding the other component may be considerably more unclear. This makes the preoperative assessment more difficult to make, especially so if a complete prosthesis change is deemed to increase the risk of more complications. If furthermore a high degree of comorbidity is the case, one is interested in shortening the surgical time as much as possible, minimise the bleeding and thereby try to reduce the risk for general complications.

It is common that only one of the components is affected by loosening. Based on the distribution of revisions of only cup, or only stem or both components, it seems to be about just as common that one prosthesis component is deemed to be loose as that both are. The decision on revising just one or both components may also be affected by the access to suitable prosthesis parts, the expected amount of bone that remains after a potential prosthesis extraction and the possibility to attain a satisfying degree of stability of the hip joint during the operation. Against this background, it could be interesting to evaluate if, and in that case to what extent, the risk of re-revision varies after only cup or stem revision, compared with revision of both components. Here, first-time revisions due to loosening have been studied.

Method

The analysis includes first-time revisions due to loosening operated between 1999 and 2019. During all operations the stem, or the cup or both components were changed in a one-stage procedure. Other measures than change of cup and/or stem, such as hips operated due to a tumour, operations carried out with other surgical approaches than direct lateral or posterior approach, as well as operations with missing data have been excluded (figure 8.6.1).

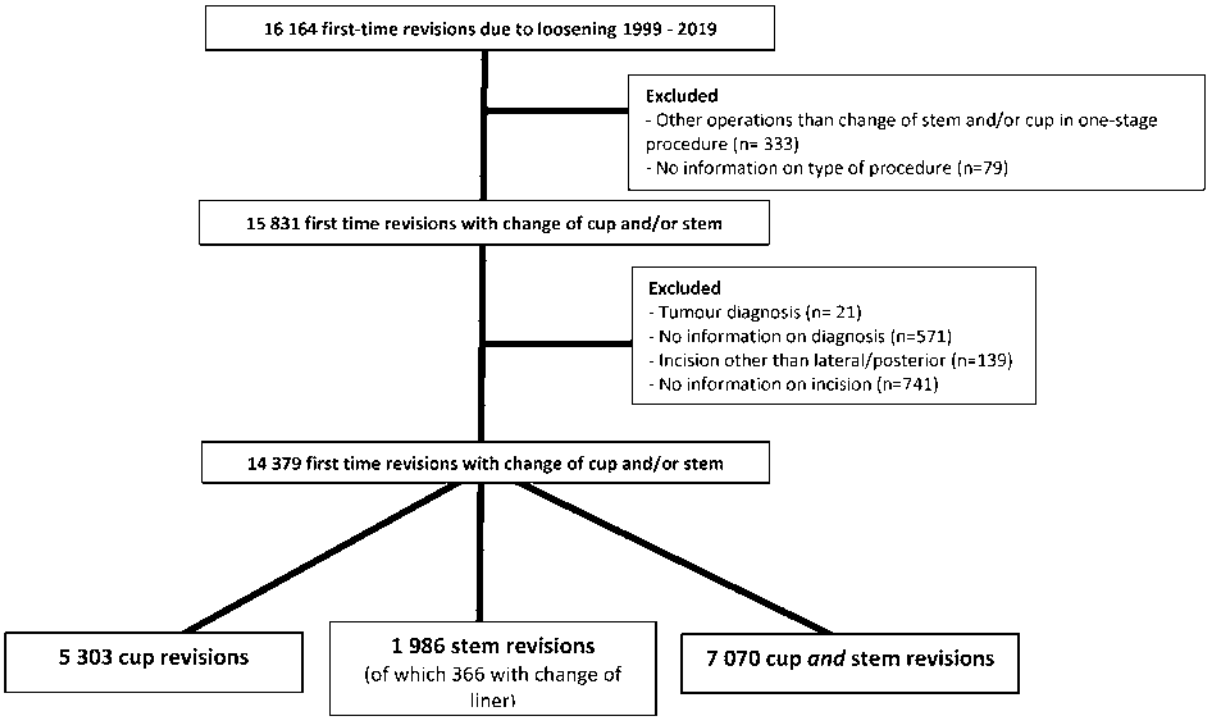


Figure 8.6.1. Flow-chart showing selection of parameters.

Change of cup was in existing cases defined as change of both shell and liner. In 366 out of 1 986 stem revisions, both stem and liner were changed. These cases were included in the group stem change mainly because they had about the same frequency of re-revision as the operations with only stem change (the whole of the studied period: 17.2 % for stem and liner change; 19.1 % during only stem change) and about the same implant survival (figure 8.6.2).

Results – comparison between all three groups

At the end of the observation time the incidence of re-revisions was highest in the group only operated with stem exchange, followed by those who had only undergone cup revision (table 8.6.1). The duration of the follow-ups is however not equally long depending on the fact that relatively more revisions of both cup and stem as well as only stem revisions were carried out in the beginning of the studied period (1999–2019) compared with during the latter part of the period, which means that the opposite is true for isolated cup revisions (figure 8.6.3). In a survival diagram that compensates for variations in duration of follow-up we find however that there is a difference between groups (figure 8.6.4, log-rank test: $p < 0.001$). Proceeding with a Cox regression analysis shows that the hazard ratio for re-revision regardless of measure at the re-rerevision is 37 % (HR = 1.37; 95 % confidence interval, C.I.: 1.23 – 1.52) and 82 % (1.82; 1.60 – 2.06) increased, if only cup or only stem revision is carried out compared with revision of both components. Adjusting for age, gender, diagnosis and surgical approach (posterior or direct lateral) affects these data only marginally (1.36, 1.22 – 1.51) (1.75, 1.54 – 1.98).

Results – comparison between only cup and cup and stem revised patients

An additional comparison has been carried out, now between the groups only cup revision and revision of both cup and stem. Hips with DMCs have been excluded (5.6 % in the group only cup revision; 5.1 % in the group cup and stem revision) when data on the diameter of the outer femoral head is missing. Moreover, only cups with an articulating surface made from polyethylene are included since only a few prostheses have an articulating surface made of ceramics or metal. Any adjustment for femoral head material has not been made, as data is missing in many cases, especially in the group cup revision only. Finally, 207 observations were excluded where data on femoral head size was missing. After these exclusions, 4 709 only cup-revised and 5 587 cup and stem-revised hips with a known femoral head size, operated with a conventional cup and with an articulating surface made of older or extra crosslinked polyethylene remained. In a regression analysis it was found that these exclusions had not affected the difference in the unadjusted risk for re-revision. It is still increased in the group that have been operated with cup revision only (RR = 1.37; 1.23 – 1.53). If adjustment for the same variables as above (age, gender, diagnosis and surgical approach) is made, as well as for femoral head size, type of polyethylene in the articulating surface of the cup, and the choice of cup fixation, the difference increases only marginally (RR = 1.39; 1.24 – 1.55).

During first-time revision due to loosening/osteolysis the risk for re-revision is increased if only one of the components is changed. The highest risk is seen during revision of stem only.

The result is affected only marginally or not at all after adjustment for differences in demography and choice of surgical approach between the groups. The same can be said when comparing cup revision only and revision of the whole prosthesis after adjusting for femoral head size, type of articulating polyethylene and the choice of cup fixation.

The reason for the observed differences is unknown. Probably the possibilities to reconstruct better biomechanics and a more stable hip increase if both components are changed. Furthermore, wear and corrosion between modular parts and possibly the wear of the hip joint itself are reduced.

The choice between revision of one or several components is mainly based on patient history, symptoms presented and degree of comorbidity combined with the result of imaging and laboratory diagnostics. During the decision process regarding more complex cases, the current analysis could be valuable since it shows the actual outcome in Sweden during the two last decades.

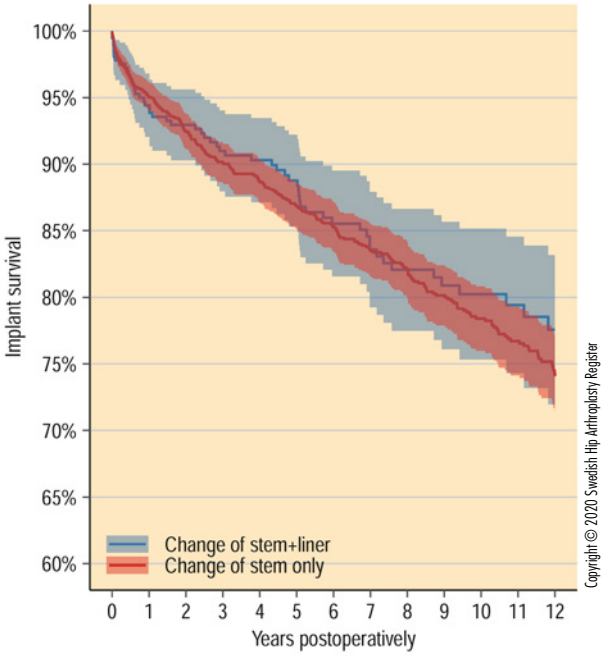


Figure 8.6.2. Comparison between stem revision with or without change of liner. All types of revision regardless of cause are included. After 12 years only 79 observations remain in the smallest group (stem- and liner change).

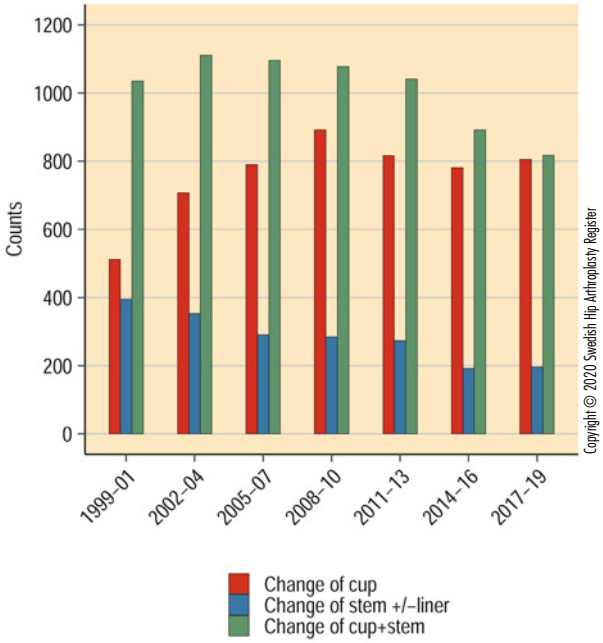


Figure 8.6.3. Distribution of the number of isolated cup changes, stem changes and change of cup and stem divided into three-year periods between 1999 and 2019.

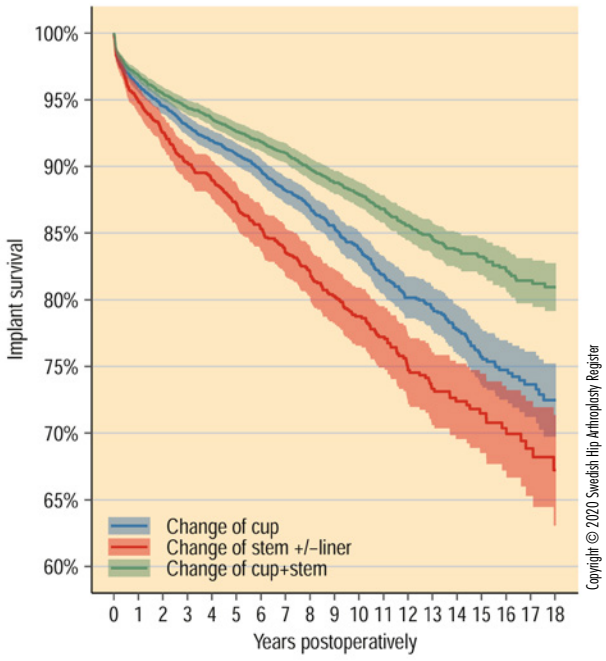


Figure 8.6.4. Probability of re-revision regardless of cause and measure after change of only cup, only stem or of the whole prosthesis due to loosening during first-time revision.

Descriptive data during first revision with change of only cup, only stem or change of both cup and stem

	Type of revision		
	Change of cup	Change of stem ± change of liner	Change of the whole prosthesis
Number	5,303	1,986	7,070
Duration of follow-up years median	6.3	6.9	7.6
Proportion of women %	63.2	42.9	46.6
Age mean *SD*	70.5 *11.4*	70.4 *11.4*	73.0 *9.6*
Diagnosis %			
Primary osteoarthritis	77.7	80.0	81.6
Inflammatory joint disease	8.3	4.1	7.1
Acute injury or sequelae after fracture/trauma	4.3	9.9	5.3
Other secondary osteoarthritis	9.7	6.0	6.0
Direct lateral approach % (supine or lateral position)	42.6	50.1	37.6
Cemented revision-cup %	55.7	-	62.5
Cemented revision-stem %	-	67.6	72.3
Dual mobility cup all variants %#	5.6	1.6	5.1
Femoral head diameter %¤			
22 mm	5.9	24.3	2.0
28 mm	36.3	45.3	53.1
32 mm	44.2	20.6	31.7
36 mm	8.4	3.3	12.3
Other sizes	0.6	2.4	0.7
Not available	4.6	4.2	0.1
Articulating surface cup %			
Older type of polyethylene*	45.0	4.9	52.6
Polyethylene with extra crosslinks*	52.5	13.3	45.3
Ceramics/metal	0.3	0	0.3
Not available	2.2	81.8	1.8
Ceramic femoral head %	5.1	8.4	8.2
Not available	26.0	4.4	1.9
Cemented stem %	92.6	75.5	65.8
Reason of re-revision %			
Loosening/osteolysis	7.0	9.2	4.9
Infection	2.2	2.8	1.7
Periprosthetic fracture	1.0	1.4	1.4
Dislocation	2.4	4.2	1.6
Other causes or cause is missing	0.7	1.2	0.7
Not re-operated	86.7	81.2	89.7

Table 8.6.1. Demographical data, choice of surgical approach, fixation and articulation and reason of re-revision grouped after measure. First revision due to loosening/osteolysis carried out between 1999 and 2019 and in one stage are included. During stem revision the liner has been changed during 366 of the operations.

 # DMC that has been cemented in a metal casing or a dual mobility liner that has been inserted in a standard cup and has been fitted with a metal-insert are included. In the group stem revision, 6 out of 366 observations were converted to dual mobility (1.6 %).

¤ Hips that have been revised with a DMC have been excluded.

** Older type of polyethylene: not radiated or radiated with less than 5 MRad. Polyethylene with extra crosslinks: radiated with 5 MRad or more.*

9. Patient-reported outcome

Author: Ola Rolfson

The PROM-programme of the Swedish Hip Arthroplasty Register

Patient-reported outcome measures are instruments to measure health or health-related aspects through the patient's own experience. The tools or instruments used to measure patient-reported outcomes are standardised questionnaires that are answered by the patient without any intermediary interpretation. The main objective with most hip arthroplasties is to reduce pain and restore function, thereby improving the health-related quality of life of the patient.

The PROM-routine of the register was initiated as a pilot-project in Norrland and the Västra Götaland-region in 2002. More units joined as time went by, and since 2008 all units are part of the follow-up routine. That we now have a 100 % coverage of units is the result of the well-established structure for the reporting of data. The programme was launched under the name "Höftdispensären" but is now called the "PROM-programme".

The logistics of the PROM-programme

All patients who will undergo an elective primary total hip arthroplasty are asked to answer a questionnaire containing twelve questions prior to the operation. The form encompasses questions on comorbidity and walking ability to decide the Charnley class, questions on hip pain divided into right and left hip (on a five-level Likert scale) and the EQ-5D-instrument that measures health-related quality of life. Since 2017, we use the new version of the EQ-5D-instrument that consists of two parts; the first part has five general questions with five response options each and gives a health-profile that can be translated into an index. The second part of the EQ-5D-questionnaire consists of a thermometer, EQ VAS (analogue-visual scale), where the patient marks current health status on a scale from 0 to 100. For the first time this year, we report the recently published Swedish value-set, that is those algorithms that are used to compute the index. There is one that computes values to VAS-units (from the worst to the best possible health 0–100) and one that can be translated to the scale dead to best possible health that ranges between 0–1. Since 2012, there is a question if the patient has met a physiotherapist and has participated in an exercise program preoperatively and in 2013 a question on smoking was added. The same PROM-questionnaire with the addition of how satisfied the patient is with the result of the operation (on a five-degree Likert scale) is sent to the patient after one, six and ten years after the last operation. The follow-up routine is managed by contact secretaries that send questionnaires, enters the questionnaire answers into the database and send a reminder if any response has not been received in two months. Those patients who preoperatively have entered an e-mail address get the follow-up questionnaires by e-mail.

In 2017, the PROM-programme was extended to include also reoperations. The same form is used prior to both primary operations and reoperations. This means that there is no need of deciding what operation it is. Two different forms are used; one for those that only have a prosthesis in one hip (unilateral) and one form for those that have prostheses in both hips (bilateral). The same follow-up questionnaire is used after both primary operation and reoperation. Earlier annual reports (2016 and 2017), contain a more thorough description of the PROM-programme and how it has changed over time.

Update of the transposition key

In 2017, when we transitioned from using VAS to use a five-level scale for pain and satisfaction, we carried out a distribution-based transposition of the old values to the new. Preceding this year's report, we have observed that the transposition of the satisfaction variable was not entirely correct. The transposition key has therefore been adjusted according to the following:

Old value	**New value**
VAS (0–100)	**Likert (1–5)**
0–10	5 Very satisfied
11–30	4 Satisfied
31–50	3 Neither satisfied nor dissatisfied
51–70	2 Dissatisfied
71–100	1 Very dissatisfied

This change is only noticed in the trend figures in the annual report, which are only part of the online version.

PROM-values in 2017

Table 9.1.1 shows PROM-values for patients who have responded to the new questionnaire during 2017–2019, divided into elective total primary arthroplasty (prior to and one, six and ten years after primary operation) and revision (prior to and one year after revision). The values are given as absolute numbers and proportions for categorical variables and as averages with standard deviation for EQ VAS that is a continuous variable. Thus, the tables show a cross-section of the different prosthesis populations that have responded during these three years, to give a general assessment of how patients respond to the PROM-questions. As an example, it can be noted that among those that underwent a primary operation six or ten years ago, 75 and 72 % respectively answer "none" or "very mild" hip pain and around 85 % are "satisfied or very satisfied" with the result of the operation during both instances of follow-up. That the general health-related quality of life is somewhat lower for those answering after one year compared with those responding after six and ten years is natural; they are in general older and some are afflicted by other diseases that influence the health status.

Responses prior to revision have as expected a larger proportion of "none"- or "mild"-responses to the hip pain question compared with responses prior to primary operation. However, a lower proportion, compared to after primary surgery, reports that they are pain free after one year. One year after revision, 67 % respond that they are "satisfied" or "very satisfied" with the result of the operation and 17 % respond that they are "dissatisfied" or "very dissatisfied". One year postoperatively, the

difference is large for all EQ-5D-dimensions between patients who have undergone a primary operation and those who are revised. The revised patients report more problems with mobility, hygiene, usual activities, pain/discomfort and anxiety.

Table 9.1.2 shows data for those patients who underwent an elective total primary hip arthroplasty during 2018 and who have complete pre- and postoperative PROM-responses. Here, it can be noted that the mean change in EQ VAS is 20 units on the 100-degree scale. When it comes to the EQ-5D-dimensions it is mainly pain, mobility and normal day-to-day activities that have improved. Response distribution differs between hospital types both preoperatively and one year postoperatively (figure 9.1.1 and 9.1.2). The change in the EQ-5D-dimensions may be described by a so-called Pareto-classification. The patient that reports an improved result in one or more dimensions without worsening in any other dimension, is classified as "better". A patient that has a poorer result in one or more dimensions without improving in any other dimension, is classified as "worse". No change is classified as "same" and change in different directions is classified as "mix". In figure 9.1.3, the changes of the EQ-5D-dimensions in different hospitals are shown. For the nation as a whole, 84 % of the patients are better and only 3 % are worse. The variation within the country is however substantial. The largest proportion of improved patients can be found at Aleris Specialistvård Ängelholm (95 %), while only 48 % are better at Karolinska/Huddinge. At several hospitals, no or only 1 % of patients are worse, while 14 % of the patients at Karolinska/Huddinge are worse. There is also a large variation of patients that are classified as the same or as mixed (5–38 %).

The proportion satisfied with the result of the operation

Since the new PROM-questionnaire has a different design regarding the question on patient satisfaction with the result of the operation, only results for those who were operated in 2018 and answered the new question in 2019 are presented. The formulation of the question means that a somewhat lower proportion report that they are satisfied (those who have answered "satisfied" or "very satisfied") with the result of the operation compared with the classification that was made based on the VAS-values that were used earlier (VAS 0–40 was counted as satisfied). With the new way of measuring satisfaction, 87 % responded that they were "satisfied" or "very satisfied".

Large differences between units

Table 9.1.3 shows values for units with 20 or more PROM-registrations. It can be noted that the differences between the units are large; the proportion of satisfied patients increases from 73 % to 98 %. 13 units have a proportion of patients who are satisfied that is lower than 80 % and 20 % of the units have 90 % or more satisfied patients. Among large producers it can be noted that Hässleholm, Ortho Center Stockholm and Lindesberg have a high proportion of satisfied patients.

Trends, expected and observed PROM-results at a unit level

The trend graphs are only presented in the Swedish online version of the annual report (available at www.shpr.se). They illustrate the development of the PROM-results one year postoperatively per operating unit. The values are given as averages. The values shown refers to four two-year periods from the years of operation 2011/2012 to 2017/2018. Values are only shown for those units that have at least 20 PROM-registrations during at least two time-periods. PROM-variables included are:

1) EQ VAS that indicates self-reported health status on a scale 0–100,
2) Pain (in the operated hip) indicated on a scale 1–5
3) How satisfied the patient is with the result of the operation on a scale 1–5.

For EQ VAS, the higher the value, the better the self-reported health status. For pain, the reverse is applicable: low values indicate little pain. For satisfaction, high values indicate a positive outcome. Black dots/lines are the national mean result and is therefore identical in all the graphs that show the same outcome measure. Red dots/lines show the observed values for each unit respectively and the blue dots/lines show the expected results of the units when adjusting for age, gender, diagnosis, Charnley class and preoperative PROM-values. If the black and blue lines are in proximity of one another, the unit's demography can be thought of as representative of the nation, while if they are apart there are differences in age, gender, diagnosis, Charnley class and/or preoperative PROM-values. As an example, the values for university and regional hospitals are shown here (figure 9.1.4), where it is obvious that the observed values (red lines) are worse than the expected values (blue lines), which in their turn are lower than the national mean (black lines).

Positive trend but large differences between units

For all PROM-variables there is a trend towards an improved health status over time on a national level, which we have reported on in earlier annual reports. This positive trend is of course encouraging. Since 2015, we also show trends of the PROM-results on unit level. The idea is to illustrate the trends so that each unit can see what the development looks like in relation to the nation as a whole and to the expected result of the unit.

Physiotherapy, exercise program and smoking

Table 9.1.4 shows what proportion of those that have answered the preoperative PROM-form who have responded that they have been to a physiotherapist, participated in an exercise program or that they are smokers. The proportions are presented on unit level and includes persons operated due to osteoarthritis during 2018–2019, where the response frequency also is shown.

What proportion participate in an exercise program?

In 2012, questions were added regarding contact with a physiotherapist and participation in an exercise program (Swedish: Artrosskola) in the preoperative PROM-questionnaire. The

PROM-responses 2018–2019

	Primary operation				Revision	
	Preoperatively	Postoperatively			Preoperatively	Postoperatively
		1 year	6 year	10 year		1 year
Number	38,436	40,756	30,305	22,082	1,222	3,018
Hip pain in the operated hip, number (%)						
None	290 (0.8)	21,635 (53.2)	16,760 (55.5)	11,867 (54.0)	54 (4.4)	1,007 (33.5)
Very mild	335 (0.9)	9,770 (24.0)	5,721 (18.9)	3,998 (18.2)	70 (5.7)	667 (22.2)
Mild	1,258 (3.3)	4,623 (11.4)	3,465 (11.5)	2,686 (12.2)	110 (9.0)	512 (17.0)
Moderate	13,653 (35.6)	3,679 (9.0)	3,285 (10.9)	2,683 (12.2)	482 (39.5)	602 (20.0)
Severe	22,808 (59.5)	951 (2.3)	981 (3.2)	761 (3.5)	504 (41.3)	216 (7.2)
Mobility, number (%)						
I have no problems in walking about	1,004 (2.6)	20,714 (50.8)	14,367 (47.4)	9,549 (43.2)	99 (8.1)	852 (28.2)
I have slight problems in walking about	4,236 (11.0)	10,147 (24.9)	6,819 (22.5)	4,920 (22.3)	186 (15.2)	782 (25.9)
I have moderate problems in walking about	13,621 (35.4)	6,708 (16.5)	5,725 (18.9)	4,487 (20.3)	415 (34.0)	779 (25.8)
I have severe problems in walking about	18,519 (48.2)	2,936 (7.2)	2,994 (9.9)	2,642 (12.0)	442 (36.2)	487 (16.1)
I am unable to walk about	1,056 (2.7)	251 (0.6)	400 (1.3)	484 (2.2)	80 (6.5)	118 (3.9)
Self-care, number (%)						
I have no problems washing or dressing myself	11,081 (28.8)	30,265 (74.3)	22,187 (73.2)	15,202 (68.8)	515 (42.1)	1,706 (56.5)
I have slight problems washing or dressing myself	12,202 (31.7)	7,458 (18.3)	5,024 (16.6)	3,916 (17.7)	352 (28.8)	729 (24.2)
I have moderate problems washing or dressing myselft	11,502 (29.9)	2,472 (6.1)	2,289 (7.6)	2,044 (9.3)	253 (20.7)	412 (13.7)
I have severe problems washing or dressing myself	3,537 (9.2)	474 (1.2)	615 (2.0)	648 (2.9)	91 (7.4)	122 (4.0)
I am unable to wash or dress myself	114 (0.3)	87 (0.2)	190 (0.6)	272 (1.2)	11 (0.9)	48 (1.6)
Usual activities, number (%)						
I have no problems doing my usual activities	1,937 (5.0)	20,154 (49.5)	14,594 (48.2)	9,915 (44.9)	144 (11.8)	850 (28.2)
I have slight problems doing my usual activities	6,538 (17.0)	12,005 (29.5)	7,918 (26.1)	5,589 (25.3)	258 (21.1)	865 (28.7)
I have moderate problems doing my usual activities	12,881 (33.5)	5,803 (14.2)	4,864 (16.1)	3,922 (17.8)	346 (28.3)	741 (24.6)
I have severe problems doing my usual activities	13,638 (35.5)	2,258 (5.5)	2,243 (7.4)	1,938 (8.8)	318 (26.0)	390 (12.9)
I am unable to do my usual activities	3,442 (9.0)	536 (1.3)	686 (2.3)	718 (3.3)	155 (12.7)	169 (5.6)

(the table continues on the next page)

PROM-responses 2018–2019, continued

	Primary operation				Revision	
	Preoperatively	Postoperatively			Preoperatively	Postoperatively
		1 year	6 year	10 year		1 year
Pain/discomfort, number (%)						
I have no pain or discomfort	78 (0.2)	15,274 (37.5)	10,725 (35.4)	7,308 (33.1)	50 (4.1)	634 (21.0)
I have slight pain or discomfort	1,135 (3.0)	14,081 (34.5)	9,173 (30.3)	6,451 (29.2)	144 (11.8)	993 (33.0)
I have moderate pain or discomfort	14,625 (38.1)	8,663 (21.3)	7,657 (25.3)	6,077 (27.5)	504 (41.2)	960 (31.9)
I have severe pain or discomfort	20,317 (52.9)	2,544 (6.2)	2,506 (8.3)	2,045 (9.3)	458 (37.5)	376 (12.5)
I have extreme pain or discomfort	2,281 (5.9)	194 (0.5)	244 (0.8)	201 (0.9)	66 (5.4)	50 (1.7)
Anxiety/depression, number (%)						
I am not anxious or depressed	14,497 (37.7)	29,052 (71.3)	20,436 (67.4)	14,191 (64.3)	496 (40.7)	1,590 (52.7)
I am slightly anxious or depressed	14,901 (38.8)	8,551 (21.0)	6,943 (22.9)	5,451 (24.7)	487 (39.9)	889 (29.5)
I am moderately anxious or depressed	6,511 (16.9)	2,258 (5.5)	2,112 (7.0)	1,772 (8.0)	147 (12.0)	385 (12.8)
I am severely anxious or depressed	2,186 (5.7)	753 (1.8)	701 (2.3)	570 (2.6)	79 (6.5)	130 (4.3)
I am extremely anxious or depressed	341 (0.9)	142 (0.3)	113 (0.4)	98 (0.4)	11 (0.9)	21 (0.7)
EQ VAS, mean (standard deviation)	56.64 (22.17)	76.33 (18.97)	72.58 (20.89)	70.22 (21.75)	57.58 (22.88)	66.30 (22.34)
Satisfaction with result of the operation, number (%)						
Very dissatisfied		824 (2.0)	811 (2.7)	532 (2.4)		204 (6.8)
Dissatisfied		1,476 (3.7)	1,258 (4.2)	876 (4.0)		311 (10.4)
Neither satisfied nor dissatisfied		2,922 (7.2)	2,388 (8.0)	1,790 (8.2)		482 (16.1)
Satisfied		8,972 (22.2)	7,110 (23.8)	5,462 (25.1)		910 (30.4)
Very satisfied		26,135 (64.8)	18,340 (61.3)	13,132 (60.3)		1,090 (36.4)
EQindex_TTO (mean (SD))	0.65 (0.13)	0.87 (0.13)	0.85 (0.14)	0.84 (0.15)	0.69 (0.15)	0.79 (0.16)
EQindex_VAS (mean (SD))	47.75 (13.09)	73.78 (15.54)	71.78 (16.85)	69.99 (17.58)	52.06 (15.71)	64.02 (18.20)

Table 9.1.1

questions are: "Have you been to a physiotherapist for your hip problems?" and "Have you participated in an exercise program during your problems-related period (may have been many years before the operation for some and a little shorter period for others?)". This year's analysis, that comprises the years 2018–2019, shows clear-cut differences between the units. The proportion of patients that are operated due to osteoarthritis (ICD codes M16.0-M16.9) that have been in contact with a physiotherapist varies from 57 % (Visby) to 94 % (Hermelinen). For participation in an exercise program the proportions run from 15 % (Karolinska/Huddinge) to 74 % (Norrköping). On a national level, 46 % of all osteoarthritis patients that have answered the questionnaire responded that they had participated in an exercise program. The proportion that respond that they have met a physiotherapist and that they have participated in an exercise program steadily increases over time. Differences between units may, to some degree, reflect the availability of physical therapy and exercise programs in different regions.

Smoking

Smoking is a well-established risk factor for complications after most surgical interventions. Smoking cessation during 6–8 weeks before and after the operation has proven to be effective in decreasing the risk for complications. In 2013, the Swedish Hip Arthroplasty Register introduced a question on smoking in the preoperative routine questionnaire. The question is simply put: "Do you smoke?" with the response alternatives "Never been a smoker", "Ex-smoker", "Smoker, but not daily" and "Daily smoker". During 2018 and 2019, 32,540 patients underwent hip arthroplasty due to osteoarthritis. Of these 26,424 (81 %), had answered the preoperative questionnaire. Out of these, 4.4 % reported that they were smokers. There were large differences in the proportion of smokers between units (0 to 16 %). The proportion of smokers has decreased over the years but the variation between units increased a little compared with the previous year.

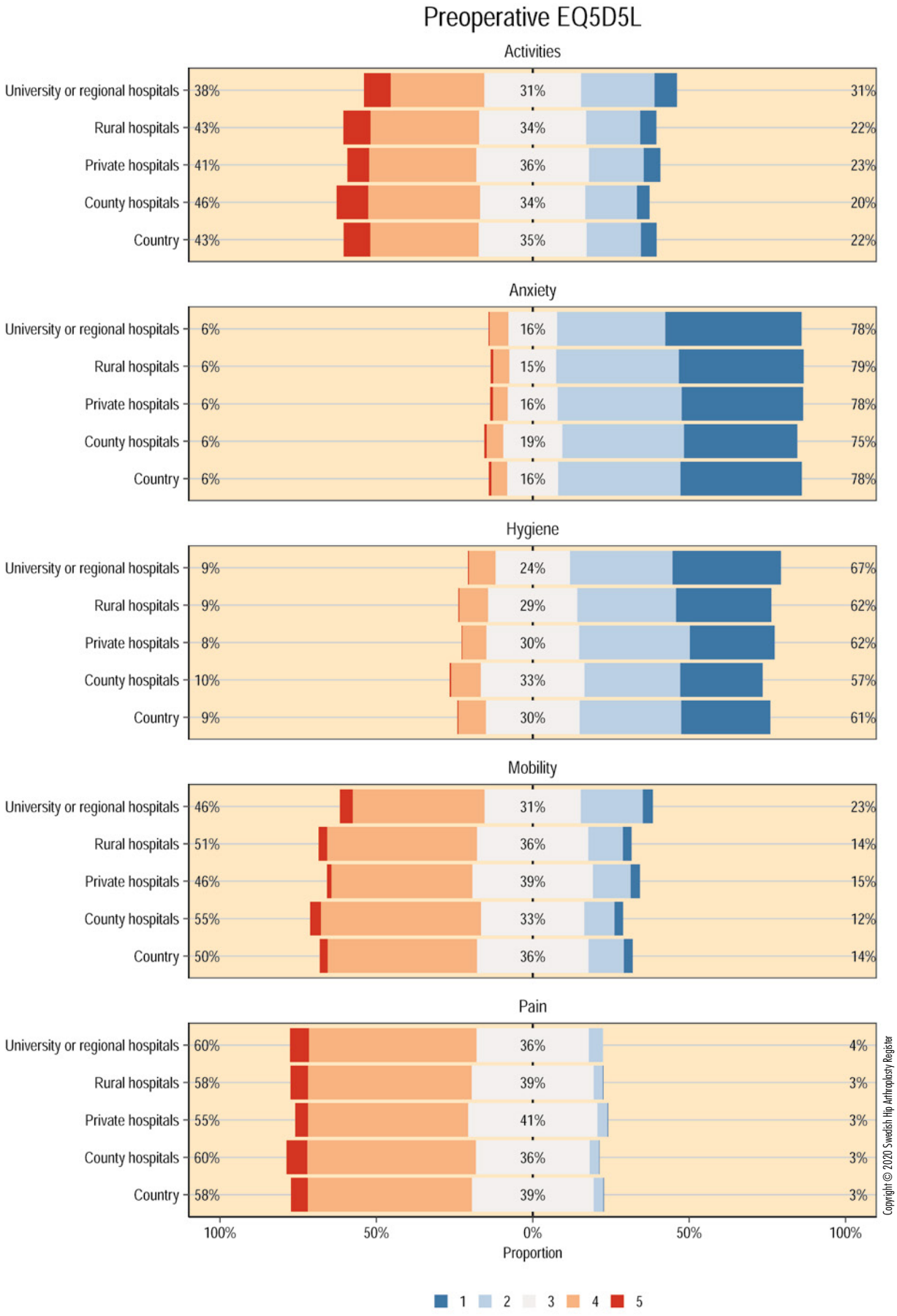


Figure 9.1.1. Preoperative EQ-5D-5L per hospital type. Patients with a primary operation from 2018 who have both a preoperative 1-year postoperative response. The five-degree scale measures different health conditions and goes from no problems (1) to unable to/extreme problems (5).

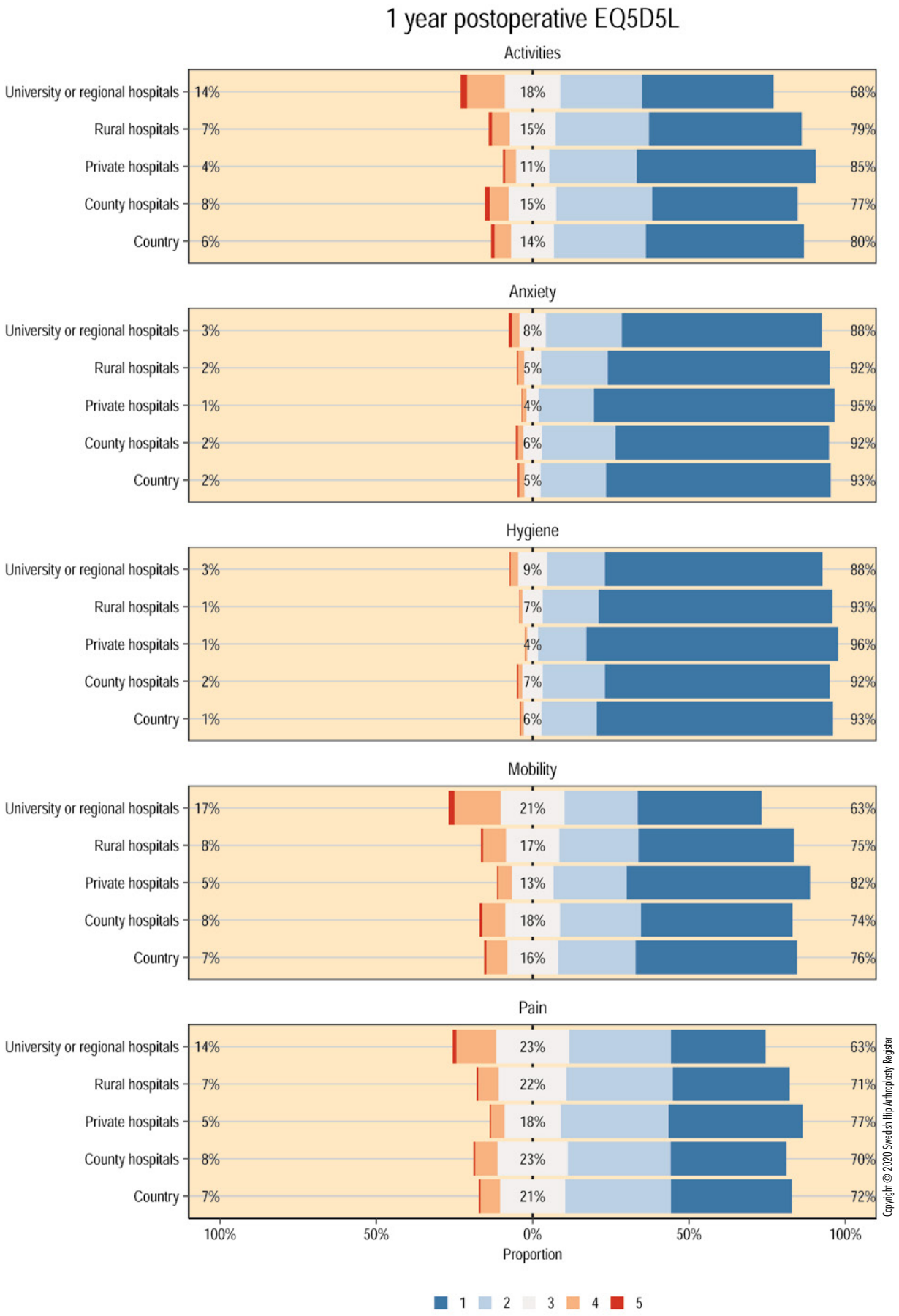


Figure 9.1.2. 1-year postoperative EQ-5D-5L. Patients with a primary operation from 2018 that both have a preoperative and a 1-year postoperative response. The five-degree scale measures different health conditions and goes from no problems (1) to un able to/extreme problems.

Patients having EQ-5D-5L both pre- and 1 year postoperatively

	Primary operation	
	Postoperatively 1 year	Preoperatively
Number	12,655	12,655
Hip pain in the operated hip, number (%)		
None	6,901 (54.7)	96 (0.8)
Very mild	2,952 (23.4)	107 (0.8)
Mild	1,381 (10.9)	415 (3.3)
Moderate	1,103 (8.7)	4,591 (36.4)
Severe	288 (2.3)	7,417 (58.7)
Mobility, number (%)		
I have no problems in walking about	6,529 (51.6)	355 (2.8)
I have slight problems in walking about	3,147 (24.9)	1,428 (11.3)
I have moderate problems in walking about	2,055 (16.2)	4,520 (35.7)
I have severe problems in walking about	851 (6.7)	6,036 (47.7)
I am unable to walk about	73 (0.6)	316 (2.5)
Self-care, number (%)		
I have no problems washing or dressing myself	9,548 (75.4)	3,601 (28.5)
I have slight problems washing or dressing myself	2,242 (17.7)	4,114 (32.5)
I have moderate problems washing or dressing myselft	727 (5.7)	3,795 (30.0)
I have severe problems washing or dressing myself	118 (0.9)	1,114 (8.8)
I am unable to wash or dress myself	20 (0.2)	31 (0.2)
Usual activities, number (%)		
I have no problems doing my usual activities	6,381 (50.4)	623 (4.9)
I have slight problems doing my usual activities	3,720 (29.4)	2,196 (17.4)
I have moderate problems doing my usual activities	1,742 (13.8)	4,372 (34.5)
I have severe problems doing my usual activities	677 (5.3)	4,392 (34.7)
I am unable to do my usual activities	135 (1.1)	1,072 (8.5)
Pain/discomfort, number (%)		
I have no pain or discomfort	4,881 (38.6)	16 (0.1)
I have slight pain or discomfort	4,287 (33.9)	392 (3.1)
I have moderate pain or discomfort	2,640 (20.9)	4,934 (39.0)
I have severe pain or discomfort	797 (6.3)	6,634 (52.4)
I have extreme pain or discomfort	50 (0.4)	679 (5.4)
Anxiety/depression, number (%)		
I am not anxious or depressed	9,080 (71.8)	4,895 (38.7)
I am slightly anxious or depressed	2,648 (20.9)	4,954 (39.1)
I am moderately anxious or depressed	666 (5.3)	2,069 (16.3)
I am severely anxious or depressed	219 (1.7)	643 (5.1)
I am extremely anxious or depressed	42 (0.3)	94 (0.7)
VASHealth (mean (sd))	77.05 (18.64)	57.08 (21.86)
Satisfaction with result of the operation, number (%)		
Very dissatisfied	237 (1.9)	0
Dissatisfied	455 (3.6)	0
Neither satisfied nor dissatisfied	884 (7.0)	0
Satisfied	2,716 (21.7)	0
Very satisfied	8,248 (65.8)	0
EQindex_TTO (mean (SD))	0.87 (0.13)	0.65 (0.13)
EQindex_VAS (mean (SD))	74.17 (15.33)	48.17 (12.86)

Table 9.1.2

Patient satisfaction

Primary operated 2018

Unit	Number	Proportion, %
Aleris Specialistvård Bollnäs	294	87.1
Aleris Specialistvård Motala	498	87.8
Aleris Specialistvård Nacka	187	92.5
Aleris Specialistvård Ängelholm	48	97.9
Alingsås	126	79.4
Art Clinic Göteborg	97	87.6
Art Clinic Jönköping	116	93.1
Arvika	186	81.7
Borås	89	87.6
Capio Artro Clinic	294	90.5
Capio Movement	304	94.7
Capio Ortopediska Huset	486	87.9
Capio S:t Göran	316	81.3
Carlanderska	201	93
Danderyd	149	89.3
Eksjö	175	88
Enköping	301	80.1
Eskilstuna	70	75.7
Falun	125	80
GHP Ortho Center Göteborg	182	91.8
Gällivare	94	86.2
Gävle	87	77
Halmstad	127	82.7
Hudiksvall	65	89.2
Hässleholm	661	92.6
Jönköping	184	82.6
Kalmar	127	88.2
Karlshamn	226	91.6
Karlstad	89	79.8
Karolinska/Huddinge	112	92
Karolinska/Solna	35	77.1
Katrineholm	216	74.1
Kungälv	126	80.2
Lidköping	138	88.4
Lindesberg	465	91.8

Unit	Number	Proportion, %
Linköping	47	83
Ljungby	144	93.8
Lycksele	250	93.2
Mora	211	86.7
Norrköping	139	85.6
Norrtälje	109	83.5
Nyköping	101	75.2
Ortho Center Stockholm	544	92.5
Oskarshamn	265	88.3
Piteå	374	89.8
Skellefteå	114	92.1
Skene	138	84.8
Skövde	46	80.4
Sollefteå	272	84.9
Sophiahemmet	192	94.3
SU/Mölndal	347	81.6
SUS/Lund	38	78.9
Södersjukhuset	144	78.5
Södertälje	98	79.6
Torsby	91	82.4
Trelleborg	529	91.7
Uddevalla	315	83.2
Umeå	25	92
Uppsala	82	79.3
Varberg	204	94.1
Visby	86	73.3
Värnamo	123	76.4
Västervik	125	80
Västerås	237	84.4
Växjö	79	87.3
Ängelholm	151	84.8
Örebro	22	86.4
Örnsköldsvik	102	86.3
Östersund	216	91.2
Country	**12 999**	**87.2**

Table 9.1.3 Units with fewer than 20 PROM-registrations for operations carried out during 2018 have been excluded.

Smoking, physiotherapy and exercise program prior to hip arthroplasty

Unit	Number (diagnosis M16.0-M16.9)	Number responses	Number smokers, %	Number physio-therapy, %	Proportion exercise program, %	Response frequency, %
Aleris Specialistvård Bollnäs	600	579	3.6	76	50	96
Aleris Specialistvård Motala	709	598	3.5	75	60	84
Aleris Specialistvård Nacka	506	452	5.2	83	40	89
Aleris Specialistvård Ängelholm	287	223	2.8	83	42	78
Alingsås	362	325	5.8	86	73	90
Art Clinic Göteborg	204	129	4	88	48	63
Art Clinic Jönköping	326	315	1	93	54	97
Arvika	441	260	8.5	82	71	59
Bollnäs	57	52	3.8	73	60	91
Borås	226	137	8.1	69	35	61
Capio Artro Clinic	743	627	5.8	81	39	84
Capio Movement	690	565	2.3	78	35	82
Capio Ortopedi Motala	320	269	5.7	75	56	84
Capio Ortopediska Huset	1,310	1,229	6.3	79	43	94
Capio S:t Göran	1,056	787	3.7	73	41	75
Carlanderska	655	291	5.7	87	50	44
Danderyd	360	212	4.8	76	39	59
Eksjö	437	380	1.8	70	36	87
Enköping	855	653	3.5	80	47	76
Eskilstuna	124	74	6.9	66	27	60
Falköping	106	102	3.2	83	56	96
Falun	263	223	5	66	59	85
GHP Ortho Center Göteborg	520	409	3.4	89	47	79
Gällivare	190	140	3.6	70	46	74
Gävle	170	152	8.6	68	45	89
Halmstad	361	285	4.9	72	28	79
Hermelinen Specialistvård	45	34	2.9	94	44	76
Hudiksvall	141	120	5.1	77	48	85
Hässleholm	1,513	1,454	4.1	73	29	96
Jönköping	359	321	1.6	74	30	89
Kalmar	260	246	1.2	77	61	95
Karlshamn	562	518	3.9	71	52	92
Karlstad	184	173	5.2	69	56	94
Karolinska/Huddinge	270	66	9	74	15	24
Karolinska/Solna	71	44	7	80	43	62
Katrineholm	572	562	6	72	36	98
Kungälv	347	259	2,9	84	50	75

(the table continues on the next page)

Smoking, physiotherapy and exercise program prior to hip arthroplasty, continued

Unit	Number (diagnosis M16.0-M16.9)	Number responses	Number smokers, %	Number physio-therapy, %	Proportion exercise program, %	Response frequency, %
Lidköping	385	347	8.3	77	49	90
Lindesberg	1,151	855	5.9	80	50	74
Linköping	122	42	4.8	76	43	34
Ljungby	325	317	2.8	68	34	98
Lycksele	546	407	1.5	82	73	75
Mora	464	269	7.4	80	53	58
Norrköping	348	275	2.6	78	74	79
Norrtälje	315	215	7.4	78	46	68
Nyköping	243	207	4.3	87	52	85
Ortho Center Stockholm	1,503	1,364	4.7	81	49	91
Oskarshamn	680	627	3.3	75	43	92
Piteå	955	645	3.3	82	50	68
Skellefteå	229	163	0	78	65	71
Skene	349	293	6	84	49	84
Skövde	73	61	6.8	57	31	84
Sollefteå	611	583	2.2	79	64	95
Sophiahemmet	532	440	4.1	83	27	83
SU/Mölndal	888	598	1.2	78	48	67
SUS/Lund	67	24	13	75	29	36
Södersjukhuset	381	83	16	72	43	22
Södertälje	276	229	7.2	76	47	83
Torsby	218	214	3.3	72	54	98
Trelleborg	1,274	1,169	7.4	71	39	92
Uddevalla	697	615	6.3	79	60	88
Umeå	101	71	2.8	80	63	70
Uppsala	159	133	6.1	73	29	84
Varberg	476	419	2.6	76	32	88
Visby	240	215	3.3	57	35	90
Värnamo	276	253	0.8	70	24	92
Västervik	279	198	2.6	73	51	71
Västerås	716	614	3.6	75	62	86
Växjö	247	198	1.5	71	31	80
Ängelholm	349	331	4.6	71	39	95
Örebro	27	22	4.5	68	36	81
Örnsköldsvik	249	214	2.8	75	51	86
Östersund	470	408	4.3	74	64	87
Country	32,540	26,424	4.4	77	46	81

Table 9.1.4 Units with fewer than 20 responses during 2018–2019 have been excluded.

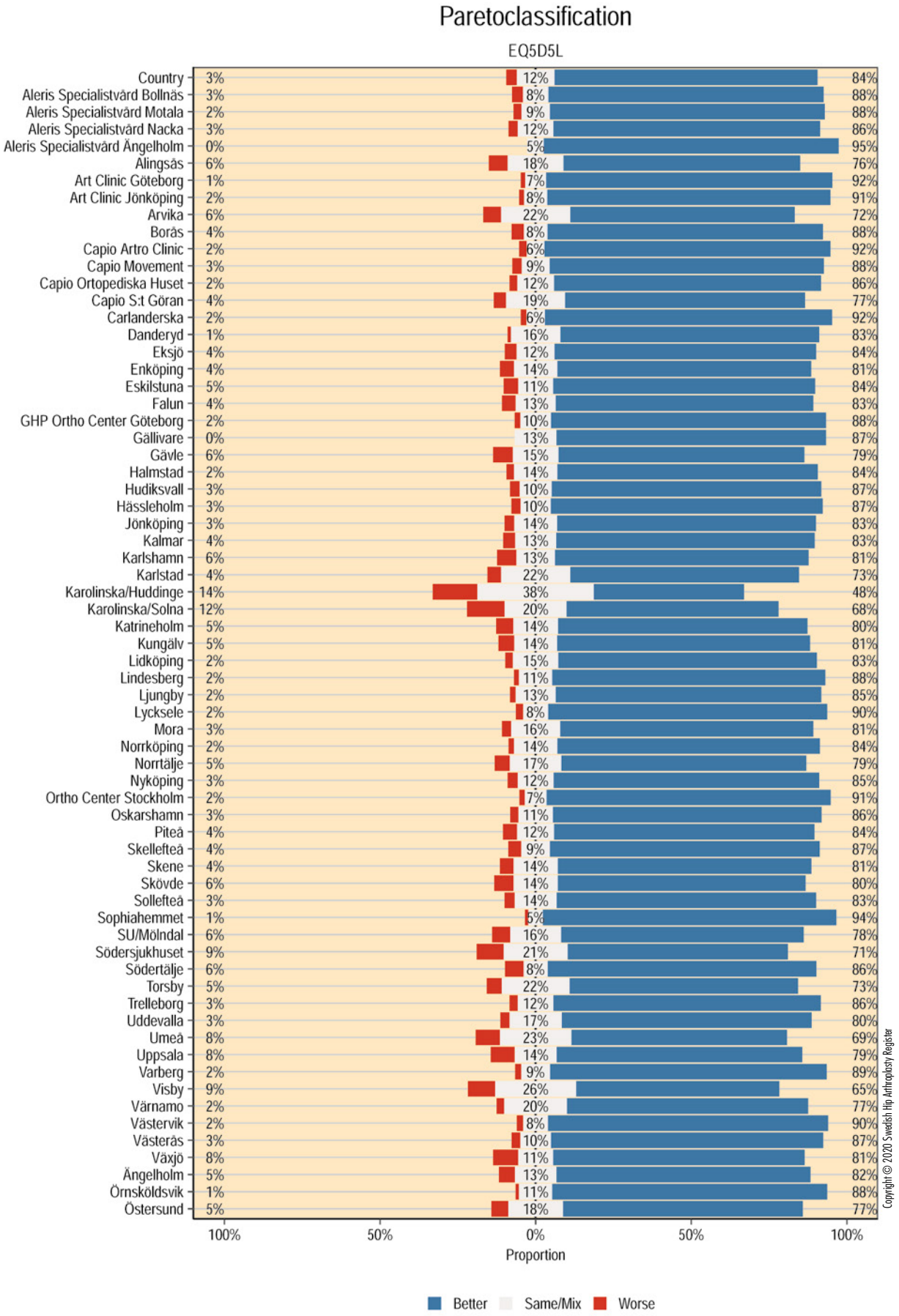
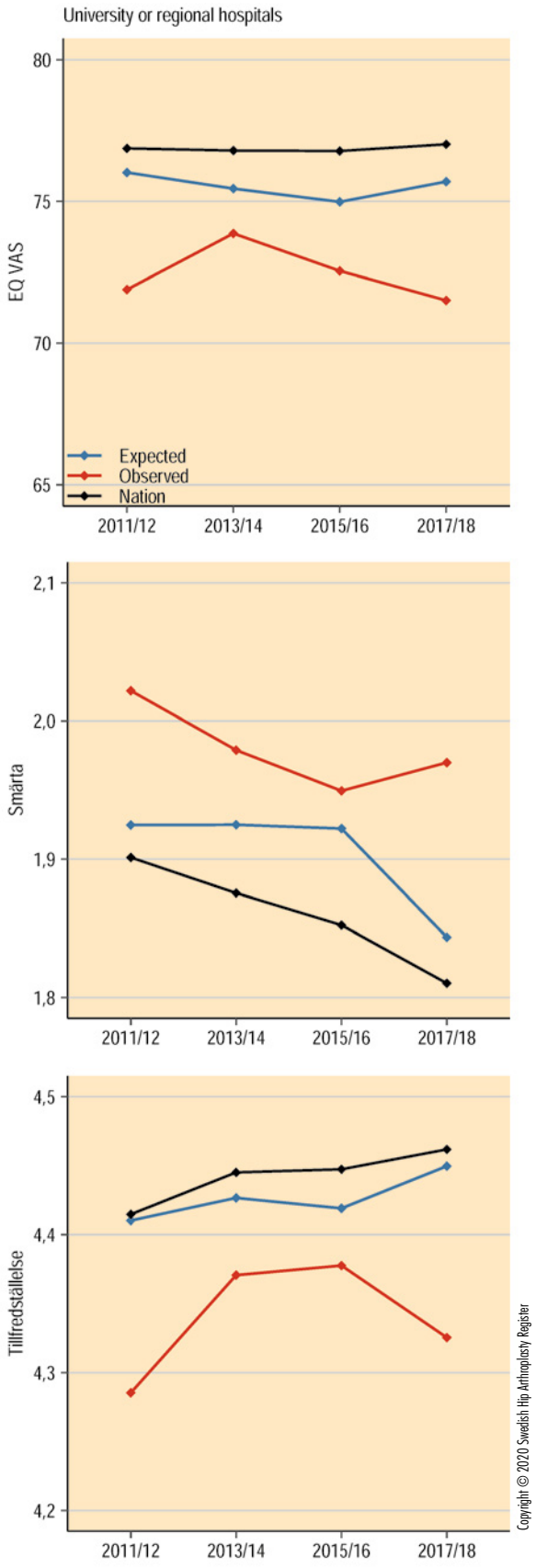


Figure 9.1.3. Pareto classification for EQ-5D for elective patients per unit. Patients with a primary operation 2018 who have both a pre-operative and a 1-year-postoperative response. EQ-5D health conditions are better if at least one dimension is better and none of the other dimensions is worse and EQ-5D health conditions are worse if at least one health condition is worse and none of the other dimensions is better.



9.1.4. PROM University hospital example.

10. 90-days mortality after hip arthroplasty

Authors: Cecilia Rogmark, Ola Rolfson

The text in Chapter 10 refers to Tables 10.1.1 and 10.2.1 in the Swedish pdf version of the annual report at https://shpr.registercentrum.se (omitted in the English version due to space reasons).

In today's healthcare, hip arthroplasty is often seen as a routine procedure, and the focus may shift towards demands on a high production and short waiting times. It is therefore important to remind of the fact that every operative procedure entails an increased risk for the patient. A hip arthroplasty has an increased risk for infections and thromboembolic events. These are complications that can become life-threatening. Prior to the decision to carry out an elective operation, the patient must be informed thoroughly, among other things about the increased mortality risk during the first month after the operation compared with non-operated contemporaries.

90-days mortality is a variable that is openly accounted for on a unit level. The Swedish Hip Arthroplasty Register database is updated each night regarding the patients' potential date of death from the Swedish Tax Agency.

The indications for prosthesis surgery grow successively wider. Both younger and older patients are operated more frequently than before. The older patients have a natural higher risk for serious complications while the younger patients that are operated appear to have a higher degree of comorbidity. Today, more risk patients are operated compared with before, especially on the larger units. An important group of such risk patients are those that undergo a total hip arthroplasty as treatment of an acute hip fracture. These individuals do not at all have the same possibility of stabilisation of potential health problems before the operation, since fracture surgery must take place within a day or so. This is in contrast with those that undergo an elective hip arthroplasty due to osteoarthritis, where the date of surgery can be postponed until the health status is favourable.

10.1 Total arthroplasty

90-days mortality is often used to assess risks with different medical treatments. The dominating reasons for the death of patient either during the hip arthroplasty itself or within 90 days (and related to the surgery) are with an overwhelming probability cardiovascular, cerebrovascular and thromboembolic diseases.

The death rate is low – the results are given in per mille. Therefore, the four last years are analysed together in order to compensate, to some degree, for the risk of random variation. The 90-days mortality is higher after operation on a university/regional hospital and county hospital compared with local hospitals and above all compared with private units. The differences reflect the different compositions of patient groups that are operated on each hospital. Units that operate fewer than 70 % osteoarthritis patients have a considerably higher mortality, which is explained by many fracture patients and in some cases also tumour cases.

The 90-days mortality varies between the Swedish hospitals during the years 2016–2019 between 0 ‰ to 47 ‰. The national mean is 6.1 ‰. Units that lie noticeably high have in many cases a large proportion of fracture patients that are treated with a total arthroplasty.

Regardless if the unit thinks the observed mortality is "expected" or not, we should analyse the mortality and its causes regularly as a natural part of the patient safety work. It is also paramount that other units and hospitals that are taking care of newly operated patients with complications inform the operating unit about these cases. If the orthopaedic surgeon is not informed about these very serious events it is easy to think that they do not occur.

10.2 Fracture patients

The patient with a hip fracture has a considerably higher mortality risk than the patient who undergoes an elective procedure, caused by for example osteoarthritis. The fracture patient should, regardless of health status, be operated immediately. In addition, they are in general more frail than osteoarthritis patients. The national 90-days mortality was just below 13 % in 2019 and it has stayed the same during the 2010s. Depending on which patients that are selected to arthroplasty treatment, the mortality is affected. If the most ill patients instead are treated with internal fixation – in most cases a worse option – the mortality for remaining patients who undergo arthroplasty decreases. The mortality varies between the hospitals, 6 % to 17 % at the units that primarily treat acute fractures. In table 10.2.1, several factors that may increase the risk of early deaths are given; aging patients, male gender, comorbidity and the proportion of acute fracture procedures (as opposed to elective secondary procedures). If the mortality of the individual unit is higher than what is to be expected with the present "risk profile", the care process of the unit should be analysed in detail.

11. Adverse event within 30 and 90 days

Authors: Cecilia Rogmark, Ola Rolfson

Adverse events are an important quality indicator. The analysis is carried out by linking the register's data with the Patient Register of the National Board of Health and Welfare. A list of diagnosis and measure codes that exist during the primary care event or during later care events is sought. Since it often is late in the year before the data for the previous operational year of the Patient Register is complete, we have chosen to include data up to the 1st of October in order to get a complete 90-days follow-up. Since we have changed the definition of adverse events, we have carried out a national analysis of the last ten-year period. We also present adverse events after first reoperation.

11.1 About the method

The data from the Swedish Hip Arthroplasty Register on hip arthroplasties (including reoperations) are used together with care events with complication codes in the Patient Register of the National Board of Health and Welfare (PAR) to analyse readmissions following hip arthroplasty.

Only one operation (the latest) is considered if both hips were operated within 90 days. All care events that match a hip arthroplasty on personal identity number and where the date of surgery in the Swedish Hip Arthroplasty Register lies between the dates of admission and discharge in inpatient care according to the PAR, or where the date of admission in the PAR falls within 90 days after the date of surgery (or date of re-surgery for reoperations) in the Swedish Hip Arthroplasty Register, are extracted. In order to be able to include the whole 90-days follow-up period, hip arthroplasties carried out after the 1st of October 2018 are excluded.

An adverse event is connected to a hip arthroplasty through the selections that are described in the code list. The indicator is computed as the proportion of hip arthroplasties that are followed by an adverse event in each group of analysis (primary elective total arthroplasty, the standard patient, fracture patients and first reoperation respectively).

Definition of adverse event

The concept adverse event includes all kinds of readmission that can be assumed to have a connection with the operation that has been carried out: local complications, general complications and death. These are divided into surgical, cardiovascular and medical complications and are based on diagnosis and measure codes that are present during inpatient care events and that are reported to the PAR. The surgical complications are furthermore divided into measure and diagnosis codes that indicate complication and diagnosis codes for hip diseases that probably are a complication after the operation (table 11.1.1).

We present results on a unit level for:
1) Elective total arthroplasties (excluding patients with an acute fracture, sequelae after hip fracture and tumour)
2) Fracture patients (total and hemi arthroplasties due to acute fracture or sequelae after hip fracture)
3) The standard patient
4) Patients undergoing a first reoperation

Trends

Earlier, the trend for adverse events has decreased steadily for elective patients, the standard patient and fracture patients (figure 11.1.1). It is therefore a little worrisome to see that there was a slight increase of adverse events for both elective patients and the standard patient during 2018. Compared with 2017, the 90-days incidence increased from 5.2 % to 5.4 %, and from 3.6 % to 4.2 % respectively. For fracture patients a plateau can be seen at 31 %. By contrast, the complication frequency for first-time reoperations decreases from 31 % to 30 % (figure 11.1.2). The data should be interpreted with caution. In the group of patients who are reoperated for the first time, all patients regardless of diagnosis during primary operation or if the primary operation was a total or a hemiarthroplasty, are included. Over the years, the distribution of different diagnoses and patient groups has changed and the registration of both local as well as general complications has improved. Nonetheless, this is an area where improvement work is possible.

Strengths, error sources and weaknesses

Through linkage with the Patient Register an important quality indicator is created, which provides guidance on early adverse events. It is an important complement to the indicators related to reoperation and mortality that the register has presented for a long time. We think that the new set of codes for the definition of adverse event better captures events that are likely to have a connection with the operation and that potentially can be avoided or prevented. That we use a set of codes that was developed by the Swedish Knee Arthroplasty Register in a thorough collaboration with the National Board of Health and Welfare, contributes to the strength of the analysis.

That only adverse events that occur during the primary care event or during readmission are included is a weakness of the analysis. Outpatient care is not included. A patient with a dislocation that is repositioned at an emergency unit and returns home is not captured. This is applicable also during vein thromboses, which often do not lead to inpatient care. Moreover, the coding practice differs between regions and units. In some cases, there may be economical incentives to register many codes in order to increase the DRG-point (diagnosis related groups). The threshold for including certain complication codes differs between units. The important thing is to monitor the result of the care unit over time and to stimulate local analyses in order to better understand the panorama of adverse events and thereby identify areas of improvement. To compare results between care units, is not the primary goal with the quality indicator.

11.2 Results on unit level 2016–2018

The incidence of adverse events within 30 and 90 days after operation are presented on unit level for elective patients, the standard patient, fracture patients, first reoperation and second

Codes for adverse events

	Used for primary operations	Used for reoperations and revisions	ICD-10 and KVÅ-codes	Additional codes for fractures
Surgical				
A Measure codes for hip arthroplasties. Complications or suspected complications.	If the measure is taken after date of surgery OR during a care event after the date of surgery.	If the measure is taken during a care event after the date of surgery.	NFA02, NFA11, NFA12, NFA20, NFA21, NFA22, NFC*, NFF*, NFG*, NFH*, NFJ*, NFK*, NFL*, NFM*, NFQ09, NFS*, NFT*, NFU09, NFU19, NFU39, NFU89, NFU99, NFW*, QDA10, QDB00, QDB05, QDB99, QDE35, QDG30, TNF05, TNF10	
	If the measure is taken during a care event after the date of surgery.	If the measure is taken during a care event after the date of surgery.	NFU49	
DA Diagnoses for complication codes that should have been used during complication.	If they are the main or secondary diagnosis during the date of surgery or are the main diagnosis during readmission.	If they are the main diagnosis during readmission.	G978, G979, M966F, M968, M969, T810, T812, T813, T814, T815, T816, T817, T818, T818W, T819, T840, T840F, T843, T843F, T844, T845, T845F, T847, T847F, T848, T848F, T849, T888, T889	
DB Diagnoses for hip-related diseases. Probably complication in close connection with the operation.	If they are the main or secondary diagnosis during the date of surgery or are the main diagnosis during readmission.	If they are the main diagnosis during readmission.	G570, G571, G572, M000, M000F, M002F, M008F, M009F, M243, M244, M244F, S730, S74*, S75*, S76*	
	If they are the main diagnosis during readmission.	If they are the main diagnosis during readmission.	M240F, M245F, M246F, M610F, M621F, M662F, M663F, M843F, M860F, M861F, M866, M866F, M895E	
Cardiovascular				
DC Diagnoses for serious cardio-vascular diseases. Likely a complication in close connection with the operation.	If they are the main or secondary diagnosis during the date of surgery or the main diagnosis during readmission.	If they are the main or secondary diagnoses during the date of surgery or the main diagnosis during readmission.	I21*, I24*, I260, I269, I460, I461, I469, I490, I60*, I61*, I62*, I63*, I649, I65*, I66*, I72*, I74*, I770, I771, I772, I819, I82*, I978, I979, J809, J819, T811	
Medical				
DM Diagnoses for medical diseases. May be related to the operation if they occur shortly thereafter.	If they are the main or secondary diagnoses during the date of surgery or the main diagnosis during readmission.	If they are the main or secondary diagnoses during the date of surgery or the main diagnosis during readmission.	I80*, J13*-J18*, J952, J953, J955, J958, J959, J96*, J981, K25*, K26*, K27*, L89*, N17*, N990, N998, N999, R339	N300, N308, N309, N390
	If they are the main diagnosis during readmission.	If they are the main diagnosis during readmission.	J20*-J22*, K29*, K590, N991	

Table 11.1.1

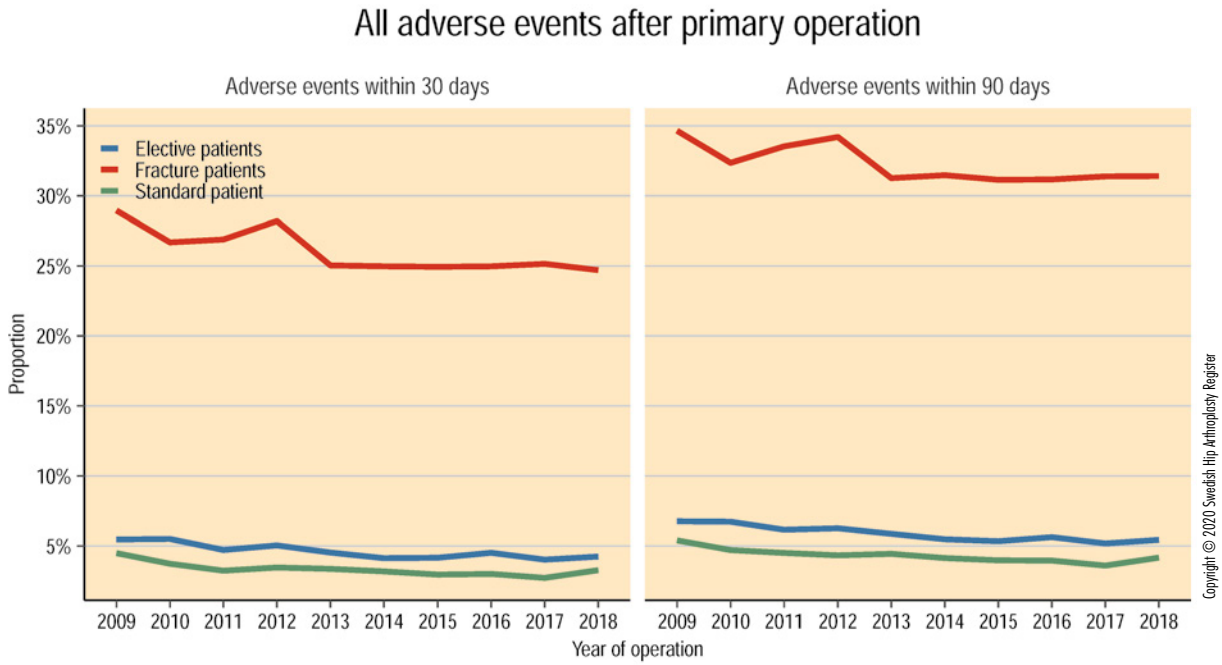


Figure 11.1.1

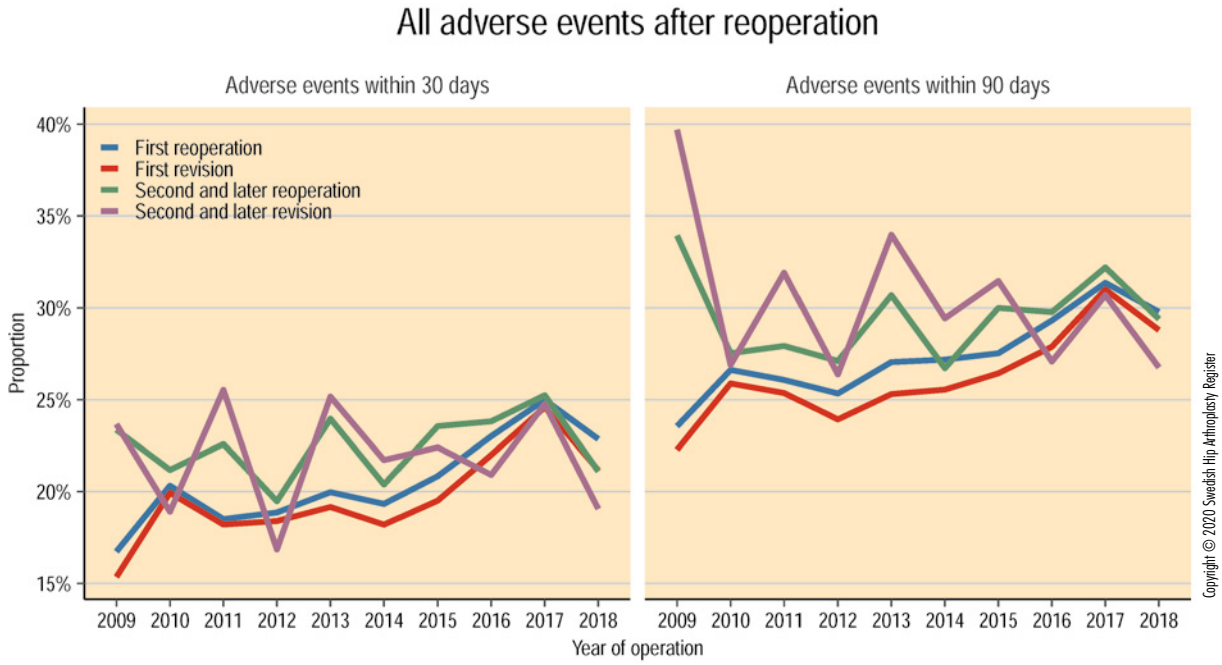


Figure 11.1.2

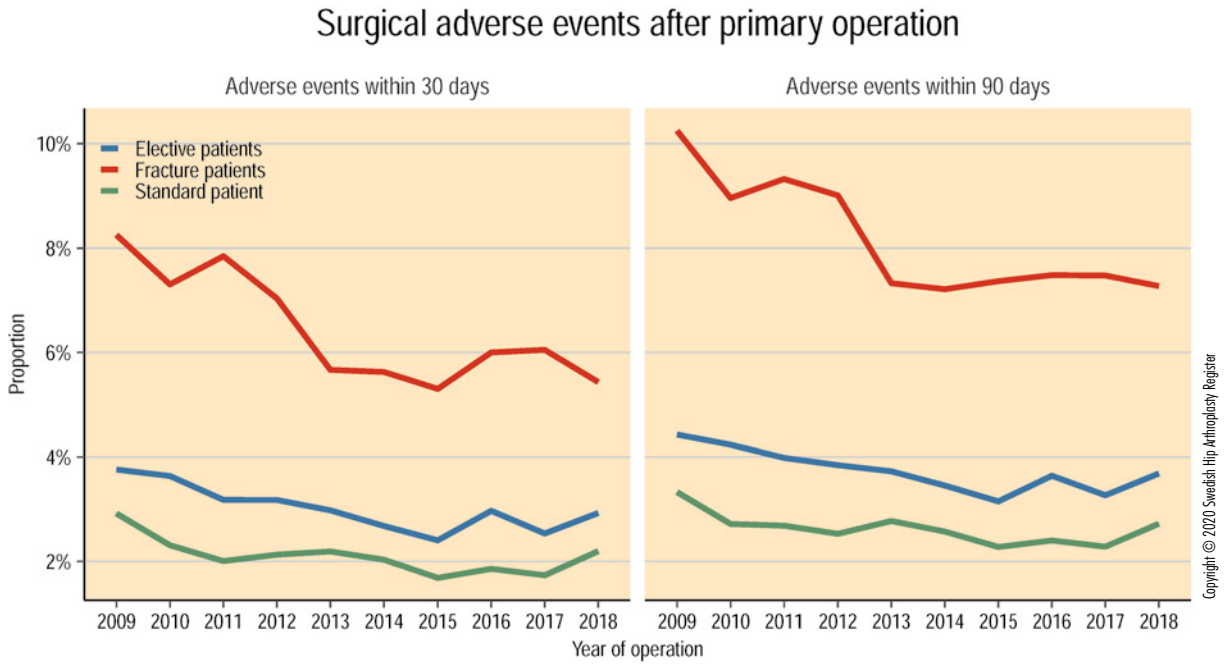


Figure 11.1.3

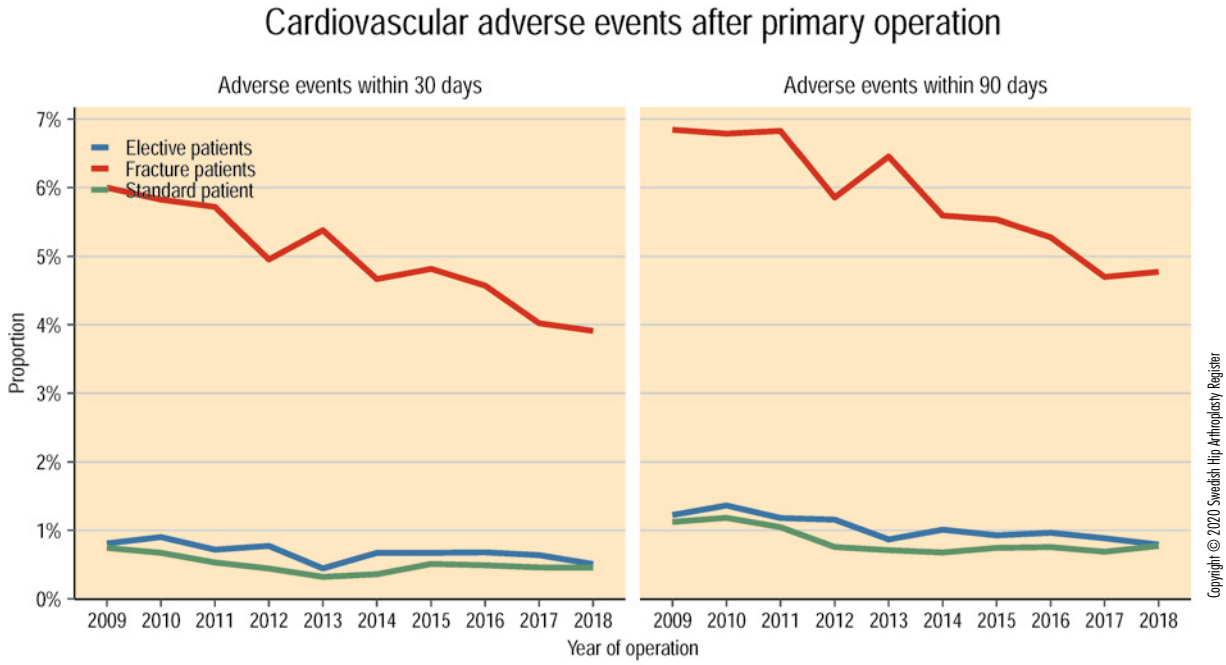


Figure 11.1.4

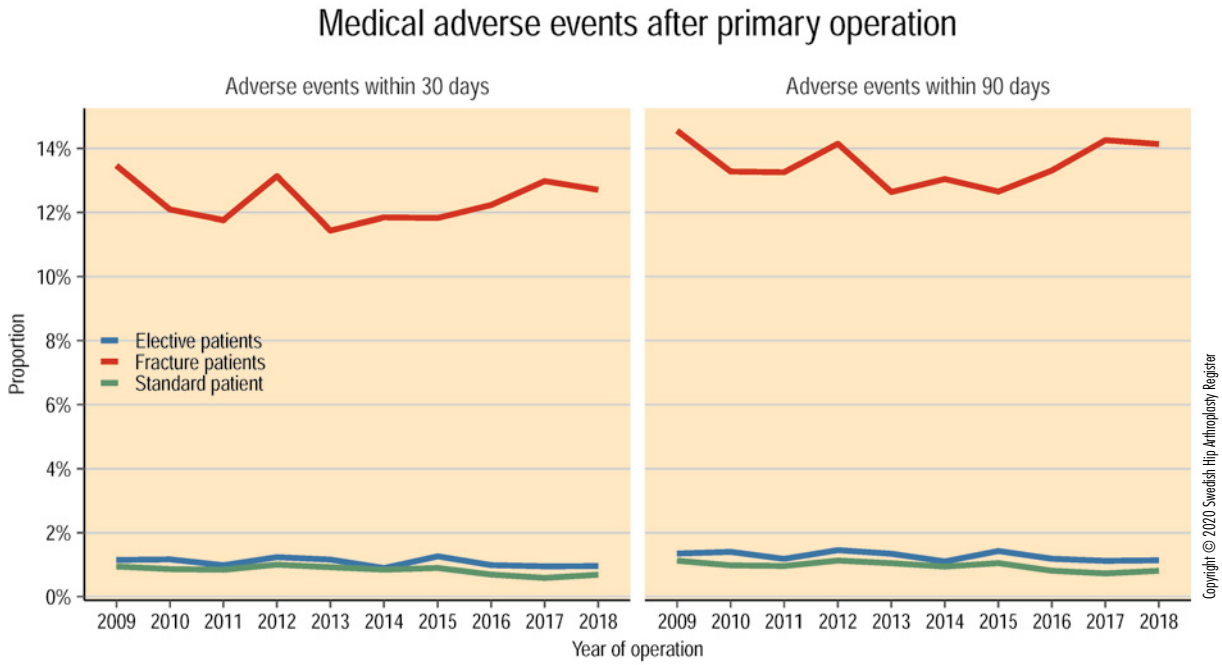


Figure 11.1.5

or later reoperation (tables 11.2.1–11.2.7). The variation is large for all units. Some units lie well above the national mean. For elective patients the variation of adverse events within 90 days is between 0 % and 16 % (one deviant unit not accounted for) with a national mean of around 6 %. The corresponding proportions for the standard patient are 0 % to 10 %. The incidence for fracture patients varies between 21 % and 48 % with a national mean of 31 %. The largest variation is observed for reoperations where the incidence varies from 8 % to 67 % with an mean of 30 %.

Adverse events for fracture patients

Individuals that undergo hip arthroplasty due to a hip fracture often have several diseases. Only 4 % have ASA class I, that is are completely healthy. Since an early operation is important, the possibilities of improving the health status prior to the procedure are slim. This can be contrasted with the individual with osteoarthritis that is operated after a thorough review of the general health. A patient that is too ill is often dissuaded from such a procedure, as opposed to fracture patients that always must be operated. Hence, adverse events after an arthroplasty due to fracture is more common, and the postoperative outlook is different. For fracture patients, the register has chosen to add codes also for urinary tract infection (related to the use of a urinary catheter), since it is both a known and preventable disease that may hit the older individual hard.

The proportion of cardiovascular and medical events after hip fracture were at a stationary level during the last year. For the proportion of hip related events ("surgical events") a decrease can be seen. To prevent adverse events demands a multi-disciplinary care effort where orthopaedics, geriatrics, internal medicine, primary care and rehabilitation come together around the patient. The focus of today's healthcare is often to shorten the duration of hospital stay and to streamline the care, but better care, both in connection with the operation and after it should reasonably be able to decrease the risk. More men are affected by adverse events within 90 days compared with women, 35 % compared with 30 %. The difference between the genders is greater after fracture than after an operation due to osteoarthritis. The scientific literature unanimously shows that the prognosis after hip fracture is worse for men. A contributing factor is that men are more ill at the time of their fracture.

For the standard patient and the elective patient, a weak increase of adverse events can be seen over the last year, but the ten-year trend is still decreasing. The fracture patients have an even greater decrease during the period.

The proportion of adverse events after first-time reoperations varies more, right now there is a decrease.

There is a large variation between different units regarding the incidence of adverse events for all categories.

There are great opportunities for health care improvements to avoid adverse events, especially regarding fracture patients and in connection with reoperations.

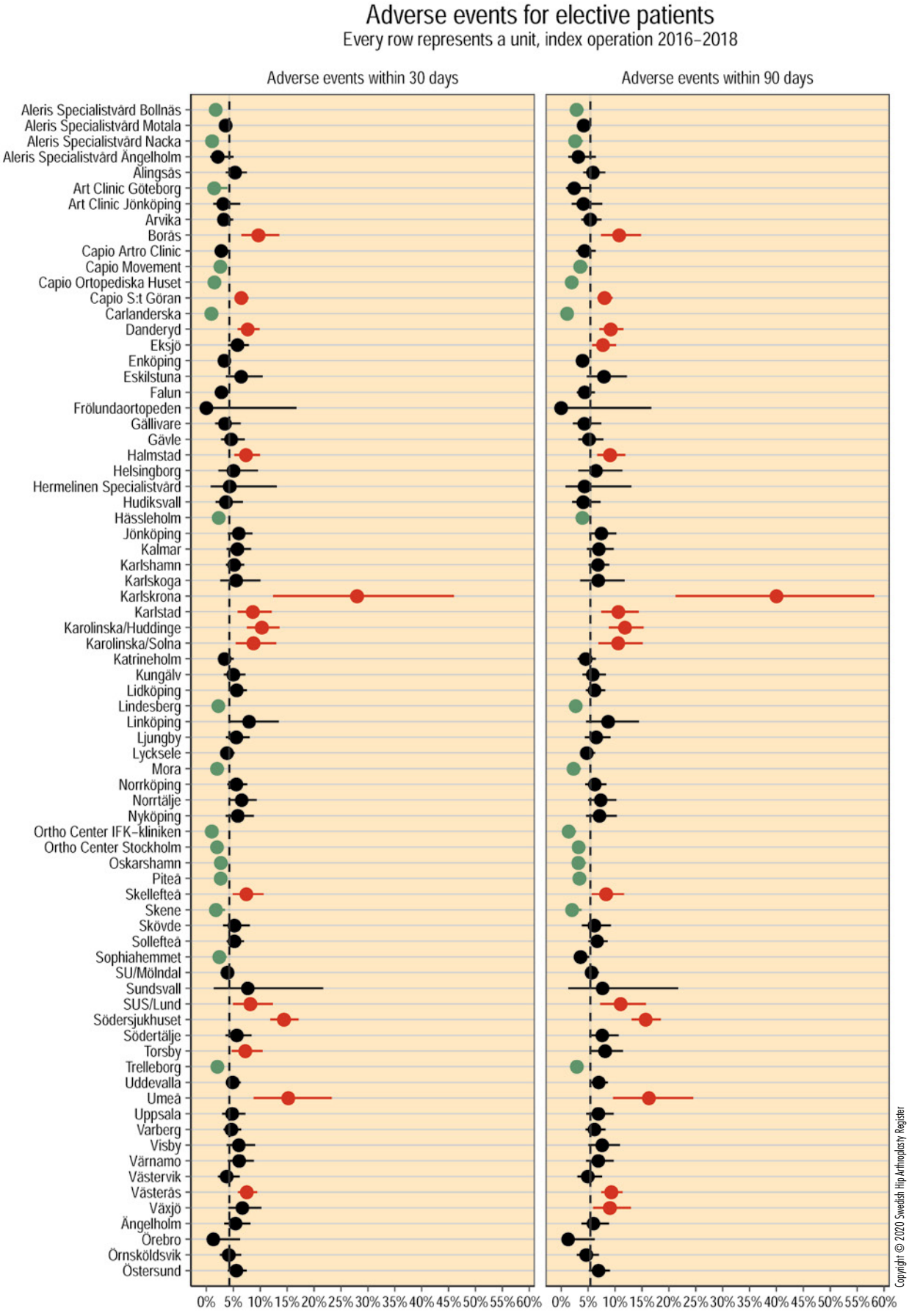


Figure 11.2.1. Proportion of adverse events with confidence interval per unit..

Units with fewer than 20 observations have been excluded.

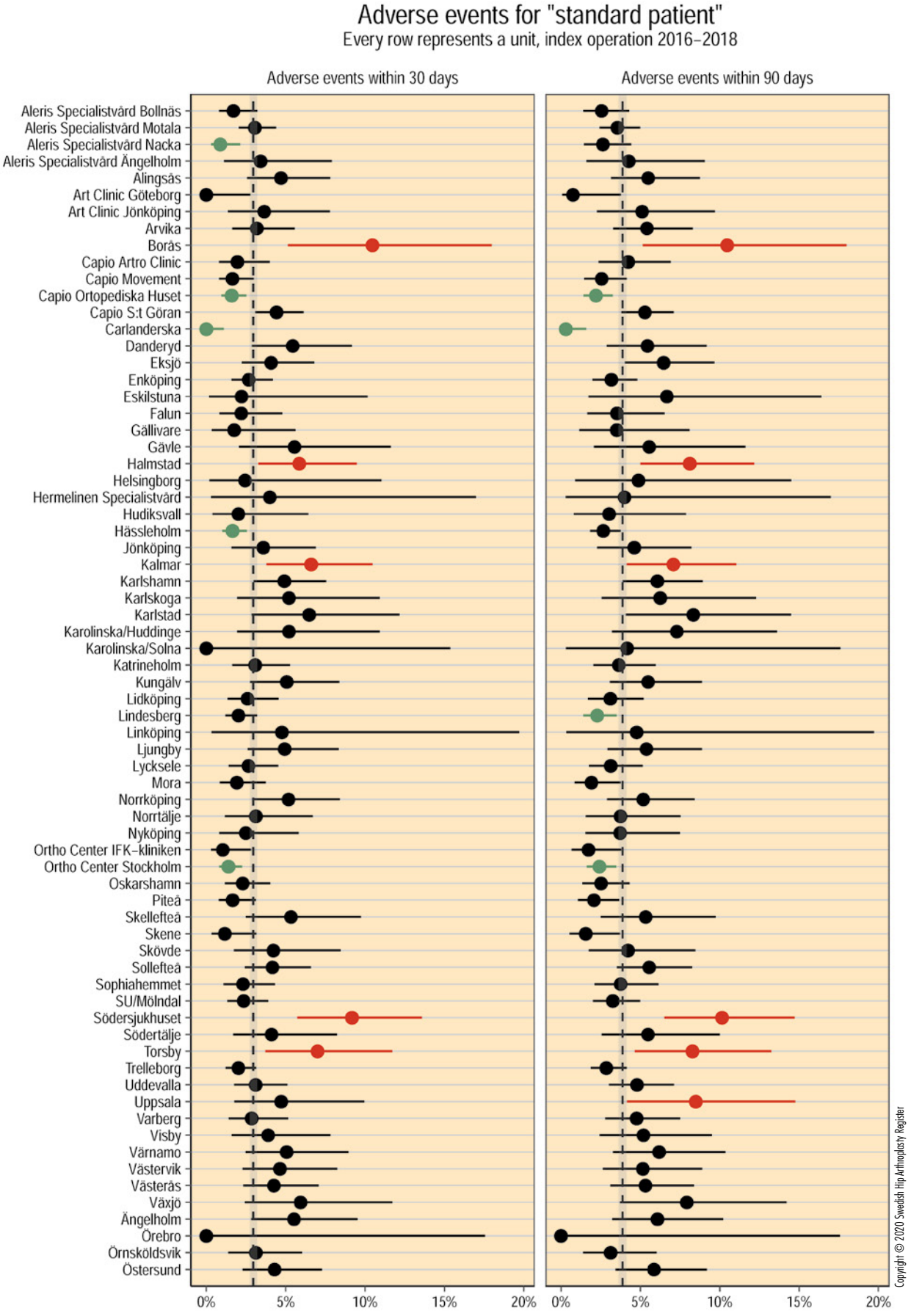


Figure 11.2.2. Proportion of adverse events with confidence interval per unit.

Units with fewer than 20 registrations have been excluded.

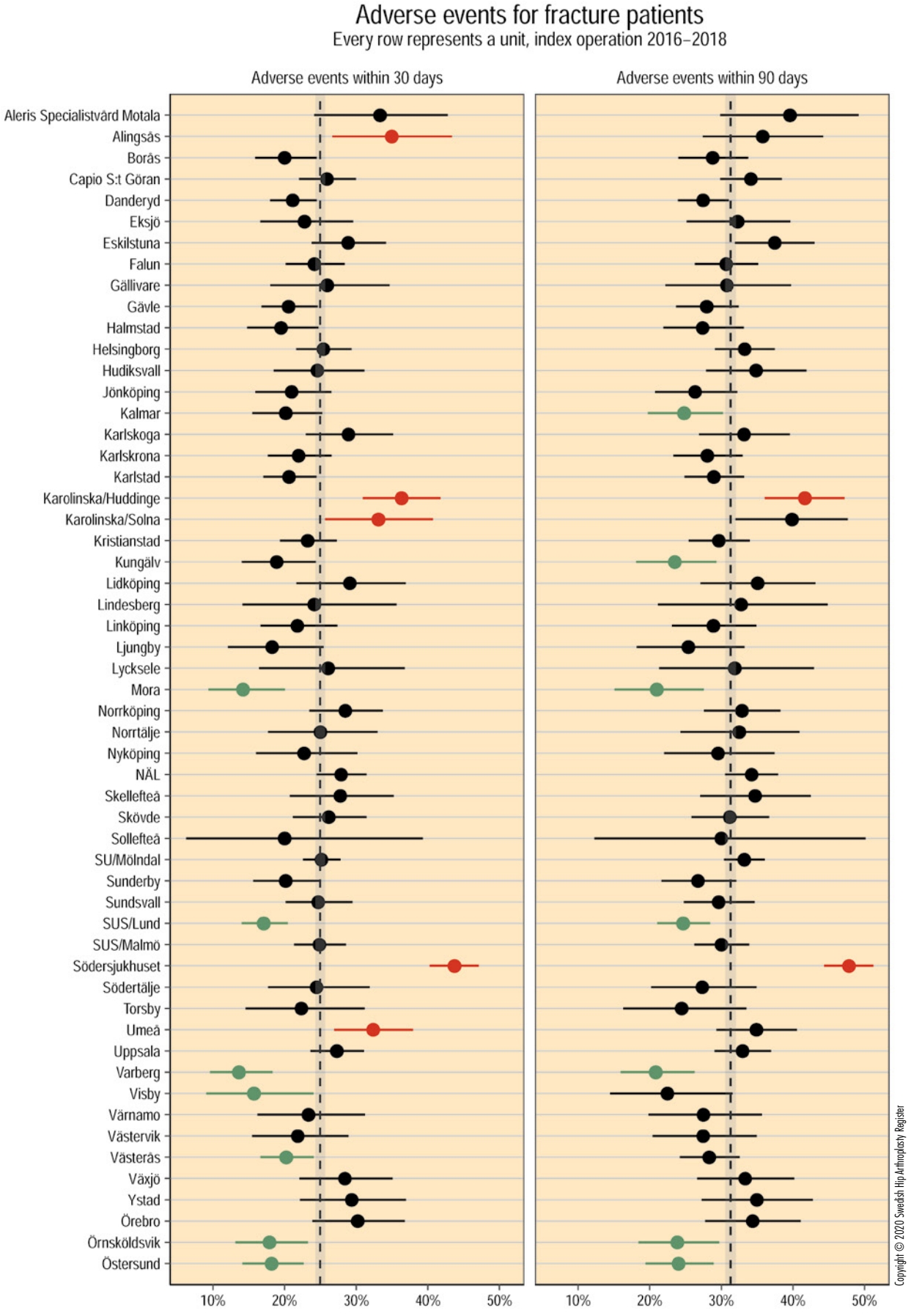


Figure 11.2.3. Proportion of adverse events with confidence intervals per unit.

Units with fewer than 20 observations have been excluded.

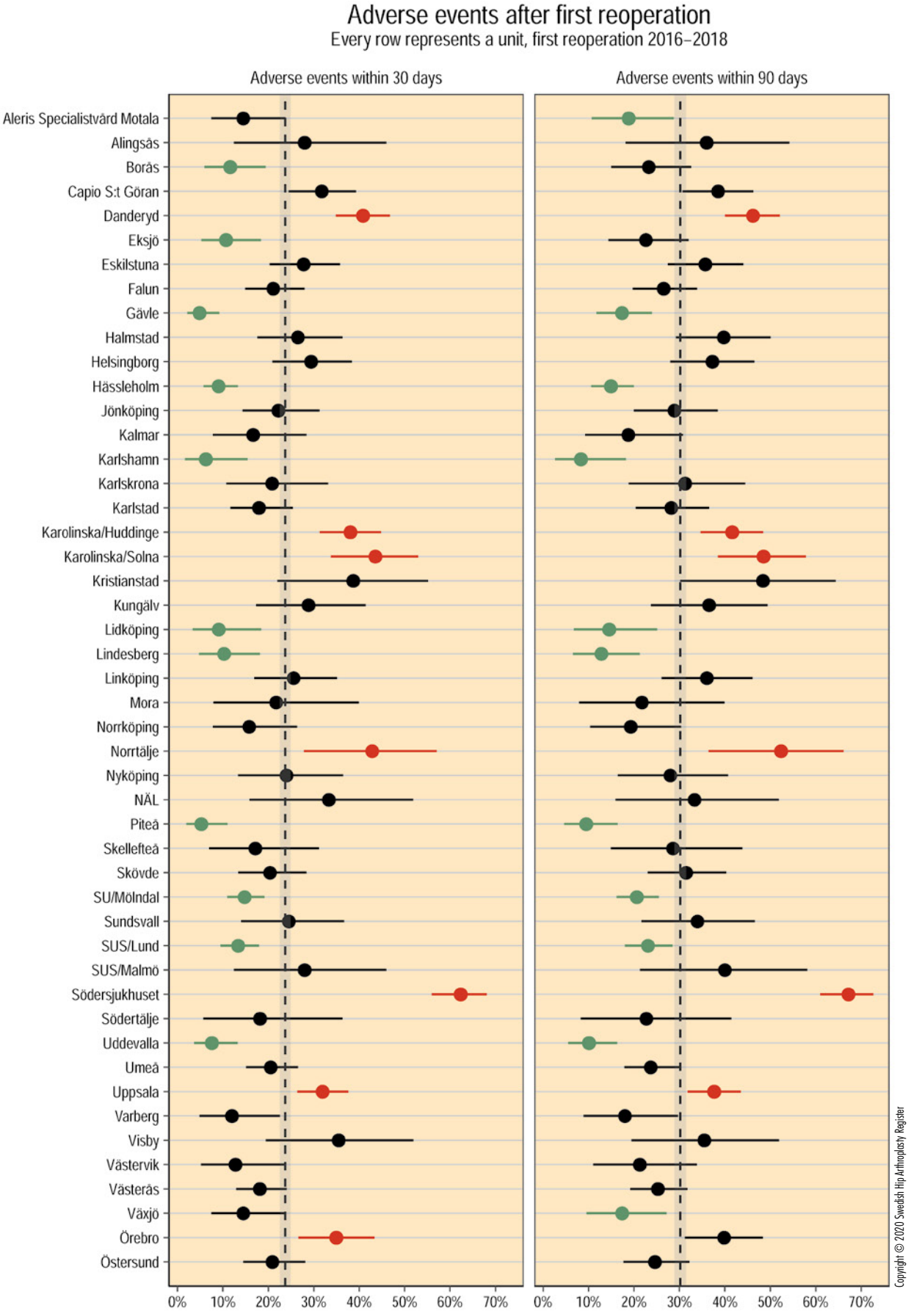


Figure 11.2.4. Proportion of adverse events with confidence interval per unit.

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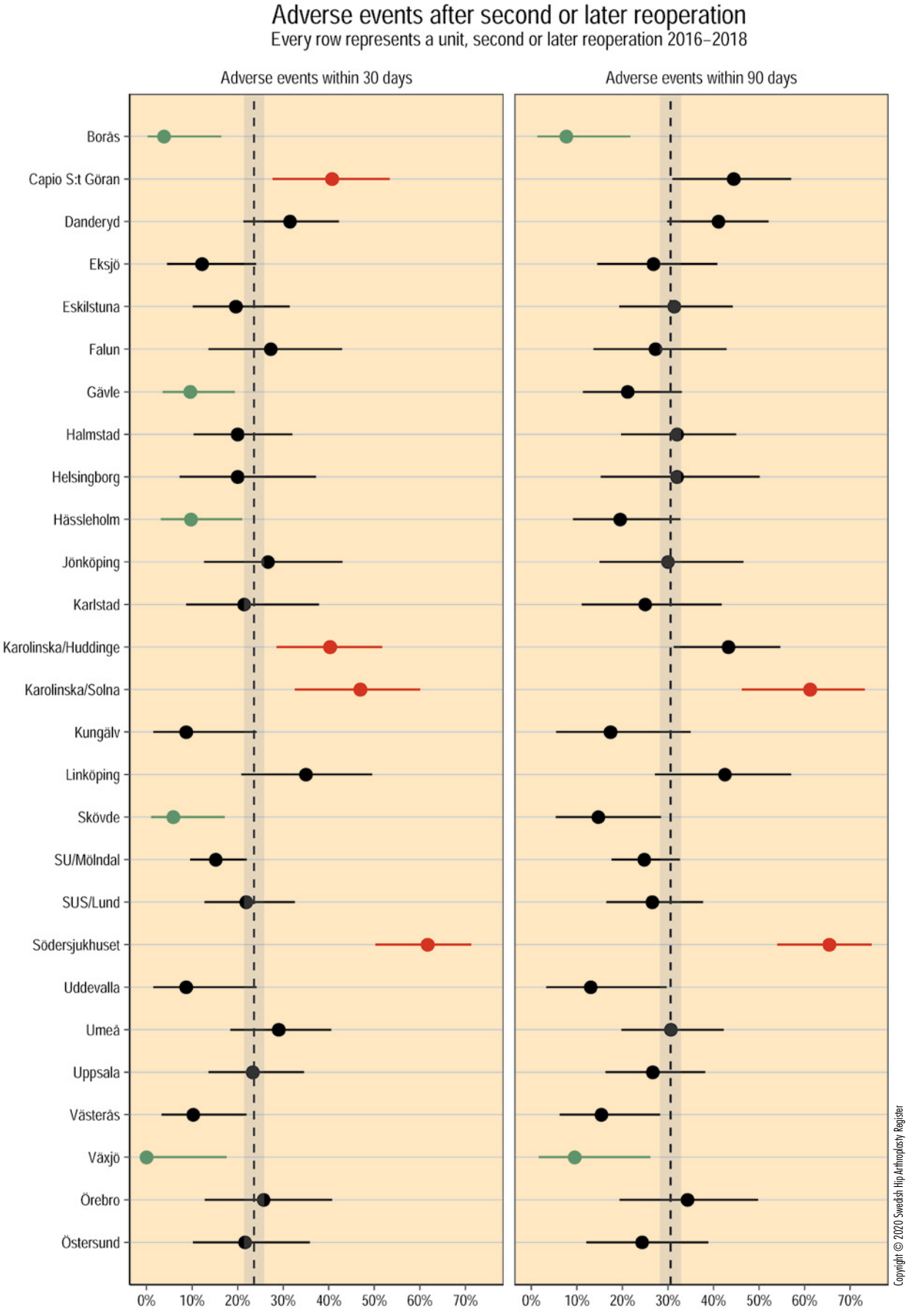


Figure 11.2.5. Proportion of adverse events with confidence intervals per unit.

Units with fewer than 20 observations have been excluded.

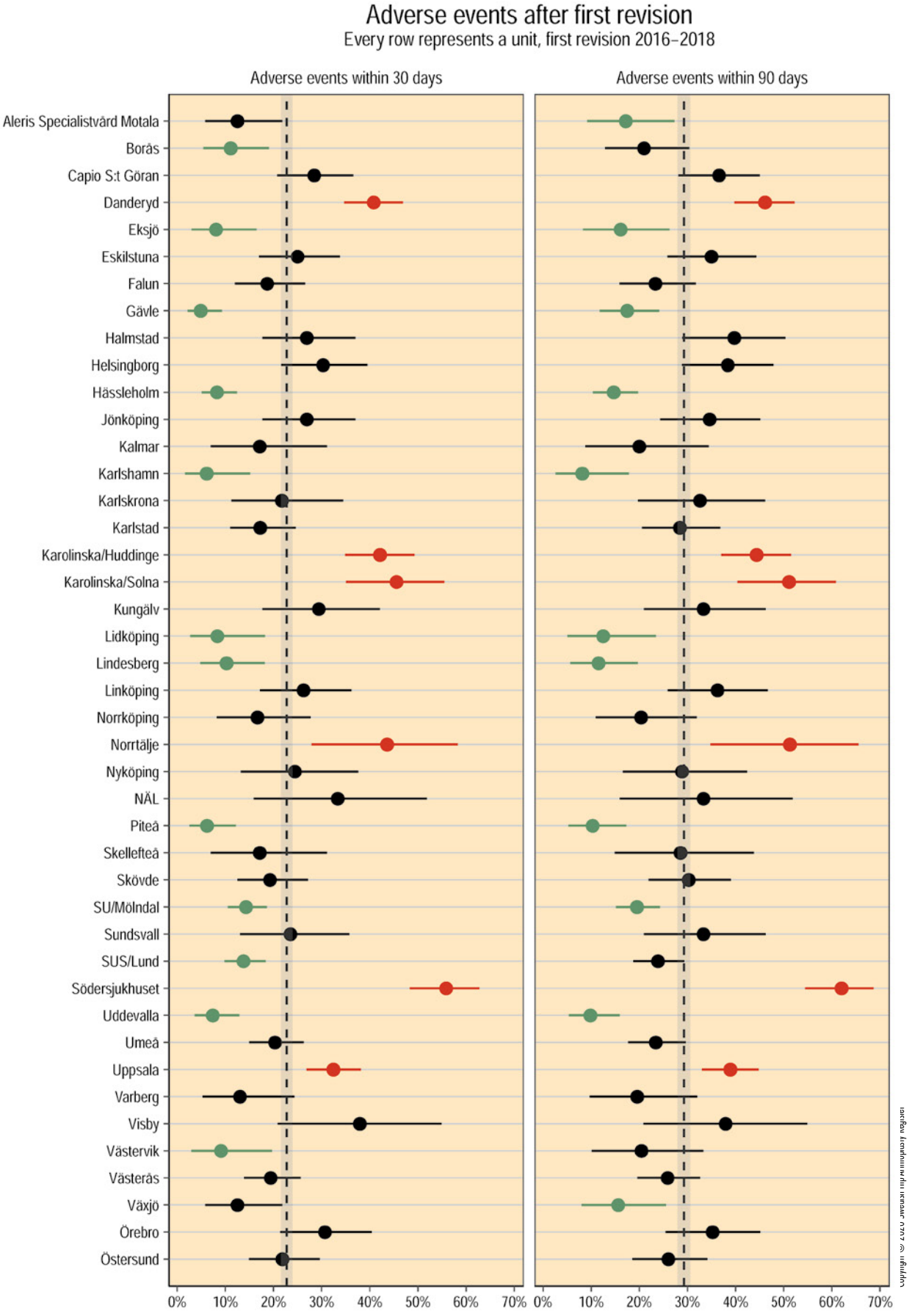


Figure 11.2.6. Proportion of adverse events on unit-level.

Units with fewer than 20 registrations have been excluded.

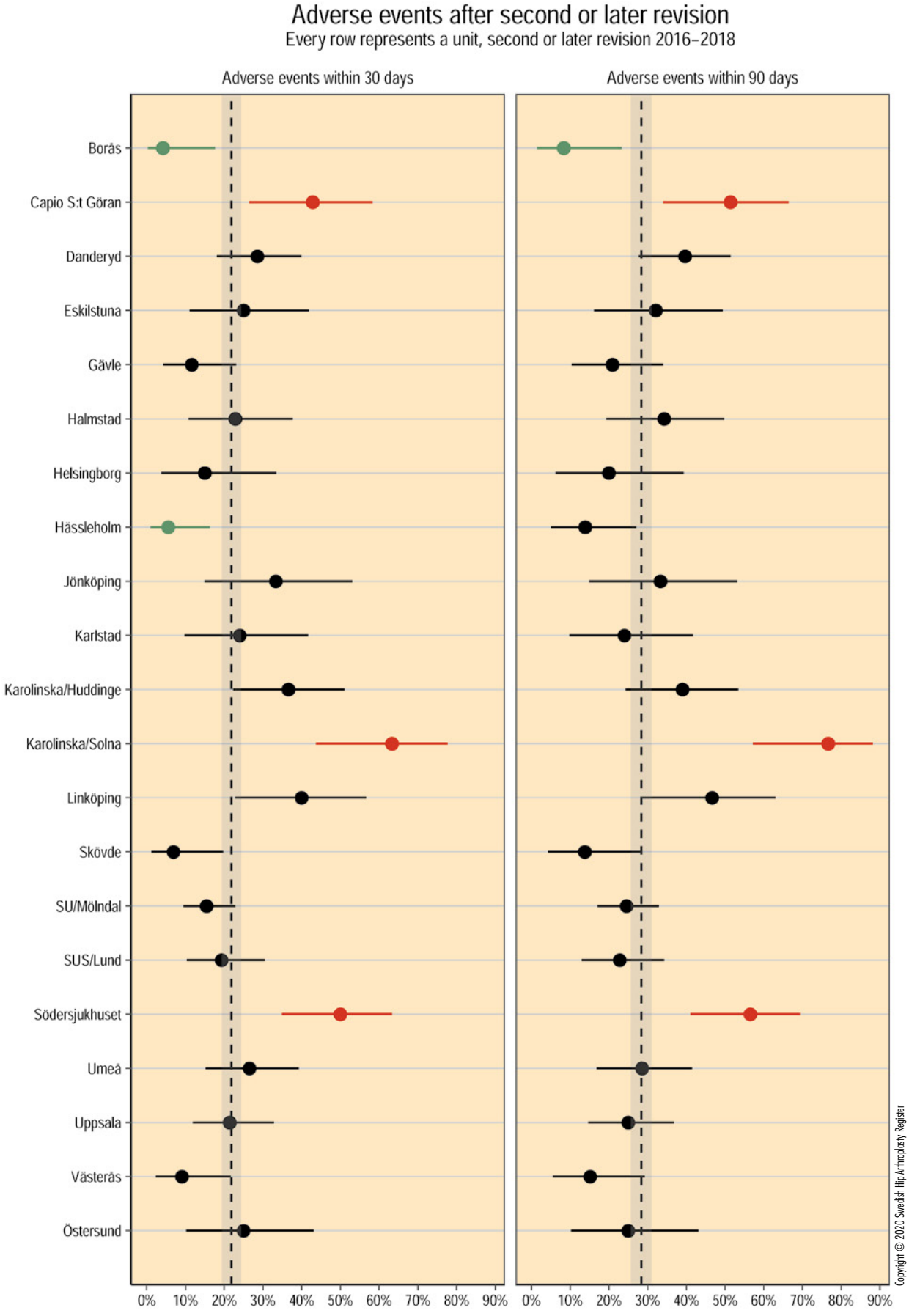


Figure 11.2.7. Proportion of adverse events on unit level.

Units with fewer than 20 observations have been excluded.

12. Fracture treatment with a total or a hemiarthroplasty

Author: Cecilia Rogmark

A hip fracture is a serious injury, both for a younger and an older individual. This is one of the fragility fractures, and a majority of the patients are older. Patients are often frail regarding their general health and the strength of the skeleton, which increases the risk of fracture when falling. More than 90 % of the displaced femoral neck fractures* in Sweden are treated with a hip arthroplasty, and almost 15 % of the undisplaced. This reflects a growing interest in treating also a undisplaced femoral neck fracture with an arthroplasty. The question is studied in a national study, HipSTHeR, that started in 2019 and that is based on data from the Swedish Fracture Register. The second most common hip fracture, the trochanteric fracture, is normally fixed by a sliding hip screw or an intramedullary nail. To primary operate complicated trochanteric fractures with an arthroplasty is advocated by single research centres internationally but has never caught on in Sweden. During the last five years, 0.6 % of the trochanteric fractures were treated with a hip arthroplasty. In contrast, Sweden stands out in an international comparison, by the large proportion of total arthroplasties as opposed to hemiarthroplasties compared with other countries. The scientific comparisons between total and hemiarthroplasties in fracture patients may point in different directions, depending on which patient group that is selected for the study. The more data that is collected, the smaller the differences between the methods seem to be. We will return to these questions in this chapter. First, an overview of 2019.

In total, there are now 90 052 procedures registered since 2005, of which 6 509 operations were registered in 2019. The number of operations is thus slowly increasing (figure 12.1.1). The increase is only seen in the group 75–85 years, around 200 more compared with last year. Those under 75 years are 100 fewer this year, while the number over 85 years is completely unchanged. Epidemiologists have feared a large toll on the healthcare system when the large nativity cohorts from the end of the 1940s reach the risk age for hip fracture for example. This is thus yet to be seen. There may be positive effects of an improved health in the population that entails that this generation may not have the same risk for hip fracture as earlier generations. Time will tell. Dementia is registered for those who are operated with a hemiarthroplasty. The proportion is steadily increasing, and in 2019 40 % of those patients undergoing a hemiarthroplasty had either an obvious or a suspected dementia. In 2005, the corresponding proportion was 28 %.

12.1 Implant choice and technique

The number of unipolar hemiarthroplasties increases and has never been more numerous for one year (3 381). The previous clear-cut increase of total arthroplasty as fracture treatment faded out in 2019, 2 121 fracture patients underwent such an operation last year. The number of bipolar hemiarthroplasties is relatively stable since a few years back (1 107) (figure 12.1.2). There is possibly a break of trend? Maybe Swedish orthopaedic surgeons have cut-back on their use of total arthroplasty, based on the recent debate (Rogmark, C. (2020). Further refinement surgery will not necessarily improve outcome after hip fracture. Acta Orthopaedica, 1–3)? The Swedish Fracture Register (SFR) focuses on all types of fracture treatment and to a lesser extent on prosthesis details. SFRs data shows that the use of total arthroplasty for dislocated femoral neck fracture starts already for patients around 45 years old and is more common than internal fixation already before 60 years of age. In a comparison with other countries Sweden has a very high usage of total arthroplasty as fracture treatment.

Also, the most common surgical approach, the direct lateral approach, increases slightly and was used in 4 602 operations during 2019, while the posterior approach stays at a stationary level (1 839) (figure 12.1.3). In some countries there is an increased interest in the anterior approach (direct anterior approach). When the few and very small studies that review anterior approach for fracture patients are summed up, a lower dislocation frequency can be seen compared with a posterior approach, but no clear gain regarding function (Kunkel et al. Europ J Orthop Surg & Trauma, 28 (2), 217–232). Studies of osteoarthritis patients give us reason to believe that an anterior approach is technically more demanding, and that the surgeon needs a greater number of operations to get a good result (Pincus et al. Jama, 323 (11), 1070–1076). During the last decade, 170 patients have been operated with the anterior Watson-Jones approach. One hospital that has chosen this approach accounts for their experience in chapter 4.4.

The two most common prosthesis stems, Lubinus SP II and Exeter, comprised 91 % of Swedish orthopaedic surgeons' choice of implants during 2019. The use of uncemented stems is still decreasing and they accounted for 1.8 % during 2019. If we look only at the acute operations, they accounted for only 0.8 %, an extremely low share compared with other countries (table 12.1.1). Femoral heads for hemiarthroplasties and cups respectively offer more choices and as a result the variation is greater, the 10 most common account for 90 %. The increase of dual mobility cups has come to a halt: in 2014, 430 such cups were inserted, compared with 630 during 2018 and 502 in 2019 (table 12.1.2).

The implant survival rate is based on the revisions reported to the register and is shown for the most common stem types in figures 12.1.4–12.1.8. The nine-year survival rate is about the same, around 94–96 %, for the cemented stems. The uncemented Corail stem has a lower implant survival than the cemented stems. Corail's curve also looks different, with both more early and late revisions. Of course, the result of all stems should be interpreted with prudence, as a varying degree of revision reporting, different treatment strategies during complications

*) data from the Swedish Fracture Register

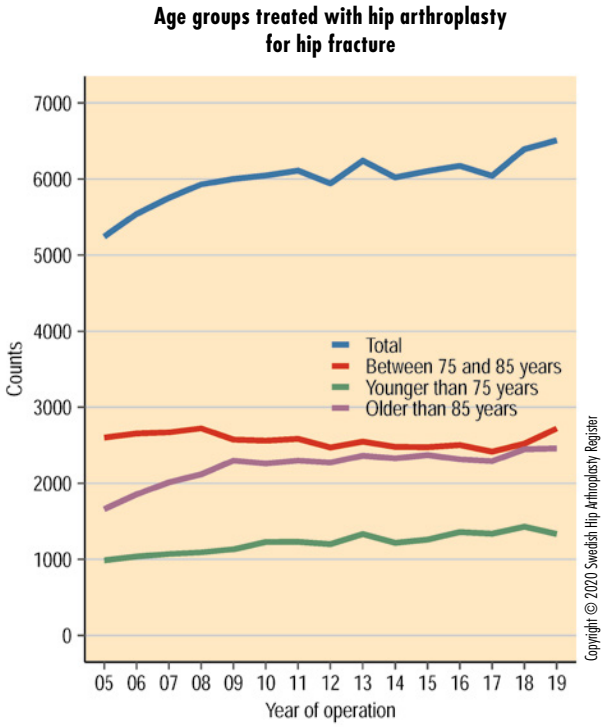


Figure 12.1.1

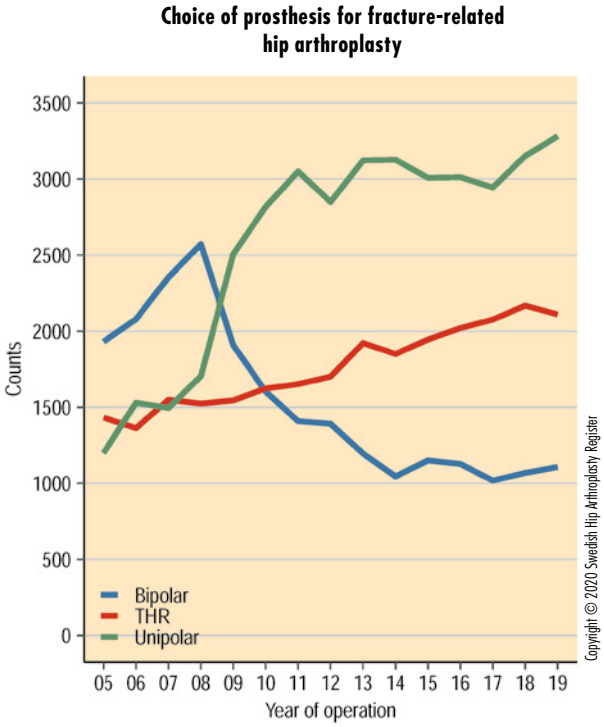


Figure 12.1.2

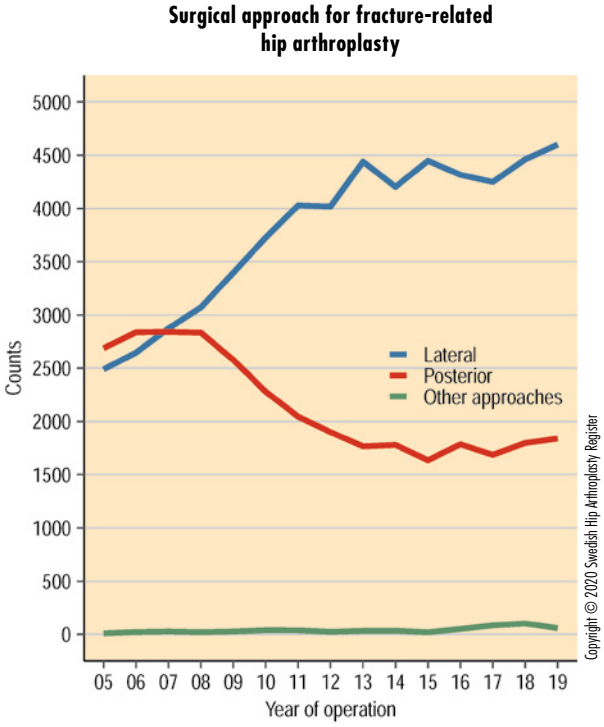


Figure 12.1.3

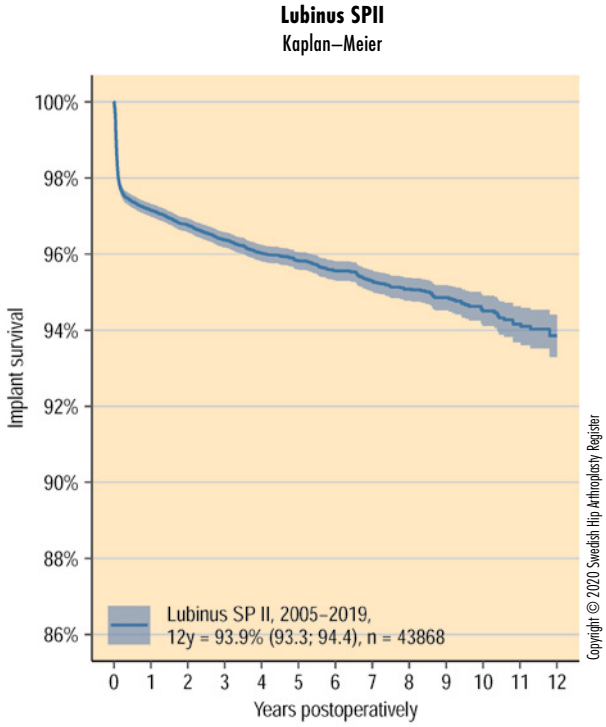


Figure 12.1.4

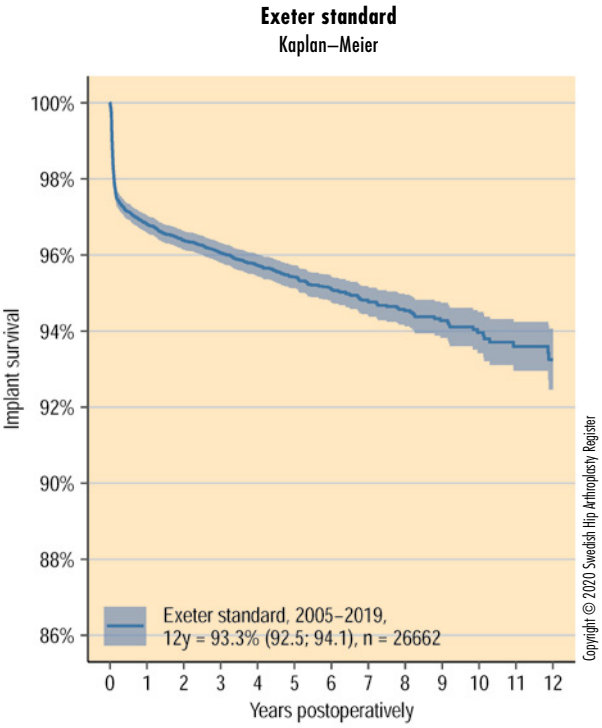


Figure 12.1.5

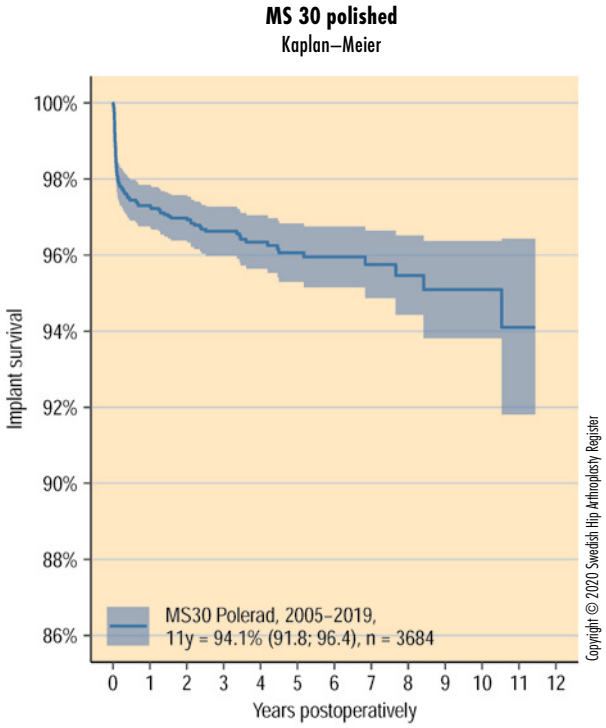


Figure 12.1.6

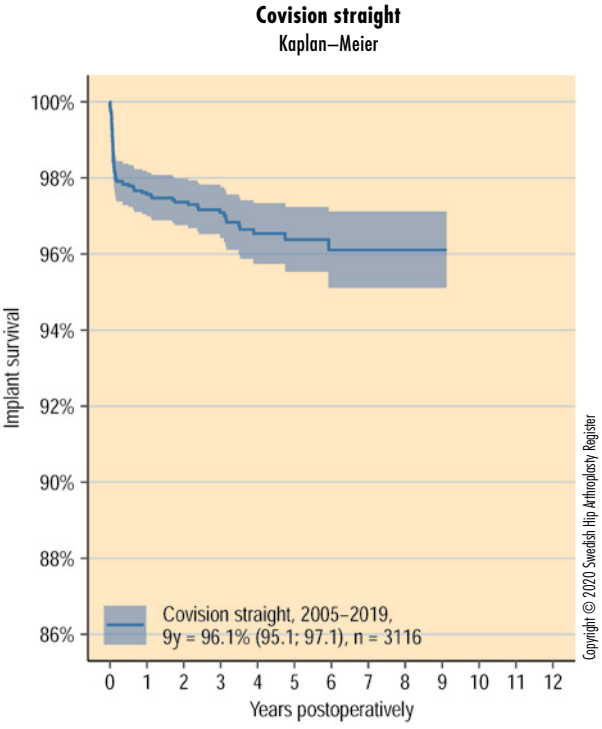


Figure 12.1.7

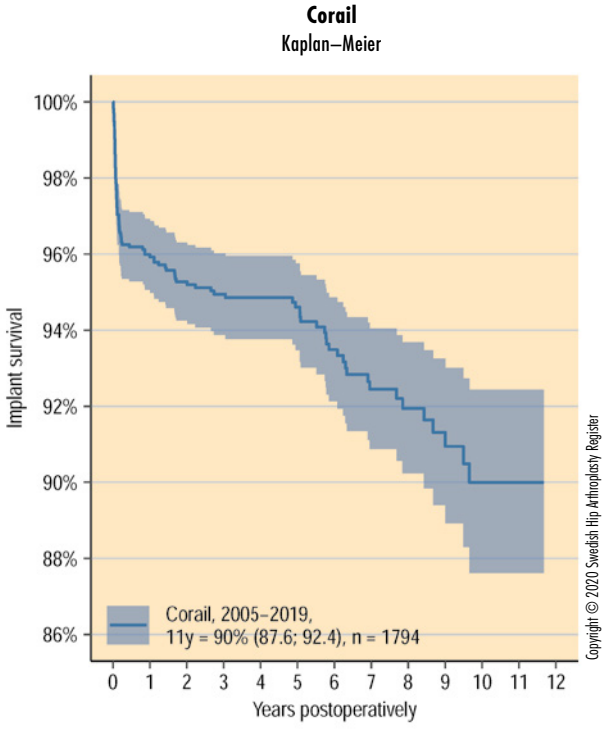


Figure 12.1.8

15 most common stems for fracture patients

Stem	2005–2013	2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
SPII standard	23,539	2,976	3,082	3,391	3,321	3,777	4,073	20,620	55.4
Exeter standard	14,814	2,078	2,118	1,995	1,957	1,974	1,831	11,953	32.1
MS-30 polished	1,772	323	321	318	304	312	346	1,924	5.2
Covision straight	1,726	385	345	250	232	142	54	1,408	3.8
Corail standard	1,146	83	89	55	49	46	25	347	0.9
Exeter long	250	38	29	23	34	21	28	173	0.5
Restoration	70	7	12	19	12	13	23	86	0.2
Corail coxa vara	123	18	14	11	18	10	13	84	0.2
Wagner Cone	105	21	17	12	12	5	6	73	0.2
MP proximal standard	112	18	10	4	13	12	15	72	0.2
Bi-Metric X por HA NC	273	17	14	11	7	5	1	55	0.1
Not available	0	0	1	0	14	19	20	54	0.1
Corail high offset	50	9	5	13	5	9	4	45	0.1
Exeter kort rev stam	16	3	2	4	6	15	10	40	0.1
CLS	210	5	12	4	11	3	4	39	0.1
Other	8,576	41	28	45	45	27	42	228	0.5
Total	52,782	6,022	6,099	6,155	6,040	6,390	6,495	37,201	

Table 12.1.1

[1)] Refers to the number the last five years.
[2)] Refers to the proportion of the total number of primary operations for fracture patients during the last five years.

15 most common cups-/femoral heads

Cup/hemiarthroplasty femoral head	2005–2013	2014	2015	2016	2017	2018	2019	Total[1)]	Proportion, %[2)]
Unipolar femoral head	9525	1758	1755	1971	1943	2064	2061	11552	31.1
UHR Universal Head	5792	743	835	832	777	817	831	4835	13
Unitrax modular endohead	1562	524	468	534	658	678	572	3434	9.2
Lubinus x-link	454	338	467	612	547	680	687	3331	9
Avantage	584	235	232	321	401	419	372	1980	5.3
Exeter Rim-fit	309	184	224	275	307	367	310	1667	4.5
Marathon	1557	324	302	269	274	203	226	1598	4.3
Covision unipolar	1743	397	348	252	228	143	55	1423	3.8
Lubinus	5448	373	297	152	146	155	187	1310	3.5
V40 unipolar	4038	348	336	158	8	0	0	850	2.3
MultiPolar Bipolar Cup	580	137	145	135	131	132	152	832	2.2
Vario cup	6861	128	131	159	108	113	122	761	2
Modular Trauma Heads	0	0	0	0	1	152	460	613	1.6
Unipolar	803	96	100	97	90	105	112	600	1.6
Polar cup cemented	197	60	83	90	95	81	93	502	1.3
Other	11569	377	380	297	324	277	257	1912	4.9
Total	51022	6022	6103	6154	6038	6386	6497	37200	

Table 12.1.2

[1)] Refers to the number the last five years.
[2)] Refers to the proportion of the total number of primary operations for fracture patients during the last five years.

and more may give a skewed representation of the real clinical result. Fracture patients may also be afflicted by serious complications that do not lead to a revision. This can for example be the case when the doctor thinks that the risks associated with such a procedure are too great for an frail individual and refrains from a revision operation.

Uncemented stems are associated with a higher revision risk in fracture patients. The Swedish orthopaedic surgeon's choice of a cemented stem in 99 % of cases seems reasonable and is a world-unique high proportion.

12.2 Reoperation and revision

4 402 reoperations have been reported to the register since 2005, which yields a reoperation frequency of 4.9 %. 3 112 of these secondary procedures are revisions, where the prosthesis has been changed in part or as a whole or extracted. The reasons for reoperation are given in table 12.2.1 and later in this chapter. There is reason to remind of that all open secondary procedures in and around the hip are to be reported to the Swedish Hip Arthroplasty Register.

That only 6 out of 6 000 fracture patients during 2019 have had a periprosthetic fracture seems to be a somewhat low figure! A dissertation (G Chatziagorous 2020, see chapter 4.5) on periprosthetic fractures after total arthroplasty in Sweden has shown that the elderly and women are overrepresented when it comes to fractures below the prosthesis stem (Vancouver C-fractures). Individuals with a hip fracture had a four times higher risk of having a C-fracture compared with patients where osteoarthritis was the reason for their hip arthroplasty. The dissertation also showed that only 17 % of all C-fractures were reported to the Swedish Hip Arthroplasty Register, so there is reason to believe that there is also a relatively large underreporting for fractures distally of a hemiarthroplasty. Spread the information to colleagues and secretaries that all femoral fractures in a femur inserted with a hip prosthesis are to be reported to the Swedish Hip Arthroplasty Register, even if the injury is "only" treated with internal fixation.

	2005–2018		2019	
	Number	Proportion, %	Number	Proportion, %
2-stage procedure	1	0	0	0
Acetabular erosion	66	0.1	0	0
Aseptic loosening	252	0.3	2	0
Other causes	94	0.1	1	0
Deep infection	1,417	1.7	113	1.7
Unspecific pain	53	0.1	0	0
Fracture	944	1.1	6	0.1
Implant rupture	3	0	0	0
Dislocation	1,222	1.5	76	1.2
Technical reason	42	0.1	2	0
No reoperation/ reason is missing	79,449	95.1	6,309	96.9
Total	83,543		6,509	

Table 12.2.1. Number of reoperations (secondary open surgery) and causes reported to the register until 2019–12–31.

Figures 12.2.1–12.2.4 show the implant survival computed with a Kaplan-Meier analysis. That younger patients undergo revisional surgery to a greater extent than do older may to some degree depend on that the younger are healthy during a longer time after their hip fracture. If they have a complication, there is a greater possibility that the patient's health admits a larger reoperation. The elderly and/or ill may be dissuaded from new surgery. The argument also shows that revision is a blunt measure of hip complications. In an in-depth analysis, through linkage with the Patient Register, we found that one third of the hemiarthroplasty patients and one sixth of the total arthroplasty patients underwent a revision when they suffered dislocation/s/. This serious clinical problem is gravely underestimated using revision as an outcome measure. That a secondary arthroplasty after failed internal fixation have an increased risk for revision is on the other hand supported by clinical studies and is usually explained by scars and deranged anatomy leads to a technically more demanding procedure, and higher risk of infection.

When the different surgical approaches are compared, the lateral approach is associated with a lower risk for revision than the posterior approach, regardless of cause. The different prosthesis types have the same risk for revision during the greater part of the duration of the follow-up. Bipolar hemiarthroplasties, and to some extent unipolar hemiarthroplasties, have a higher revision risk than total arthroplasties during the first two years.

In table 12.2.2 the reoperations within six months on participating units are shown. The national mean is 3 % and the units varies from 0 % to just under 8 %. Most of the reoperations thus take place early. This is an important quality indicator, but the account is to be read with prudence. Several factors may interfere: in addition to underreporting and a special case-mix for the unit, the units may be more or less inclined to operate during complications – see the underreporting during dislocation above. Local treatment traditions also play a part. During for example suspected infection one nowadays operates acutely and removes infected tissue in order to try to heal the infection and keep the primary prosthesis in combination with the right antibiotics. How aggressive this infection investigation and treatment is, varies between the units in the country and may explain the variation in reoperation frequency to some extent.

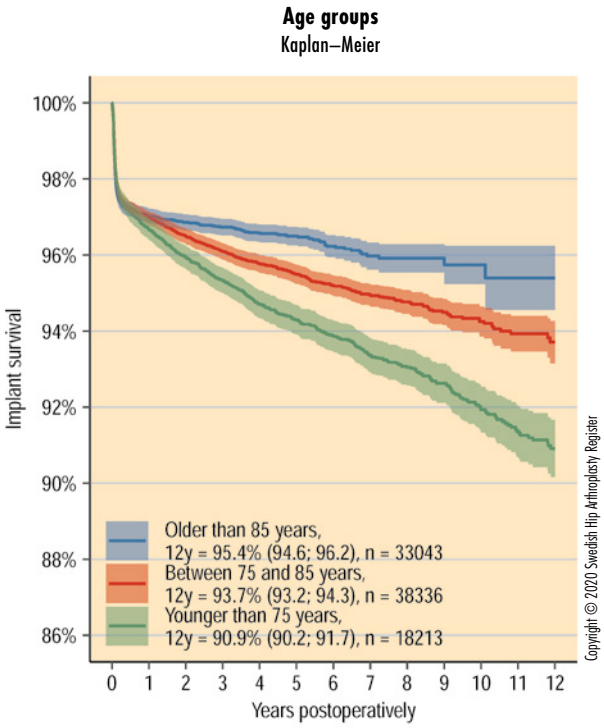


Figure 12.2.1

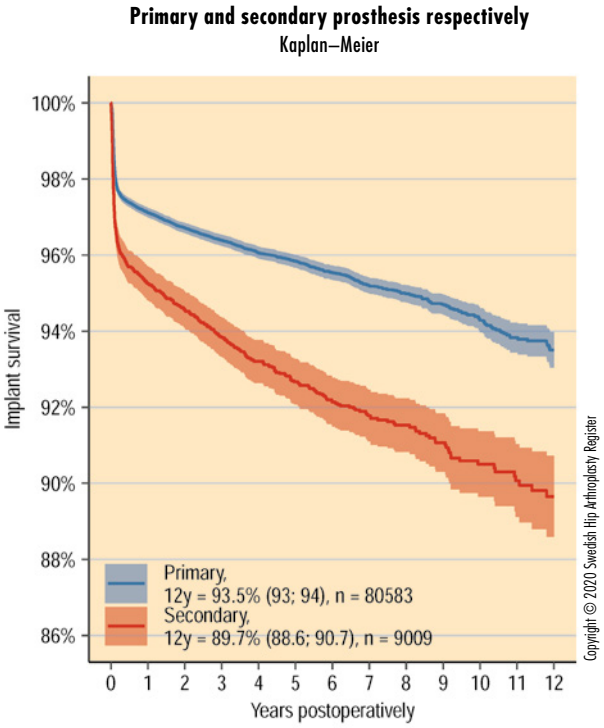


Figure 12.2.2

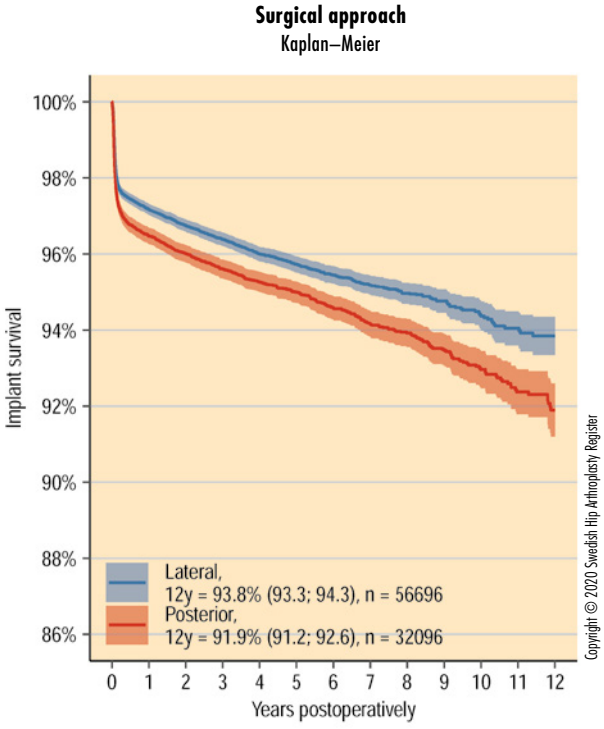


Figure 12.2.3

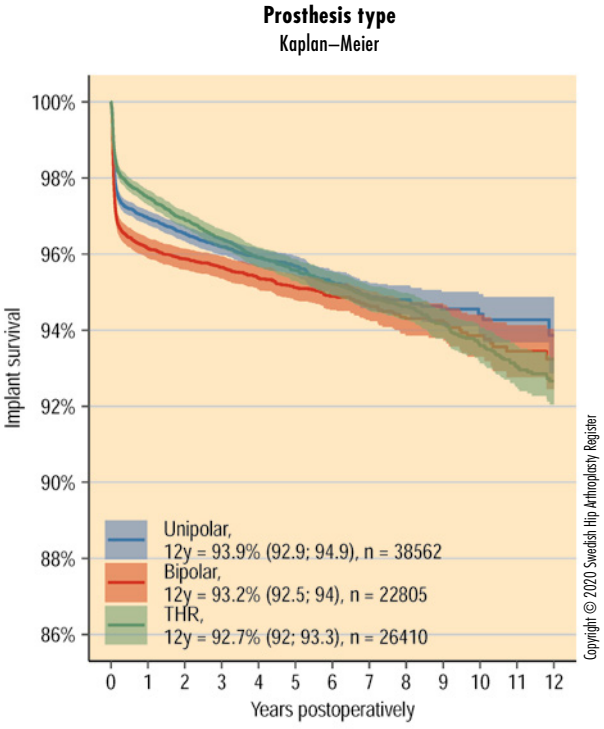


Figure 12.2.4

Reoperations within six months per unit

Fracture patients 2017–2019

Unit	Number of primary operations[1)]	Number of reoperations[2)]	Proportion, %[3)]
University or regional hospitals			
Karolinska/Huddinge	374	15	4.1
Karolinska/Solna	123	9	7.4
Linköping	293	9	3.2
SU/Mölndal	1,222	30	2.6
SUS/Lund	629	17	2.8
SUS/Malmö	621	24	4
Umeå	322	7	2.2
Uppsala	667	27	4.2
Örebro	216	11	5.3
County hospitals			
Borås	402	9	2.4
Danderyd	795	20	2.6
Eksjö	182	11	6.1
Eskilstuna	358	16	4.5
Falun	439	18	4.2
Gävle	488	4	0.8
Halmstad	292	10	3.5
Helsingborg	593	31	5.4
Hässleholm	65	2	3.1
Jönköping	269	10	3.8
Kalmar	291	3	1
Karlskrona	395	12	3.1
Karlstad	569	21	3.8
Kristianstad	480	22	4.7
Norrköping	375	3	0.8
NÄL	731	17	2.4
Skövde	356	22	6.4
Sunderby	351	4	1.2
Sundsvall	337	8	2.4
Södersjukhuset	990	27	2.9
Uddevalla	21	0	0
Varberg	297	4	1.4
Västerås	519	13	2.6
Växjö	233	2	0.9
Ystad	158	8	5.4
Östersund	342	24	7.2
Local hospitals			
Alingsås	148	11	7.5
Gällivare	133	6	4.6
Hudiksvall	252	7	2.9
Karlskoga	274	14	5.2
Kungälv	247	8	3.4
Lidköping	178	12	7
Lindesberg	120	2	1.8
Ljungby	134	6	4.5
Lycksele	96	2	2.1
Mora	235	4	1.8
Norrtälje	145	6	4.2
Nyköping	170	4	2.4
Piteå	30	0	0
Skellefteå	182	12	6.8
Södertälje	187	5	2.7
Torsby	97	1	1.1
Trelleborg	38	1	2.7
Visby	113	1	0.9
Värnamo	145	6	4.2
Västervik	179	10	5.8
Örnsköldsvik	282	7	2.6
Private hospitals			
Aleris Specialistvård Motala	89	2	2.2
Capio S:t Göran	610	11	1.8
Country	18,946	608	3.3

Table 12.2.2

[1)] Refers to the number of primary operations for fracture patients 2017–2019. Units with fewer than 20 operations during the period are excluded.

[2)] Refers to the number of patients who have been reoperated within 6 months.

[3)] Proportion of reoperations calculated using competing risk-analysis during six months-follow-up.

Units with an elective focus mainly carry out secondary prosthesis procedures, something that could explain a higher reoperation incidence (figure 12.2.2). Another reason for a higher reoperation frequency may be the use of either an uncemented stem or a posterior approach, which may lead to an increased risk for periprosthetic fracture and dislocation respectively. If a unit has many reoperations, the register proposes that a local improvement work with an in-depth analysis is carried out. This could take place within the framework of a resident's project and the register management is happy to pass on the experience that exists from earlier quality work.

As always, the reoperations are attributed to the hospital that carried out the primary operation, regardless of where the reoperation thereafter is carried out.

12.3 Risk factors for reoperation

Many factors have an influence on both whether a patient will develop hip complications and whether a reoperation then will be carried out. Register-data only comprises a small part of these factors that may be hard to capture. In earlier annual reports, we have analysed risk factors for complications leading reoperation. The risk factors have not changed much over the years and some factors are also not possible to change – men for example have a higher reoperation risk than do women. Younger patients have a higher risk than older. Furthermore, implants are chosen based on the patient's general condition and function level. Healthy, active patients often undergo a total arthroplasty. They live relatively longer after their hip fracture and have the time to develop complications and – since they are healthy – are reoperated to a large extent. The opposite is true for those that undergo a unipolar hemiarthroplasty – these patients live a short while and may be too ill to be operated anew. Consequently, unipolar hemiarthroplasties seem to have much fewer reoperations than do total arthroplasties. Table 12.3.1 shows the unadjusted number of reoperations for different age groups and prosthesis types.

This year we replace these analyses with an analysis of the long-term result after hemiarthroplasty, which is lesser known. The most common problems, infection and dislocation normally occur early, within the first half-year. At the same time, the mortality is high, and already during the first month, 6% of the women and 11% of the men die (source: the Swedish Fracture Register). After 5 years fewer than half are alive. The aim of the analysis is to try to compare bi- and unipolar hemiarthroplasties in a fair way. The register showed inferior early results for bipolars several years ago, with more reoperations the first postoperative years. Theoretically, bipolar hemiarthroplasties should have advantages in the long run, as the prosthesis was designed to reduce the risk of acetabular erosion, wear of the cartilage in the hip socket cavity.

Out of 57 800 arthroplasties carried out during acute fracture between 2005 and 2015, 16 216 bipolar and 22 186 unipolar hemiarthroplasties are part of the analysis. Then we have excluded total arthroplasties (12 473), the second procedure in those with bilateral fractures, and patients with missing data on prosthesis design and surgical approach. The patients are matched on age, gender, year of operation, surgical approach and hospital type (propensity score matching). 12 280 patients in each group of patients is the result of the matching, with an mean age of 84 years, 71% are women. When comparing prosthesis types regarding reason for reoperation (table 12.3.2), there are not any decisive differences, especially when the actual number of individuals is considered: 127 more individuals with a bipolar prosthesis need a reoperation when more than 24,000 individuals are studied! And what clinical significance should we attach to acetabular erosion. Certainly, 41 more patients are affected by this in the unipolar group, but in light of the fact that not even half of the hip fracture patients regain their earlier functional ability, it is probably not a change in choice of prosthesis design that will improve their result, but a coordinated effort along the whole clinical care pathway.

With a Kaplan-Meier analysis (figure 12.3.1), we see that the long-term result is virtually identical for both patient groups, when reoperation is used as outcome. The slightly increased incidence of reoperations for the bipolar group during the very early stage should, as discussed above, not be of decisive clinical significance.

12.4 Extracapsular hip fractures treated with hip arthroplasty

Analysis in collaboration with Nils Hailer

Extracapsular hip fractures, i.e. trochanteric and subtrochanteric fractures, are identified with the diagnosis codes S27.10 and S72.20 in the register. A sliding hip screw or an intramedullary nail are the methods that are most often used for their treatment. To primary treat complicated trochanteric fractures with a hip arthroplasty is advocated by single research centres internationally but has never gained any popularity in Sweden. The Swedish Fracture Register reports that 0.6% of the trochanteric fractures over the last five years were operated with a hip arthroplasty.

In the Swedish Hip Arthroplasty Register, we have analysed the result after 1 130 patients with extracapsular fractures underwent a total or a hemiarthroplasty, compared with 73 441 patients due to intracapsular fractures (S72.00). The patients had a fracture 2005–2018 and were followed up to 2019-12-31 or to their death. The patient groups are comparable in many respects, but those with extracapsular fractures are somewhat younger. The surgical details however differ, which should be considered when the results are compared. During extracapsular fracture a total arthroplasty is carried out more often and the proportion of posterior surgical approaches is somewhat greater (table 12.4.1).

Number of reoperations

	Number of primary operations	Unipolar prosthesis		Bipolar prosthesis		Total prosthesis		All prostheses	
		Number	Proportion, %	Number	Proportion, %	Number	Proportion, %	Number	Proportion, %
< 75 years	18,231	190	6,2	177	8,2	854	6,6	1,221	6,7
75–85 years	33,338	666	3,4	445	4,4	117	4,1	1,228	3,8
> 85 years	38,483	770	4,7	591	5,6	505	4,7	1,866	4,9

Table 12.3.1. Number of reoperations (secondary open surgery) divided into age groups and prosthesis types reported to the register until 2019–12–31.

Reasons for reoperation

	Bipolar prosthesis		Unipolar prosthesis	
	Number	Proportion, %	Number	Proportion, %
Not reoperated	11,677	95.1	11,804	96.1
Infection	212	1.7	141	1.1
Dislocation, instability	192	1.6	157	1.3
Fracture femur	155	1.3	107	0.9
Loosening	17	0.1	9	0.1
Unclear pain, acetabular erosion	7	0.1	48	0.4
Other	20	0.1	14	0.1

Table 12.3.2. Reasons for reoperation.

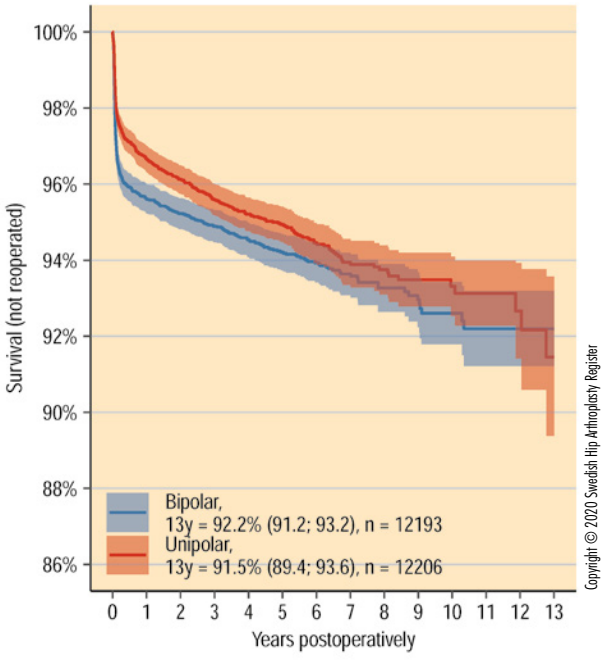


Figure 12.3.1. Proportion of patients free from reoperation, Kaplan-Meier analysis. Red line = unipolar hemiprosthesis, blue line = bipolar hemiprosthesis.

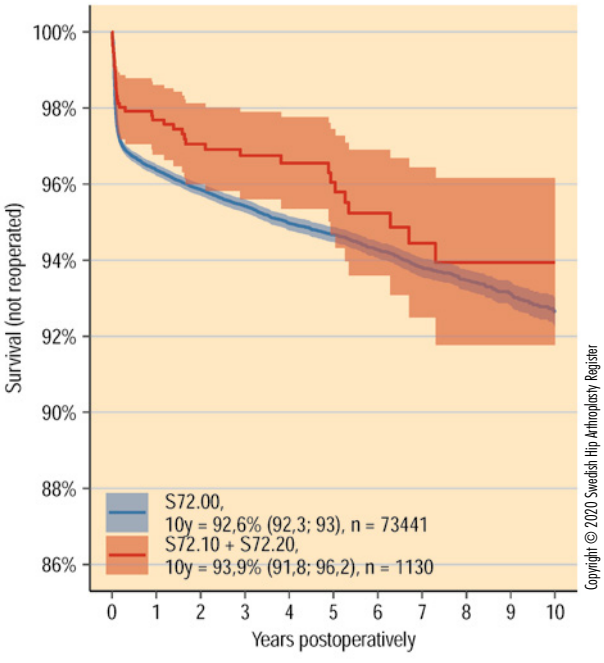


Figure 12.4.1. Proportion of patients free from reoperation, Kaplan–Meier analysis. Red line = extracapsular hip fractures, blue line = intra- capsular hip fractures.

Description of the patient groups and surgical details

	Intracapsular fractures	Extracapsular fractures
Number	73,441	1,130
Age mean (SD)	82.1 (8.4)	81.0 (9.2)
Age group		
<75	13,015 (17.7)	240 (21.2)
75–85	32,162 (43.8)	490 (43.4)
>85	28,264 (38.5)	400 (35.4)
BMI mean (SD)	23.9 (4.1)	24.2 (4.3)
ASA-class		
1	2,292 (4.1)	23 (2.8)
2	21,438 (38.6)	326 (39.9)
3	28,747 (51.8)	417 (51.0)
4	3,014 (5.4)	49 (6.0)
5	34 (0.1)	2 (0.2)
Gender		
Women	50,746 (69.1)	757 (67.0)
Surgical approach		
Posterior	26,005 (35.4)	433 (38.3)
Direct lateral	46,817 (63.7)	682 (60.4)
Other	619 (0.8)	15 (1.3)
Prosthesis type		
Total prosthesis	17,277 (23.5)	539 (47.7)
Bipolar hemiprosthesis	20,675 (28.2)	188 (16.6)
Unipolar hemiprosthesis	33,792 (46.0)	393 (34.8)
Hemiprosthesis, unknown type	1,697 (2.3)	10 (0.9)
Fixation hemiprosthesis		
Uncemented stem	1,395 (2.5)	10 (1.7)
Fixation total prosthesis		
Cemented	15,888 (92.1)	437 (81.2)
Hybrid	300 (1.7)	10 (1.9)
Uncemented	284 (1.6)	17 (3.2)
Reversed hybrid	779 (4.5)	74 (13.8)

Table 12.4.1. Description of the patient groups and surgical details.

Reasons for reoperation

	Intracapsular fractures		Extracapsular fractures	
	Number	Proportion, %	Number	Proportion, %
Not reoperated	70,199	95.6	1,089	96.4
Infection	1,120	1.5	12	1.1
Dislocation, instability	1,021	1.4	9	0.8
Fracture femur	737	1.0	12	1.1
Loosening	152	0.2	4	0.4
Unclear pain, acetabular erosion	103	0.1	2	0.2
Other	109	0.1	2	0.2

Table 12.4.2. Reasons for reoperation

A Kaplan-Meier analysis shows the same result for both groups regarding the incidence of reoperations, up to 10 years after the fracture (figure 12.4.1). The distribution of reasons for reoperation are also fairly similar (table 12.4.2). If the two groups are compared regarding incidence of revision surgery, the outcome in both groups is once again similar. This is a little surprising since surgery during extracapsular fractures is considered much more difficult. That an arthroplasty due to extracapsular fracture may be more complicated is for example illustrated by the use of long stems (Exeter long) and revision prosthesis (MP Proximal Standard, Wagner SL Revision, Revitan cylinder) in around 10 % of the cases. The same prosthesis types are very rare during the more routine arthroplasties due to intracapsular fracture.

Possibly, only experienced arthroplasty surgeons carry out arthroplasties on patients with extracapsular fractures, and thereby achieving a better result? Or those patients that are offered an arthroplasty as an acute treatment are so strictly selected that they have fewer risk factors for dislocation and infection? Another unknown factor is if some basocervical fractures are classified as S72.10 and thereby are counted as trochanteric fractures in our presentation. The basocervical fracture straddles the line between the femoral neck and the trochanteric part of the femur and has no diagnosis code of its own. Regarding arthroplasty, the basocervical fractures resemble the femoral neck fracture much more and should not be as technically demanding to operate as extracapsular fractures are. Local samples and review of radiographs at two Swedish university hospitals, indicate that the proportion of basocervical fractures in patients with an extracapsular fracture is low, so this possible error source should be relatively limited.

In Sweden, an arthroplasty during a extracapsular fracture is regarded as something exceptional. There are however single comparative studies that have proposed arthroplasty as a good alternative to internal fixation. In theory, it can be appealing to get an immediately stable system with a prosthesis, compared with the drawn-out convalescence we see after internal fixation of an instable extracapsular hip fracture. Also, completely other considerations may underlie the choice of arthroplasty for patients with an extracapsular fracture: the samples mentioned showed that the pre-existence of osteoarthritis in the fractured hip was a common reason for the choice of arthroplasty. In such cases, the choice of an acute arthroplasty will address both sources of pain, and hopefully facilitate rehabilitation. Theoretically, internal fixation of a fracture adjacent to a stiff joint will lead to increases strain of the osteosynthesis with risk of fixation failure. The question however is if an arthroplasty procedure of such injuries is such a great technical challenge that only experienced arthroplasty surgeons should take it on. In that case, dissemination to the emergency surgery will be difficult.

The analysis above comes with several limitations but may stimulate to a discussion if there is something to gain with arthroplasty as an acute treatment also of some extracapsular hip fractures. The question must be addressed through a research study in that case, at first hand through an in-depth analysis of medical records and radiographs, but preferably in randomised form. Finally, it can be noted that the reoperation frequency, as it is reported to the Swedish Fracture Register, after operation with an intramedullary nail or a sliding hip screw of an instable extracapsular fracture, is of the same size as after arthroplasty in our analyses above (see SFRs annual report 2019).

12.5 Clinical significance

A lot of energy is spent on the discussion of choice of prosthesis types – total arthroplasty, bi- or unipolar hemiarthroplasty – both in scientific contexts and in clinical everyday practice. Right now, we see that the use of total arthroplasty has come to a halt, and the number of unipolar hemiarthroplasties is increasing again. The curves over implant survival show no greater

difference between the prosthesis types, and maybe we are barking up the wrong tree? In the discussion on how we treat our patients best, it is important to decide which outcome that is of the greatest importance for the patient. To be able to go back to an independent life, not to have any pain and to trust the ability of your own body are probably the things that are most highly valued. Not having any complications is of course also of great importance. In this context it is important to understand that reoperations and revisions are only the tip of the iceberg out of the real complications. The studies of the SHAR have shown that the underreporting is substantial during infections and dislocations, and some periprosthetic fractures are also treated without open surgery. Only the unit's own reviews of patient satisfaction and the total number of complications can answer if the given treatment is satisfactory. Probably, there are more decisive factors in the care process, than differences in prosthesis design, that are possible to influence. Remember that the residents' projects can be designed as quality improvement contributions.

An obvious issue to debate on a national level is the high incidence of revisions in those younger than 75 years old, with hip fractures treated with a hip arthroplasty. One in ten undergo a revision within the first ten years. What can orthopaedic surgeons, staff and departments do to improve on this number? Compare their fate with "the standard patient" operated due to osteoarthritis, he/she has a considerably better outcome, one in 20 need a revision. Is the fracture patient bound to have a result that is so much worse? Has it got to do with the experience of the surgeon and the quality of the care? Or maybe perfunctory choices regarding surgical approach, cementing and rehabilitation? Or is it only the patients' risk factors that confers this poor diagnosis? Here, there is room for local quality projects – are fracture patients operated under worse conditions than elective patients? What are the reasons for revision of the unit – could any case have been prevented?

Remember that all open procedures in and around the hip are to be reported. Do not forget to report soft tissue procedures during infection and fracture surgery! The register is happy to assist in the education of new local co-workers!

Remember that *all* open procedures in and around the hip are to be reported. Do not forget to report soft tissue procedures during infection and fracture surgery! The register is happy to assist in the education of new local co-workers!

13. Quality indicators – value compasses

Authors: Ola Rolfson, Cecilia Rogmark

The Swedish Hip Arthroplasty Register began to openly report unit results in 1999. The number of variables reported in this way have increased over the years, and they are presented in tabular form at different places in this report. These tables are by necessity extensive, and at times difficult to interpret. Furthermore, it is difficult using tables to acquire a quick overview of the results of the units in multiple dimensions. In order to facilitate interpretation and to quickly gain an overview of the results of the units, we make use of what is termed the value compass, which includes seven or eight quality indicators (compass directions). The compasses have been developed with the aim of providing a quick and pedagogical overview. A deviant result in a value compass is an indication that there is room for improvement in one area. The compass should be seen as a simple signalling system. We have developed value compasses for all total arthroplasties, the standard patient and for patients undergoing an arthroplasty due to a fracture.

Each variable has been re-scaled to values from 0 to 1. The lowest value (0.0) for the variables is the origin and the highest value (1.0) is on the periphery. The limits are determined by taking the highest and lowest mean value (on the unit level) and adding and subtracting one standard deviation respectively. The national mean is stated for each compass direction through the outer edge of the red area. Each unit's mean value for the variable in question is given for each compass direction through the outer edge of the green area. Green values within the red area are lower than the national mean value, and values outside the red area are higher. The more of the red field that can be seen, the poorer the results. It should be noted that the observation period for the variables differs.

13.1 Quality indicators after total arthroplasty

Result variables in value compasses:

- Patient satisfaction at the 1-year follow-up (operating year 2018–2019).
- Pain alleviation. The value is calculated by subtracting the value of the preoperative pain from the value that was given one year after the operation (operating year 2018–2019).
- Improvement in self-reported health (gain in EQ VAS). The value is calculated by subtracting the preoperative EQ VAS-value from the EQ VAS one year after the operation (operating year 2018–2019).
- Adverse event within 90 days for the last three year-period (operating year 2016–2018). For definitions see the chapter on adverse events. The indicator also encompasses mortality.
- Completeness rate at the individual level according to the latest linkage with the Patient Register of the National Board of Health and Welfare (operating year 2018).
- Reoperation within two years. Reports all forms of reoperation within two years after primary operation and during the last four year-period (operating years 2016–2019).
- Five-year implant survival. Implant survival after five years with Kaplan-Meier statistics (operating years 2014–2019).
- Ten-year implant survival. The same variable as above but with a longer duration of follow-up (operating years 2009–2019).

Linked to the value compass for each unit is a graphic representation of the unit's case mix. This part is constructed the same way as the value compass and includes some of the patient-related variables that have proven to be associated with patient-reported outcome and long-term result regarding the need for revision. The larger the area of the green surface is in this figure, the better patient profile for the unit in question. For the standard patient there are no case-mix compasses since this is adjusted for via the selection. Variables in the case-mix compasses:

- Charnley classification. Patients with Charnley class A or B (without other diseases and/or problems from other joints than the hips that affect the walking ability of the patient) has a lower risk of complications and a better patient-reported outcome.
- The proportion of primary osteoarthritis. Compared with other underlying joint diseases, primary osteoarthritis is associated with a lower risk for complications and a better patient-reported outcome.
- The proportion of patients 60 years old or more. The risk of being operated is lower for individuals over 60 years of age.
- The proportion of women. The risk of being reoperated is lower for women.

13.2 Quality indicators after arthroplasty as treatment of hip fracture

The value compasses, a reflection of the units' results, include total arthroplasties and hemiarthroplasties due to hip fractures. and consist of five variables (compass directions). The fracture compasses are limited by the fact that most fracture patients are not part of the register's PROM-programme.

We encourage each unit to compare itself with the national mean and identify any problem areas that may prompt local improvement work. The results must be seen in their context however, where many factors are influencing the outcome. The value compass could be regarded as a balanced scorecard. The larger the area, the better the total multidimensional result for each unit.

We have chosen somewhat different result variables for fracture-related arthroplasties compared to those for elective total arthroplasties. The observational times for reoperation and implant

survival are shorter since individuals with a hip fracture have a shorter remaining lifetime due to high age and diseases. Most reoperations take place within a few months of the fracture and long-term complications are rare.

Result variables in the value compasses for fracture patients:

- Completeness rate at the individual level for hemiarthroplasties according to the latest linkage analysis with the Patient Register (2018).
- Adverse events within 90 days. Adverse events according to the latest linkage analysis with the Patient Register. These are defined as cardio- and cerebrovascular conditions, thromboembolic disease, pneumonia, ulcus and urinary tract infection if these have led to readmission or death. Moreover, all types of reoperation of the hip are included.
- 90-day mortality. In international literature this variable is used to illustrate mortality after hip arthroplasty.
- Reoperation within six months. All open, subsequent procedures on the hip in question.
- Implant survival after one year with Kaplan-Meier statistics.

The selection of fracture patients that undergo an arthroplasty (instead of an internal fixation) may differ between different units, and each unit's case-mix must be read in parallel with its value compass. The layout of the case-mix compass is constructed the same way as the value compass and includes the variables that have proven to be important demographical parameters for the risk of reoperation and to some extent mortality. The larger the surface area of this figure is, the better the patient profile is for the unit in question. Variables in the case-mix compasses for fracture patients:

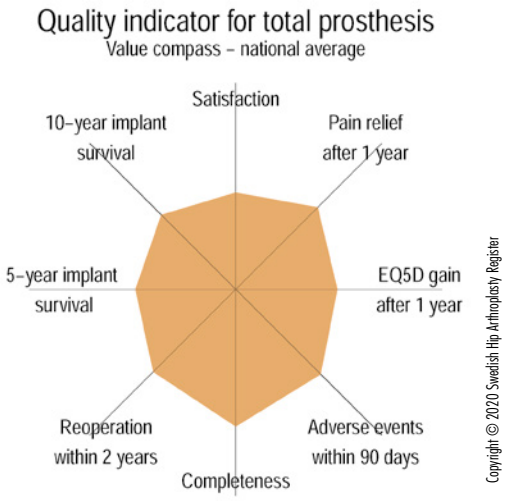
- The proportion of patients 85 years of age or older. A high age protects against reoperation and revision. The reasons may be several; a reduced activity decreases the risk for erosion for example and probably also for dislocation. The few remaining years of the lifetime means that the time is not enough for loosening to develop. On the other hand, the "risk-reduction" we see may be due to that an older individual has a complication after all but is dissuaded from reoperation or revision for medical reasons. Units that operate many patients over 85 years of age have a better result regarding reoperation/revision, but a worse result regarding mortality.
- The proportion of acute fractures (diagnosis S72.0). The more patients the unit operate with the diagnosis acute fracture, the better the long-term result of the unit according to the register's regression analysis of the database.
- The proportion of patients that do not have dementia. In the figure the unit's proportion of patients that are deemed as cognitively intact is given. Patients with dementia have a higher mortality after hip fracture. If a unit has a large proportion of patients that do not have dementia, their mortality numbers are improved.
- The proportion of women. Women have a better result than men in general regarding the need of reoperation/revision, especially depending on a lower risk for periprosthetic fracture.

Discussion

The value compasses for fracture patients are surprisingly similar to those of last year for most hospitals. Well-functioning units continue to have a good outcome, while other units drag one or several "problem-directions" with them into and through 2019. Something to emphasise, compared with 2018, is that Capio S:t Göran, Gällivare, Jönköping, Norrtälje and Sunderbyn have improved their value compasses. Nyköping has a "zero" on the completeness rate axis since the completeness rate is based on the hemiarthroplasty-registration, Nyköping only carries out total arthroplasties and its completeness rate should therefore not be viewed as a problem. Likewise, Karolinska/Solna's value compass should be viewed in the light of the very special case-mix that the hospital has.

In aged hip fracture patients who are also ill, non-surgical treatment of complications is probably more common than in osteoarthritis patients. For both infections and dislocations, the treatment could in certain circumstances be aimed at the symptoms, thus avoiding surgery, e.g. if a new operation were to be associated with substantial medical risks. Non-surgical treatment may therefore be appropriate, and when assessing the value compasses, this relationship ought to be considered. To a certain limit, a higher incidence of reoperations and revisions, on the other hand, may indicate that a more active approach regarding complications has been adopted.

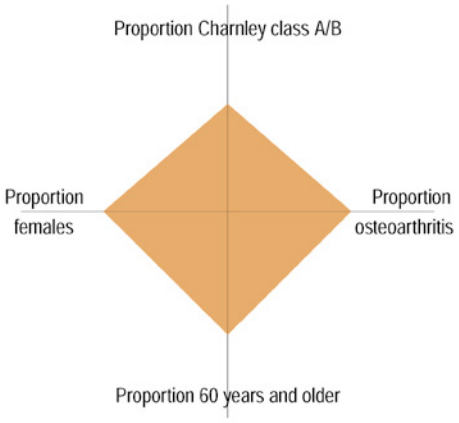
Units with a consistently poor or worsening result should analyse the different factors that affect the clinical result. Then, measures should be taken. The register gladly passes on the experience that exists after corresponding analyses at other hospitals and can also contribute with practical help.

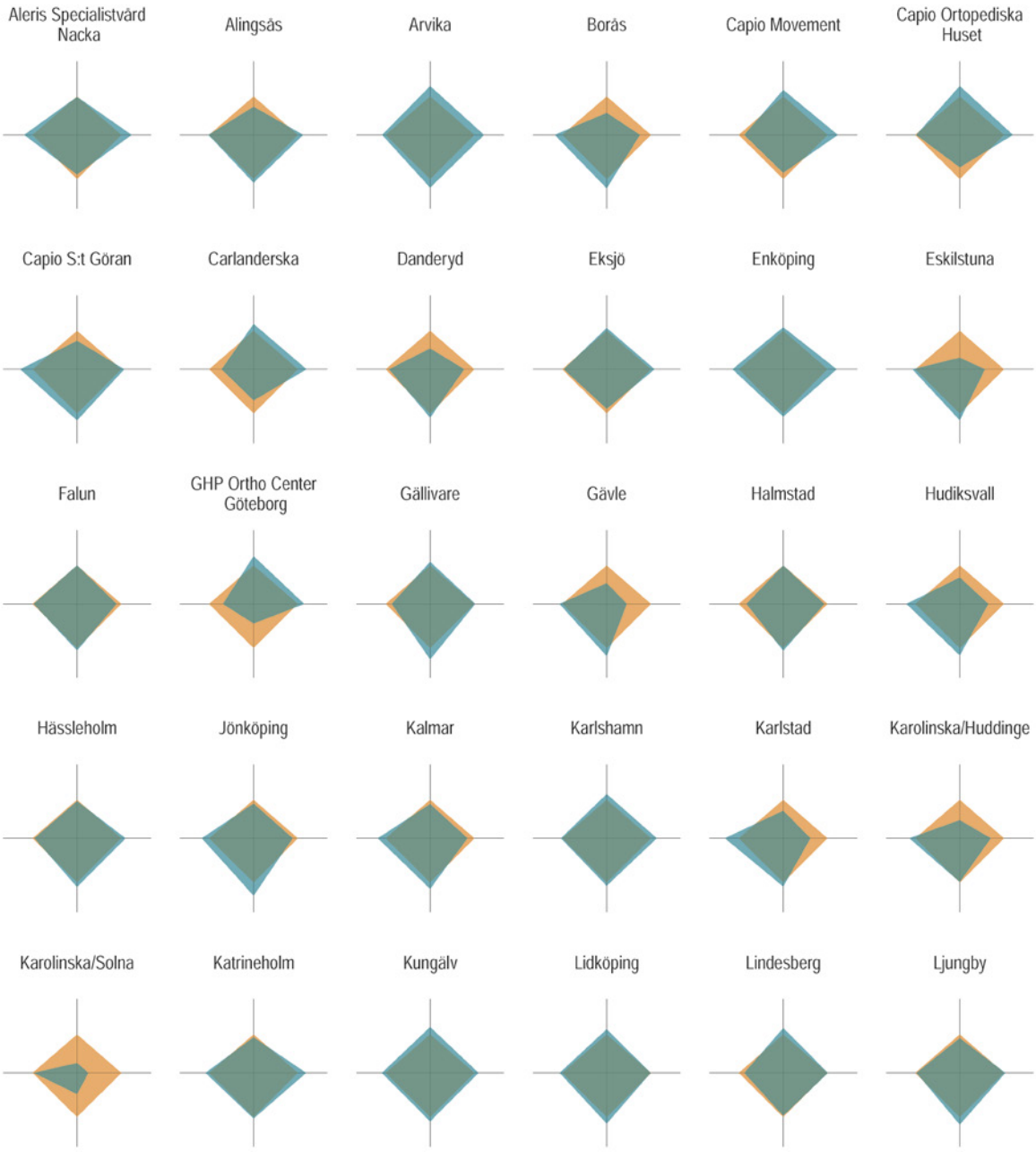


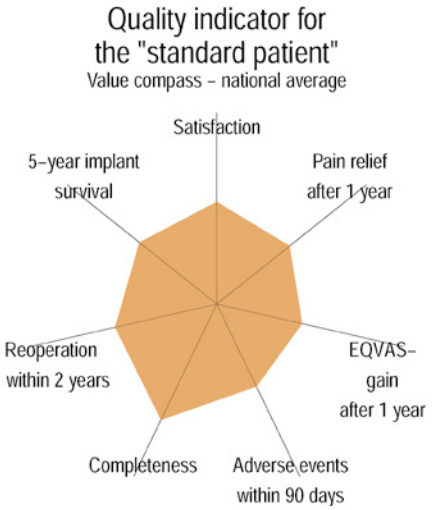
*Since these units do not have any reported operations to the Patient Register of the National Board of Health and Welfare, a completeness rate cannot be calculated.

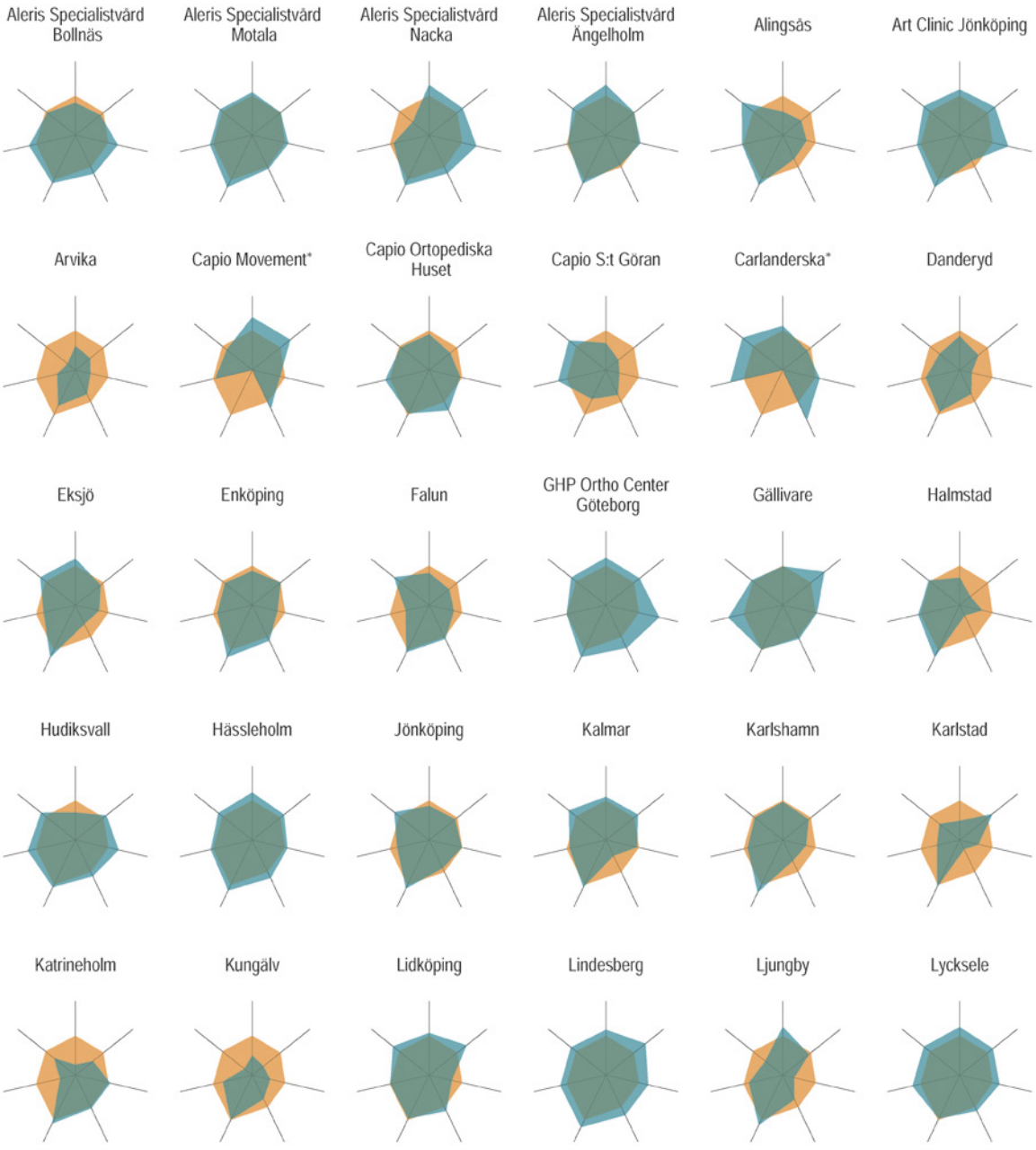
Case–mix–profile for total prosthesis

National average

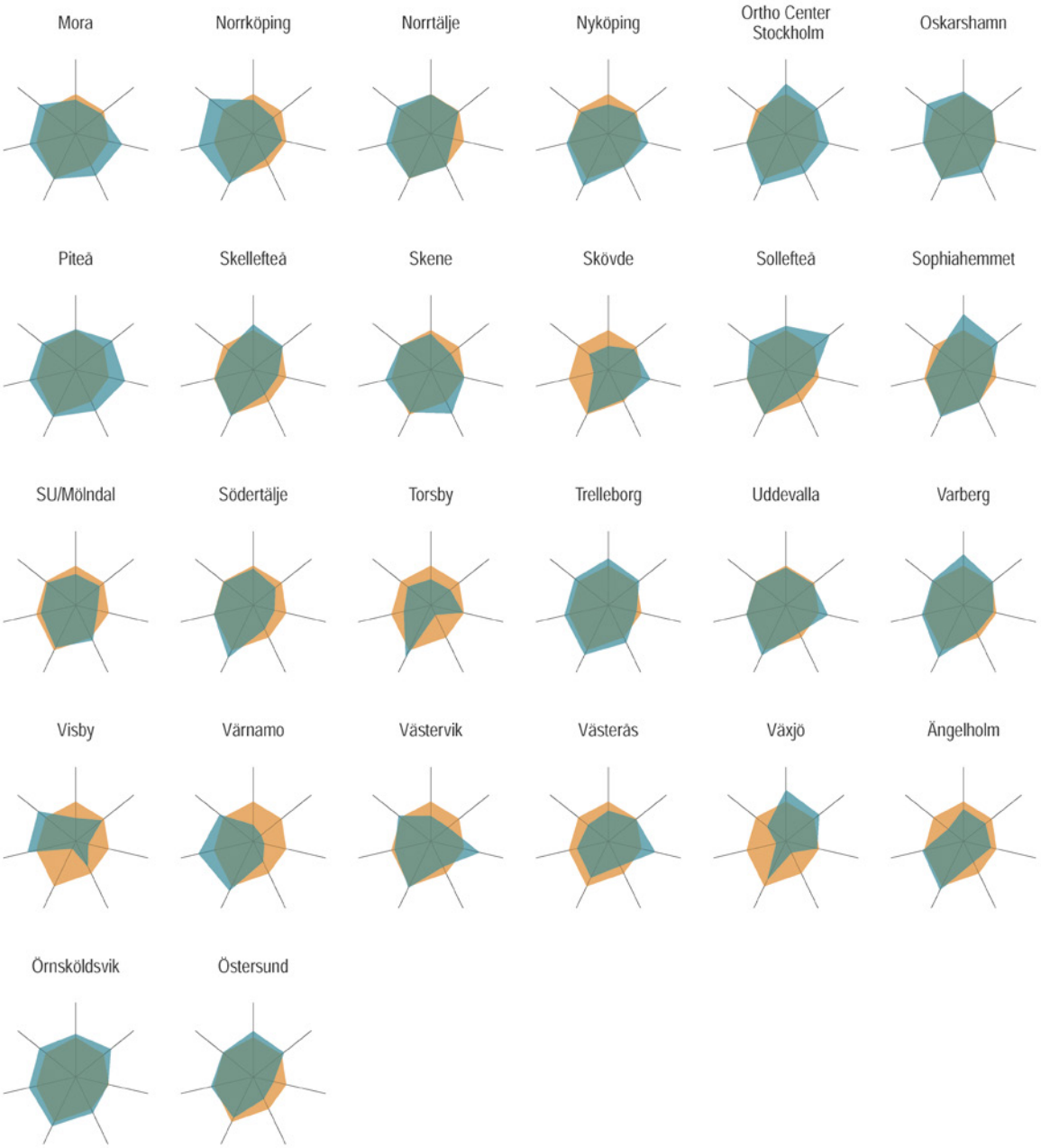






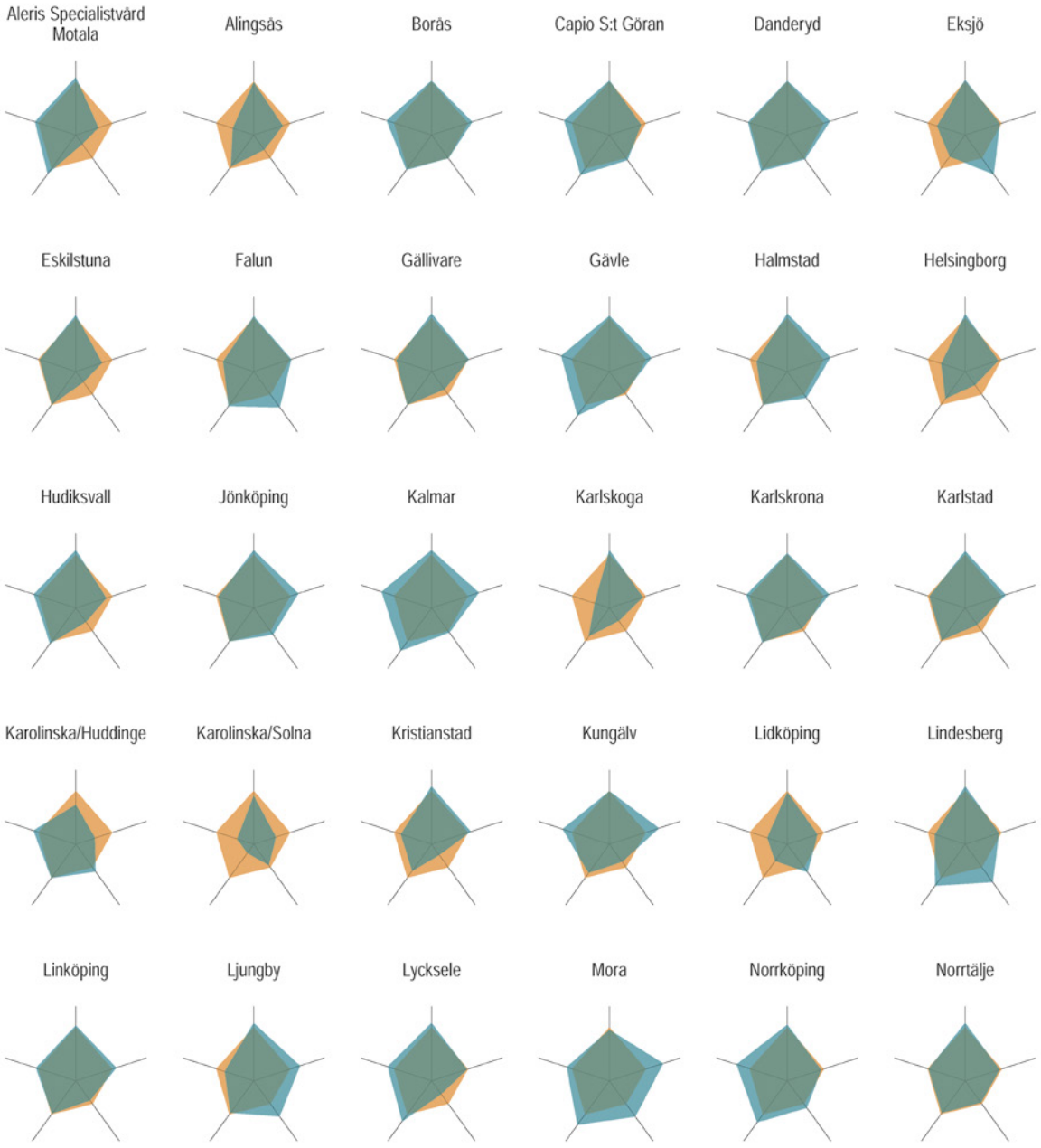


*Since these units do not have any reported operations to the Patient Register at the National Board of Health and Welfare, a completeness rate cannot be given.



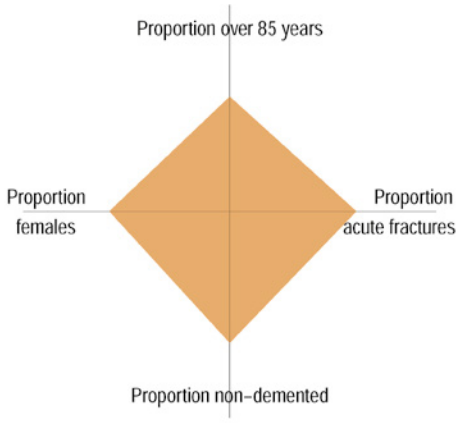
Quality indicator for hip fracture patients

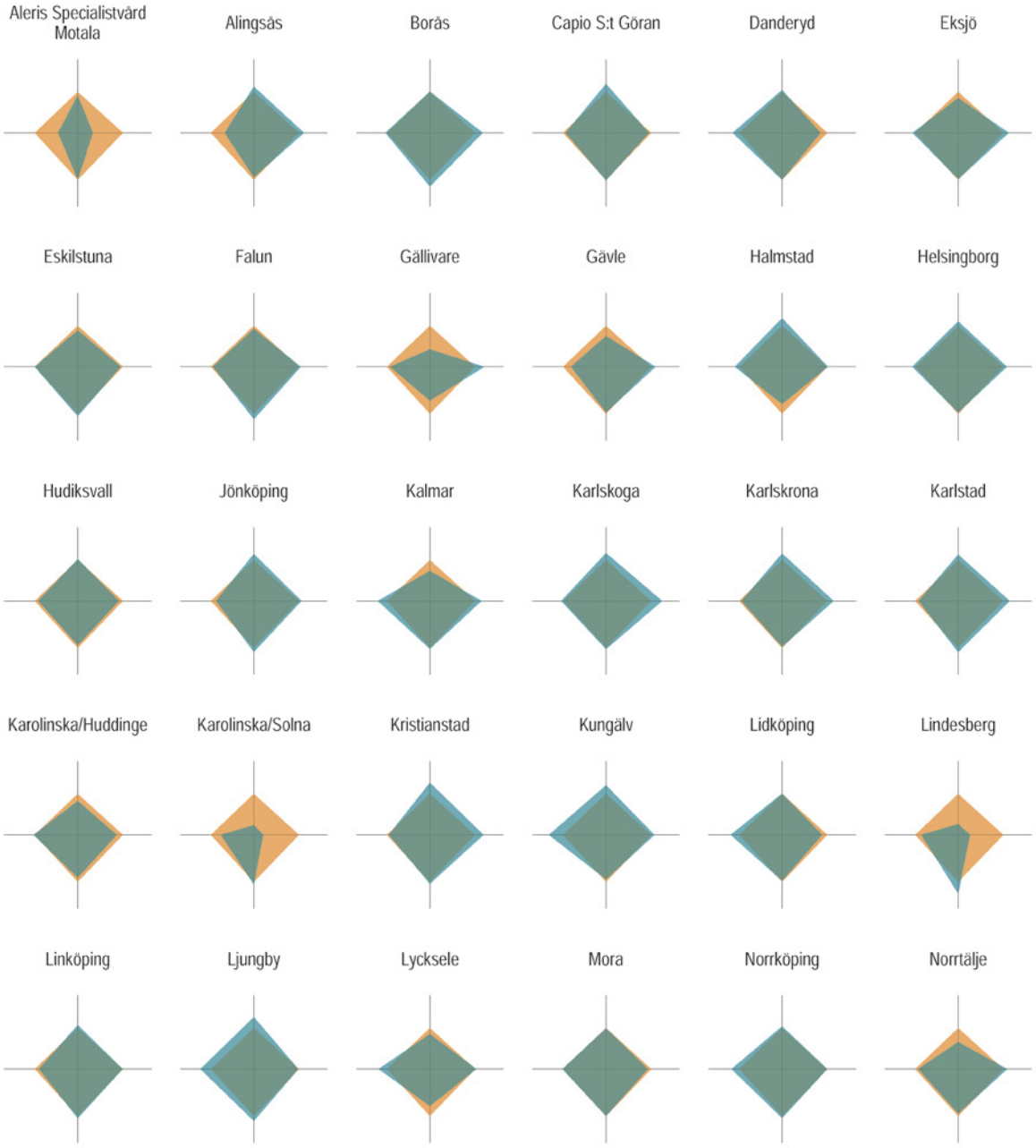
Value compass – national average

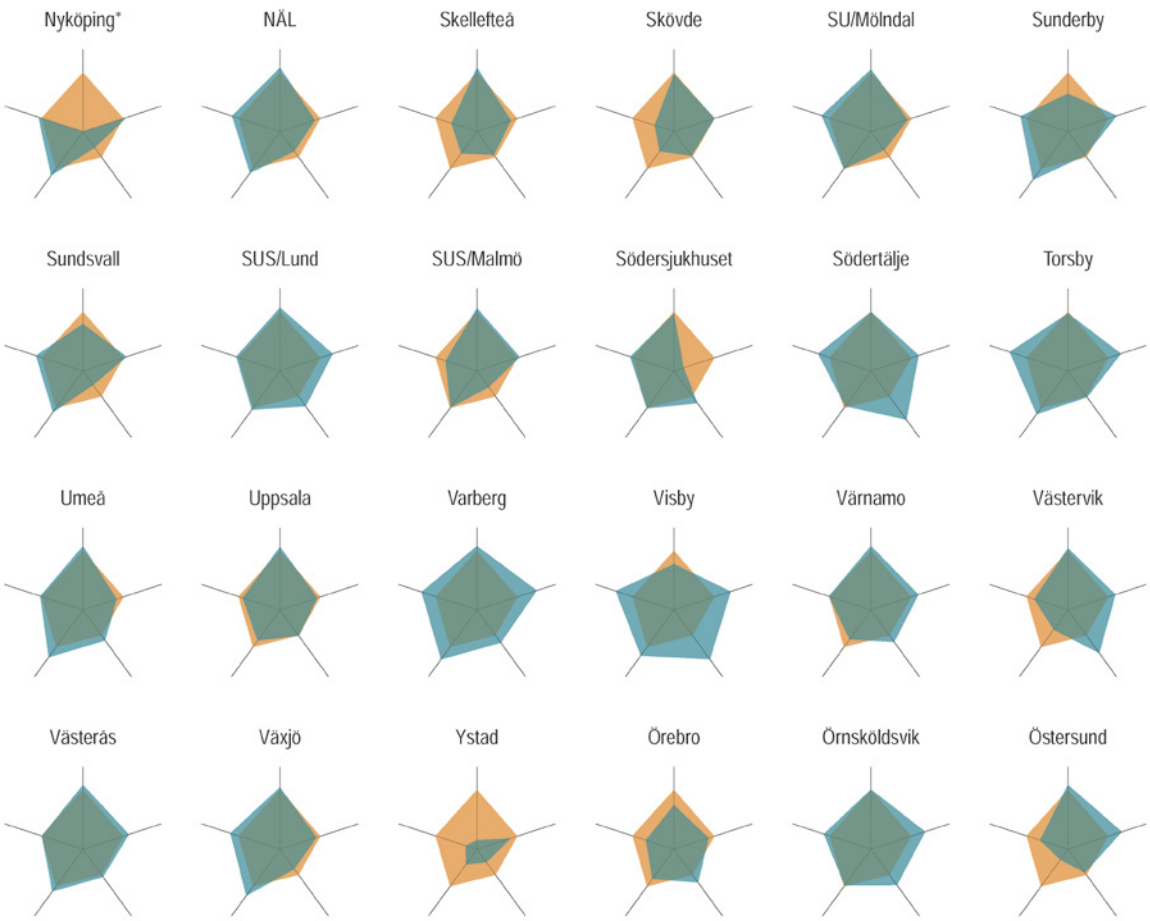


Case-mix-profile for hip fracture patients

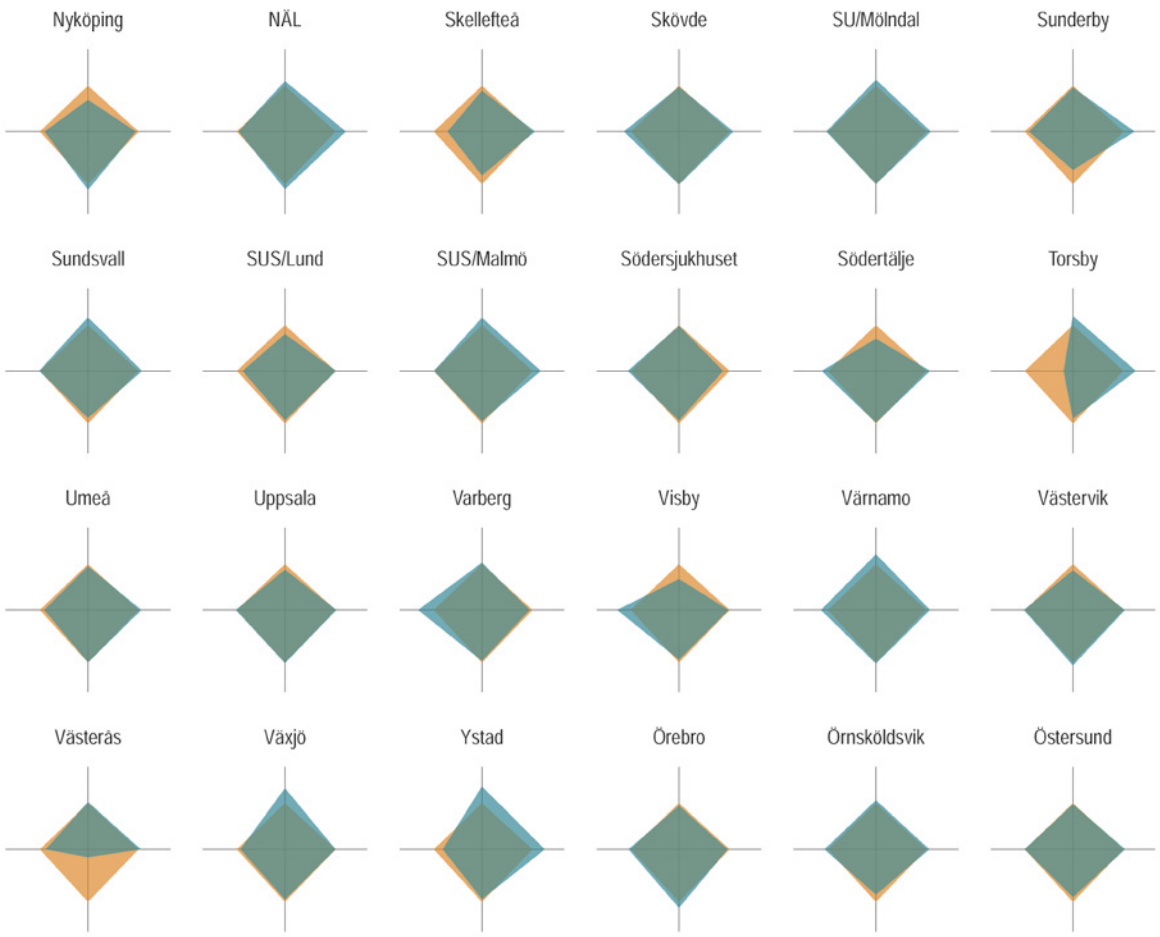
National average







* Units that mainly use total prostheses and therefore lack completeness rate for hemi prostheses, which is what the axis shows here.



14. The Swedish Hip Arthroplasty Register and clinical research

Author: Ola Rolfson

The state has made an agreement with the Swedish Association of Local Authorities and Regions (SALAR) regarding funding of the quality registers. The vision is that the Swedish National Quality Register should contribute to saving lives and achieve equal health, and be used actively for follow-up, learning, quality development, improvement, research, and guidance. The aim is that quality registers should be an integrated part of a national system for knowledge management and follow-up of Swedish healthcare. National quality registers should be used for improvement initiatives within care and welfare and as a source of knowledge for clinical research, including collaboration with the life science sector. In addition to cover operational costs, grants from SALAR and the state should be used for quality assurance and quality improvement. Register-based research should be funded from other sources.

What is research and what is register work?

The limit for what can be viewed on as clinical research and evaluation of the healthcare and improvement work is unclear. All register-analysis aimed at providing feedback on results and improvement work is based on scientific methods. Each year, the annual report contains specific in-depth analyses, validation studies and linkage of data with other health data registries, which are carried out according to well-established register-research methods. A continuous work effort is carried out within the register to improve and develop the methods used in the register work according to scientific principles. Even though the central funding is not intended for research, SALAR and Agency for Health and Care Services continuously evaluate the research activity of the registries. A high research activity is a criterion for granting a register the highest level of certification.

30 dissertations from the Swedish Hip Arthroplasty Register

We have conducted strategic work within the register to improve the infrastructure with the aim of increasing and strengthening the research activity. This has been successful, which among other things is noticeable through the 22 PhD-students that are affiliated with the register. The PhD-students base parts of or the whole dissertation on data from the Swedish Hip Arthroplasty Register and represent seven Swedish universities (Uppsala University, Lund University, Gothenburg University, Umeå University, Linköping University, the Karolinska Institute, and Örebro University. During 2019, 41 research papers were published based on data from the register and we held more than 70 presentations at national and international meetings. Since 1986, when Lennart Ahnfeldt defended the first register-based hip arthroplasty thesis, an additional 29 PhD-students have defended their thesis based on data from the register and under the supervision of co-workers of the register. A strong contributing factor to the continuous increase of research-activity is that the register has several statisticians working with the register.

Linkage studies

Another explanation for the increase in research activity is the use of other health data registries to a greater extent in the research. By using personal identity number, register data can be linked with data from Statistics Sweden, regional patient registries and health data registries of the National Board of Health and Welfare and offer unique research opportunities. In 2016, we published a description of the process of linking data from the National Board of Health and Welfare, Statistics Sweden, and the Hip Arthroplasty Register (Cnudde et al, BMC Musculoskelet Disord. 2016 Oct 4;17(1):414). An updated research database includes all patients who underwent surgery up to 2016. In an ongoing research project, we are linking data from the Swedish Hip Arthroplasty Register, the Swedish Knee Arthroplasty Register, the National Diabetes Register and the BOA-register with the longitudinal integration database of health insurance and labour market studies and the health data registries of the National Board of Health and Welfare (Dell'Isola et al. BMJ Open. 2019 Dec 17;9(12):e032923). The main goal of the project is to study how diabetes affects the result of non-surgical and surgical treatments of osteoarthritis and how non-surgical and surgical treatments of osteoarthritis affect diabetes control.

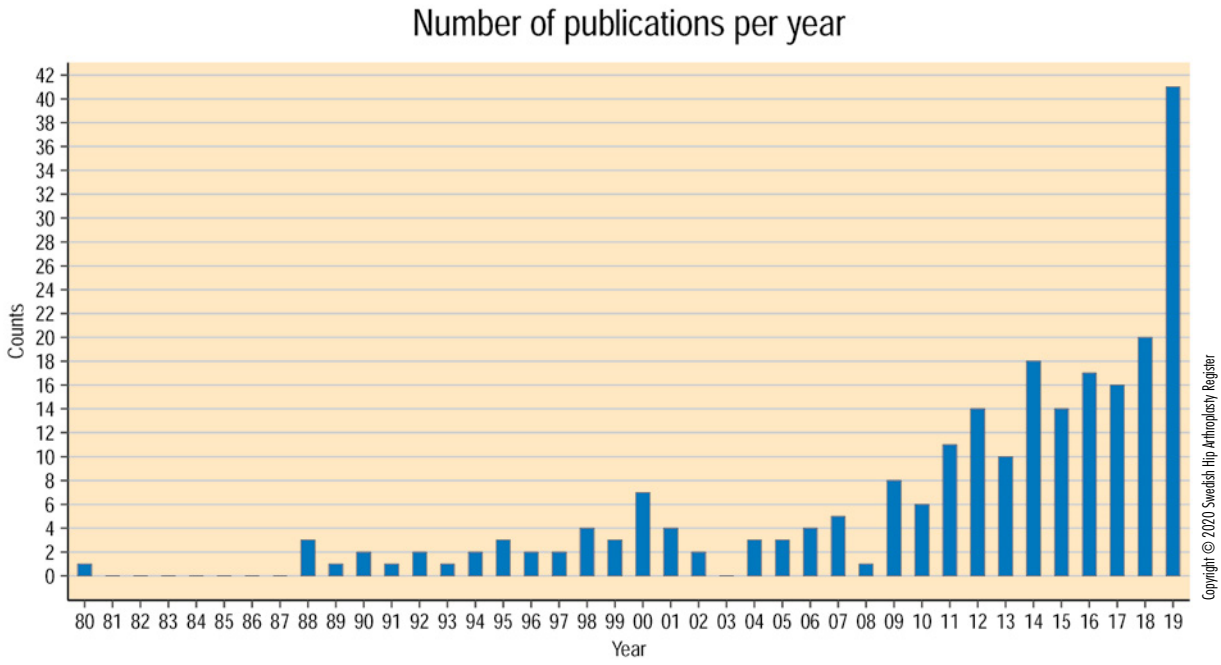
Why is observational research needed?

Register-studies and randomised clinical trials (RCTs) complement each other. Research within the field of arthroplasty requires a long follow-up period and a large number of patients. Several important outcome parameters (reoperations, implant survival and mortality) are relatively rare. This makes register-studies especially suitable in arthroplasty research. 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 provides a fair view on the performance of a certain treatment in routine hospital care of the normal population.
- Regardless if exposure or outcome is studied, a register-study, due to size and long follow-up period, makes it is possible to study events that seldom occur.
- 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 conducted at a low cost.
- Continuous longitudinal collection of data makes it possible to analyse changes in patient demography, treatment and results over time.

What is required in order to use register data for research purposes?

All register-based research requires approval from the Swedish Ethical Review Committee. All information in the register is



considered as part of the public domain but is protected by the Public Access to Information and Secrecy Act. The register director has, by the central data controller of the Västra Götaland-region, been delegated the responsibility of reviewing confidentiality aspects related to data requests. Forms for data requests can be downloaded from Registercentrum Västra Götalands website. https://registercentrum.se/forskning/

All research projects are documented in the register's project database and are published on the register's website. If one wants to discuss research projects, we recommend that the register director is contacted.

The register management team is open to suggestions, ideas and discussion on collaboration in new register-studies.

All tools are available at the SODA

In order to ensure maximum data security, all data used in research is accessed via a server (the SODA-server = Secure Online Data Access). Using this server, the user has access to a virtual computer by two factor authentication. The virtual computer contains project specific databases, common statistical software, the Office suite and other software.

Research meeting

Since 2012, the register hosts a two-day research meeting in January each year. All PhD students, supervisors and other researchers contributing to the registry's work are invited. Both general as well as specific research questions are discussed in a workshop format. This year's meeting (2020) had around 50 participants and was arranged together with the Swedish Knee Arthroplasty Register, the Swedish Fracture Register and the BOA-register. Researchers and PhD-students from all the other quality registries of the musculoskeletal diseases were invited. All PhD-students held short presentations on their projects and received feedback.

PhD defences in 2019

2019–06–13
International Outcomes of Total Hip Arthroplasty.
Elizabeth Walton Paxton

2019–05–16
Adverse events following surgery of the hip.
Martin Magnéli

2019–04–12
The Uncemented Cup in Total Hip Arthroplasty: stability, Wear and Osteolysis.
Volker Otten

PhD defences in 2020 (up to and including June)

2020–05–08
Dislocation after hip fracture related arthroplasty – Incidence, risk factors and prevention.
Ammar Jobory

2020–05–08
Fast-track programs in total hip and knee replacement at Swedish hospitals – influences on safety, outcome and patients' experiences.
Urban Berg

2020–03–27
Outcomes following primary total hip arthroplasty. With focus on the surgeon & surgeons' perceptions about feedback.
Per Jolbäck

2020–03–20
Periprosthetic femoral fracture after total hip replacement. Incidence, risk factors, and treatment
Georgios Chatziagorou

The databases of the register are also well-suited for research work during specialist training, degree projects within the medical programme and other masters' theses. Over the last five years, several such projects have been conducted and many of them are summarised in the annual reports.

Many researchers contribute to the register activities

Within the register management team and the steering committee there are senior researchers who are supervisors and co-supervisors for PhD-students that are affiliated to the register. The group conducts wide-ranging research within the field. There are ongoing studies on different implants and fixation types, epidemiology, health economics, equal care, hip fractures and arthroplasty, periprosthetic fractures, revisional surgery, statistical methodology and patient-reported outcome following an arthroplasty. The group includes:

Johan Kärrholm, Göteborg
Cecilia Rogmark, Malmö
Ola Rolfson, Göteborg
Henrik Malchau, Göteborg
Maziar Mohaddes, Göteborg
Hans Lindahl, Lidköping
Leif Dahlberg, Lund
André Stark, Stockholm
Per Wretenberg, Örebro
Nils Hailer, Uppsala
Rüdiger Weiss, Stockholm
Olof Sköldenberg, Stockholm
Max Gordon, Stockholm
Kjell G Nilsson, Umeå
Arkan Sayed Noor, Umeå
Sebastian Mukka, Umeå
Annette W-Dahl, Lund
Martin Sundberg, Lund
Otto Robertsson, Lund
Harald Brismar, Stockholm
Clas Rehnberg, Stockholm
Viktor Lindgren, Stockholm
Anne Garland, Visby
John Timperley, Exeter, England
Ashley Blom, Bristol, England
Stephen Graves, Adelaide, Australia
Liz Paxton, San Diego, USA
Peter Cnudde, Llanelli, Wales
Anne Lübekke, Geneva, Switzerland
Li Felländer-Tsai, Stockholm
Håkan Hedlund, Visby
Kristina Burström, Stockholm
Volker Otten, Umeå
Susanne Hansson, Malmö
Szilard Nemes, Göteborg
Jörg Schilcher, Linköping
Ted Eneqvist, Stockholm
Michael Möller, Göteborg
Anders Troelsen, Copenhagen, Denmark

The NARA-group with representatives from the knee and hip arthroplasty registries in Finland, Norway and Denmark.

PhD-students

On the back-cover of the annual report there is a list of PhD-students that base whole or parts of their dissertation on data from register.

International research collaboration

The register is part of NARA (Nordic Arthroplasty Register Association), which is a register research collaboration between Finland, Norway, Denmark and Sweden. NARA was founded in 2007 and a common database is created each year. The group has published close to 40 research papers and additional manuscripts are in progress. The NARA database is available to Swedish PhD students.

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16. Thank you to contact secretaries and contact doctors

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