Akademiska sjukhuset
Alingsås
ArtClinic Göteborg
ArtClinic Jönköping
Arvika
Bollnäs
Borås
Capio Artro Clinic
Carlanderska
Danderyd
Eksjö
Elisabethkliniken
Enköping
Eskilstuna
Falun
Gällivare
Gävle
Halmstad
Halmstad Capio Movement
Helsingborg
Huddinge
Hudiksvall
Hässleholm
Jönköping
Kalmar
Karlshamn
Karlskoga
Karlstad
Karolinska
Kullbergska
Kungälv
Lidköping
Lindesberg
Ljungby
Luleå-Hermelinen
Lund
Lycksele
Mora
Motala
Mölndal
Nacka
Norrköping
Norrtälje
Nyköping
OrthoCenter IFK kliniken
OrthoCenter Stockholm
Ortopediska huset
Oskarshamn
Piteå
S:t Göran
Sabbatsberg
Sahlgrenska
Skellefteå
Skene
Skövde
Sollefteå
Sophiahemmet
Sunderby
Sundsvall
Södersjukhuset
Södertälje
Torsby
Trelleborg
Uddevalla
Umeå
Varberg
Visby
Värnamo
Västervik
Västerås
Växjö
Ängelholm
Ängelholm - Aleris
Örebro
Örnsköldsvik
Östersund

Annual Report 2020

Swedish Knee Arthroplasty Register

Lund University
Department of Clinical Sciences, Orthopedics
Skåne University Hospital, Lund
Sweden

Primary knee arthroplasties 1975-2019
Revision knee arthroplasties 1975-2018
Knee osteotomies 2013-2019

To our contact surgeons

It is with pride and joy that we present this annual report 2020, which in its format will be the last that the knee prosthesis register produces after several decades of reports. Undoubtedly, the reporting has resulted in substantial improvement in the quality of knee replacement surgery as well as societal savings in Sweden. We dare to say that thanks to our Knee Arthroplasty Register, the results after surgery are among the best in the world and this regardless of which clinic operates. The register has also been a model for other registers around the world. In recent years, we have also spent a lot of time and energy presenting data to professionals, patients and suppliers online, and it is gratifying that our websites seem to be quite popular. Our patient website (www.gangbar.se), which as of this year became common to the Knee and Hip registries, was most popular with just under 18,000 visits in the first half of 2020. This is a decrease compared to last year, which is understandable considering the start of the Covid-19 pandemic. The register website (www.knee.se) attracted almost 4,500 visitors during and the statistics webpage which was completed in 2017 and includes both perioperative- as well as PROM-data had 2,400 visits during the period. On the statistics webpage, it is possible to compare hospital results with that of counties/regions and the whole country while making selections that include different time periods, implant models and gender. The number of visitors and that the average visitor stayed on the webpage for 12 minutes indicates great interest in results from the register.

The EU is imposing new stricter rules concerning medical equipment in class 3 (covering knee implants). This means that it must be possible to identify part numbers and LOT (batch) numbers of implants in individual patients. The SKAR has for the last 20 years registered both LOT and part numbers for the implants inserted. This means that the SKAR can quickly identify a patient having an implant from a specific batch, in case it becomes necessary to perform additional clinical controls. That the SKAR has done this for 20 years shows its engagement concerning patient safety.

For the fifth year we account for adverse events that occurred within 90 days of the primary knee replacement. These events are based on ICD- and procedure codes registered when knee arthroplasty patients after their primary surgery are treated within the healthcare system. The codes to be used were decided on in cooperation with the National Patient Register of the National Board of Health and Welfare which performes the calculations.
Although there may be sources of error such as differences in coding procedures among the hospitals and counties, we are convinced that the data still yield useful information on how common adverse events are following knee arthroplasty surgery and may indicate where additional analyses and improvement measures are motivated.

Your dedicated work over the years with accurate reporting, focus on quality and sharing of the information is a prerequisite for the register having high coverage of reliable data that can be implemented into clinical practice.

The structure of the annual report is similar to that of last year with the first part summarizing the register procedures, the epidemiology, and general results.
The second part contains information on the data reported to the register in 2018 as well as analyses covering the 10-year period 2009-2018.
The third part concerns the osteotomy registry.
The fourth part is specifically prepared for each individual hospital. It is only delivered to the contact surgeon in charge on an USB-stick. It provides PDF files with compilations of what was reported by the unit for 2019 (sorted by ID and date of surgery). It is our hope that the compilations will be compared to other available hospital information in order to identify and correct any errors.
Additionally the USB stick contains the annual report, an Excel file with all the reported surgeries by the hospital, graphical presentation of the hospital revision rate as compared to that of the national average. As previously mentioned, it is important that the information is spread to your colleagues so it can be analyzed, discussed and used for initiating improvement efforts.
Again we use this opportunity to remind you that the registration is prospective and that a reported revision can only be included in the analyses if the primary procedure was reported previously according to normal routines. This means that if a primary operation is discovered only because of a revision at a later time, neither the primary operation nor the revision will be included in the analyses.

From the autumn of 2020, the Swedish Knee Arthroplasty Register will be merged with the Swedish Hip Arthroplasty Register to form the Swedish Arthroplasty Register. This implies that the routines for reporting to and from the register will change and that the register database will be located on the Västra Götaland's register platform "Stratum".
The plan at the time of writing is that the reporting to Lund will continue as usual for the rest of the year but will be phased into the new platform during next year. From 2021 the Arhtroplasty register will publish a joint report for both hip- and knee arthroplasties. As of 2020, the two registers have a joint steering group to facilitate this merger.

The register office in Lund would like to thank all contact surgeons, operation staff and secretaries for their important contribution throughout the years and ask you to carefully review and distribute the information we provide in this latest report in its current format.

Lund, September 1st, 2020.

On behalf of the Swedish Knee Arthroplasty Register

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CONTENT

Introduction

The beginning – In the early seventies, knee arthroplasty was an uncommon procedure restricted for those with severe disability. Little information was to be found in the literature while there was an abundant choice of implants which were continuously being modified. In this setting, the Swedish Orthopedic Association initiated a nationwide multicenter study in 1975, to prospectively monitor knee arthroplasty surgery. The orthopedic surgeons realized that it would be impossible for an individual surgeon to base his choice of optimal operative methods or implants on his own experience. The aim was to collect, analyze and render information that could warn against suboptimal techniques and implants.

Number of units – The vast improvement in quality of life for the majority of patients quickly made the surgery a success and the technique dispersed to more hospitals and surgeons. Since the start of the registration in 1975, participation has been voluntary. 24 units reported during the first year increasing to 51 in 1985 and to 82 in 1996. In the late nineties, the number of units diminished somewhat due to the merger of hospitals. In 2019, 72 orthopedic units reported to the register, i.e. all units that routinely performed knee arthroplasty surgery in Sweden.

Volumes – Since the registration started, there has been an exponential increase in the number of operations (see page 18). However, during 2013-15 the numbers diminished slightly to increase again after 2016. In 2019 16,929 primaries were reported, a 9.7% increase as compared to 2018. We consider it likely that the volumes will continue to increase as the incidence in Sweden still is lower than in countries such as USA and Germany (see page 19). Further, even without an additional increase in age specific incidence, the expected changes in the age distribution of the population will increase the demand for surgery.

Patient Reported Outcome – The SKAR began early evaluating PROMs and put in effort searching for the most relevant instrument for patients undergoing knee arthroplasty surgery which resulted in a thesis published in 2001. Recently there has been a renewed interest in PROMs by the authorities for the purpose of quality improvement. Thus, in 2008 the register started gathering PROM data from Skåne and since then, 29 units from other parts of the country have joined. Results can be found on the pages 68-77.

Registration of osteotomies – Osteotomies have been prospectively registered since 2013. This year the registration has a separate section on page 78.

Reporting to the register – The SKAR recommends that the form (see page 85) is filled out in the operation theater and that one set of the stickers found in the implant and cement packages are stuck on the backside. The form is then sent to the register office in Lund where the information is entered into the database. The hospitals are requested to send the forms to the registry at least once a month. In the case of revisions, a copy of the operation report and discharge letter is required. The majority of the units observe the recommendations.
The reason for not having introduced decentralized computer registration is that we consider it important that the registration is done in the operation room. This would call for improved computer solutions as well as a better flow of information from the implant distributors to the register in order to maintain an up-to-date part-number database. In our view, the paper-based system has at present essential advantages such as less workload at the surgical units, the most reliable information and fewer input errors. Further, during data entry, register staff can check part numbers on the attached implant labels against a local database and in the case of new numbers turning up, contact the distributors.
However, decentralized Internet data entering is used for PROMs. Those units that have decided to participate in the PROM project have an access to a specific Web application for this purpose.

Annual report – Each annual report accounts for primary arthroplasties reported during the previous year (in this report 2019). Analyses concerning the revision rate end one year earlier (2018). The reason for this is that only a few errors in the registration of revisions can have a large impact on the final result and an extra year allows for as complete and correct information as possible. As revisions are often complicated, the forms, discharge letters and operation reports have to be examined thoroughly. Supplementary information is often needed before the reason for and the type of revision is reasonably clear. It also happens that unit's send completing information after discovering, by examining the annual report and the accompanying lists, that their previous reporting had been

incomplete. The register is trying to improve the response times so that waiting an extra year will not be needed. However, this will demand an increased effort from the register staff as well as a quicker response from the hospitals when asked to complete their reporting or provide supplementary information.

10-year analyses – Some have wondered why the register most often accounts for a 10-year revision rate while the registration has been going on for more than 40 years. – There are several reasons: The main reason is that the interest usually focuses on relatively modern techniques and implants. Another reason is that survival analyses allow for inclusion of patients during the entire observation period. I.e. implants have been inserted in the beginning as well as in the end of the observation period. This implies that the first part of a revision (survival) curve includes operations performed both during the first and last part of the observation period. The end of the curve (to the right), only includes operations inserted during the first part of the period. The result is that the latter part of the curve represents older techniques and implants as well as mainly the younger patients (those more likely to live to the end of the observation period). In summary, this means that without special selections it is difficult to interpret curves that stretch over long time periods. A description of how the register compares implants can be found on page 16.

Cooperation – The Nordic countries cooperate through the framework of NARA (Nordic Arthroplasty Register Association) and have built a common database allowing for analyses of a combined dataset from Denmark, Norway, Sweden and Finland). The SKAR and the Australian Joint Replacement Registry also have common research projects. Further, the SKAR cooperates with other international organizations such as ISAR (International Society of Arthroplasty Registries) and OECD (Organisation for Economic Co-operation and Development) as well as with individual scientists in different countries. Besides collaborative projects resulting in interesting findings, they give the participants insight into each other´s methods for registration, selection, analyses and reporting. In turn this hopefully will result in the registers approaching each other so that it will be easier to compare their results in scientific papers and reports in the future.

The reporting form – Knee arthroplasty surgeries as well as osteotomies are reported on a very similar one page form that is used for both primaries and revisions (see page 85 and 89). One set of the stickers that are found in the packages for the parts, that are implanted in the patient (prosthesis, cement, osteotomy plates, bone substitute...) and which contain the part- and lot numbers, should be placed on the back of the form.

Data quality – In order to use register data for scientific studies and quality improvement, it is of greatest importance that the information found in the register is complete and valid. A description of how the register validates the information can be found on pages 6-7.

The benefit of the register for health care –
The register started as a research project and during the first 5 years it was supported by grants from the Medical Research Council and for the next 6 years by a variety of research grants. After a period of financial support by the National Board of Health and Welfare, the Swedish Association of Local Authorities and Regions became responsible for distribution of funds to the National Quality registers.

The annual report has been produced for years in order to inform decision makers, the profession, patients and other interested about the knee arthroplasty surgery with respect to demography, epidemiology, processes and outcome. The aim has been to provide ground for informed decisions which again have been reflected in a clear and sound improvement of quality.

The Office for the National Quality Registers announced in July 2017 that the annual report first and foremost was to describe the benefit of the register for the health care and how the register can be used to improve the healthcare. This information can be found on pages 8-9.

Unfortunately, the authorities have also reduced the funding of the registry by more than 30% since 2016. This has already affected the register and has among other things contributed to the decision to join the Swedish knee and hip registers. Thus, the worlds first national arthroplasty register will cease to exist as a indipendent unit.

Definitions

Revision is defined as a new operation in a previously resurfaced knee in which one or more of the components are exchanged, removed or added (incl. arthrodesis or amputation). This implies that soft tissue operations such as arthroscopy and lateral release are not considered revisions. The reason for this stringent definition is that not all surgeons consider minor surgeries to be related to the arthroplasty or be a complication why reporting of such procedures is inconsequent.

TKA (Total or Tricompartmental Knee Arthroplasty) is defined as a knee arthroplasty in which the femoral component has a flange and thus all three compartments of the knee are affected. Even in cases where a patellar button is absent, the flange resurfaces half of the femoropatellar compartment and the arthroplasty is still considered to be a TKA.

Bicompartmental arthroplasty (historical) uses two components, one on the femoral and one on the tibial side to resurface both the femorotibial compartments (medial and lateral) but not the femoropatellar compartment. Thus, this implant has no femoral flange and is not meant to allow for resurfacing of the patella.

UKA (Unicompartmental Knee Arthroplasty) implies an arthroplasty that separately resurfaces the medial or lateral femorotibial compartment. (med. UKA or lat. UKA). If 2 UKA implants are used to resurface both femorotibial compartments the arthroplasty is named bilateral UKA.

Patello-femoral arthroplasty is an arthroplasty which resurfaces the femoropatellar compartment. Even if this arthroplasty is unicompartmental by definition, it is accounted for separately.

Partial Replacement Knee Arthroplasty (PRKA) are implants (e.g. buttons) that only replace a part of a knee compartment.

Hinged implants. As the name implies these implants only allow for flexion and extension through a fixed axis.

Linked implants (Linked/Rotating hinge) have a mechanical coupling between the femoral and tibial components allowing for flexion and extension as well as for a varying amount of rotation.

Stabilized implants. Even if the hinges and the linked implants are extremely stabilizing, the term stabilized implants is used for a group of prostheses that are a kind of TKA but use the form of the femoral and tibial components to restrict movement in valgus, varus and rotation. The posterior cruciate sacrificing type most often has an eminence in the middle part of the tibial polyethylene that can be contained by a box in the femoral component that lies between the medial and lateral sliding surfaces. By a camshaft-like property, the femoral component is forced to slide back during flexion, which simulates the effect of the posterior cruciate ligament. The fit between polyethylene and metal is such that it allows for some rotation. In so-called super stabilized implants the congruency has been increased by making the eminence larger with a total fit against the box of the femoral component thus, restricting the rotation and varus/valgus movement. Intermediary forms also occur. Stabilized implants are most often used for revision but also for the more difficult primary arthroplasties.

The ordinary TKA can be made somewhat more stabilized by increasing the congruency between the sliding surfaces. In these instances, there is a slight eminence of the polyethylene that fits against the femoral component. However, the term stabilized is only used for those implants that are more stabilized than usual by use of the above mentioned camshaft construction.

TKA-revision models are TKA that are mainly used for revisions or difficult primaries. These are typically stabilized implants that often are used with stems. Many have proper names making them easy to distinguish from common TKA's. However, due to the modularity of the modern TKA, a TKA brand may represent either a common TKA or a stabilized stemmed TKA depending on which components have been assembled. For the primary surgeries, this implies that some TKA brands are only used for standard cases while others also may be used for difficult primary cases. This can result in bias when comparing models. In order to make comparison of revision rates after primary surgery as fair as possible, the SKAR classifies certain TKA as being "revision models" and excludes them from the analyses. Accordingly, revision models with identifiable names are excluded (e.g. NexGen-LCCK, AGC-Dual Articular and F/S-Revision) as well as those modular TKA's that have been inserted using extra-long stems (longer than 5 cm).

For those interested there is an excellent article on the history and the developement of the TKA; Robinson RP; The Early Innovators of Today's Resurfacing Condylar Knees. J of Arthroplasty 2005 (suppl 1); 20: 1.

Completeness concerning primaries reported in 2018

It is difficult to estimate the proportion of knee arthroplasties performed in Sweden that are reported to the SKAR. However, we can compare the SKAR with the National Patient Register (NPR), an inpatient register, based on ICD- and surgical coding although it complicates the comparison that the registers focus on different variables (operations vs. admissions) and that laterality is inconsequently recorded in the NPR.

A further issue is when surgeries are reported to the NPR not as being performed at a specific hospital but by an administrative body containing many hospitals.

The SKAR completeness was estimated by comparing it to the NPR and assuming that the true number of admissions is the combined number of admissions in both registers. There is a possibility for patients having knee arthroplasty surgery without being registered in any of the registers but they are presumably few. Using this method, we found that the SKAR had captured 97.1% of all admissions and the NPR 91.9%.

Below is a list of the units containing the combined number of operations from both registers as well as the completeness for each of the hospitals. When the completeness is less than 96%, the percentages are marked in red. Units with low coverage are encouraged to investigate if they missed reporting any surgeries or if their surgical coding was erroneous.

Hospital 2018	Total Number	SKAR-percent	NPR percent
Akademiska	94	96,8	97,9
Alingsås	181	97,2	97,8
Art Clinic Göteborg	143	96,5	72,7
Art Clinic Jönköping	147	99,3	88,4
Arvika	190	97,4	97,4
Blekinge hospitals *	279	99,6	99,6
Bollnäs (Aleris)	380	96,6	96,1
Capio Artr Clin / Sophiahem.	583	97,8	89,7
Carlanderska	323	100,0	0,0
Danderyd	191	96,9	97,4
Eksjö Högland	294	99,3	99,0
Elisabeth hospital	13	100,0	100,0
Enköping	384	99,2	99,2
Eskilstuna-Mälar hosp.	85	95,3	97,6
Falun	171	99,4	99,4
Gällivare	91	96,7	96,7
Gävle	76	98,7	89,5
Halland hospitals **	20	0,0	100,0
Halmstad	205	100,0	98,0
Halmstad Capio Movement	467	100,0	0,2
Helsingborg	18	88,9	100,0
Huddinge	115	93,9	99,1
Hudiksvall	62	98,4	98,4
Hässleholm	770	98,4	98,7
Kalmar	90	95,6	100,0
Karlskoga	7	100,0	100,0
Karlstad	108	97,2	99,1
Karolinska Solna	66	83,3	97,0
Kullbergska	224	98,7	99,6
Kungälv	200	99,5	98,0
Ljungby	191	88,0	70,2
Luleå-Hermelinen	19	100,0	0,0
Lund	56	91,1	100,0
Lycksele	145	98,6	98,6
Mora	206	99,0	98,1

Hospital 2018	Total Number	SKAR-percent	NPR percent
Motala	669	97,0	99,6
Nacka	229	97,4	98,7
Norrköping-Vrinnevi	155	98,7	100,0
Norrtälje	171	95,9	100,0
NU-sjukvården ***	245	98,8	99,6
Nyköping	92	95,7	96,7
Ortho Center IFK-Clinic	172	98,3	98,8
Ortho Center Sthlm (Löw.)	685	98,5	96,6
Ortopediska Huset	681	97,8	97,9
Oskarshamn	376	99,5	99,2
Piteå	372	98,4	97,8
S:t Göran	486	95,5	96,3
Sahlgrenska ****	428	94,2	98,1
Skaraborg hospitals *****	198	96,5	98,0
Skellefteå	91	94,5	98,9
Sollefteå	198	76,3	98,5
Sundsvall	15	100,0	93,3
Södersjukhuset	234	97,0	99,6
Södertälje	150	96,7	99,3
Södra Älvsborgs hosp. ******	252	96,8	94,8
Torsby	125	97,6	100,0
Trelleborg	767	98,4	97,7
Umeå	143	96,5	96,5
Varberg**	176	100,0	98,3
Visby	125	92,0	96,0
Värnamo	213	97,7	98,6
Västervik	96	97,9	99,0
Västerås	205	93,7	93,2
Växjö	96	97,9	69,8
Ängelholm	251	96,4	98,4
Ängelholm Aleris	81	100,0	97,5
Örebro / Lindesberg	491	99,6	99,6
Örnsköldsvik	142	100,0	99,3
Östersund	187	95,2	97,9
Other institutions	14	7,1	100,0

* Blekinge hospitals is the combined name for the hospitals in Karlshamn and Karlskrona.
** Halland hospitals includes Halmstad and Varberg (which both are in the list) as well as Kungsbacka.
*** NU-Sjukvården includes Uddevalla and Norra Älvsborgs hospitals (NÄL).
**** Sahlgrenska also includes Mölndal and Östra.
***** Skaraborgs hospitals includes Lidköping, Skövde, Falköping and Mariestad.
****** Södra Älvsborgs hospitals includes Borås and Skene.

Validation of data quality

Background

The SKAR has been validated using a mail survey to patients (Robertsson et al. 1999) as well as by yearly comparisons against data in the National Patient Register (NPR) since 2007. All Swedish hospitals that routinely perform knee arthroplasty surgery report to the register and for several years the comparisons against the NPR have shown around 97% completeness (see previous page).

January 1st, 2009, the register added 13 new variables concerning operative technique, prophylactic treatment and additional data about the patient. Such information is difficult to validate by comparison to other registries and in order to judge the accuracy in the reporting it has to be validated at the reporting hospital by review of patient records. This is essential to discover problems that can be addressed by targeted improvement measures at the register or at the hospitals.

The aim

The aim of validating the data quality is to investigate the accuracy of the information in the register as compared to that in hospital records. This provides us with knowledge regarding the quality of the entered data and helps us assess if the information has the quality allowing for reliable statistical analyses and process measures.

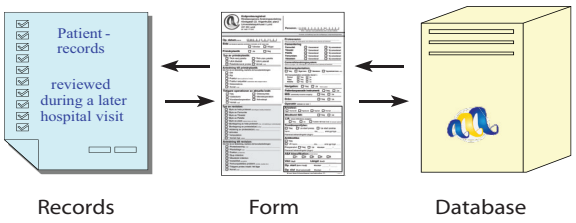
Method of validation at the hospital level

Nine hospitals that performed more than 50 arthroplasties a year were randomly selected from around the country. The hospitals were each asked to produce patient records (incl. op- and anesthesia reports) for 25 consecutive primary knee arthroplasty operations performed after March 1st 2010.

In this way it was possible to examine 225 surgeries. This was considered an adequate statistical selection as the data quality in the SKAR has been found to be good. Thus, by assuming the information for a variable to be correct in at least 90 percent of cases, 180 surgeries would allow for estimating the accuracy in the reporting within a reasonable confidence interval.

During the winter 2011/2012 the hospital was visited by staff from the SKAR that together with the local contact secretary/contact physician filled in a new reporting form using the information found in the hospital records.

The data of the new form filled in on location were compared to the original paper form that had been sent to SKAR as well as to what had been entered into the register database.



Patient data gathered during the hospital visit are compared to the form prevousoy sent to the register and again to the information that was entered into the register database.

Since this validation of the nine hospitals in 2010, 26 additional hospitals were validated 2012-2016. Depending on the resources of the register, the number of hospitals visited has varied from 3 to 8 a year. The approach has been the same as for the original validation with the exception that revisions and re-operations were also included.

Results

A summary of the validation results 2010-2016 is shown in the table on the next page. In all, information on 957 surgeries has been validated (900 primaries, 53 revisions and 4 re-operations). Only one revision was missing in the SKAR.

The majority of the hospitals had electronic medical records althogh paper records also existed. The majority of the anesthesia records were paper forms that had been scanned, although completely computerized anesthesia records existed.

Summary

No hospital visits for validation were performed during the last 3 years because of reduced financial resources. We hope to be able to resume the validation and continue until all the reporting units have been visited.

Besides being an important quality control, the validation visits have resulted in improved routines and understanding between register- and hospital staff which has facilitated cooperation and in turn improved the registration.

Summary of data validation 2010-2016

Overview of variables:	Difference between the original form and the SKAR database	Difference between the original form and hospital records	Information on reported data is not found
Number	**n (%)**	**n (%)**	**n (%)**
3,832 Essential data (date, hospital, laterality, diagnosis)	15 (<1)	27 (<1)	0 (0)
7,533 Part No and/or fixation	63 (<1)	8 (<1)	196 (2.6)
900 Information on previous surgery	5 (<1)	122 (13.6)	6 (<1)
4,770 Surgical variables	6 (<1)	105 (2.2)	27 (<1)
6,78 Prophylaxis	23 (<1)	318 (4.8)	48 (<1)
Specific variables:			
Number	**n (%)**	**n (%)**	**n (%)**
953 Planned length of AB treatment	3 (<1)	44 (4.7)	19 (2)
Number	**λ minutes**	**more than 15 min**	**n (%)**
953 Preop admin of AB (minutes)	0.5	170 (18.7)	46 (5.1)
Number	**λ days**	**more than 1 week**	**n (%)**
953 Planned thromboprhylaxis (days)	0.8	32 (3.5)	36 (3.9)
Number	**n (%)**	**n (%)**	**n (%)**
953 Type of anaesthesia	2 (<1)	43 (4.6)	16 (1.7)
Number	**λ cm/kg**	**λ cm/kg**	**n (%)**
953 Height	0.5	1.2	21 (2.2)
953 Weight	0.2	0.8	23 (2.5)
Number	**λ start (minutes)**	**λ start (minutes)**	**n (%)**
953 Surgery time	0	4.8	35 (3.8)
Number	**λ end (minutes)**	**λ end (minutes)**	**n (%)**
953 Surgery time	0	14.5	35 (3.8)
Number	**n (%)**	**n (%)**	**n (%)**
953 ASA	0	65 (7)	15 (1.6)

The value of the register for healthcare

Background

The Swedish knee project (The Swedish Knee Arthroplasty Register / SKAR) was initiated in 1974 by the Swedish Orthopedic Society and is the oldest Swedish quality register and the first national arthroplasty register in the world. It has been a model for registries in other countries and the international interest has resulted in the annual report being published in English for over 16 years and being downloaded more than 1,000 times a year. Scientific articles have been published and results of studies have been presented regularly at national and international meetings. The register cooperates with other registers, authorities and individual researchers, in and outside Sweden.

In 2019, almost 17,000 primary knee arthroplasties were performed to the cost of more than 1 billion SEK. Additionally almost 900 revisions were performed (approx. 200 million SEK). Using a fraction of this cost for quality control and improvement work within the field of knee arthroplasty surgery seems reasonable.

The basic value

The main function of the register has been to describe the knee arthroplasty surgery performed in the Swedish health care system. What patients are treated, what methods and implants are used, how the results are affected and how the patients experience their treatment. Without such information it is not possible for the profession or decision makers to realize that their own routines may not be the most optimal or cost-effective. The patients gain knowledge on what they can expect, why some methods are preferred and if and when it is appropriate to have surgery.

As the only orthopedic register, SKAR has for the last 19 years registered both Part- and Lot numbers for the inserted components. This means that SKAR can quickly identify a part from a specific production batch in a patient, in case this becomes necessary. As of 2020 the EU will have stricter rules concerning medical equipment in class 3 (covering knee implants) that requires that implants can be identified in patients this way. That the SKAR has done it for 19 years shows its engagement concerning patient safety.

The register contributes to new knowledge by performing research. E.g. a recently published study showing that the routinely used antibiotic for patients allergic to penicillin, does not seem to provide the same cover as the ordinary prophylaxis which may change praxis in Sweden with respect to the handling of patients that state they have reacted to penicillin (see publication list on page 93).

Feedback

Collecting data on its own does not contribute to better healthcare. The information has to be compiled, analyzed, summarized and reported.

The register reports in several ways; verbally, in print and on the internet. At annual meetings, contact surgeons from the participating hospitals are informed. Each unit receives their own data annually so they have the opportunity to check their own results. By publication of annual reports and scientific articles, as well as through participation in national and international conferences the register disseminates information to professionals, administrators and other interested bodies.

The register has a web-site (www.knee.se) where annual reports can be downloaded and a list of publications are available. There is also a secure server where the contact physicians at the participating units can access the information that their unit has delivered to the registry and which includes information on primaries having been revised elsewhere. The register website (www.knee.se) has an open statistics section in which it is possible to get information for the country as a whole as well as for individual counties and hospitals.

There is also a separate website for patients (www.gangbar.se) where they can find practical information before surgery on how they can prepare themselves, what they can expect and how they can exercise when they come home after surgery. During 2019, the website had 50,000 visits by 34,000 users which indicate that the patients are interested in the information provided.

Is the information from the registry used?

If not utilized, information on its own does not result in a better health care. That the register actually is being used at the hospitals providing data was shown 2011 in a survey among the contact surgeons. 73% stated that they had distributed information from the registry to their colleagues at the hospital and 53% stated that their presentations had in fact resulted in changes at their hospitals. This is gratifying because the register on its own cannot effectuate changes at the hospitals unless the changes are rooted locally. The survey also shows that the hospitals around the

country have trust in the results provided and the data reported to the registry.

Indirect signs of register data being used can be seen by how inferior implants have disappeared from the market, in the improved compliance to recommended prophylactic routines when the register started registering the prophylaxis as well as the diminishing revision rate over the years that has resulted in Sweden having the world lowest proportion of revisions.

Improvement projects

In order to use register data for improvement projects there have to be outcomes that are possible to improve. It may be about the hospital having more revisions than on average, poor compliance to recommended prophylactic routines, less or more use of certain methods than other hospitals or deviant patient reported outcome.

A printed version of the annual report is sent to all contact surgeons, heads of departments and academic representatives. In many cases the information in the annual report can be used directly as a basis for local improvement initiatives but sometimes additional information is needed. We can only ascertain that the register is contacted by a number of hospitals every year that want supplementary information in order to carry out local quality controls or improvement initiatives.

Identifying prioritized fields for improvement

In order to find processes that can be improved it has to be possible to describe how improvement should occur.

It is apparent for indicators such as implant survival, patient health and satisfaction that it is possible to aim for 100%. As no hospital has such results, every hospital can theoretically improve, although it is obviously most important for those with results inferior to the average.

For many other indicators it is more difficult, such as the distribution of diagnoses, implants and surgical methods used, prophylaxis, type of anesthesia, ASA grade etc. E.g., as compared to other countries we consider it favorable that surgery of younger patients is unusual in Sweden, because the younger have a high failure rate. However, we do not know if the reason is, that the younger in Sweden have less need for knee arthroplasty surgery or if there is less tendency to offer them surgery. In case of a hospital having a higher proportion of younger patients, we do not know if this is because younger patients to a higher degree attend or are being referred to that hospital. Thus, we are not able to tell if the proportion is proper or not. The same applies for surgical methods, e.g. the use of CAS (computer aided surgery), for which we have no prerequisites to recommend that a specific proportion of patients should be treated using the method.

The information we deliver can however be important for head of departments and administrators which may discover that their hospital to a larger extent than other hospitals is using an expensive method and can examine the reasons and if they are warranted.

A focus area is prosthetic infection which today is the most common and serious complication after knee arthroplasty surgery. A contributing factor may be latent diabetes or poorly controlled type 2 diabetes which we plan to study in a pilot project. The register has also started gathering microbial culture results in order to increase the precision in the registration of infections and to map the antibiotic resistance evolution.

Research is needed to find other improvement areas than those that we consider obvious, and in that case the register is mainly a hypothesis generator. Even without providing specific targets, the information on processes and indicators, provided by the registry, may stimulate to new guidelines being introduced and monitored. However, in order to create national guidelines consensus is needed among experts in workgroups created specifically for that purpose.

Summary

We consider the register itself being a large improvement project that since the start has contributed to the continuous improvement of outcome after knee arthroplasty and leading to Sweden having the lowest revision rate in the world. As compared to one of our closest neighboring countries this implies reduced costs by at least SEK 100 million/year.

Information fed back from the registry has warned against inferior techniques and implants, stimulated hospitals and surgeons to improve processes and routines, disclosed regional differences etc. It is important that this control of quality and improvement work continues as new implants and techniques are continuously being introduced that need monitoring and evaluation.

Adverse events within 90 days of knee arthroplasty 2016-2018

Introduction

Resurfacing a damaged joint considerably improves quality of life, making joint replacements among the most cost-effective interventions. Although the procedure is considered safe with few complications, some patients experience health problems that may have been caused by, or become symptomatic as a result of the surgery.

Of historical and practical reasons, the Knee Arthroplasty Register (SKAR) has focused on reoperations in the knee and not registered other health issues. However, the national patient register (NPR) does that by registering ICD- and procedure codes for all patients treated in the official health system.

The SKAR has together with Registerservice, of the National Board of Health and Welfare, examined the codes that occur in the NPR during admission for, and after knee arthroplasty in order to identify codes that may represent adverse events when they occur during the hospital stay or in readmissions within 90 days of surgery.

This resulted in the classifaction of adverse events used here, which also was taken into use for knee surgery by the National Board of Health and Welfare in their publication "Öppna Jämförelser - Säker vård" as well as when accounting for adverse events on the website "Vården i Siffror" (https://vardenisiffror.se/),

Description

Patients having primary total knee arthroplasty for osteoarthritis during 2016-2018 were included. If both knees were operated within 90 days only the latter was included and only one knee in the case of simultaneous bilateral surgery. The SKAR sent data on registered patients to the NPR which performed the match. For all the patients it was examined if they had received diagnostic and/or procedure codes that corresponded to the definition of adverse events, during or after the hospital stay and up to 90 days after the primary surgery.

The codes were classified into the following groups:

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

DA) Diagnostic codes that imply surgical complications.

DB) Diagnostic codes that cover knee related diseases that may have been used for complications after knee arthroplasty surgery.

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

DM) Diagnostic codes concerning other medical events not related to the knee but that may be related to the surgery if they occur shortly afterwards.

Additionally it was checked if patients had died during the first 90 days.

The codes and information on how they were used can be found on page 91.

Sources of error

The definition of an adverse event is based on diagnostic and procedure codes and there may be differences between counties and units in how carefully the coding has been performed. However, information on death is not dependent on coding.

Inadequate registration in the NPR of secondary surgical dates during the primary hospital stay can result in an adverse event not being included.

Occasional units performing knee arthroplasty surgery do not report to the NPR. For these, adverse events occurring during the primary admission will not be included..

As the information in the NPR on laterality of the surgery is uncertain a complication in the opposite knee will count as an adverse event. However, we consider it unlikely that a complication or a procedure will be registered in the opposite knee within 90 days of surgery.

Finally it is important to realize that many adverse events (especially the medical ones) do not need to be causally related to the surgery. E.g. a patient might have a heart attack or die even without having an arthroplasty. This implies that regional differences in general health, access to health care and preventive medicine may influence the outcome.

Results

In the following pages we show for the different counties and units what adverse events occurred within 90 days (surgical, cardiovascular, other medical, death and all adverse events). Note that only one adverse event is counted for a patient within each group while the same patient can occur in multiple groups.

WOMEN in the counties

Adverse surgical events within 90 days (A, DA & DB)

County	Surgeries	Events	Risk/1000
Blekinge	424	7	16.5
Dalarna	640	16	25.0
Gotland	156	6	38.5
Gävleborg	742	13	17.5
Halland	1,186	22	18.5
Jämtland	252	9	35.7
Jönköping	814	17	20.9
Kalmar	844	25	29.6
Kronoberg	274	8	29.2
Norrbotten	535	9	16.8
Skåne	3,013	63	20.9
Stockholm	4,757	130	27.3
Sörmland	529	13	24.6
Uppsala	711	24	33.8
Värmland	643	17	26.4
Västerbotten	514	36	70.0
Västernorrland	509	20	39.3
Västmanland	361	14	38.8
Västra Götaland	3,057	69	22.6
Örebro	729	13	17.8
Östergötland	855	34	39.8
The Counrty	21,545	565	26.2

MEN in the counties

Adverse surgical events within 90 days (A, DA & DB)

County	Surgeries	Events	Risk/1000
Blekinge	371	11	29.6
Dalarna	547	24	43.9
Gotland	123	5	40.7
Gävleborg	587	11	18.7
Halland	1,026	23	22.4
Jämtland	190	6	31.6
Jönköping	711	20	28.1
Kalmar	708	32	45.2
Kronoberg	227	5	22.0
Norrbotten	459	11	24.0
Skåne	2,235	65	29.1
Stockholm	3,534	105	29.7
Sörmland	376	7	18.6
Uppsala	587	18	30.7
Värmland	495	21	42.4
Västerbotten	404	37	91.6
Västernorrland	371	20	53.9
Västmanland	238	7	29.4
Västra Götaland	2,482	78	31.4
Örebro	567	18	31.7
Östergötland	635	29	45.7
The Counrty	16,873	553	32.8

Adverse cardiovascular events within 90 days (DC)

County	Surgeries	Events	Risk/1000
Blekinge	424	2	4.7
Dalarna	640	7	10.9
Gotland	156	0	0.0
Gävleborg	742	13	17.5
Halland	1,186	2	1.7
Jämtland	252	3	11.9
Jönköping	814	3	3.7
Kalmar	844	3	3.6
Kronoberg	274	3	10.9
Norrbotten	535	2	3.7
Skåne	3,013	25	8.3
Stockholm	4,757	28	5.9
Sörmland	529	2	3.8
Uppsala	711	7	9.8
Värmland	643	0	0.0
Västerbotten	514	4	7.8
Västernorrland	509	6	11.8
Västmanland	361	9	24.9
Västra Götaland	3,057	19	6.2
Örebro	729	1	1.4
Östergötland	855	5	5.8
The Counrty	21,545	144	6.7

Adverse cardiovascular events within 90 days (DC)

County	Surgeries	Events	Risk/1000
Blekinge	371	2	5.4
Dalarna	547	2	3.7
Gotland	123	1	8.1
Gävleborg	587	7	11.9
Halland	1,026	3	2.9
Jämtland	190	3	15.8
Jönköping	711	2	2.8
Kalmar	708	6	8.5
Kronoberg	227	2	8.8
Norrbotten	459	3	6.5
Skåne	2,235	18	8.1
Stockholm	3,534	15	4.2
Sörmland	376	5	13.3
Uppsala	587	3	5.1
Värmland	495	6	12.1
Västerbotten	404	2	5.0
Västernorrland	371	8	21.6
Västmanland	238	3	12.6
Västra Götaland	2,482	14	5.6
Örebro	567	6	10.6
Östergötland	635	6	9.4
The Counrty	16,873	117	6.9

Other adverse medical events within 90 days. (DM)

County	Surgeries	Events	Risk/1000
Blekinge	424	3	7.1
Dalarna	640	7	10.9
Gotland	156	1	6.4
Gävleborg	742	4	5.4
Halland	1,186	6	5.1
Jämtland	252	3	11.9
Jönköping	814	6	7.4
Kalmar	844	10	11.8
Kronoberg	274	4	14.6
Norrbotten	535	1	1.9
Skåne	3,013	28	9.3
Stockholm	4,757	56	11.8
Sörmland	529	1	1.9
Uppsala	711	3	4.2
Värmland	643	5	7.8
Västerbotten	514	13	25.3
Västernorrland	509	9	17.7
Västmanland	361	2	5.5
Västra Götaland	3,057	22	7.2
Örebro	729	4	5.5
Östergötland	855	8	9.4
The Counrty	21,545	196	9.1

Other adverse medical events within 90 days. (DM)

County	Surgeries	Events	Risk/1000
Blekinge	371	7	18.9
Dalarna	547	4	7.3
Gotland	123	1	8.1
Gävleborg	587	5	8.5
Halland	1,026	7	6.8
Jämtland	190	7	36.8
Jönköping	711	4	5.6
Kalmar	708	17	24.0
Kronoberg	227	2	8.8
Norrbotten	459	4	8.7
Skåne	2,235	26	11.6
Stockholm	3,534	63	17.8
Sörmland	376	3	8.0
Uppsala	587	6	10.2
Värmland	495	6	12.1
Västerbotten	404	20	49.5
Västernorrland	371	10	27.0
Västmanland	238	3	12.6
Västra Götaland	2,482	28	11.3
Örebro	567	4	7.1
Östergötland	635	12	18.9
The Counrty	16,873	239	14.2

WOMEN in the counties
Death within 90 days

County	Surgeries	Events	Risk/1000
Blekinge	424	1	2.4
Dalarna	640	0	0.0
Gotland	156	1	6.4
Gävleborg	742	0	0.0
Halland	1,186	2	1.7
Jämtland	252	0	0.0
Jönköping	814	1	1.2
Kalmar	844	0	0.0
Kronoberg	274	0	0.0
Norrbotten	535	0	0.0
Skåne	3,013	3	1.0
Stockholm	4,757	3	0.6
Sörmland	529	1	1.9
Uppsala	711	0	0.0
Värmland	643	0	0.0
Västerbotten	514	1	1.9
Västernorrland	509	0	0.0
Västmanland	361	0	0.0
Västra Götaland	3,057	4	1.3
Örebro	729	0	0.0
Östergötland	855	1	1.2
The Country	21,545	18	0.8

MEN in the counties
Death within 90 days

County	Surgeries	Events	Risk/1000
Blekinge	371	1	2.7
Dalarna	547	1	1.8
Gotland	123	0	0.0
Gävleborg	587	1	1.7
Halland	1,026	1	1.0
Jämtland	190	1	5.3
Jönköping	711	1	1.4
Kalmar	708	2	2.8
Kronoberg	227	1	4.4
Norrbotten	459	1	2.2
Skåne	2,235	3	1.3
Stockholm	3,534	3	0.8
Sörmland	376	0	0.0
Uppsala	587	0	0.0
Värmland	495	1	2.0
Västerbotten	404	0	0.0
Västernorrland	371	1	2.7
Västmanland	238	0	0.0
Västra Götaland	2,482	4	1.6
Örebro	567	2	3.5
Östergötland	635	0	0.0
The Country	16,873	24	1.4

All adverse events within 90 days (incl. death)

County	Surgeries	Events	Risk/1000
Blekinge	424	13	30.7
Dalarna	640	27	42.2
Gotland	156	7	44.9
Gävleborg	742	26	35.0
Halland	1,186	31	26.1
Jämtland	252	15	59.5
Jönköping	814	26	31.9
Kalmar	844	37	43.8
Kronoberg	274	14	51.1
Norrbotten	535	12	22.4
Skåne	3,013	106	35.2
Stockholm	4,757	202	42.5
Sörmland	529	17	32.1
Uppsala	711	33	46.4
Värmland	643	22	34.2
Västerbotten	514	52	101.2
Västernorrland	509	30	58.9
Västmanland	361	23	63.7
Västra Götaland	3,057	113	37.0
Örebro	729	18	24.7
Östergötland	855	48	56.1
The Country	21,545	872	40.5

All adverse events within 90 days (incl. death)

County	Surgeries	Events	Risk/1000
Blekinge	371	19	51.2
Dalarna	547	30	54.8
Gotland	123	7	56.9
Gävleborg	587	22	37.5
Halland	1,026	33	32.2
Jämtland	190	17	89.5
Jönköping	711	27	38.0
Kalmar	708	53	74.9
Kronoberg	227	8	35.2
Norrbotten	459	18	39.2
Skåne	2,235	110	49.2
Stockholm	3,534	176	49.8
Sörmland	376	15	39.9
Uppsala	587	26	44.3
Värmland	495	33	66.7
Västerbotten	404	56	138.6
Västernorrland	371	37	99.7
Västmanland	238	13	54.6
Västra Götaland	2,482	120	48.3
Örebro	567	28	49.4
Östergötland	635	45	70.9
The Country	16,873	893	52.9

The unadjusted tables, for the counties above and for the hospitals on the following pages, show the adverse events occurring during the primary stay or within 90 days or surgery.

Adverse events are more common for men in all the groups. This is also true after adjustment for age (not shown). As compared to last year the overall number of events is quite similar. Surgical events which may include aspirations, wound problems, manipulation under anesthesia, hematoma etc. occur in 2.9% of the patients. The "true revisions" in which implant components are added, removed or exchanged, and which the SKAR focuses on, account for ca. one fifth of these adverse events the first three months. Cardiovascular events occur in 0.7% and other adverse medical events in 1.1% while only 0.11% die within the first 90 days. The overall risk for a patient for experiencing a least one adverse event during this time is 4.6%.

It may be helpful to have access to this information when patients are informed about possible risks associated with the surgery.

It can be problematic to compare the number of adverse events between hospitals and counties as there may be a variation in how events are coded. Anyhow, the numbers provide useful information of how common adverse events are at the different locations and may indicate where additional analyses and improvement measures are indicated.

Age- and sex adjusted results for the counties
Death within 90 days

County	Surgeries	Events	Risk/1000
Blekinge	795	2	2.3
Dalarna	1,187	1	0.8
Gotland	279	1	3.3
Gävleborg	1,329	1	0.8
Halland	2,212	3	1.4
Jämtland	442	1	2.0
Jönköping	1,525	2	1.3
Kalmar	1,552	2	1.3
Kronoberg	501	1	1.9
Norrbotten	994	1	0.8
Skåne	5,248	6	1.1
Stockholm	8,291	7	0.8
Sörmland	905	1	1.0
Uppsala	1,298	0	0.0
Värmland	1,138	1	1.1
Västerbotten	918	1	1.1
Västernorrland	880	1	1.0
Västmanland	599	0	0.0
Västra Götaland	5,539	8	1.5
Örebro	1,296	2	1.7
Östergötland	1,490	1	0.6
The Country	38,418	42	1.1

Age- and sex adjusted results for the counties
All adverse events within 90 days (incl. death)

County	Surgeries	Events	Risk/1000
Blekinge	795	31	38.4
Dalarna	1,187	57	48.0
Gotland	279	16	56.3
Gävleborg	1,329	48	35.8
Halland	2,212	64	29.0
Jämtland	442	31	70.5
Jönköping	1,525	52	34.4
Kalmar	1,552	91	58.3
Kronoberg	501	21	41.5
Norrbotten	994	29	29.0
Skåne	5,248	214	40.7
Stockholm	8,291	387	46.6
Sörmland	905	32	35.2
Uppsala	1,298	59	45.6
Värmland	1,138	55	48.1
Västerbotten	918	108	118.1
Västernorrland	880	65	73.8
Västmanland	599	36	59.3
Västra Götaland	5,539	236	42.6
Örebro	1,296	46	35.4
Östergötland	1,490	93	62.3
The Country	38,418	1,765	45.9

The tables above show age- and gender adjusted results for the counties concerning death as well as all adverse events. It can be seen for all adverse events that there is considerable variation between the counties in spite of the adjstment. This is also true for the number of deaths which are differently registered and not affected by differences in coding.

The following tables show the unadjusted number of adverse events in the different hospitals. It might be of interest for individual hospitals to receive information om which of their patients were affected. However, as the SKAR only receives aggregated information from the PAR we unfortunately do not have access to this information.

Adverse surgical events within 90 days (A, DA & DB)

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	230	16	69.6
Aleris-Ängelholm	62	2	32.3
Alingsås	525	14	26.7
Art Clinic Gbg	287	3	10.5
Art Clinic Jönköping	224	0	0.0
Arvika	511	16	31.3
Bollnäs	909	11	12.1
Borås	231	7	30.3
Capio Artro Clinic	549	6	10.9
Carlanderska	679	6	8.8
Danderyd	297	12	40.4
Eksjö-Nässjö	641	19	29.6
Enköping	1,068	26	24.3
Eskilstuna	188	9	47.9
Falun	599	22	36.7
Gällivare	184	5	27.2
Gävle	239	7	29.3
Halmstad	510	21	41.2
Halmstad Capio	1,240	14	11.3
Helsingborg	73	2	27.4
Huddinge	290	13	44.8
Hudiksvall	181	6	33.1
Hässleholm	2,060	63	30.6
Jönköping	140	1	7.1
Kalmar	254	9	35.4
Karlshamn	795	18	22.6
Karlskoga	122	2	16.4
Karlstad	352	13	36.9
Karolinska	134	9	67.2
Kullbergska sjukhuset	521	9	17.3
Kungälv	473	24	50.7
Lidköping	617	25	40.5
Lindesberg	1,131	29	25.6
Ljungby	299	6	20.1
Luleå-Hermelinen	45	0	0.0
Lund	88	1	11.4
Lycksele	362	22	60.8
Mora	588	18	30.6
Motala	1,043	47	45.1
Mölndal	1,141	32	28.0
Nacka-Proxima/Aleris	542	6	11.1
Norrköping	447	16	35.8
Norrtälje	406	21	51.7
Nyköping	196	2	10.2
Ortho Center Sthlm.(Löw)	1,436	17	11.8
OrthoCenter IFK Klin	438	2	4.6
Ortopediska huset	1,927	28	14.5
Oskarshamn	1,027	30	29.2
Piteå	765	15	19.6
S:t Göran	1,199	55	45.9
Skellefteå	237	11	46.4
Skene	329	7	21.3
Skövde	195	11	56.4
Sollefteå	443	18	40.6
Sophiahemmet	344	8	23.3
Sundsvall	28	1	35.7
Södersjukhuset	724	47	64.9
Södertälje	443	13	29.3
Torsby	275	9	32.7
Trelleborg	2,169	33	15.2
Uddevalla	624	16	25.6
Umeå	319	40	125.4
Varberg	462	10	21.6
Visby	279	11	39.4
Värnamo	520	17	32.7
Västervik	271	18	66.4
Västerås	599	21	35.1
Växjö	202	7	34.7
Ängelholm	796	27	33.9
Örebro	43	0	0.0
Örnsköldsvik	409	21	51.3
Östersund	442	15	33.9
The Country	38,418	1,118	29.1

Adverse cardiovascular events within 90 days (DC)

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	230	1	4.3
Aleris-Ängelholm	62	1	16.1
Alingsås	525	2	3.8
Art Clinic Gbg	287	1	3.5
Art Clinic Jönköping	224	0	0.0
Arvika	511	4	7.8
Bollnäs	909	15	16.5
Borås	231	3	13.0
Capio Artro Clinic	549	4	7.3
Carlanderska	679	5	7.4
Danderyd	297	3	10.1
Eksjö-Nässjö	641	3	4.7
Enköping	1,068	9	8.4
Eskilstuna	188	1	5.3
Falun	599	4	6.7
Gällivare	184	0	0.0
Gävle	239	3	12.6
Halmstad	510	2	3.9
Halmstad Capio	1,240	3	2.4
Helsingborg	73	2	27.4
Huddinge	290	1	3.4
Hudiksvall	181	2	11.0
Hässleholm	2,060	19	9.2
Jönköping	140	1	7.1
Kalmar	254	4	15.7
Karlshamn	795	4	5.0
Karlskoga	122	0	0.0
Karlstad	352	2	5.7
Karolinska	134	0	0.0
Kullbergska sjukhuset	521	5	9.6
Kungälv	473	5	10.6
Lidköping	617	6	9.7
Lindesberg	1,131	7	6.2
Ljungby	299	4	13.4
Luleå-Hermelinen	45	0	0.0
Lund	88	2	22.7
Lycksele	362	3	8.3
Mora	588	5	8.5
Motala	1,043	8	7.7
Mölndal	1,141	8	7.0
Nacka-Proxima/Aleris	542	4	7.4
Norrköping	447	3	6.7
Norrtälje	406	0	0.0
Nyköping	196	1	5.1
Ortho Center Stockh.(Löw)	1,436	5	3.5
OrthoCenter IFK Klin	438	1	2.3
Ortopediska huset	1,927	7	3.6
Oskarshamn	1,027	3	2.9
Piteå	765	5	6.5
S:t Göran	1,199	11	9.2
Skellefteå	237	2	8.4
Skene	329	0	0.0
Skövde	195	0	0.0
Sollefteå	443	10	22.6
Sophiahemmet	344	0	0.0
Sundsvall	28	1	35.7
Södersjukhuset	724	6	8.3
Södertälje	443	2	4.5
Torsby	275	0	0.0
Trelleborg	2,169	15	6.9
Uddevalla	624	2	3.2
Umeå	319	1	3.1
Varberg	462	0	0.0
Visby	279	1	3.6
Värnamo	520	1	1.9
Västervik	271	2	7.4
Västerås	599	12	20.0
Växjö	202	1	5.0
Ängelholm	796	4	5.0
Örebro	43	0	0.0
Örnsköldsvik	409	3	7.3
Östersund	442	6	13.6
The Country	**38,418**	**261**	**6.8**

Other adverse medical events within 90 days. (DM)

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	230	5	21.7
Aleris-Ängelholm	62	0	0.0
Alingsås	525	4	7.6
Art Clinic Gbg	287	0	0.0
Art Clinic Jönköping	224	1	4.5
Arvika	511	2	3.9
Bollnäs	909	4	4.4
Borås	231	5	21.6
Capio Artro Clinic	549	0	0.0
Carlanderska	679	4	5.9
Danderyd	297	16	53.9
Eksjö-Nässjö	641	5	7.8
Enköping	1,068	4	3.7
Eskilstuna	188	1	5.3
Falun	599	6	10.0
Gällivare	184	0	0.0
Gävle	239	4	16.7
Halmstad	510	6	11.8
Halmstad Capio	1,240	5	4.0
Helsingborg	73	5	68.5
Huddinge	290	16	55.2
Hudiksvall	181	1	5.5
Hässleholm	2,060	27	13.1
Jönköping	140	1	7.1
Kalmar	254	4	15.7
Karlshamn	795	10	12.6
Karlskoga	122	0	0.0
Karlstad	352	6	17.0
Karolinska	134	5	37.3
Kullbergska sjukhuset	521	1	1.9
Kungälv	473	7	14.8
Lidköping	617	8	13.0
Lindesberg	1,131	8	7.1
Ljungby	299	6	20.1
Luleå-Hermelinen	45	0	0.0
Lund	88	5	56.8
Lycksele	362	5	13.8
Mora	588	5	8.5
Motala	1,043	9	8.6
Mölndal	1,141	10	8.8
Nacka-Proxima/Aleris	542	1	1.8
Norrköping	447	11	24.6
Norrtälje	406	8	19.7
Nyköping	196	2	10.2
Ortho Center Sthlm.(Löw)	1,436	3	2.1
OrthoCenter IFK Klin	438	1	2.3
Ortopediska huset	1,927	8	4.2
Oskarshamn	1,027	18	17.5
Piteå	765	5	6.5
S:t Göran	1,199	21	17.5
Skellefteå	237	12	50.6
Skene	329	1	3.0
Skövde	195	4	20.5
Sollefteå	443	4	9.0
Sophiahemmet	344	1	2.9
Sundsvall	28	0	0.0
Södersjukhuset	724	26	35.9
Södertälje	443	14	31.6
Torsby	275	3	10.9
Trelleborg	2,169	13	6.0
Uddevalla	624	6	9.6
Umeå	319	16	50.2
Varberg	462	2	4.3
Visby	279	2	7.2
Värnamo	520	3	5.8
Västervik	271	5	18.5
Västerås	599	5	8.3
Växjö	202	0	0.0
Ängelholm	796	4	5.0
Örebro	43	0	0.0
Örnsköldsvik	409	15	36.7
Östersund	442	10	22.6
The Country	**38,418**	**435**	**11.3**

Death within 90 days

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	230	0	0.0
Aleris-Ängelholm	62	0	0.0
Alingsås	525	2	3.8
Art Clinic Gbg	287	0	0.0
Art Clinic Jönköping	224	0	0.0
Arvika	511	1	2.0
Bollnäs	909	0	0.0
Borås	231	1	4.3
Capio Artro Clinic	549	0	0.0
Carlanderska	679	1	1.5
Danderyd	297	1	3.4
Eksjö-Nässjö	641	0	0.0
Enköping	1,068	0	0.0
Eskilstuna	188	0	0.0
Falun	599	0	0.0
Gällivare	184	0	0.0
Gävle	239	1	4.2
Halmstad	510	2	3.9
Halmstad Capio	1,240	1	0.8
Helsingborg	73	0	0.0
Huddinge	290	0	0.0
Hudiksvall	181	0	0.0
Hässleholm	2,060	5	2.4
Jönköping	140	1	7.1
Kalmar	254	1	3.9
Karlshamn	795	2	2.5
Karlskoga	122	0	0.0
Karlstad	352	0	0.0
Karolinska	134	0	0.0
Kullbergska sjukhuset	521	0	0.0
Kungälv	473	0	0.0
Lidköping	617	2	3.2
Lindesberg	1,131	2	1.8
Ljungby	299	0	0.0
Luleå-Hermelinen	45	0	0.0
Lund	88	0	0.0
Lycksele	362	1	2.8
Mora	588	1	1.7
Motala	1,043	0	0.0
Mölndal	1,141	0	0.0
Nacka-Proxima/Aleris	542	0	0.0
Norrköping	447	1	2.2
Norrtälje	406	0	0.0
Nyköping	196	1	5.1
Ortho Center Stockh.(Löw)	1,436	1	0.7
OrthoCenter IFK Klin	438	0	0.0
Ortopediska huset	1,927	0	0.0
Oskarshamn	1,027	1	1.0
Piteå	765	1	1.3
S:t Göran	1,199	2	1.7
Skellefteå	237	0	0.0
Skene	329	1	3.0
Skövde	195	0	0.0
Sollefteå	443	1	2.3
Sophiahemmet	344	0	0.0
Sundsvall	28	0	0.0
Södersjukhuset	724	1	1.4
Södertälje	443	1	2.3
Torsby	275	0	0.0
Trelleborg	2,169	1	0.5
Uddevalla	624	1	1.6
Umeå	319	0	0.0
Varberg	462	0	0.0
Visby	279	1	3.6
Värnamo	520	1	1.9
Västervik	271	0	0.0
Västerås	599	0	0.0
Växjö	202	1	5.0
Ängelholm	796	0	0.0
Örebro	43	0	0.0
Örnsköldsvik	409	0	0.0
Östersund	442	1	2.3
The Country	**38,418**	**42**	**1.1**

All adverse events within 90 days (incl. death)

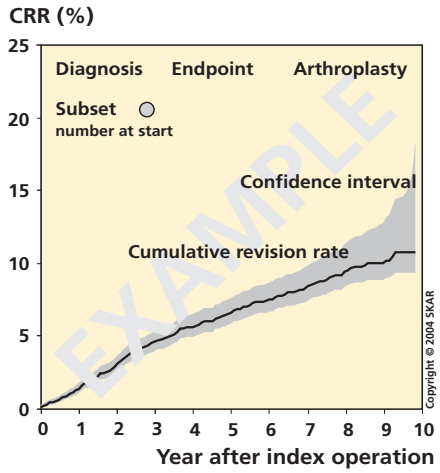
Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	230	21	91.3
Aleris-Ängelholm	62	3	48.4
Alingsås	525	21	40.0
Art Clinic Gbg	287	4	13.9
Art Clinic Jönköping	224	1	4.5
Arvika	511	23	45.0
Bollnäs	909	26	28.6
Borås	231	16	69.3
Capio Artro Clinic	549	9	16.4
Carlanderska	679	16	23.6
Danderyd	297	31	104.4
Eksjö-Nässjö	641	27	42.1
Enköping	1,068	38	35.6
Eskilstuna	188	11	58.5
Falun	599	30	50.1
Gällivare	184	5	27.2
Gävle	239	14	58.6
Halmstad	510	30	58.8
Halmstad Capio	1,240	22	17.7
Helsingborg	73	8	109.6
Huddinge	290	28	96.6
Hudiksvall	181	8	44.2
Hässleholm	2,060	107	51.9
Jönköping	140	3	21.4
Kalmar	254	17	66.9
Karlshamn	795	32	40.3
Karlskoga	122	2	16.4
Karlstad	352	20	56.8
Karolinska	134	13	97.0
Kullbergska sjukhuset	521	15	28.8
Kungälv	473	35	74.0
Lidköping	617	38	61.6
Lindesberg	1,131	44	38.9
Ljungby	299	14	46.8
Luleå-Hermelinen	45	0	0.0
Lund	88	7	79.5
Lycksele	362	28	77.3
Mora	588	27	45.9
Motala	1,043	63	60.4
Mölndal	1,141	50	43.8
Nacka-Proxima/Aleris	542	11	20.3
Norrköping	447	30	67.1
Norrtälje	406	27	66.5
Nyköping	196	6	30.6
Ortho Center Sthlm.(Löw)	1,436	26	18.1
OrthoCenter IFK Klin	438	4	9.1
Ortopediska huset	1,927	40	20.8
Oskarshamn	1,027	48	46.7
Piteå	765	25	32.7
S:t Göran	1,199	84	70.1
Skellefteå	237	25	105.5
Skene	329	9	27.4
Skövde	195	15	76.9
Sollefteå	443	30	67.7
Sophiahemmet	344	9	26.2
Sundsvall	28	2	71.4
Södersjukhuset	724	70	96.7
Södertälje	443	30	67.7
Torsby	275	12	43.6
Trelleborg	2,169	58	26.7
Uddevalla	624	25	40.1
Umeå	319	55	172.4
Varberg	462	12	26.0
Visby	279	14	50.2
Värnamo	520	22	42.3
Västervik	271	25	92.3
Västerås	599	36	60.1
Växjö	202	8	39.6
Ängelholm	796	33	41.5
Örebro	43	0	0.0
Örnsköldsvik	409	35	85.6
Östersund	442	32	72.4
The Country	**38,418**	**1,765**	**45.9**

How the register compares implants

Survival analyses are used for graphical presentation of data. The curves show the Cumulative Revision Rate (CRR) which describes what percentage of the operated patients was expected to become revised with time. The calculation is based on the sum of all the revisions and expresses the rate for surviving patients. Most often the time axis shows a 10-year period. However, it has to be kept in mind that patients are continuously being added during this time. Thus, all the patients have not been followed for the whole period. This implies that if 1,000 patients were operated on each year (and nobody dies), a 10-year study would include 10,000 patients of which only 1,000 had been followed for more than 9 years. The last part of the curve (at the right) therefore expresses the long-term rate of revision for patients operated more than 9 years earlier. As the number of these patients is relatively small, the 95% confidence interval becomes large. When the number of patients at risk is small (at the right of the curve), each revision has a large effect (e.g. 50% are revised when 2 patients are left at risk and one of them has a revision). For this reason, the Register cuts the curves when less than 40 patients are left at risk.

Survival statistics are used to calculate how long an implant is left unrevised. With increasing observation time, the fraction of deceased patients increases (figure below). These patients are not disregarded because they were at risk of becoming revised during their lifetime and are thus allowed to deliver data for the period they lived. The probability for each revision is related to the number of remaining unrevised patients. The sum of all the probabilities is the cumulative risk of revision which specifies the risk for a surviving patient of becoming revised at a given time.

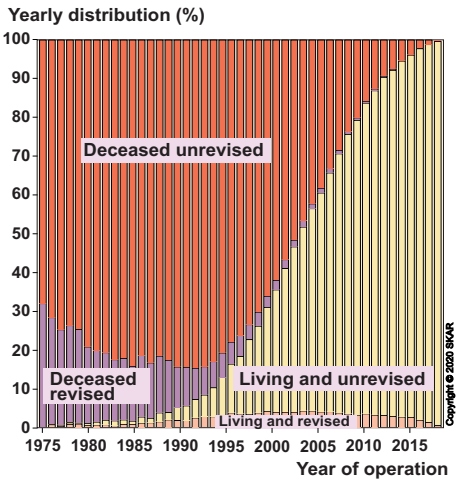
Cox regression allows for taking into account different factors that may vary within groups. The results are expressed as risk ratios (RR) between factors. If a factor is a category (e.g. implant model), one category is defined as a reference with a risk of 1 to which the other categories are compared. An implant or a unit with the risk of 1.2 thus has a 20% increased risk of becoming revised etc. For numerical variables (e.g. age) the risk ratio relates to the change in risk if the variable increases by one unit (e.g. 1 year). When comparing groups where uneven distribution of factors can be expected (e.g. age in cemented vs. uncemented implants) the Cox regression is especially important.



CRR curve example.

It is important to note that as the individual patient also is at risk of dying, the real proportion of revisions is lower than the CRR. As the figure below shows, almost 80% of the patients that were operated in 1980 have deceased without having been revised while more than half of the few still alive have been revised.

Estimating differences between units in risk of revision is complicated by their varying volumes. The reason is that units performing few operations are more likely to have overly good or bad results. Therefore, the register received help from RCSyd statisticians to calculate risks using a "shared gamma frailty model" which takes volume into consideration. Still it has to observed that the units may have different "case-mix", e.g. patients with different grades of joint destruction, differences in general health, activity etc.. Such factors, which we are unable to take into account, may influence the risk of revision and thus the results of individual units.

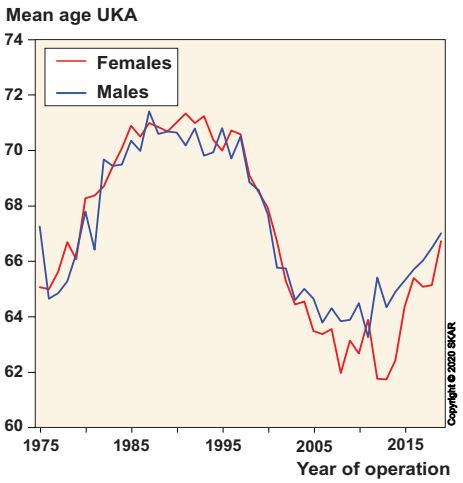


The present status for each yearly batch of patients operated since 1975.

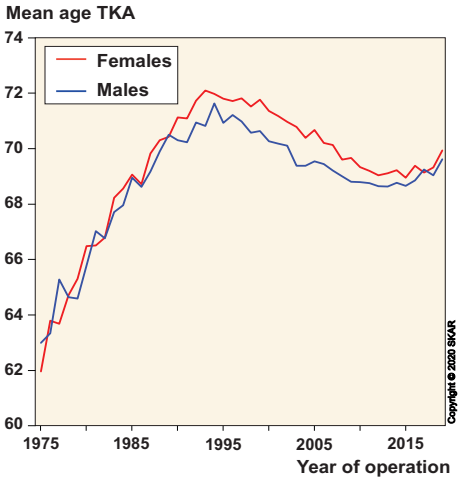
Gender and age distribution

Between 1975 and 1994, the mean age at primary operation increased from 65 years to almost 72 years. The main reason was a relatively large increase in number of operations among the older age groups. Probable explanations are improvements in anesthetic techniques as well as a changed age distribution of the population. After 1994 the proportion of patients less than 65 years of age increased and the mean age started to decrease. This tendency has not continued the last few years and the mean age in 2019 was 69.4 years (figure on the right).

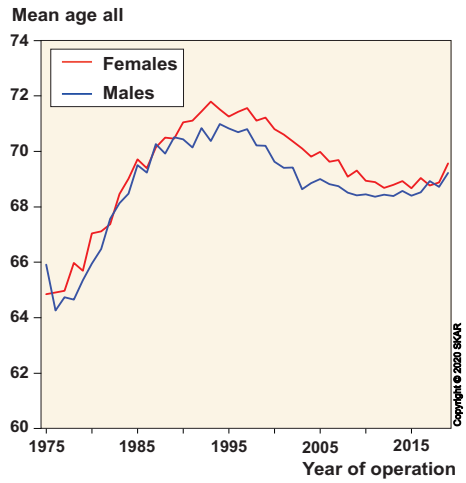
When TKA and UKA are analyzed separately, it is apparent that when TKA was introduced in the seventies it was used for younger patients than the UKA, which at the time was the standard treatment (figures below and on the next page). However, in the late nineties the mean age at UKA surgery fell considerably which coincided with the introduction of mini-invasive surgery. An interpretation of these observations may be that new technology to a larger extent is being tested in younger patients.



For UKA, the mean age of patients at surgery has decreased sharply in recent years coinciding with the introduction of mini-invasive surgery.

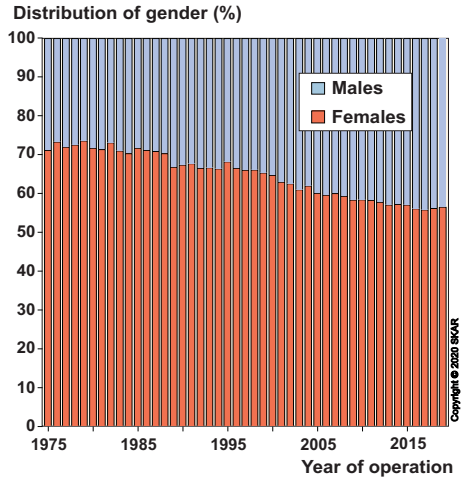


The mean age at surgery was lower for TKA than UKA when TKA was introduced in the seventies (cp the figures above).



The mean age of patients at surgery (all types of implants) increased until the mid-nineties when it started to decrease.

When comparing a series of patients operated on during different periods, the changes in the mean age make it necessary to account for age by use of regression or to analyze different age groups separately.



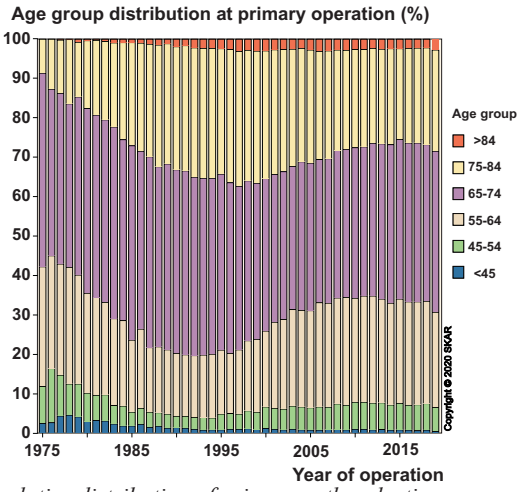
The proportion of males has increased slightly over the years.

Knee arthroplasty is more common in females than in males. At the start of the registration, females accounted for about 70% of the operations. As the figure above shows, the proportion of men has been slowly increasing and in 2019 they accounted for 43.5%. Separate analyses of OA and RA show that it is mainly in OA that the proportion of men has increased. In RA men account only for one fourth of the operations and the proportion has not changed.

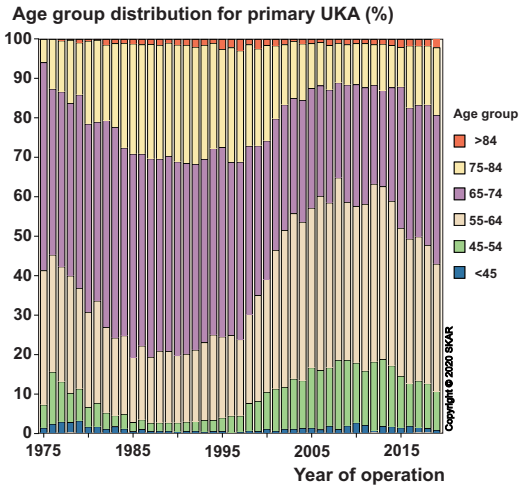
The figure to the right shows the relative number of operations performed in the different age groups over a period of thirty five years. In a somewhat different manner than the mean age (previous page) it shows how the relative proportion of the older groups increased until the mid-nineties after which their proportion again started to diminish.

The figures below show the age distribution for UKA respective TKA. It is evident that when the registration began in the seventies, the relative proportion of the young age groups was higher for TKA than for UKA.

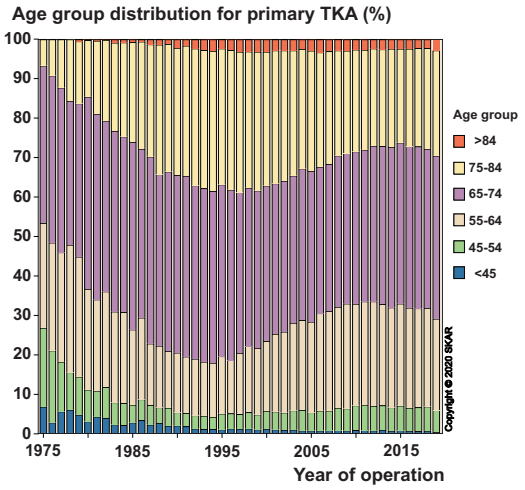
In UKA the relative proportion of patients less than 65 years of age doubled during 1998-2002, i.e. during the time when mini-invasive surgery caught on in Sweden. However, it has to be kept in mind that the actual number of UKA´s has diminished since 1993 in contrast to the TKA´s where it has increased more than fourfold. This implies that although the relative number of TKA among younger age groups did not increase as much as for UKA, the actual number in 2019, of TKA patients, younger than 65 years of age, had increased 7.6 times as compared to 1993 while the number of UKA patients under 65 only had increased 1.8 times during the same period.



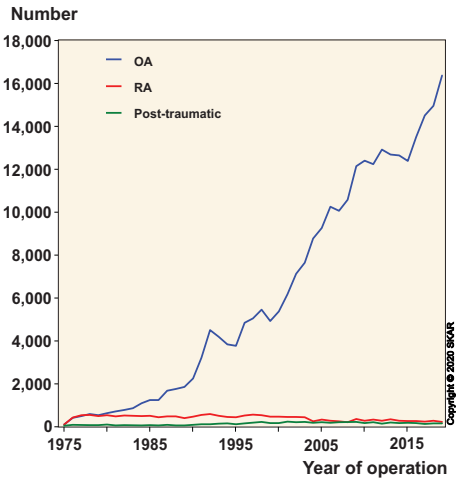
The relative distribution of primary arthroplasties among different age groups (all types of implants).



The relative distribution of primary UKA arthroplasties among different age groups.



The relative distribution of primary TKA arthroplasties among different age groups.



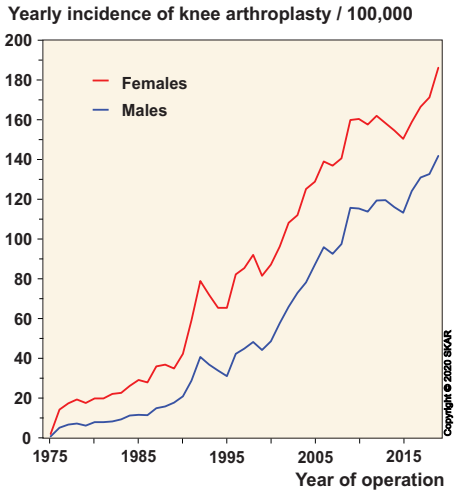
The yearly number of arthroplasties for different diagnoses

In the eighties, the use of knee arthroplasty really started to increase (graph above) mainly because of the increased treatment of osteoarthritic patients. On the other hand, the number of operations for rheumatoid arthritis lessened, especially during recent years which may be explained by the advancement of new types of medical treatment. The number of operations for post-traumatic conditions has only increased slightly during the years. During the last decade, these three diagnoses were stated as the reason for primary surgery in 98% of cases.

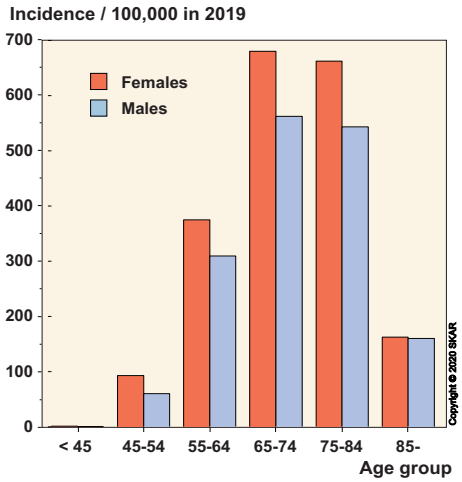
Incidence and prevalence

The incidence of knee arthroplasty is found by dividing the number of primary knee arthroplasties by the number of inhabitants. As the graph to the right shows, the rise in incidence that began in the late eighties leveled off in 2009. A part of the increase in incidence over time reflects aging of the population as knee arthroplasty is mainly used in the elderly.

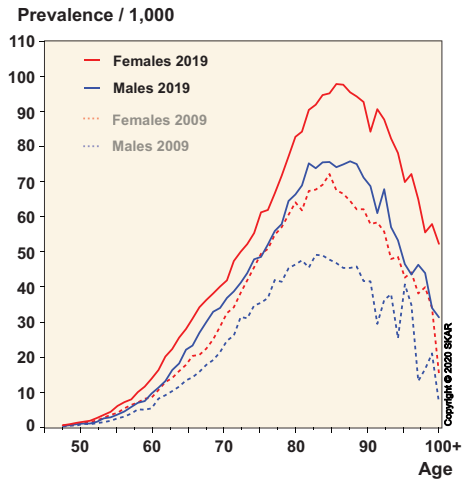
The figure below shows the incidence among different age groups during 2019. It is highest in the groups of those 65-84 years of age. At this age, knee arthroplasty is 8 times more common than among those 45-54 years old and 4 times more common than among those 85 years or older. In 2019 women were heavily overrepresented in all the age groups but the oldest. A table showing the incidence for the different age groups can be found on page 22.



Incidence of primary knee arthroplasty per 100,000 inhabitants (all types of implants).



Incidence of primary knee arthroplasty in 2019 per 100,000 inhabitants (males and females) in the different age groups.



The prevalence of knee arthroplasty in 2009 and 2019. One of fourteen elderly women has a knee arthroplasty.

As the incidence is so dependent on age, and because the age distribution may vary among different nations, it is difficult to compare different countries without performing some form of age standardization.

The increase in the number of operations causes a rise in the number of patients walking around with knee implants. The figure below on the left shows the prevalence, i.e. the number of patients per 1,000 inhabitants in different age groups that were alive with at least one knee implant. As a quarter of the patients have bilateral implants the prevalence of implants is higher than that of patients.

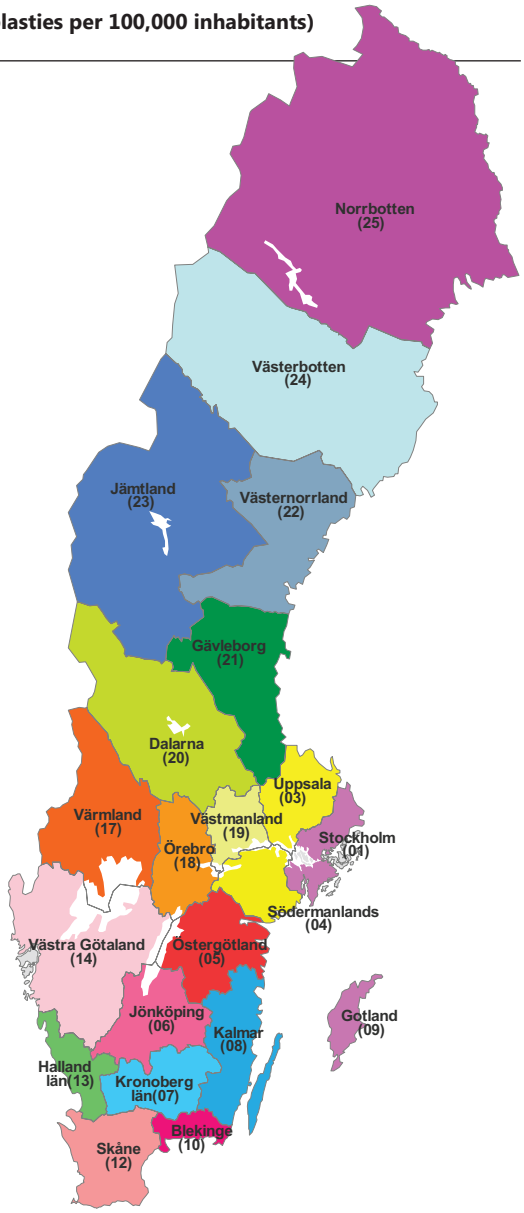
For both men and women in 2018, the prevalence peaks around 80-85 years of age at which almost 10% of the women and almost 8% of the men had at least one knee arthroplasty. Comparing the prevalence in 2019 with that in 2009, it can be seen that it has increased for all age groups. The fact that a large proportion of the older population is walking around with knee-, hip- or other types of joint implants, will probably result in an increase need for revisions in the future as well as as an increased risk of periprosthetic fractures when such patients are exposed to trauma.

The incidence in the counties 2013-2019 (knee arthroplasties per 100,000 inhabitants)

County and number of inhabitants 2019

No	County	Inhabitants
01	Stockholm	2,360,603
03	Uppsala	380,034
04	Södermanland	296,118
05	Östergötland	463,539
06	Jönköping	362,212
07	Kronoberg	200,678
08	Kalmar	245,058
09	Gotland	59,468
10	Blekinge	159,645
12	Skåne	1,369,996
13	Halland	331,600
14	Västra Götaland	1,717,848
17	Värmland	281,948
18	Örebro	303,529
19	Västmanland	274,887
20	Dalarna	287,579
21	Gävleborg	286,965
22	Västernorrland	245,400
23	Jämtland	130,545
24	Västerbotten	270,945
25	Norrbotten	250,295

Mean population during the year (www.scb.se)



Knee arthroplasties per 100,000 inhabitants

County	2013	2014	2015	2016	2017	2018	2019
01 Stockholm	104.9	99.4	93.2	111.4	124.1	125.1	130.6
03 Uppsala	174.8	142.9	161.9	123.3	131.2	136.3	156.0
04 Södermanland	157.2	161.9	145.6	140.3	189.8	175.8	205.3
05 Östergötland	154.2	135.0	134.5	137.0	151.9	153.0	161.4
06 Jönköping	147.6	172.4	153.7	150.2	131.3	168.0	172.8
07 Kronoberg	115.3	150.4	154.5	175.1	155.0	166.1	173.4
08 Kalmar	175.9	167.0	172.8	175.0	196.0	199.9	208.9
09 Gotland	178.3	134.6	106.4	150.8	178.4	218.9	225.3
10 Blekinge	177.7	161.6	165.6	206.5	196.3	185.5	174.8
12 Skåne	137.3	142.6	144.4	158.4	167.8	159.5	166.9
13 Halland	165.6	168.4	155.4	177.0	199.6	194.1	193.0
14 Västra Götaland	130.7	125.6	127.8	126.0	124.1	134.0	154.2
17 Värmland	180.3	195.4	184.5	181.5	184.0	194.0	221.3
18 Örebro	120.3	116.8	104.6	152.6	126.6	109.5	126.8
19 Västmanland	125.4	134.8	109.1	118.4	144.4	161.1	197.5
20 Dalarna	231.4	199.5	174.7	199.8	171.4	180.7	205.9
21 Gävleborg	188.6	213.6	206.1	202.3	174.7	211.1	220.6
22 Västernorrland	141.3	132.3	141.3	155.3	199.4	148.5	172.0
23 Jämtland	138.5	95.6	120.4	145.3	171.8	187.6	218.3
24 Västerbotten	126.2	118.1	117.9	120.5	146.7	139.2	148.7
25 Norrbotten	150.2	131.0	120.9	144.3	157.4	193.3	213.7
The whole country	139.1	135.5	131.9	141.5	148.7	151.9	164.7

Information on domicile is by the Swedish Tax Agency

For age-standardized incidence see page 37

The incidence in the counties 2013-2019 (knee arthroplasties per 100,000 inhabitants)

Incidence for women

County	2013	2014	2015	2016	2017	2018	2019
01 Stockholm	123.0	113.3	106.4	126.9	145.5	147.6	146.8
03 Uppsala	193.1	170.6	186.2	134.5	155.9	143.8	189.7
04 Södermanland	180.4	184.5	154.4	159.7	209.7	204.8	234.7
05 Östergötland	172.5	159.9	159.6	154.1	165.7	184.5	180.1
06 Jönköping	174.4	202.1	176.1	164.5	143.9	178.1	198.0
07 Kronoberg	148.4	166.7	168.3	186.1	166.9	182.4	189.0
08 Kalmar	201.2	193.1	199.7	207.5	205.3	227.5	234.1
09 Gotland	208.1	128.5	114.5	169.2	171.1	254.1	225.0
10 Blekinge	187.5	182.3	168.9	235.6	219.5	186.8	177.7
12 Skåne	154.4	166.0	169.6	177.9	188.5	176.0	195.3
13 Halland	188.4	186.6	173.0	190.2	227.9	205.9	221.4
14 Västra Götaland	148.2	140.7	146.4	140.8	137.7	154.4	179.4
17 Värmland	190.1	233.5	204.5	194.4	197.5	219.8	243.5
18 Örebro	129.6	135.7	127.0	176.9	137.7	119.4	136.1
19 Västmanland	140.3	157.5	128.1	148.0	165.1	173.0	217.9
20 Dalarna	260.7	222.4	195.0	217.1	186.4	187.0	230.1
21 Gävleborg	206.4	232.6	221.4	221.6	195.7	236.5	247.7
22 Västernorrland	165.4	149.7	155.2	181.0	221.6	170.9	191.0
23 Jämtland	179.4	107.9	153.6	156.1	175.4	216.6	251.5
24 Västerbotten	151.4	132.5	137.4	138.9	159.0	158.8	178.9
25 Norrbotten	170.8	150.2	142.1	162.6	179.5	218.9	240.2
The whole country	158.3	154.8	150.5	158.9	166.6	171.3	187.2

Information on domicile is by the Swedish Tax Agency

The incidence calculations for the counties are based on the number of knee arthroplasties their inhabitants received, irrespective of if the surgery was performed in their home county or elsewhere. While the calculations do not consider differences in the age distribution, age-standardized calculations for the year 2019 can be found on page 37.

The calculations are based on information from the Swedish tax authorities concerning the domicile of patients at the time of surgery. Note that that only surgeries on patients that are Swedish residents are considered.

Incidence for men

County	2013	2014	2015	2016	2017	2018	2019
01 Stockholm	86.5	85.4	79.9	95.7	102.7	102.7	114.5
03 Uppsala	156.5	115.0	137.4	112.0	106.4	128.8	122.5
04 Södermanland	133.7	139.3	136.9	120.9	170.1	146.9	176.2
05 Östergötland	136.1	110.3	109.7	120.2	138.4	122.2	143.1
06 Jönköping	120.8	143.0	131.6	136.0	118.9	158.1	148.3
07 Kronoberg	82.8	134.5	141.1	164.5	143.6	150.4	158.4
08 Kalmar	150.5	141.0	146.3	143.0	186.8	172.8	184.2
09 Gotland	148.0	140.7	98.2	132.3	185.7	183.6	225.6
10 Blekinge	168.1	141.4	162.4	178.5	174.0	184.4	171.9
12 Skåne	119.9	118.7	118.9	138.6	146.9	143.0	138.5
13 Halland	142.7	150.1	137.7	163.7	171.5	182.4	164.8
14 Västra Götaland	113.1	110.4	109.1	111.3	110.6	113.9	129.4
17 Värmland	170.5	157.4	164.7	168.7	170.7	168.5	199.4
18 Örebro	110.9	97.9	82.3	128.2	115.6	99.6	117.6
19 Västmanland	110.4	112.1	90.3	89.1	124.0	149.3	177.5
20 Dalarna	202.3	176.8	154.6	182.8	156.7	174.5	182.2
21 Gävleborg	170.8	194.7	190.9	183.2	153.9	186.1	193.9
22 Västernorrland	117.2	115.1	127.5	129.9	177.5	126.6	153.3
23 Jämtland	97.9	83.4	87.6	134.7	168.3	159.4	186.0
24 Västerbotten	101.4	103.8	98.8	102.5	134.7	120.2	119.4
25 Norrbotten	130.3	112.4	100.4	126.8	136.3	168.9	188.6
The whole country	119.7	116.2	113.3	124.2	131.1	132.7	142.5

Information on domicile is by the Swedish Tax Agency

Incidence in different age groups over time (number of arthroplasties/100,000 inhabitants)

Women

Age group	1976-1988	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	2019
<45	1.0	1.0	1.2	1.7	1.8	2.5	2.0	1.4
45-54	12.7	13.9	22.1	38.5	64.1	89.4	86.2	93.7
55-64	45.2	86.5	122.5	163.0	251.7	331.9	358.8	377.9
65-74	104.6	257.5	345.5	408.6	536.9	562.0	545.0	683.1
75-84	83.0	253.0	351.8	420.8	543.2	621.4	590.9	665.2
>84	8.3	43.0	71.8	86.7	109.2	122.5	113.7	164.1
Total	24.1	57.9	78.3	97.3	134.3	159.7	160.5	187.2

Men

Age group	1976-1988	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	2019
<45	0.4	0.5	0.6	0.8	1.2	1.6	1.4	0.7
45-54	5.3	7.3	10.9	22.6	40.0	52.1	54.0	60.7
55-64	20.0	54.6	71.7	116.9	185.8	265.6	283.3	310.5
65-74	48.3	146.6	211.9	284.7	411.6	459.5	476.7	565.6
75-84	43.7	165.0	223.9	286.3	409.7	497.7	487.3	546.4
>84	10.4	41.6	64.0	76.1	115.7	121.9	117.3	160.4
Total	9.8	29.3	40.3	58.2	90.5	116.8	123.6	142.5

Number of primary arthroplasties per unit and year

Hospital	1975-2014	2015	2016	2017	2018	2019	Total	Percent
Akademiska sjukhuset	3,088	108	88	85	91	85	3,545	1.2
Alingsås	2,424	193	160	200	179	208	3,364	1.1
Art Clinic Göteborg	.	16	55	108	140	109	428	0.1
Art Clinic Jönköping	23	29	24	90	146	265	577	0.2
Arvika	1,880	171	189	193	213	276	2,922	1.0
Avesta	67	.	.	.	.	.	67	0.0
Boden	1,622	.	.	.	.	.	1,622	0.5
Bollnäs	3,835	353	344	325	367	388	5,612	1.9
Borås	3,010	72	74	69	115	113	3,453	1.1
Capio Artro Clinic Sthlm.		.	.	242	393	490	1,125	0.4
Carlanderska	782	136	156	224	323	429	2,050	0.7
Dalslands Sjukhus	81	.	.	.	.	.	81	0.0
Danderyd	3,624	185	187	185	189	168	4,538	1.5
Eksjö (Höglandssjukh.)	3,319	202	221	217	299	331	4,589	1.5
Elisabethsjukhuset	834	1	7	6	13	.	861	0.3
Enköping	3,284	393	346	365	381	434	5,203	1.7
Eskilstuna	1,934	42	55	69	81	66	2,247	0.7
Eskilstuna Spec. Cent. Scand.	.	.	.	.	.	12	12	0.0
Fagersta	71	.	.	.	.	.	71	0.0
Falköping	1,688	.	.	.	1	38	1,727	0.6
Falun	5,567	205	270	215	170	179	6,606	2.2
Frölunda Spec.	1,428	124	.	.	.	.	1,552	0.5
Gällivare	1,591	46	53	54	88	104	1,936	0.6
Gävle	3,539	132	147	85	76	147	4,126	1.4
Halmstad	3,560	186	208	185	206	191	4,536	1.5
Halmstad Capio (Movement)	1,950	430	417	434	467	452	4,150	1.4
Helsingborg	1,842	67	41	19	16	19	2,004	0.7
Huddinge	3,126	159	168	111	108	182	3,854	1.3
Hudiksvall	1,711	87	74	57	62	63	2,054	0.7
Hässleholm	8,831	669	761	883	891	877	12,912	4.3
Jönköping	3,110	141	135	11	.	.	3,397	1.1
Kalix	215	.	.	.	.	.	215	0.1
Kalmar	2,747	89	91	100	86	112	3,225	1.1
Karlshamn	3,335	249	305	295	278	263	4,725	1.6
Karlskoga	2,155	124	104	39	7	1	2,430	0.8
Karlskrona	1,117	.	.	.	.	.	1,117	0.4
Karlstad	4,492	182	162	132	118	123	5,209	1.7
Karolinska	2,781	91	98	59	55	21	3,105	1.0
Kristianstad	1,297	1	.	.	.	.	1,298	0.4

(cont..)

Number of primary arthroplasties per unit and year (cont.)

Hospital	1975-2014	2015	2016	2017	2018	2019	Total	Percent
Kristinehamn	252	.	.	.	.	.	252	0.1
Kullbergska sjukhuset	2,773	153	157	244	222	295	3,844	1.3
Kungsbacka	38	.	.	.	.	.	38	0.0
Kungälv	2,351	215	197	207	199	233	3,402	1.1
Köping	1,606	.	.	.	.	.	1,606	0.5
Landskrona	1,918	.	.	.	.	.	1,918	0.6
Lidköping	2,356	234	224	250	170	231	3,465	1.1
Lindesberg	2,353	162	319	424	493	423	4,174	1.4
Linköping	1,735	.	.	.	.	.	1,735	0.6
Linköping medical cent	15	.	.	.	.	.	15	0.0
Ljungby	2,024	141	150	135	170	178	2,798	0.9
Ludvika	339	.	.	.	.	.	339	0.1
Luleå-Sensia	13	7	11	19	19	14	83	0.0
Lund	2,867	82	68	43	52	23	3,135	1.0
Lycksele	914	42	130	150	143	102	1,481	0.5
Malmö	2,240	.	.	1	.	.	2,241	0.7
Mora	2,401	186	203	195	204	216	3,405	1.1
Motala	5,450	512	552	605	653	630	8,402	2.8
Mölndal	2,912	405	505	379	402	404	5,007	1.7
Nacka	203	.	.	.	.	.	203	0.1
Nacka-Proxima	896	143	154	173	223	205	1,794	0.6
Norrköping	2,900	137	160	175	153	119	3,644	1.2
Norrtälje	1,463	94	123	152	164	196	2,192	0.7
Nyköping	1,887	101	74	102	89	154	2,407	0.8
Ortho Center IFK klin.	1,124	113	129	162	176	240	1,944	0.6
Ortho Center Sthlm*	3,965	431	444	463	676	701	6,680	2.2
Ortopediska huset	4,457	460	625	719	667	671	7,599	2.5
Oskarshamn	3,261	276	316	370	374	397	4,994	1.7
Piteå	3,034	245	279	305	373	422	4,658	1.5
S:t Göran	8,131	424	470	521	466	546	10,558	3.5
Sabbatsberg (Aleris)	2,153	23	.	.	.	.	2,176	0.7
Sahlgrenska	1,550	1	.	.	.	.	1,551	0.5
Sala	115	.	.	.	.	.	115	0.0
Sandviken	301	.	.	.	.	.	301	0.1
Sergelkliniken	160	.	.	.	.	.	160	0.1
Simrishamn	1,021	.	.	.	.	.	1,021	0.3
Skellefteå	1,664	119	80	77	86	119	2,145	0.7
Skene	1,793	97	131	127	129	174	2,451	0.8
Skövde	3,252	120	114	73	20	29	3,608	1.2
Sollefteå	1,594	93	102	206	151	218	2,364	0.8
Sophiahemmet***	1,796	138	127	229	185	184	2,659	0.9
Spenshult	1,605	.	.	.	.	.	1,605	0.5
Sunderby	398	.	.	.	.	.	398	0.1
Sundsvall	3,152	44	12	5	15	56	3,284	1.1
Säffle	484	.	.	.	.	.	484	0.2
Söderhamn	279	.	.	.	.	.	279	0.1
Södersjukhuset	5,535	281	320	284	227	221	6,868	2.3
Södertälje	1,673	113	163	149	145	155	2,398	0.8
Torsby	1,886	130	108	134	130	132	2,520	0.8
Trelleborg	7,888	791	823	850	814	821	11,987	4.0
Uddevalla	4,153	187	244	247	242	280	5,353	1.8
Umeå	3,188	147	111	120	138	151	3,855	1.3
Varberg	3,269	127	185	214	177	173	4,145	1.4
Visby	1,649	60	76	97	115	117	2,114	0.7
Vänersborg-NÄL	939	.	.	.	.	.	939	0.3
Värnamo	2,384	148	142	193	208	198	3,273	1.1
Västervik	2,165	90	99	81	94	106	2,635	0.9
Västerås	3,561	177	217	273	194	387	4,809	1.6
Växjö	2,477	115	101	77	95	97	2,962	1.0
Ystad	1,169	.	.	.	.	.	1,169	0.4
Ängelholm - Aleris	.	.	.	.	82	212	294	0.1
Ängelholm	2,697	221	338	345	242	224	4,067	1.3
Örebro	3,467	30	47	8	3	2	3,557	1.2
Örnsköldsvik	2,296	115	143	172	142	119	2,987	1.0
Östersund	2,586	120	141	164	178	208	3,397	1.1
Östra sjukhuset	2,100	.	.	.	.	.	2,100	0.7
Total	**228,237**	**12,933**	**14,054**	**14,976**	**15,459**	**16,929**	**302,589**	**100**

* Lövenströmska was taken over by Stockholms Specialistvård in 2001 and OrthoCenter Stockholm in 2008.

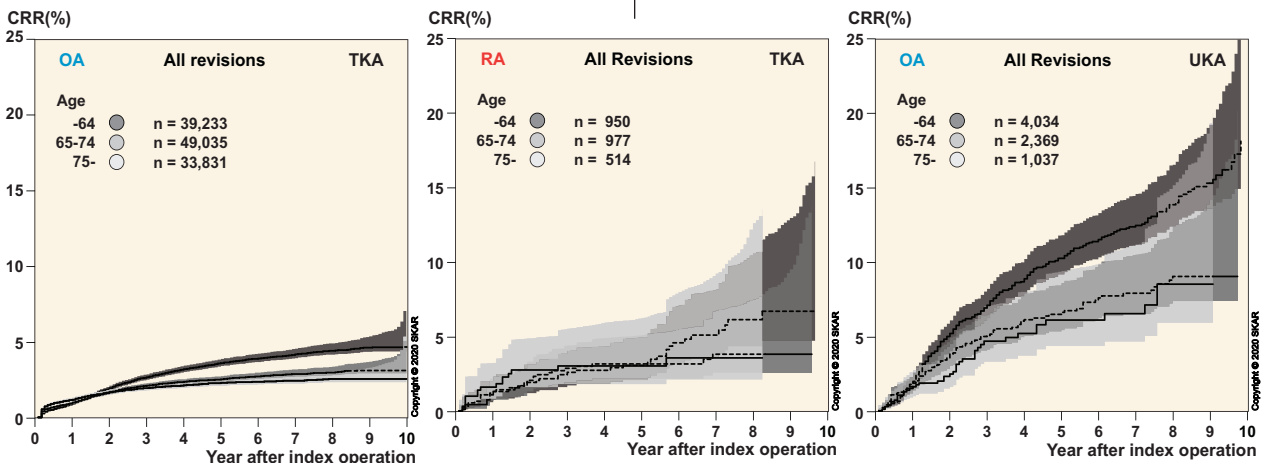
** Gothenburg Medical Center was replaced by OrthoCenter IFK kliniken in 2008.

*** Sophiahemmet was taken over by Orthopedisk Center Sept. 1st, 2019

Factors that influence the revision rate

Primary disease – Early it became evident that patients with rheumatoid arthritis (RA) and osteoarthritis (OA) were different with respect to outcome. Therefore, the registry always showed outcome for these diagnoses separately. However, the modern medical treatment of RA has resulted in a reduced need for knee arthroplasty for these patients (fig. page 18) making statistical differences more difficult to detect.

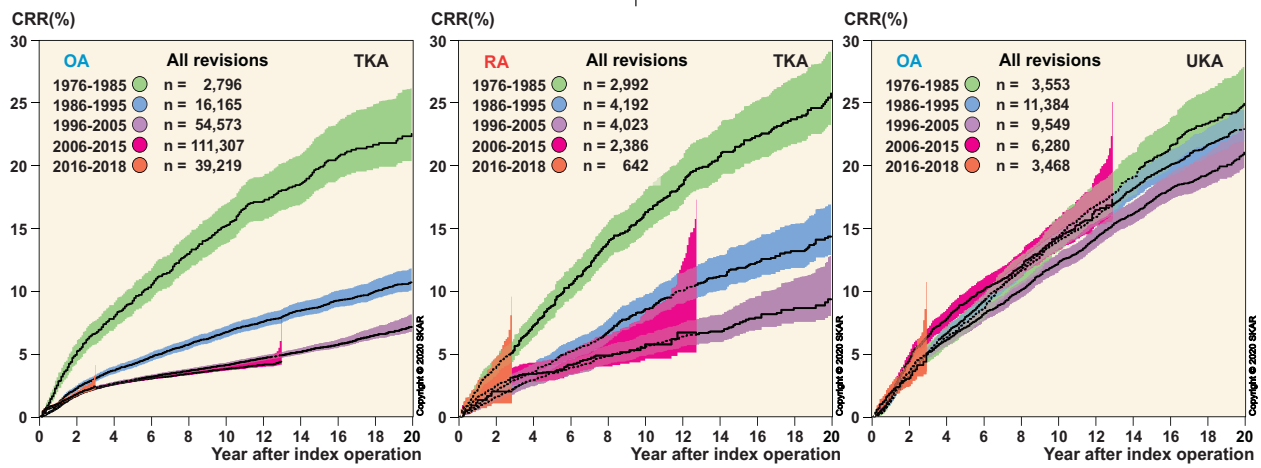
Age – The effect of age at primary surgery can be illustrated by dividing patients into separate age groups. This shows for both TKA and UKA that that the risk is higher for the younger groups (see figures below). Possible explanations are that the younger have higher physical activity, higher expectancy of pain relief and/or a health condition that better allows for revision surgery.



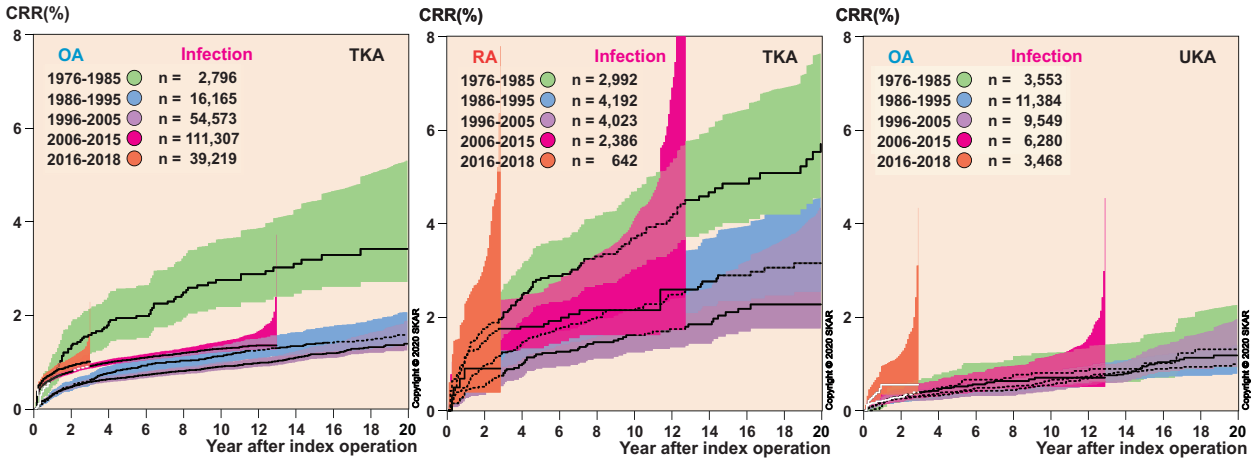
The CRR (2009–2018) for the 3 age groups (<65, 65–75, >75) shows an increase in revision rate with younger age. In TKA/OA those younger than 65 have 1.5 times the risk of those over 75 and 1.8 times higher risk in UKA/OA. The difference in TKA/RA is not significant.

Year of operation – For TKA we see a large reduction in risk for revision during the first 3 decades that is not as obvious for UKA (figures below). However, during the period 2006-2015 the number of early revisions inreased, a tendency that continued in the period 2016-2018. This mainly because of an increase in early revisions for infection (see next page).

For UKA, the reduction in CRR during the first 3 decades was not at all as markant as for TKA. But as for TKA, the number of early revisions increased during 2006-2015 and 2016-2018. The reason is mainly that since the late nineties the proportion of younger patients has increased (see page 18) and they have a higher risk of revision.



CRR for surgeries performed during four 10-year periods and during 2016-2018. For TKA, the risk for the 2 first periods is considerably higher than for the later ones while the risk for early revision increased in the latest 2 periods which can be explained by increased number of early revisions for manifest or suspected infection. For UKA/OA the reduction of risk with time is not as obvious as for TKA and the CRR has increased in the latest 2 periods which is mainly explained by a higher proportion of younger patients having surgery.



Comparing the CRR, using only revision for infection as end-point, there is an improvement during the first decades for both TKA and UKA. However, the risk has increased again during the period 2006-2015 and in 2016-18.

When the Knee Register estimates the risk of revision due to infection, it counts the first revision due to infection in the affected knee. It does not matter if it is the primary or any subsequent revision. During the first decades we saw a reduction in this risk both for OA and RA. However, for TKA the risk increased significantly in the period 2006-2015 as compared to earlier, a trend which continues in 2016-18, now even for UKA.

The increase is mainly due to early insert exchanges performed for infections or suspected infections probably as the surgeons have become more proactive in suspected early infections.

TKA´s have a significantly higher risk of infection than UKA´s (RR 1.9) and patients with RA have a higher risk than those with OA (RR 1.7). If changes of inserts are excluded, the differences diminish somewhat (RR 1.3 and RR 1.6).

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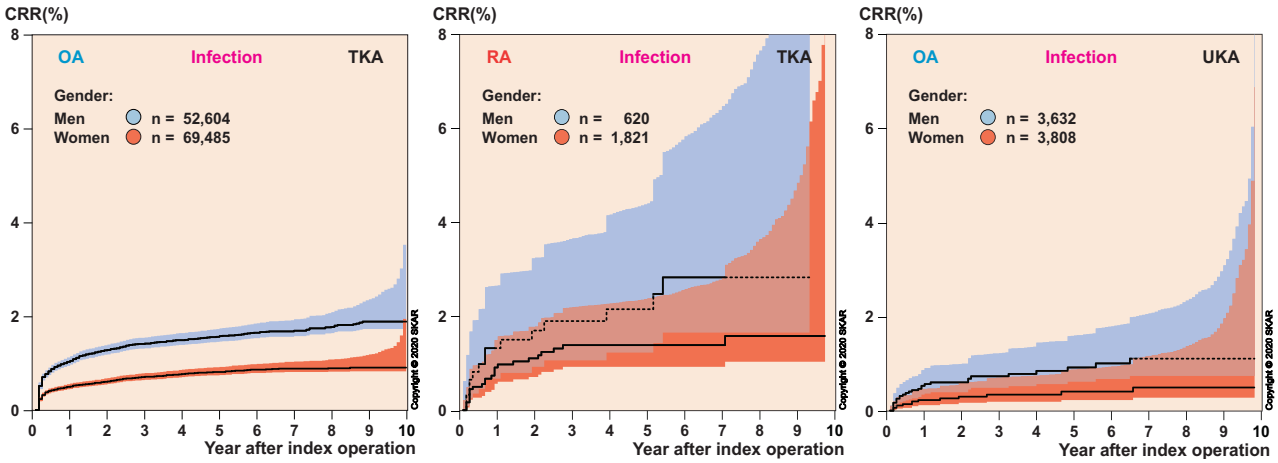
Gender – It is somewhat complicated to evaluate the effect of gender on the risk of revision as males and females have somewhat different revision pattern. Early revision for infection is more common in males (figures below) but early revision for loosening and patellar pain in women. Due to their higher risk of revision for infection, men have somewhat higher 10-year CRR for all type of revisions (RR 1.1).

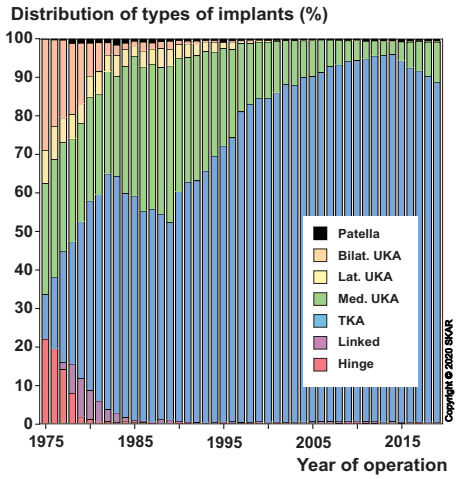
The difference between the sexes becomes even greater when the endpoint only includes revisions for infection (see figures with text below).

While it is well known that RA patients have a higher risk of infection, being ascribed to the effect of corticosteroid and immunosuppressive medications, it is not obvious why men, more often have their knee arthroplasties revised for infection.



CRR (2009–2018) using the end-point; revision for infection shows men having a higher risk than women. For TKA/OA the Risk Ratio is 2.0 and 1,8 for TKA/RA. In UKA, which has a lower risk of infection than TKA, men also have a higher risk (RR 2.4).
In TKA, patients with RA are more affected than those with OA (RR 1.7).

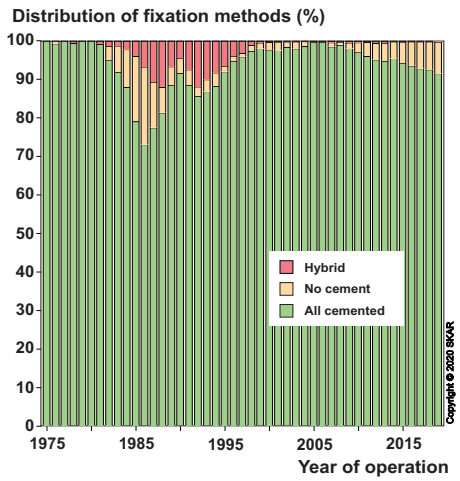
Type of implant – The modern condylar tricompartmental knee implant (TKA) was developed in the seventies when hinged and unicondylar implants were already available. When the register started in 1975, TKA had just been introduced in Sweden, why hinges and UKA's were used for the majority of the primary surgeries at the time (figure right). It was also common to use two UKA's in the same knee (bilateral UKA) when the disease affected more than one compartment. As the use of TKA increased, the surgeons quit using bilateral UKA's as well as hinges, linked and stabilized implants in other than difficult primary cases, trauma, malignancies and revisions. Today, uncomplicated primary cases are mainly treated with TKA although UKA are sometimes used in unicompartmental arthritis. The use of UKA diminished constantly between 1990 and 2015 after which its use has increased somewhat again. UKA being used on the lateral side has been uncommon since the mid-nineties. The reason for the diminished use of UKA may be that as compared to TKA it has higher risk of revision (see figures on page 24). However, it has to be kept in mind that in an UKA, only one compartment in the knee is resurfaced. Thus, as the un-resurfaced compartments



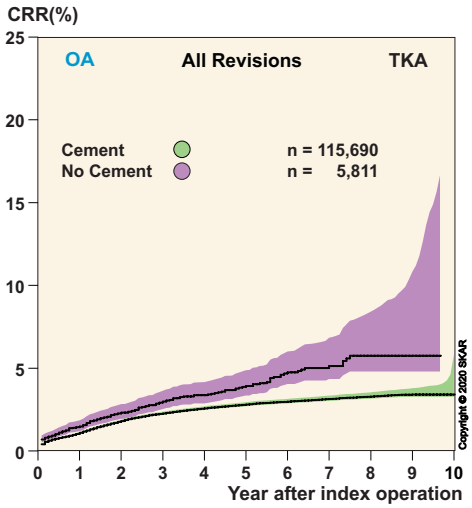
The relative yearly distribution of implant types used for primary surgery.

of the knee may be affected by disease this it can be tempting to offer a revision of an UKA to a TKA in patients with knee pain of unclear reason. However, an advantage of the UKA is that the risk of revision for infection is considerably lower than for TKA (RR 0.5) as well as the need for revision with stabilized implants, arthrodesis or amputation (see page 39).

Use of bone-cement – As the figure below shows, bone cement has been used for the majority of arthroplasties since the nineties. Vi have previously shown an analysis of total knees inserted during 1985-1994 when use of uncemented implants was more common in which the uncemented implants had a higher risk of revision. During the latest 10-year period we now also see that the uncemented TKAs have a significantly higher risk than the cemented. The figure to the right shows the CRR without adjustment for differ-



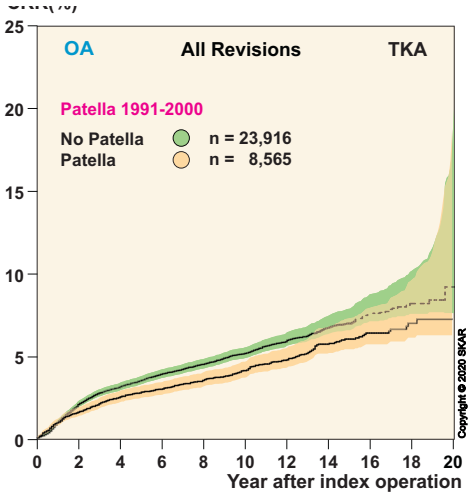
The relative yearly distribution regarding the use of cement for fixation.



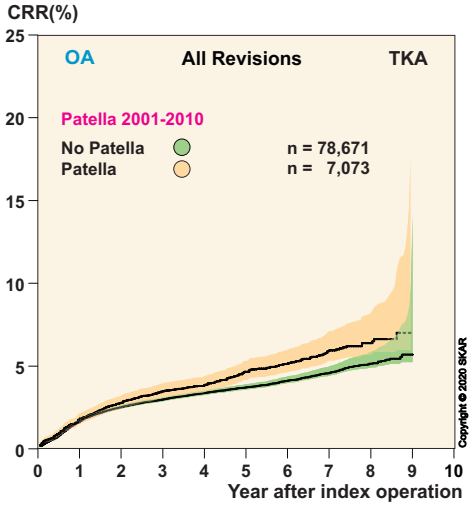
CRR for TKA/OA inserted with and without cement during the 10-year period 2009-2018.

ences in age. However Cox regression, adjusting for age and gender also shows a significantly increased risk (RR 1.2 (CI 1.1-1.4). It has to be noted that 72% of the uncemented cases were performed at the same hospital and 73% used the same implant brand. Additionally, loosening was not found to be a more common reason for revision among the uncmented cases. It is therefore possible that other factors than the fixation of the implant are playing a role.

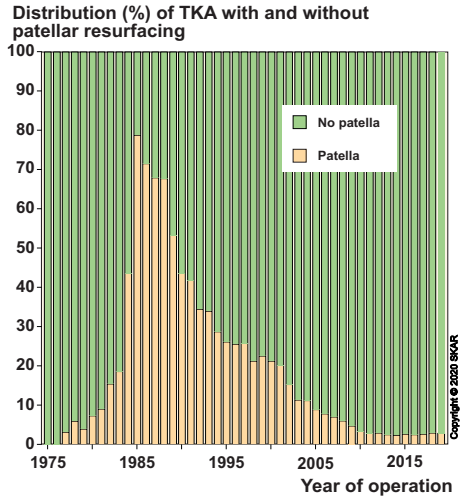
Patellar resurfacing in TKA – Estimating how the use of a patellar button affects the revision rate is complex. The use of a patellar button varies with the brand of prosthesis used and its usage has also decreased in recent years. During the eighties, when patellar button was used in just over half of the cases, its use had a negative effect on the revision rate. Since then its use has diminished so that it was only used in 2.7% of the TKA cases in 2019 (see figure right). In our 2002 annual report (for the period 1991-2000) we observed for the first time that TKA with a patellar button had a lower risk of revision than those without. The figure below shows the 10-year CRR for TKA inserted during that period where TKA without a patellar button had a significantly higher risk of revision than those without (RR x 1.3 (CI 1.1-1.4)).



CRR for TKA/OA inserted during the 10-year period 1991-2000, with and without patellar component respectively. TKA without patella has a higher CRR



CRR for TKA/OA inserted during the 10-year period, 2001-2010 with and without patellar component respectively. TKA with patella has a higher CRR.



The figure shows the yearly distribution regarding the use of patellar button in TKA.

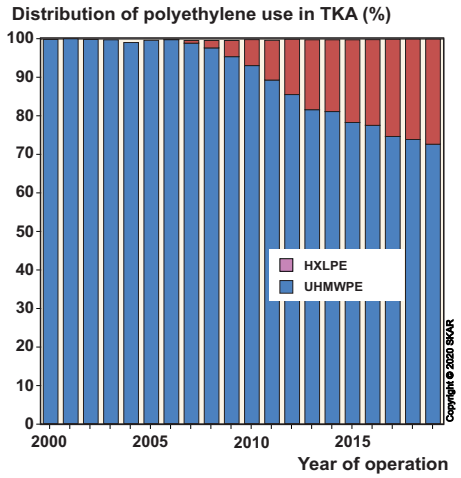
In contrast, an analysis of the period 2001-2010 (figure left, below) shows that TKA without a button have a lower risk than those with a button (RR x 0.8 (CI 0.7-0.9)). This was also the case for the period 2008-2017 in last year's report. However, for the current period 2009-2018 the risk difference is not significant (RR x 0.9 (CI 0.7-0.1)).

One can only speculate on the reasons for these variations in findings. The insertion of the button takes time and there is an additional component that has to stay fixed to bone and that can wear. This increases the possibility of infection, loosening and wear. Thus, changes in the quality of the poly as well as fixation may explain changes in CRR over time. On the other hand, a number of TKA without a button will be revised to have a secondary one due to patellar pain. Thus, more "patellar friendly" femoral components or changes in the surgeons belief concerning the benefit of patellar additions may also help explaining the observed inconsistency.

It may be debated if one should take the use of patellar button into consideration when units and implants are compared with respect to risk of revision. We have decided to show in the figures the total CRR of all TKA together (with and without a button) giving a general picture of the results for certain groups of patients and implants. When comparing the risk-ratios of implants (page 48-51), we separately account for the results of TKA with, and without a button and when comparing the risk of revision for the different hospitals (page 56-59), we include the use of patellar button in the regression analysis.

Types of polyethylene – As can be seen from the figure to the right, the Swedish orthopedic surgeons started relatively late to replace the standard UHMWPE polyethylene with the newer highly crosslinked types (HXLPE). In 2006 when the new poly variants were introduced for TKA in Sweden, they were already being used for a quarter of all TKA cases in Australia according to the 2019 annual report of the AOANJRR (https://aoanjrr.sahmri.com).

96 percent of the implants that used highly crosslinked polyethylene through 2019 were Triathlon (X3 poly) and PFC (XLK poly). So far, we at the Swedish Knee Arthroplasty Register have not seen any signs of reduction of the revision frequency for those Triathlon or PFC implants using HXLPE polyethylene. However, the AOANJRR has previously reported a lower revision frequency for HXLPE poly (Steiger et al. 2015) but the effect was dependent on the brand used and was true for NexGen and Natural II knees but not for the Triathlon or Scorpio NRG. They had no information on the PFC.



The yeary distribution in use fo the older UHMWPE poly and the newer highly crosslinked poly (HXLP)

It is important to realize that the methods used to increase the durability of the different polyethylene types by radiation and/or doping by antioxidants are different and it still remains to be seen how the revision rate will be affected in the longer term.

Implant model (brand) – The implant model is what generates the most interest and which is most often connected to the results of knee arthroplasties. As can be seen from what has been said previously, the results are not only affected by the model or design of the implants but also by other factors such as the so called "case-mix". In the analyses, we try to limit the effect of the case-mix on results by adjusting for factors such as diagnosis, gender, age and the time period during which the operations were performed. However, there is a multitude of patient related factors that we do not adjust for, such as grade of joint disease, activity, expectations and socioeconomic factors just to mention a few.

An additional important factor, which the register is unable to adjust for, is the surgical routine of the individual surgeons. It is obvious that surgeons may be more or less competent with respect to arthroplasty surgery, which may influence the results for specific models, especially if use of that model has been limited to a few surgeons or hospitals. Just as it may be claimed that deviating results are being influenced by surgical skill, it could be debated if it is at all fair to account for the results of specific models.

Responding to this, we can only say that the risk of revision for specific brands shows what its users could bring about with that particular model. The final result is determined by a combination of factors including design, material, durability, accompanying instruments, user-friendliness, safety marginal (how the implant behaves if it is not inserted exactly) together with the surgeons skill and training in using the instruments/implant as well as selecting the appropriate patients for the surgery. The producers together with the distributors have an opportunity to influence many of these factors. Therefore, it cannot be considered inappropriate to associate the model to the result, in spite of the outcome being affected not only by design, material and durability.

Historically, the most commonly used implants in Sweden have also been those with the lowest CRR. This may be due to a good design but also due to the increased surgical routine when the same implant is used often.

Models that have been found to have considerably inferior results have most often been withdrawn from the Swedish market. An exception is the Oxford implant that initially had inferior results but after modifications and increased training of surgeons showed improved results leading to continued use.

Type of operations and implants in 2019

Types of primary arthroplasties

	Number	Percent
Linked	63	0.4
TKA	14,977	88.5
UKA Medial	1,773	10.5
UKA Lateral	47	0.3
Fem-Pat	64	0.4
Partial (PRKA)	5	0.0
Total	16,929	100

In primary knee arthroplasty the TKA is the standard treatment which accounted for 88% of the surgeries in 2019 (table above). The use of UKA increased again and accounted for almost 11% of the cases. The use of femoro-patellar and especially partial implants is still very limited.
73 hospitals performing elective knee arthroplasties reported to the registry during 2019 which are all the hospitals performing elective knee arthroplasty surgery. Although a few reports may not yet have been turned in, their effect on the total number of operations is expected to be negligible. This report includes 16,929 primaries reported for 2019 which is 9,7% more than what had been reported last year for 2018 (15,430).

Primary TKA implants

	Number	Percent
NexGen MBT	7,563	50.5
PFC-MBT	2,916	19.5
Triathlon	2,217	14.8
Persona	567	3.8
Genesis II	400	2.7
NexGen TM	399	2.7
Legion/Gen II Prim	307	2.0
PFC-APT	301	2.0
Journey	19	0.1
Attune	10	0.1
PFC-RP	9	0.1
Other*	269	1.7
Total	14,967	100

*Mainly revision models (see separate table) except 10 knees for which part numbers are missing

As compared to last year, the number of TKA increased by 7.9%. As last year, 3 TKA brands dominate. NexGen from Zimmer was used in good half of the primaries, PFC from DePuy in almost 20% and Triathlon from Stryker in almost 15%. The use of other brands was less common.
The group "Others" mainly stands for revision models (see table right).

After having diminished for many years the use of UKA has increased since 2014 and accounted in 2019 for 10.8% of the primary knee arthroplasties. The Oxford model was used in 69% of the cases, which is approximately the same proportion as in 2018.

Primary UKA implants

	Number	Percent
Oxford	1 256	69.0
Link	250	13.7
ZUK	122	6.7
Triathlon-PKR	113	6.2
Sigma-PKR	34	1.9
Ibalance	24	1.3
Persona-PK	18	1.0
Missing	3	0.2
Total	1,820	100

Ordinary TKA implants, used with stems longer than 5 cm on either side, are defined as being revision models. Together with specific revision brands they are not included in our survival analyses for TKA's as such implants are mainly used for difficult cases and not for typical OA cases.

Besides these revision models, 63 linked implants were used for primary arthroplasty, mainly rotating hinges for treatment of malignancies, fractures and other difficult cases.

TKA revision implants for primary surgery

	Number	Percent
Triathlon revision	118	45.6
PFC Revision	78	30.1
NexGen Revision	47	18.1
Legion/Genesis II Rev.	16	6.2
Total	259	100

63 linked prostheses not included (29 NexGen RHK, 21 Link RHK and 13 other)

866 revisions were reported in 2019 of which 217 were secondary (not the first revision). In 687 cases the original surgery had been a TKA, in 152 an UKA, in 16 a linked implant, in 10 a Femoro-patellar implant and in one case a PRKA (button).
The annual report together with accompanying lists of reported surgeries are sent to the contact surgeons each year. This usually results in some extra revisions being reported. As a few missed revisions can have a large effect on the results and because revisions are complicated procedures for which supplementary information is often needed, our survival analyses end 2018.

The most common implants in the counties in 2019

The 3 most common TKA brands in the counties

	Model 1	n	Model 2	n	Model 3	n	Other
01 Stockholm	NexGen MBT	2,123	Triathlon	670	PFC Sigma MBT	115	219
03 Uppsala	PFC Sigma MBT	504	Rev. models	2	NexGen MBT	1	.
04 Södermanland	PFC Sigma MBT	259	NexGen MBT	111	Rev. models	9	8
05 Östergötland	Persona	321	Legion/Genesis II	111	NexGen MBT	76	4
06 Jönköping	NexGen MBT	746	Persona	11	NexGen TM	10	.
07 Kronoberg	PFC Sigma MBT	193	Rev. models	5	.	.	.
08 Kalmar	NexGen MBT	606	Rev. models	4	NexGen TM	2	.
09 Gotland	PFC Sigma MBT	115	Rev. models	2	.	.	.
10 Blekinge	NexGen MBT	239	Rev. models	1	.	.	.
12 Skåne	Triathlon	1,525	PFC Sigma MBT	241	NexGen MBT	101	138
13 Halland	NexGen MBT	694	NexGen TM	8	Persona	6	3
14 Västra Götaland	NexGen MBT	1,315	PFC Sigma MBT	787	Persona	165	82
17 Värmland	NexGen MBT	474	NexGen TM	21	.	.	.
18 Örebro	Genesis II	400	Journey	16	Rev. models	5	2
19 Västmanland	NexGen MBT	276	NexGen TM	94	Rev. models	4	.
20 Dalarna	NexGen MBT	268	NexGen TM	37	Persona	18	5
21 Gävleborg	PFC Sigma MBT	351	PFC Sigma APT	157	NexGen TM	10	1
22 Västernorrland	NexGen MBT	317	NexGen TM	49	Rev. models	3	.
23 Jämtland	NexGen MBT	133	NexGen TM	25	Triathlon	20	5
24 Västerbotten	Legion/Genesis II	187	NexGen MBT	81	NexGen TM	44	21
25 Norrbotten	PFC Sigma MBT	350	PFC Sigma APT	66	Rev. models	5	.

The table above shows for 2019 that 10 counties reported use of at least 3 TKA brands.8 counties reported 2 TKA brands and 3 counties only one brand (revision models are not included).

The 3 most common UKA brands in the counties

	Model 1	n	Model 2	n	Model 3	n	Other
01 Stockholm	Oxford	325	Link	122	Triathlon PKR	64	73
03 Uppsala	ZUK	9					
04 Södermanland	Oxford	134	ZUK	2			
05 Östergötland	Oxford	225	Sigma PKR	5	PartNo. Missing	1	
06 Jönköping	Oxford	27					
07 Kronoberg	Oxford	77					
08 Kalmar	Link	1					
09 Gotland							
10 Blekinge	Oxford	23					
12 Skåne	Link	63	Oxford	57	Triathlon PKR	36	6
13 Halland	ZUK	70	Oxford	30			
14 Västra Götaland	Oxford	96	ZUK	15			
17 Värmland	Oxford	36					
18 Örebro							
19 Västmanland	Triathlon PKR	13					
20 Dalarna	Oxford	62					
21 Gävleborg	Link	62	Oxford	1			
22 Västernorrland	Oxford	23					
23 Jämtland	Oxford	25					
24 Västerbotten	Persona PK	18	Link	2			
25 Norrbotten	Oxford	117					

The table above shows for 2019 that 10 counties reported 50 or more UKA's, 4 counties reported between 25 and 50 UKA's, and 5 from 1 to 22 procedures. No UKA procedures were reported from Gotland and Örebro.

Bone cement and minimally invasive surgery in 2019

Use of cement in primary surgery

	Primary TKA	Primary UKA
No component without cement	13,706	605
Only the femoral component without cement	21	42
Only the tibial component without cement	8	33
The femur- and tibial components without cement	1,220	1 133
Information on cemented parts missing	22	7
Total	14,977	1 820

	Primary TKA		Primary UKA	
	Number	Percent	Number	Percent
Optipac Refobacin (gentamicin)	7,119	51,7	252	37,1
Refobacin Bone Cement (gentamicin)	470	3,4	57	8,4
Palacos R+G Pro Prefilled (gentamicin)	4,792	34,8	174	25,6
Palacos R+G (gentamicin)	1,247	9,1	155	22,8
Smartset GHV Gentamicin	116	0,8	38	5,6
CMW w gentamicin	0	0,0	3	0,4
Copal (gentamicin+clindamycin)	7	0,1	0	0,0
Copal (gentamicin+vancomycin)	2	0,0	1	0,1
Refobacin Revision Cement (gentamicin+clindamycin)	7	0,1	0	0,0
Cement brand unknown	7	0,1	0	0,0
Subtotal	13,767	100,0	680	100,0
No information on cement being used	1,210		1,140	
Total	14,977		1,820	

Type of bone cement

In Sweden, the use of bone cement is the most common method for fixing components to the bone although uncemented fixation has increased somewhat in recent years. In 2019, 8% of the TKA's were uncemented and 0.2% were hybrids. However, in UKA uncemented fixation has increased much recently. In 2010 practically all UKA were cemented while in 2019 62% of the cases were uncemented and 4.1% hybrids. The reason is the popularity of the Oxford cementless type which accounted for 96% of the Oxford cases.

Practically all the cement used for the primary knee arthroplasties contained the antibiotic gentamicin.

Minimally invasive surgery (MIS)

For UKA, we have registered the use of miniarthrotomy since 1999. Our definition of MIS implies that the surgeon gains access to the knee joint by the use of a small arthrotomy (no specific length) without dislocating / everting the patella.
From the start of the registration in 1999, use of MIS in TKA has been infrequent while its use in UKA quickly increased, reaching maximum in 2007 when it was being used in 61% of cases. Some implants are more often used with MIS than others (see table below).
In 2019, 37% of the UKA and only 3.2% of the TKA were inserted using MIS.

The type of incision for 1,820 primary UKA's

	Standard incision	Mini-incision	Unknown
Oxford	649	605	2
Link	214	19	17
ZUK	112	9	1
Triathlon-PKR	92	21	0
Sigma-PKR	34	0	0
Ibalance	12	12	0
Persona-PK	11	7	0
Missing	2	1	0
Total	1,126	674	20

When MIS initally started to become popular in UKA there were signs that it was associated with a higher revision rate. However, this may have been caused by an initial learning curve as this tendency disappeared and with the present 18-year follow-up, we cannot see that miniarthrotomy negatively affects the overall revision rate.

The use of patella button for TKA in 2019

The use of patellar resurfacing has been decreasing since the mid-eighties so that it is now only used in 2.8% of the TKA cases. During 2019 a button was most commonly used in the counties of Gävlsborg and Västerbotten but not at all in Uppsala, Blekinge, Värmland and Västmanland (see figure below).

It is not only in Sweden that geographical variations are to be found. The Australian arthroplasty register in the 2009 annual report also found substantial regional differences in the use of patellar buttons (https://aoanjrr.sahmri.com/home).

In Sweden, the use of a patella button has also been heavily related to the implant brand used although this effect has diminished as its use has become more uncommon. In 2019, a button was most often used in primary arthroplasty together with the Legion/Genesis II and PFC.

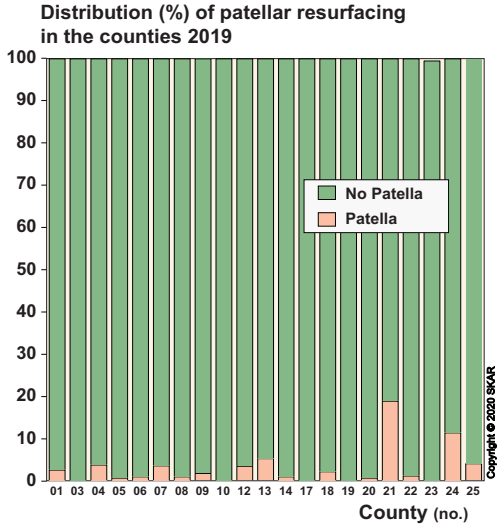
In Sweden, females have their patella resurfaced slightly more often in TKA than males. Thus, in the whole material, from 1975 to the end of 2019, 11.5% of the women had their patella resurfaced compared to 8.2% of the men, which is a significant difference. It has been attempted to explain this difference by femoro-patellar pain being more common in women. In 2018, 2.3% of the men had a patella button compared to 3.1% of the women which also is a significant difference.

Use of patella button with different TKA implants

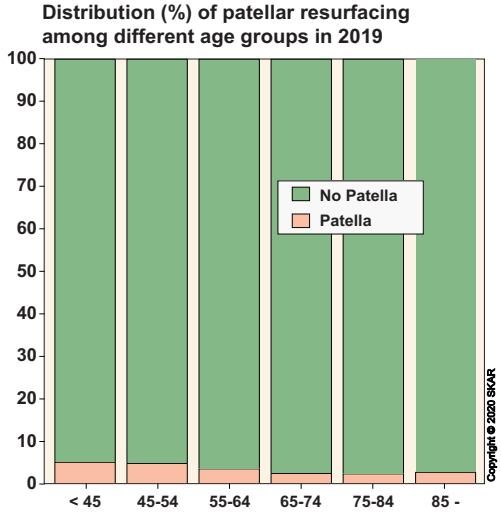
	No patella button	%	Patella button	%
NexGen MBT	7,435	98.3	128	1.7
PFC-MBT	2,769	95.0	146	5.0
Triathlon	2,158	97.3	59	2.7
Persona	560	98.8	7	1.2
Genesis II	391	97.8	9	2.3
NexGen TM	386	96.7	13	3.3
Legion/Genesis II	285	92.8	22	7.2
PFC-APT	292	97.0	9	3.0
Journey	18	94.7	1	5.3
Attune	10	100.0	0	0.0
PFC-RP	8	88.9	1	11.1
Missing	10	100.0	0	0.0
Others*	241	92.7	19	7.3
Total	14,563	97.2	414	2.8

*Revision models

Looking at the relative use of patella button among the different age groups in 2019 (see figure below), it can be seen that patellar resurfacing is slightly more common in the youngest age groups. However, the proportions have varied in recent years because the low number of young patients. How the risk of revision is influenced by the use of a patella button is discussed on page 27 where CRR curves can be found illustrating how its effect has changed over time.



The figure shows the relative proportion of TKA with and without patella button in the different counties. (a list and a chart for the counties is on page 20 and a list on page 36).



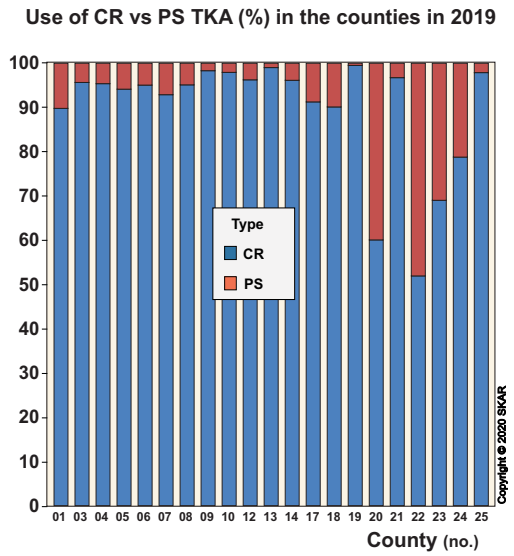
The figure shows the relative proportion of TKA with and without patella button in the different age-groups.

Posterior stabilized prostheses during 2019

As explained on page 4, there are TKA types called posterior stabilizing (PS) as they simulate the effect of the posterior cruciate ligament by an eminence in the middle part of the tibial polyethylene that is contained by a box between the medial and lateral sliding surfaces in the femoral component. The construct limits the anterior posterior slide but allows for some rotation. The type assumes resection of the posterior cruciate ligament if present.

Those advocating the use of PS claim that it allows for better flexion and more normal knee movement than the cruciate retaining (CR) type which spares the posterior cruciate ligament.

The disadvantage of PS is that the increased stability may result in increased stress on the polyethylene as well as the bone surfaces and thus theoretically increase the risk of wear and loosening. The use of PS is common in other countries such as the USA. However, in Sweden surgeons have hitherto preferred using the CR implants at least for knees with intact posterior cruciate and without gross deformity.

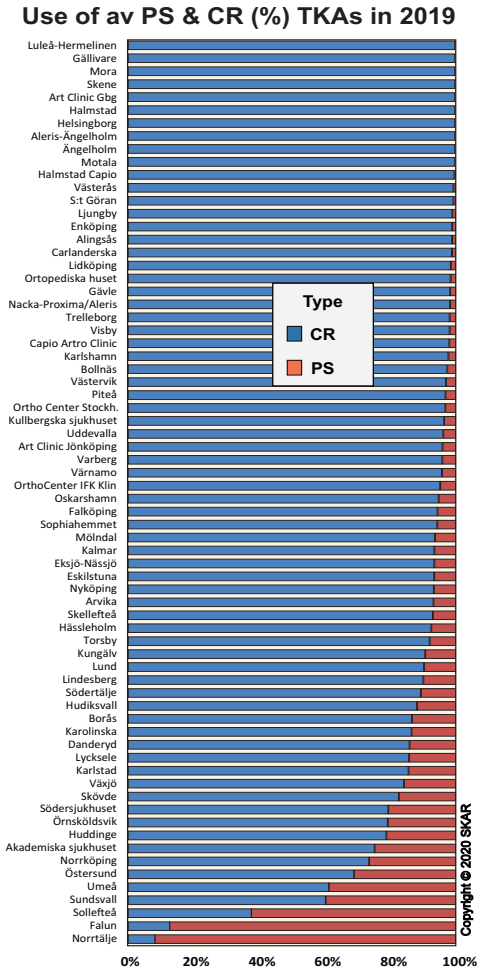


The figure shows the relative use of CR and PS implants in the different counties.

As can be seen from the figure above, the counties are different with respect to their use of PS implants. During 2019, PS implants were most commonly used in 4 counties; Dalarna, Västernorrland, Jämtland and Västerbotten (a list and a chart for the counties can be found on page 20 and a list on page 36).

During 2019, 8% of the primary TKAs were PS (including revision and stemmed implants). The proportion has increased since the turn of the millennium when it was used in 1% of cases.

As can be seen from the figure below the use of PS knees varies among the hospitals with no unit exclusively using PS implants, 3 units using PS for more than 50% of cases and 10 exclusively using CR implants.



The figure shows the relative use of CR and PS implants in the different hospitals.

We do not have any good explanation why the use of PS implants differs so much among the hospitals. Common for those 3 that mostly used PS knees was that they used the NexGen MBT or TM implant (see table on next page). However, in the whole country, 91% of the NexGen MBT implants and 73% of the NexGen TM implants were of the CR type. (cont.)

Posterior stabilized prostheses cont. –
There was no significant difference in use of PS implants depending on gender. The relative use of PS implants in the different age groups was relatively similar although PS was more common in the youngest and oldest age groups (see figure right).

The relative proportion of CR and PS implants among the brands used for primary TKA in 2019

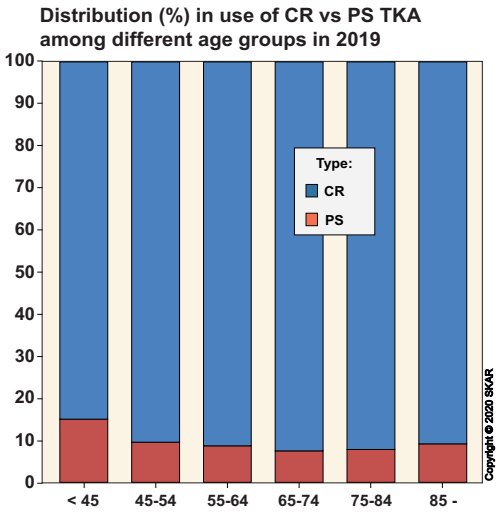
	CR	%	PS	%
NexGen MBT	6,862	90.9	690	9.1
PFC-MBT	2,809	96.5	101	3.5
Triathlon	2,203	99.4	14	0.6
Persona	567	100.0	0	0.0
Genesis II	332	94.3	20	5.7
PFC-HPT	301	100.0	0	0.0
NexGen TM	291	72.9	108	27.1
Legion/Genesis II	258	84.0	49	16.0
Others	78	28.9	192	71.1
Attune	10	100.0	0	0.0
Journey	3	17.6	14	82.4
PFC-RP	1	11.1	8	88.9
Totalt	13,715	92.0	1,196	8.0

Unfortunately it is not straight forward to compare the results of CR and PS implants. The reason is that because of their greater stability, many surgeons reserve the use of PS knees for cases having insufficient ligaments and/or greater deformity.

Even though some hospitals exclusively use one or the other type, the comparison is not straightforward as it is possible that more difficult cases are referred from hospitals exclusively using CR knees to hospitals that have more experience with PS knees.

An additional complicating factor is that the use of PS knees is more common in some implant brands as compared to others (see table above).

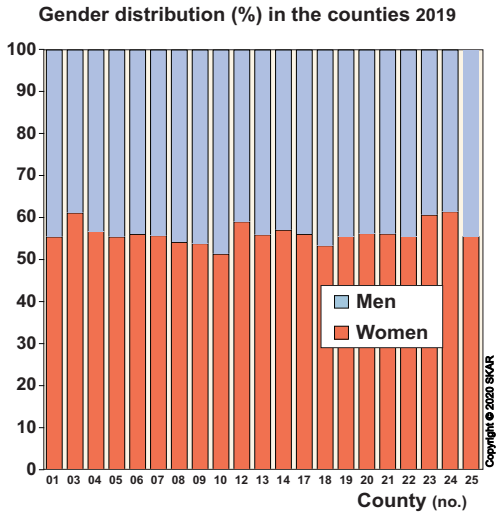
It is probably necessary to perform a randomized trial in order to estimate the differences in survival between the types.



The figure shows the relative use of cruciate retaining (CR) and posterior stabilized (PS) implants among the different age groups.

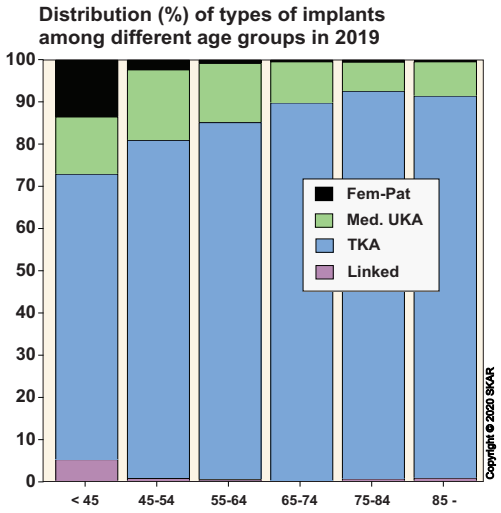
Please note that tibial components that in order to increase stability use an anterior lip or an extra concave polyethylene (deep dish) are not considered being PS implants. Some can be used both with an intact cruciate ligament as well as when the cruciate is insufficient or absent. However, there are several versions having different degree of conformity and in Sweden relatively few of the more stabilizing versions for substituting the posterior cruciate ligament have been used.

Gender distribution in the counties



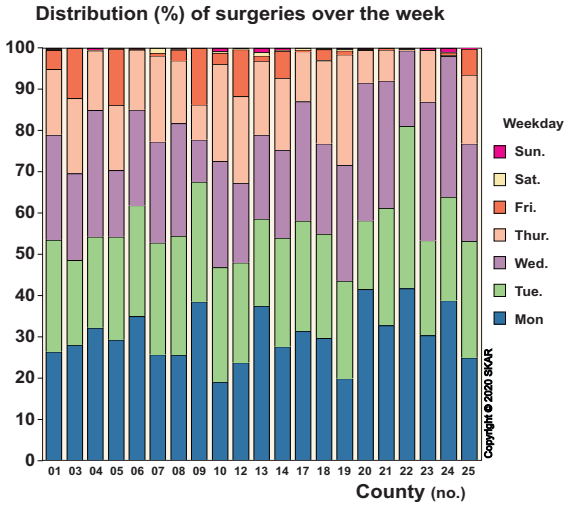
The proportion of females having surgery in the different counties was similar, varying between 51.3% and 61.6% .

Type of implants in different age groups

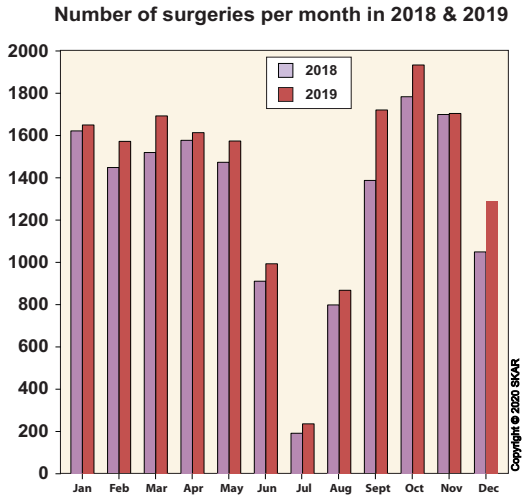


Uncommon models are most often used in younger patients. The use of linked implant in primaries is limited, but these are mainly used for serious conditions (tumors. trauma etc.)

Distribution of primary surgery on weekdays and months



Distribution of surgery on weekdays during 2019. Surgery on Fridays and weekends is uncommon.



The mean number of primary knee arthroplasties inserted each month.

Knee arthroplasty is not often performed on Fridays and weekends. Among other, the reasons are reduced working hours on Fridays as well as reduced means for rehabilitation in combination with reduced number of available hospital beds during weekends. This results in arthroplasty surgery being concentrated during the first part of the week so that the patients can be discharged not later than Friday.

All the counties perform at least 86% of their surgeries Monday to Thursday. Skåne, Gotland and Uppsala are the counties performing the highest proportion of their surgeries on Fridays.

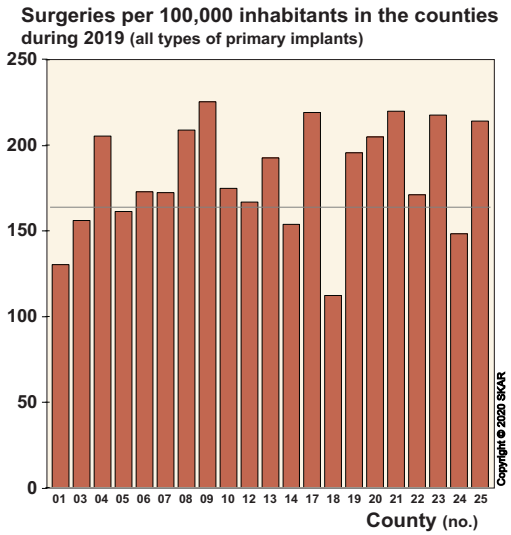
The figure above shows the number of surgeries during the different months of 2018 and 2019. It is evident how the production drops during the summer as around Christmas.

Age distribution and incidence in the counties 2019

County, number of inhabitants and incidence in 2019

Nr	County	No. of inhabitants	no. of primaries	Incidence/ 100.000
01	Stockholm	2,360,603	3,083	130.6
03	Uppsala	380,034	593	156.0
04	Sörmland	296,118	608	205.3
05	Östergötland	463,539	748	161.4
06	Jönköping	362,212	626	172.8
07	Kronoberg	200,678	348	173.4
08	Kalmar	245,058	512	208.9
09	Gotland	59,468	134	225.3
10	Blekinge	159,645	279	174.8
12	Skåne	1,369,996	2,287	166.9
13	Halland	331,600	640	193.0
14	Västra Götaland	1,717,848	2,649	154.2
17	Värmland	281,948	624	221.3
18	Örebro	303,529	385	126.8
19	Västmanland	274,887	543	197.5
20	Dalarna	287,579	592	205.9
21	Gävleborg	286,965	633	220.6
22	Västernorrland	245,400	422	172.0
23	Jämtland	130,545	285	218.3
24	Västerbotten	270,945	403	148.7
25	Norrbotten	250,295	535	213.7
Country		**10,278,887**	**16,929**	**164.7**

(mean yearly no. of inhabitants: www.scb.se)

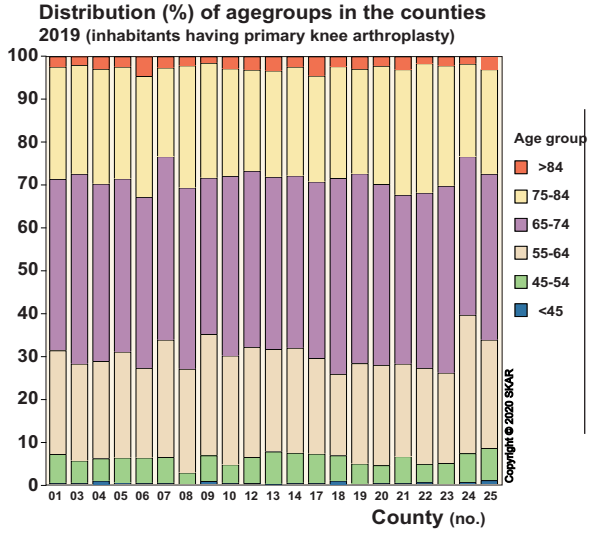


Incidence (no. of arthroplasties per 100.000 inhabitants)

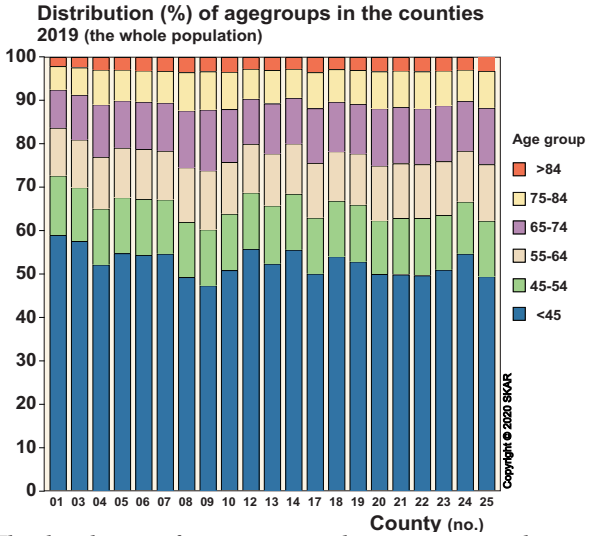
The table and figure above show the number of primary knee arthroplasties per 100,000 inhabitants in each county in 2019. They are based on the domicile of patients at surgery. The incidence (not age-standardized) is highest in Gotland and Värmland county and lowest in the county of Örebro.

The figure below shows for each county, the relative proportion of age groups having a primary arthroplasty. The proportion of patients less than 65 years of age was highest in Västerbotten but lowest in Jämtland. Jönköping and Gävleborg had the highest proportion of patients 75 years and older.

How many younger or older inhabitants have surgery is partially affected by how many they are. The figure below as well as the table next page show for each county the relative proportion of inhabitants in each of the age groups. It can be seen that Stockholm county has the highest proportion of inhabitants less than 45 years of age (59%) while Gotland has the highest proportion of those 65 years and older (26%). When the 2 figures are compared, a correlation can be seen between the number of inhabitants in the different age groups and of those having surgery, although the correlation is not always consistent.



The agedistribution at primary surgery varies somewhat between the counties.



The distribution of age-groups in the counties according to information from the SCB (Statistics Sweden)

Age standardized incidence in 2019

Distribution (%) of age groups in the counties in 2019 (whole population)

Age group:	0-44	45-54	55-64	65-74	75-84	85-
01 Stockholm	58.9	13.7	11.0	8.8	5.5	2.1
03 Uppsala	57.5	12.4	11.0	10.4	6.3	2.4
04 Södermanland	52.1	12.9	12.0	12.2	7.9	3.0
05 Östergötland	54.8	12.8	11.4	10.9	7.2	2.9
06 Jönköping	54.3	12.9	11.5	10.9	7.2	3.2
07 Kronoberg	54.6	12.5	11.2	11.2	7.3	3.3
08 Kalmar	49.2	12.7	12.6	13.2	8.8	3.5
09 Gotland	47.3	13.0	13.7	14.0	8.8	3.3
10 Blekinge	50.8	13.0	11.9	12.2	8.6	3.4
12 Skåne	55.7	13.0	11.3	10.5	6.9	2.7
13 Halland	52.3	13.4	12.0	11.6	7.7	3.1
14 Västra Götaland	55.5	13.0	11.6	10.5	6.7	2.7
17 Värmland	50.0	13.0	12.6	12.6	8.3	3.5
18 Örebro	54.0	12.8	11.4	11.4	7.5	2.8
19 Västmanland	52.8	13.1	11.8	11.5	7.7	3.1
20 Dalarna	49.9	12.5	12.6	13.2	8.5	3.3
21 Gävleborg	49.8	13.1	12.6	13.0	8.4	3.2
22 Västernorrland	49.6	13.1	12.5	12.9	8.5	3.3
23 Jämtland	50.9	12.6	12.4	12.9	8.0	3.2
24 Västerbotten	54.6	12.0	11.7	11.5	7.3	2.9
25 Norrbotten	49.4	12.9	13.0	13.0	8.5	3.2
Country	54.9	13.1	11.6	10.8	6.9	2.8
ESP (European Standard Population)	54.0	14.0	12.5	10.5	6.5	2.5

The age distribution differs in the counties (table above from the SCB). For a meaningful comparison of incidence, i.e. how common it is for the inhabitants of the counties of having knee replacement, the age distribution has to be taken into account because a younger population does not have the same need for arthroplasties as an older one. This can be achieved by age standardization in which the incidence is recalculated to what it would have been if the age distribution had been the same in all the counties.

To make it possible to compare different countries we used a 2013 recommendation to the European Commission on a new ”EU-27 + EFTA standard population” (Report of Eurostat’s task force ISBN 978-92-79-31094-2).

The distribution of age groups according to this European standard population is shown in the last line of the table above and the age standardized incidence in the table to the right.

It can be seen that the age-standardized incidence is lowest 120.2 in Örebro county and highest 215.9 in Jämtland. In 2018 Örebro also had the lowest incidence while Gävleborg, which this year has the fourth highest incedence, was at the top.

In 2015 Uppsala had 50% higher incidence than Stockholm but the 2 counties have since 2016 had roughly the same incidene.

We have really no good explanation for the large differences between counties in how often their inhabitants are provided with a knee arthroplasty or the variation between years.

Age standardized incidence in the counties
(primaries per 100.000 inhabitants in 2019)

Nr	County	Incidence
01	Stockholm	152.2
03	Uppsala	164.3
04	Södermanland	185.9
05	Östergötland	158.9
06	Jönköping	167.7
07	Kronoberg	171.0
08	Kalmar	203.9
09	Gotland	183.9
10	Blekinge	155.1
12	Skåne	170.2
13	Halland	180.1
14	Västra Götaland	156.4
17	Värmland	192.2
18	Örebro	120.2
19	Västmanland	184.8
20	Dalarna	174.2
21	Gävleborg	188.5
22	Västernorrland	146.3
23	Jämtland	215.9
24	Västerbotten	145.2
25	Norrbotten	183.4
	Country	163.7

Implants for primary arthroplasty 2009–2018

In the tables below, the implants used during the investigated period 2009-2018 are listed. One must observe that the individual models, especially in case of modular types, may include several different implant variants. During the 10-year period, NexGen was the most commonly used model, followed by the PFC and Triathlon. Vanguard in fourth place was not registered at all during 2018-19.

Implants for primary TKA

	Number	Percent
NexGen MBT	56,217	44.2
NexGen APT	2,279	1.8
NexGen TM	1,925	1.5
NexGen unscpecified	1	0.0
PFC Sigma MBT	22,820	18.0
PFC Sigma APT	11,144	8.8
PFC Sigma RP	668	0.5
PFC Sigma unscpec.	24	0.0
Triathlon MBT	13,003	10.2
Triathlon-APT	97	0.1
Triathlon unscpec.	1	0.0
Vanguard I-Beam	7,879	6.2
Vanguard Finned	2 053	1.6
Vanguard-XP	26	0.0
Vanguard-unscpec.	18	0.0
Genesis II	1,766	1.4
GenesisII/Legion Pri	1,249	1.0
AGC	1,368	1.1
Profix	1,297	1.0
Duracon	541	0.4
Persona	232	0.2
Journey	186	0.1
Attune	115	0.1
Link-Gemini_TKA	68	0.1
Other (revision models)*	1,957	1.5
Model missing	126	0.1
Total	127 060	100

* For "Other" (revision) models. see table right.

Among the UKA's, 2 models accounted for the majority of surgeries during the period.

Implants for primary UKA

	Number	Percent
Oxford	4,435	57.7
Link	1,359	17.7
ZUK	966	12.6
Triathlon PKR	390	5.1
Genesis UKA	162	2.1
Sigma PKR	161	2.1
MillerGalante	136	1.8
Persona-PK	42	0.6
Ibalance UKA	26	0.3
Preservation	7	0.1
Model missing	6	0.1
Total	7,690	100

Implants that are specifically made for use in revision surgery or standard models with extra-long stems (5 cm or longer) are classified as revision models. When used for primary surgery they are excluded from the analyses concerning standard models. The same applies for hinges and linked implants. The most common types are listed below.

Revision Models* for primary TKA

	Number	Percent
Triathlon revision	607	31.0
NexGen revision	583	29.8
PFC revision	521	26.6
Vanguard-revision	114	5.8
Legion/GenesisII rev	65	3.3
Profix-Revision	35	1.8
AGC revision	21	1.1
Duracon revision	11	0.6
Total	1,957	100

* "Revision models" are implants made specifically for revisions. or ordinary models with extra long stems (longer than 5 cm).

Hinged implants (primary)

	Number	Percent
NexGen RHK	232	38.3
Link-Endo RHK	205	33.9
MUTARS Tumor impant	43	7.1
S-ROM Noiles RHK	33	5.5
Stryker/Howmedica RHK	33	5.5
METS	30	5.0
Smith&Nephew HK	8	1.3
Stanmore	7	1.2
Biomet RHK	6	1.0
Other	5	0.8
Model missing	3	0.5
Total	605	100

Femoro-patellar implants are uncommon. Only 496 cases using 6 different brands were reported during the 10 year period.

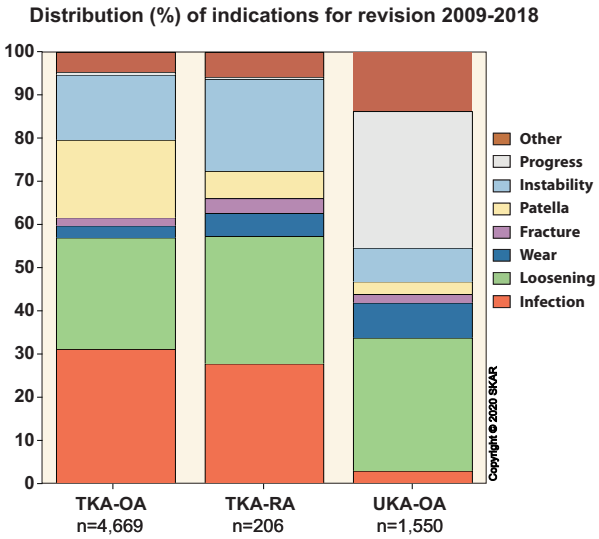
Femoro-Patellar implants

	Number	Percent
Zimmer P-F	341	68.8
PFC P-F	79	15.9
Avon	51	10.3
Link P-F	12	2.4
Vanguard P-F	6	1.2
Journey P-F	4	0.8
Model missing	3	0.6
Total	496	100

Revisions during 2009–2018

During the 10-year period, 6,906 first time revisions were performed. In 93 cases the primary was a linked implant, in 5,124 cases a TKA, in 1,612 an UKA, in 74 a P-F implant and in 3 a partial implant (PKRA). The reasons for the revisions in which the primary was a TKA/OA, TKA/RA and UKA/OA are shown in the figure to the right. Note that some primary operations may have been performed before the accounted 10-year period. After TKA/OA, infection is now a more common reason for revision than loosening which previously dominated. "Progress" in TKA mainly reflects revisions performed for femoropatellar arthrosis/arthritis. "Patella" includes all kinds of problems associated with the patella in patients that had their primaries inserted with or without a patellar button (excluding loosening and wear). Please note that the distribution of the indications does not have to reflect the risk for revision. The sharp increase in the number of primaries over the years leads to overrepresentation of early revisions that include infection.

The tables show the different types of revisions (first) that were performed during 2009-2018. There



are separate tables depending on if the primary surgery was TKA/OA, TKA/ RA or UKA/OA. It should be noted that in revision surgery, only one type of revision can be stated. This implies that exclusive patellar surgery is listed, but not patellar surgery done in combination with exchange of other components.

For TKA the proportion of revisions in which the poly is exchanged has increased as compared to previously (28% in OA and 25% in RA) which is because of increased aggressively in revision of early infections. Extensive revisions using linked implants seem more common in RA.

For UKA, it is satisfying to note that no revisions are with a completely new UKA, as these types of revisions have been found to have a very high rate of re-revision.

Type of revision in which the primary was a TKA/OA

	Number	Percent
Linked (rot. hinge)	441	9.4
TKA	1,288	27.5
Exchange of femur comp.	49	1.0
Exchange of tibia comp.	263	5.6
Exchange of disc/insert	1,329	28.3
Patella addition	839	17.9
Patella removal	9	0.2
Patella exchange	23	0.5
Total implant removal	404	8.6
Arthrodesis	6	0.1
Amputation	32	0.7
Other	5	0.1
Missing	3	0.1
Total	4,691	100

Type of revision in which the primary was a UKA/OA

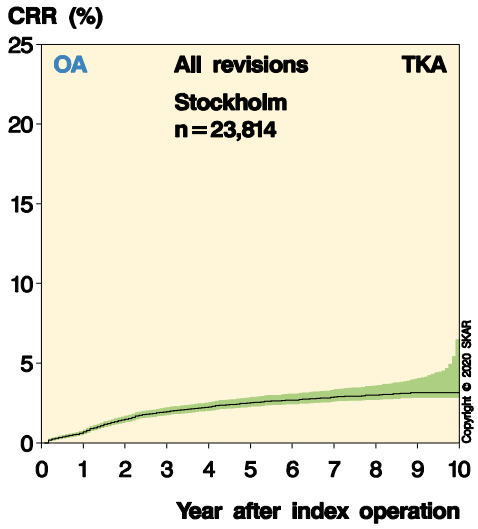
	Number	Percent
Linked (rot. hinge)	31	2.0
TKA	1,400	89.6
UKA	2	0.1
Exchange of femur comp.	5	0.3
Exchange of tibia comp.	10	0.6
Exchange/reposition of poly	90	5.8
Patella addition	4	0.3
Total implant removal	17	1.1
Amputation	2	0.1
Missing	1	0.1
Total	1,562	100

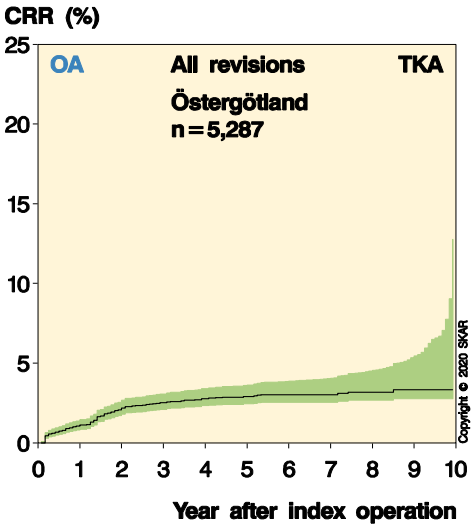
Type of revision in which the primary was a TKA/RA

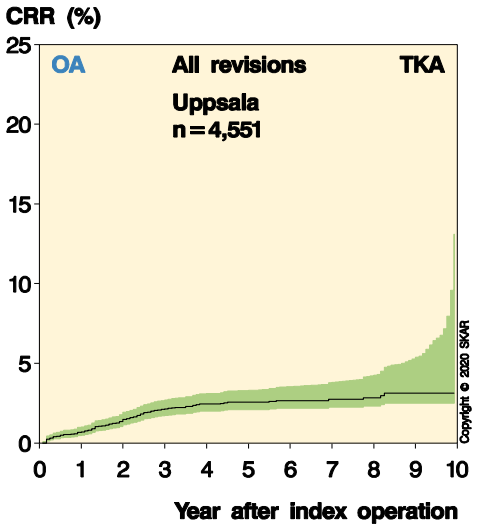
	Number	Percent
Linked (rot. hinge)	46	22.3
TKA	54	26.2
Exchange of femur comp.	6	2.9
Exchange of tibia comp.	4	1.9
Exchange of disc/insert	51	24.8
Patella addition	15	7.3
Total implant removal	22	10.7
Arthrodesis	1	0.5
Amputation	7	3.4
Total	206	100

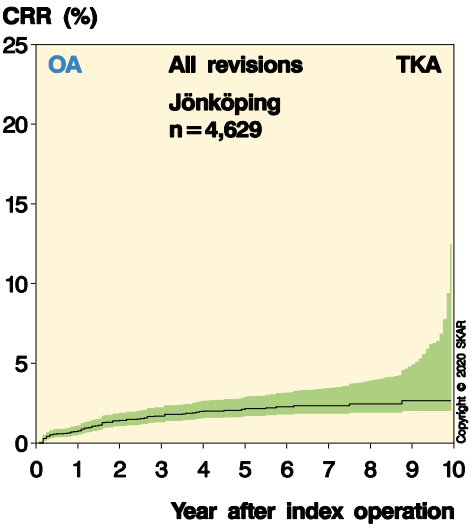
When evaluating the survival curves it should be noted that as the part of the curve to the right contains implants with long follow-up it also to a larger extent reflects older models.

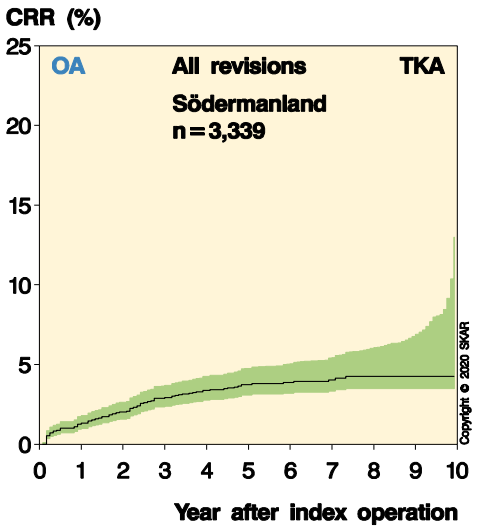
CRR in the counties after primary TKA for OA 2009–2018

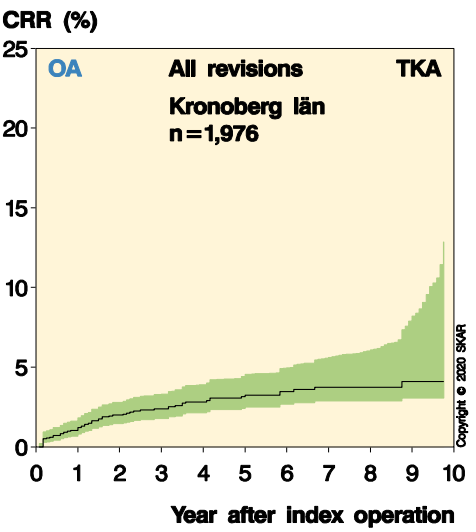




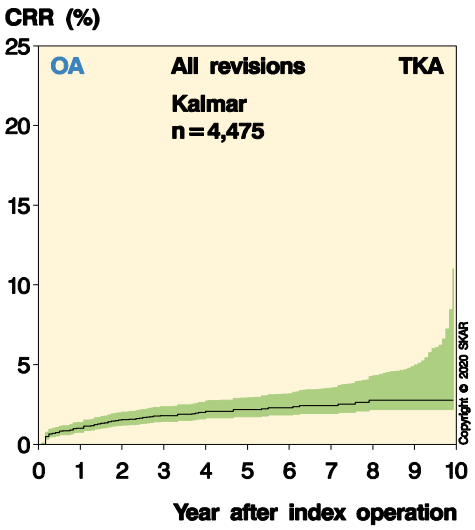


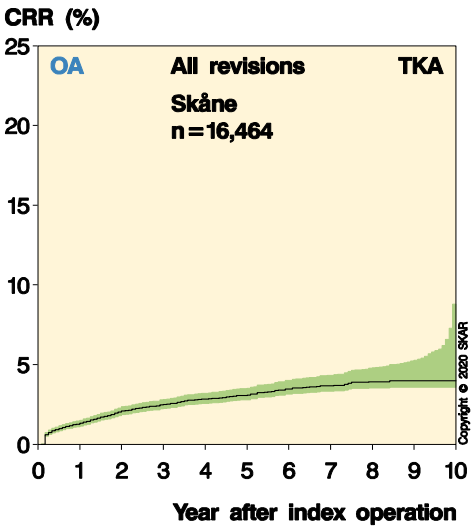


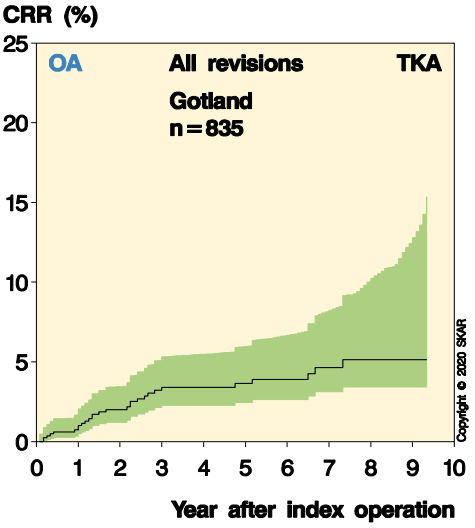


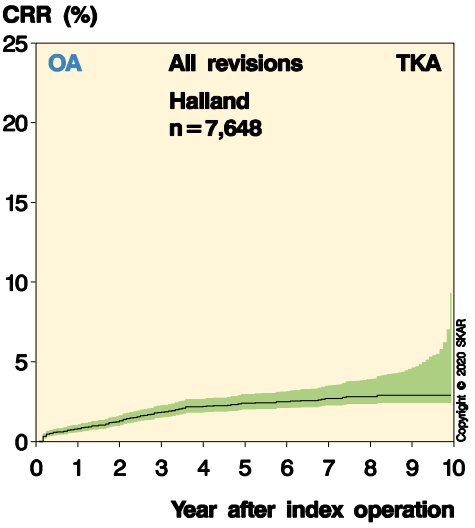


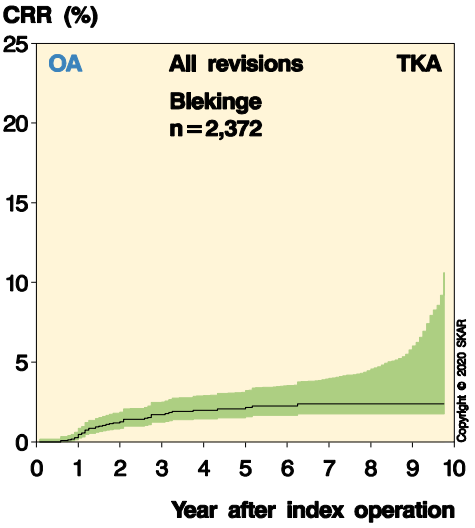
The curves are cut when less than 40 patients are left "at risk"

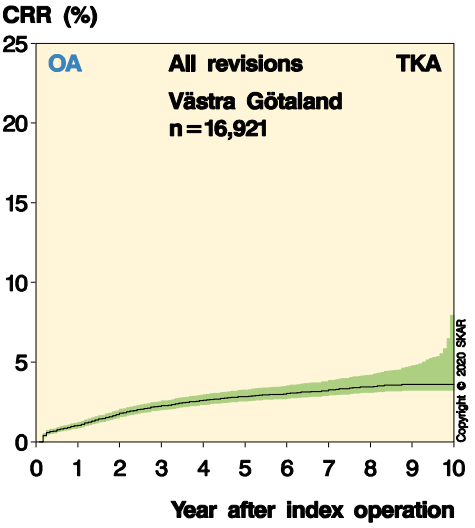






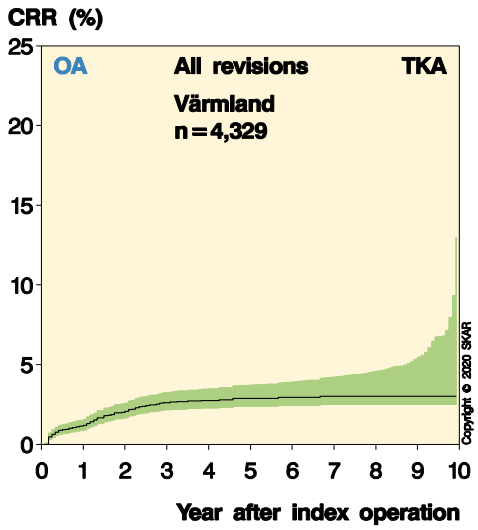


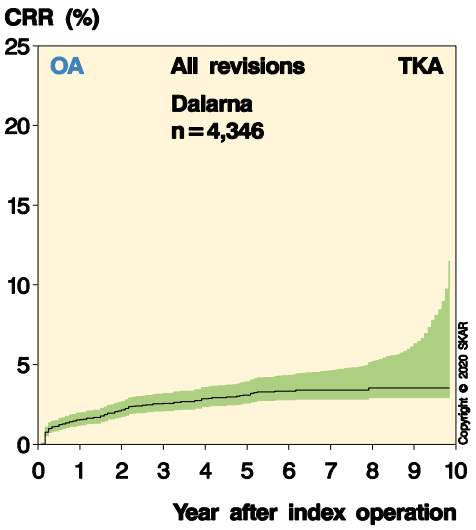


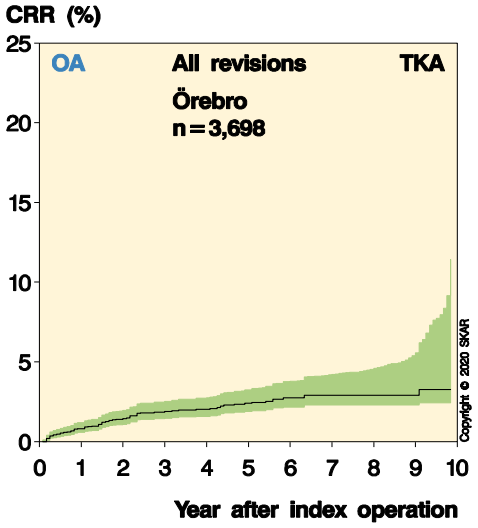


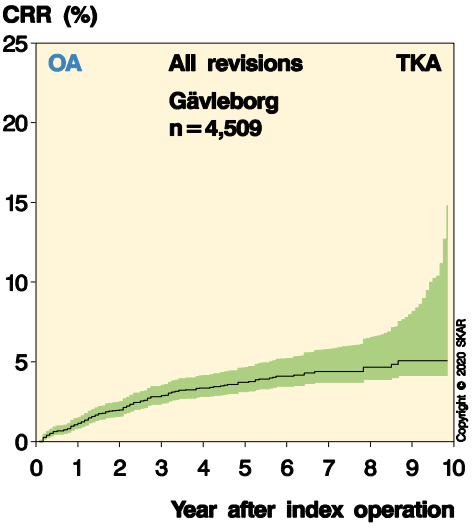
The curves are cut when less than 40 patients are left "at risk"

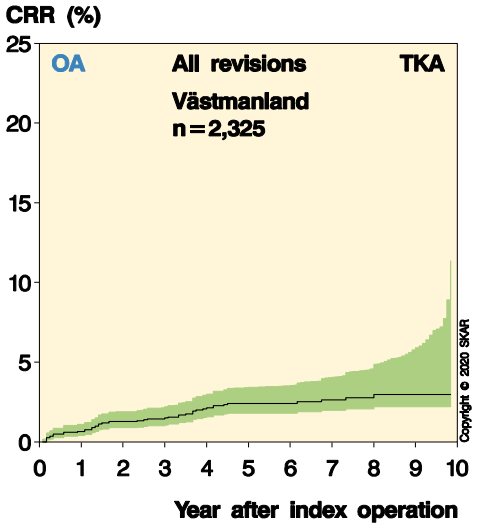
CRR in the counties after primary TKA for OA 2009–2018

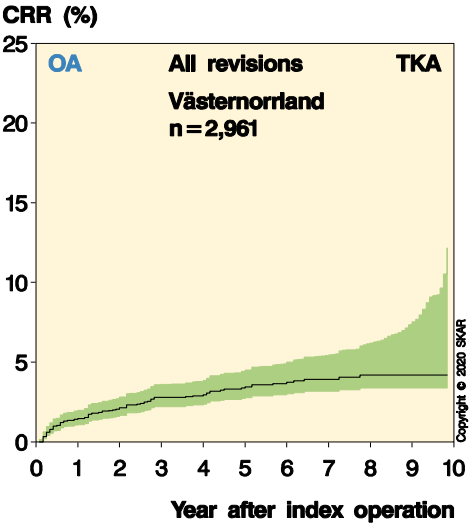




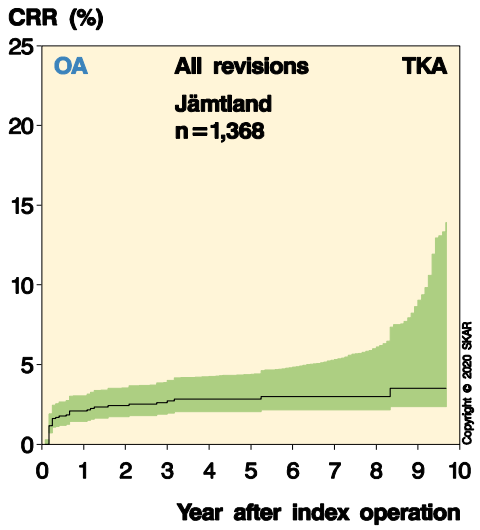


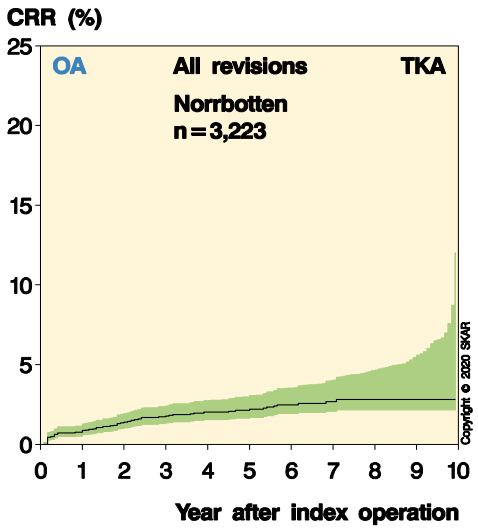


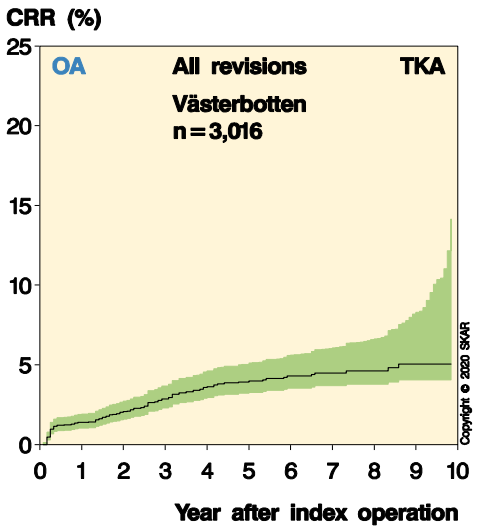


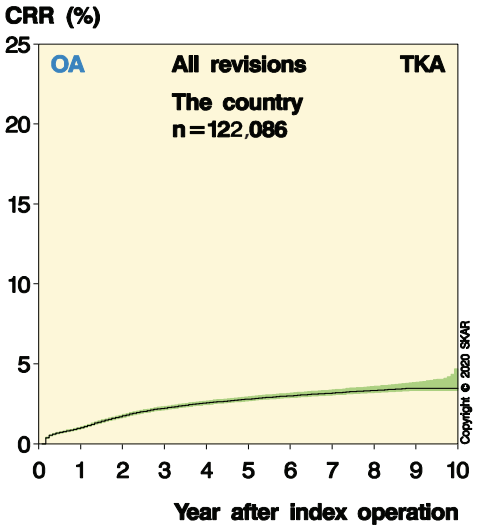


The curves are cut when less than 40 patients are left "at risk"



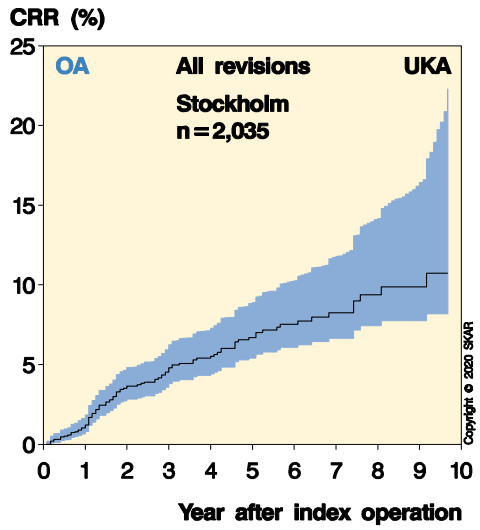


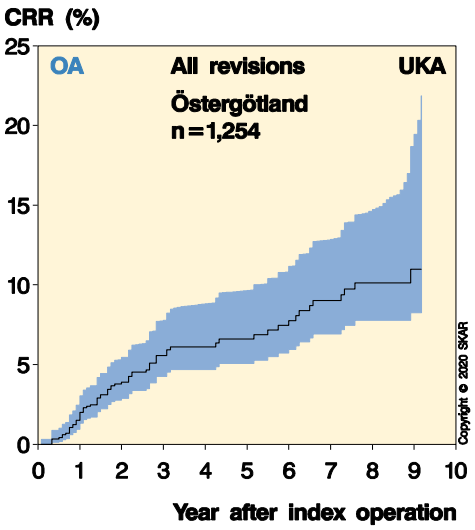


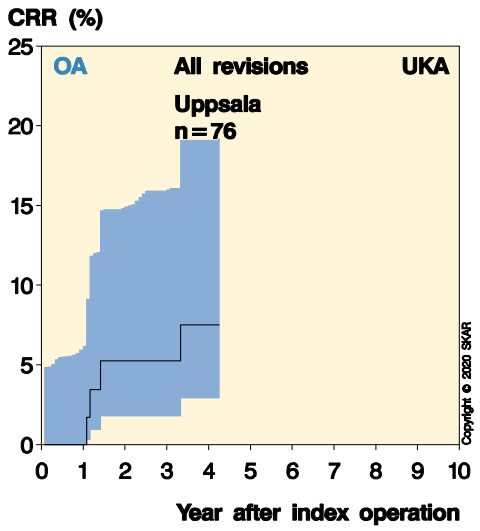


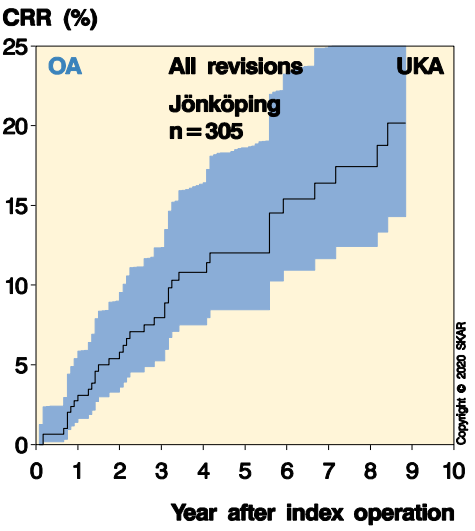
The curves are cut when less than 40 patients are left "at risk"

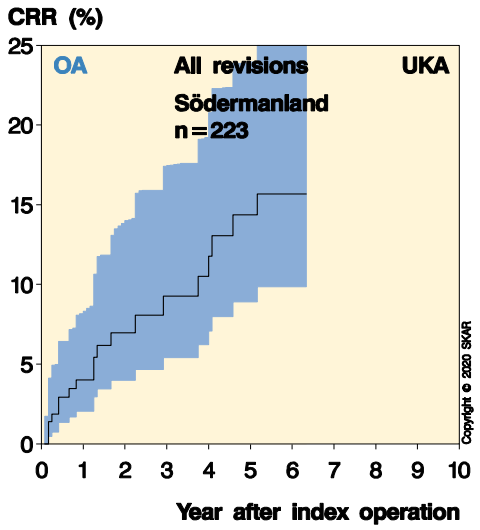
CRR in the counties after primary UKA for OA 2009–2018

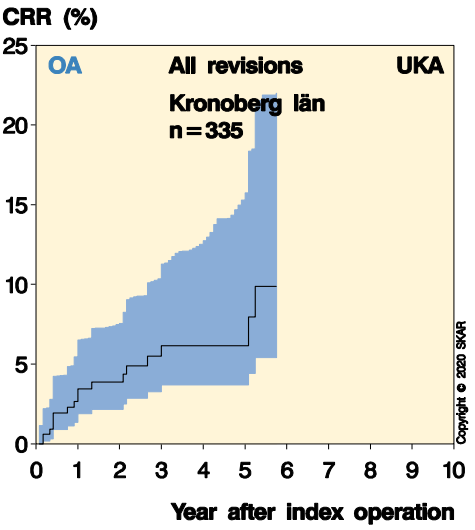




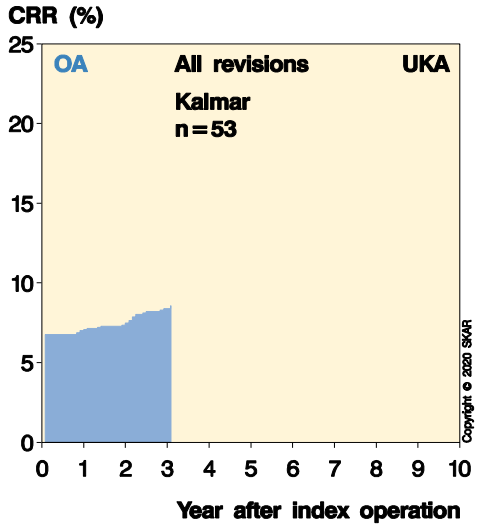


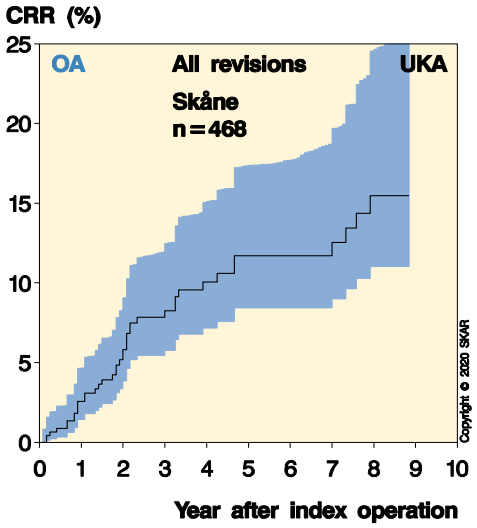


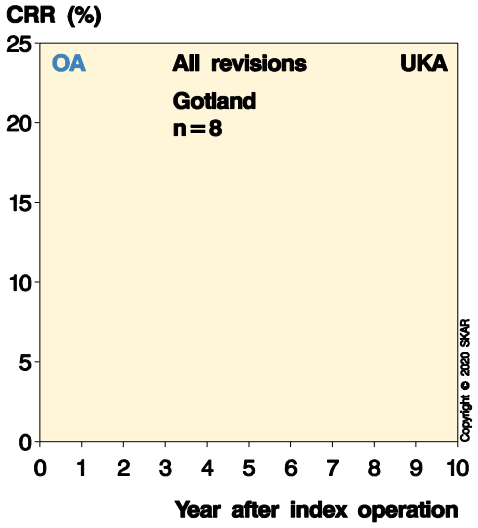


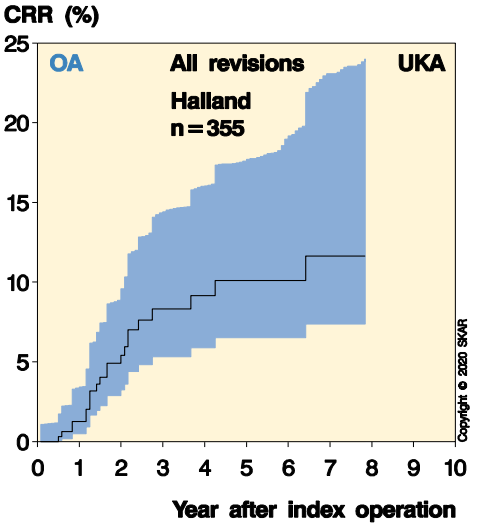


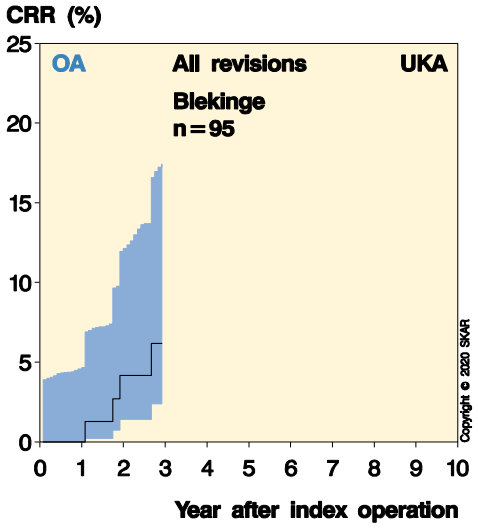
The curves are cut when less than 40 patients are left "at risk"

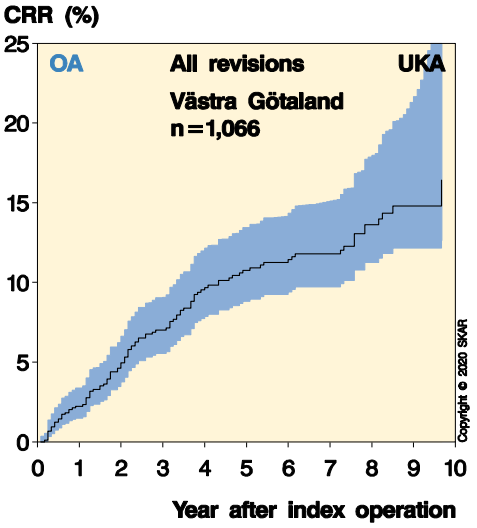






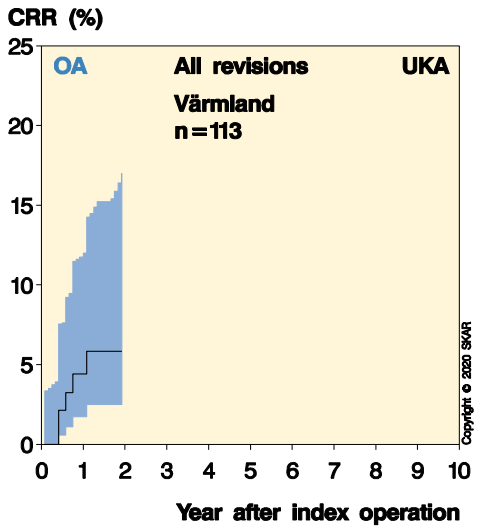


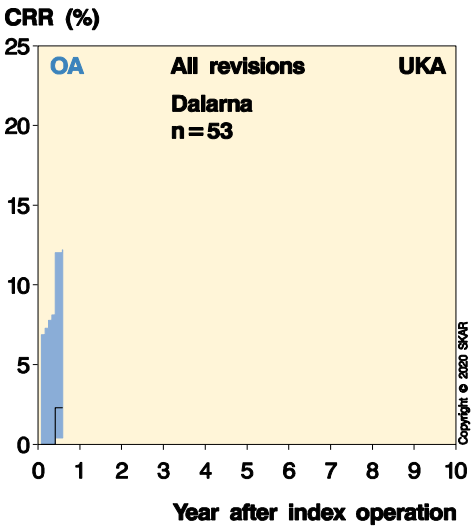


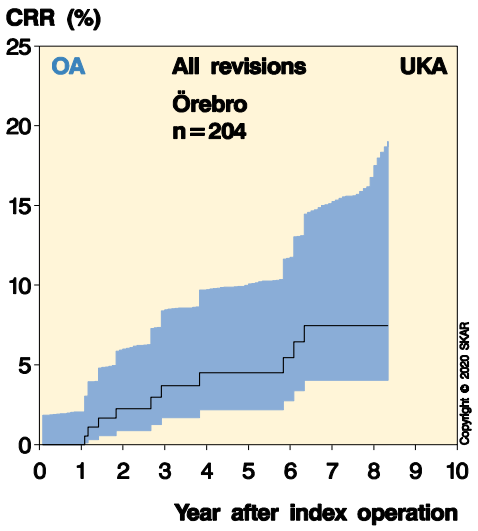


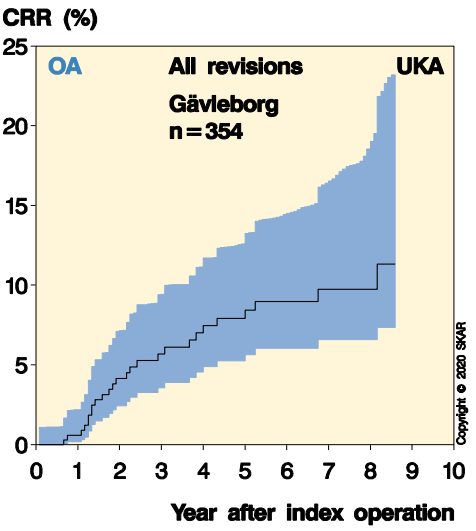
The curves are cut when less than 40 patients are left "at risk"

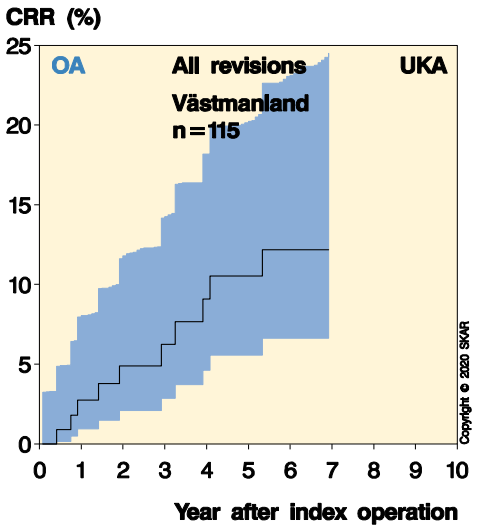
CRR in the counties after primary UKA for OA 2009–2018

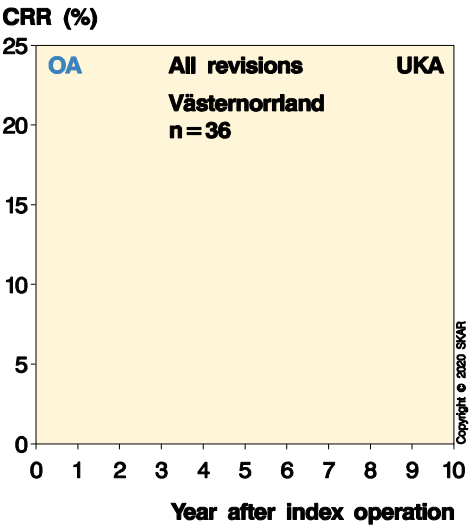




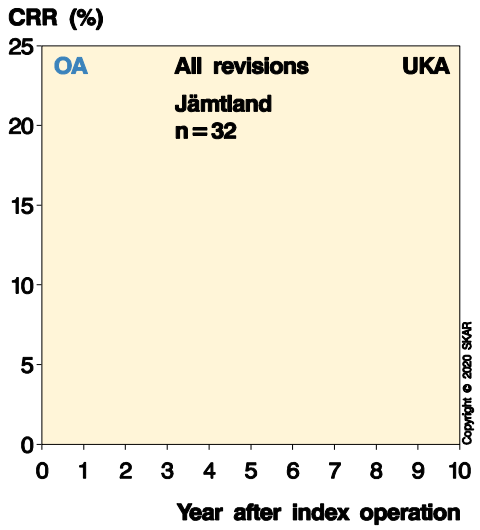


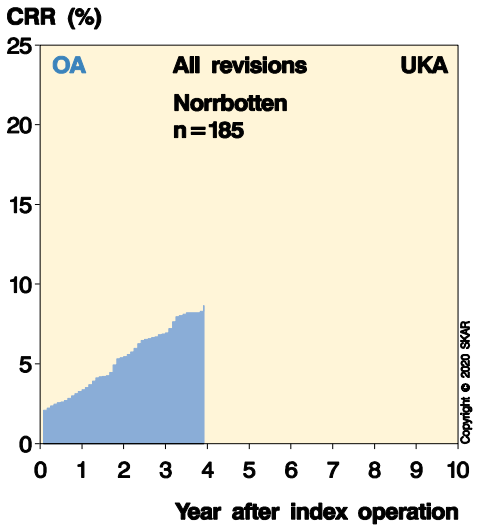


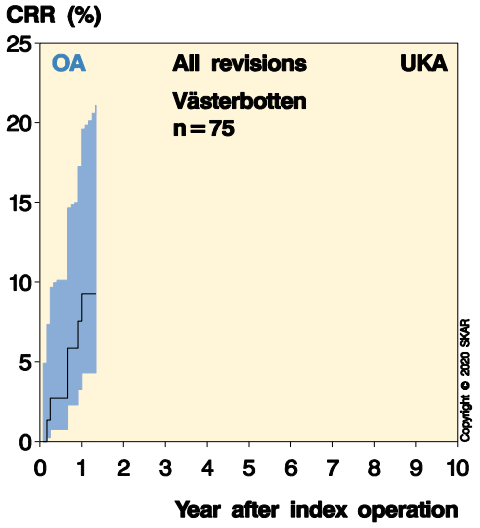


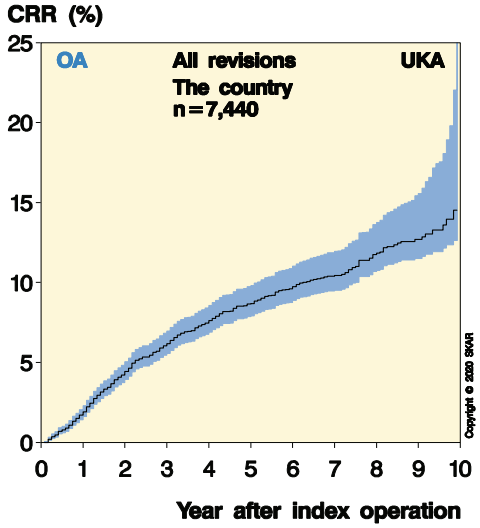


The curves are cut when less than 40 patients are left "at risk"









The curves are cut when less than 40 patients are left "at risk"

The relative risk for implants used in primary arthroplasty during 2009–2018

In order to account for results of relatively modern implants with reasonably long follow-up, the registry uses the latest 10-year period available for analysis. When an implant has been put on the list, it stays on the list as long as there are reasonable numbers to be analyzed even if its use has ceased. One must realize that individual models may represent different variants depending on modularity and marketing. Still, there are usually a few combinations that dominate within each brand.

The PFC Sigma-MBT is as previously used as the reference for TKAs as it is a relatively well defined brand, i.e. it mainly consists of the same type of femur, together with the same type of tibia baseplate and insert.

The risk of revision is one of the many measures of outcome. Although not accounted for here, the type of the revision should also be considered. Deliberately avoiding the use of patellar button in primary surgery and instead preparing for secondary resurfacing when needed, may increase the risk of revision, at least in the short term. Therefore, we separately account for OA/TKA when used with and without a patellar button and also make separate calculations in which isolated exchanges of inserts due to infection are not considered being revisions. The explanation for doing so is discussed together with the tables on page 50-51.

Below you will find Cox regression tables for TKA/OA and UKA/OA, in which the different models are compared to a reference implant. For TKA the reference is as described above the PFC-MBT but for UKA it is the Endo-Link.

For TKA implants inserted for OA (table below, left), 2 new implants, Attune and Persona, have been added to the list and one, F/S MIII has been removed. Attune and Persona were introduced 2015-16 while the use of F/S MIII ceased in 2008. As last year, the Genesis II/Legion, Journey, PFC RP and the combination of "Other" models have significantly higher risk than the reference PFC-MBT. The PFC rotating platform was introduced at the start of the millennium and became most popular during 2009-2010 after which its use sharply diminished with only 9 inserted in 2019. However, the Journey as well as the Genesis II/Legion combination were relatively recently introduced (2008 and 2013 respectively) and are still in use.

At the other end, the NexGen APT, NexGen MBT, NexGen TM and the PFC-Sigma MBT all have lower risk than the reference.

As last year, we show separate result for 2 variants of the Vanguard brand depending on if it used a tibial baseplate with an I-Beam stem or a baseplate with a Finned stem which was introduced in 2010. In the 2018 report we found the Finned version to

The risk of revision (RR) with 95% confidence interval. For TKA the reference is PFC-Sigma MBT and for UKA Link. The Cox regression adjusts for differences in gender, age and year of operation.

OA / TKA	n	p-value	RR	95% CI
PFC-Sigma MBT	21 935		ref.	
AGC Anatomic	1 324	0.77	1.04	0.78-1.40
Attune	114	0.13	2.14	0.80-5.73
Duracon	514	0.68	0.90	0.55-1.48
GenesisII	1 720	0.17	0.77	0.52-1.12
GenesisII/Legion	1 197	<0.01	1.67	1.18-2.37
Journey	179	<0.01	3.51	2.17-5.68
NexGen APT	2 229	<0.01	0.67	0.50-0.89
NexGen MBT	54 362	<0.01	0.83	0.75-0.91
NexGen TM	1 789	0.02	0.71	0.53-0.95
Persona	229	0.85	1.12	0.36-3.48
PFC-Sigma APT	10 812	<0.01	0.66	0.56-0.77
PFC-Sigma RP	616	<0.01	1.74	1.28-2.37
Profix	1 236	0.84	0.97	0.70-1.34
Triathlon MBT	12 574	0.86	0.99	0.86-1.13
Vanguard Finned	1 965	0.09	1.25	0.97-1.61
Vanguard I-beam	7 582	0.61	0.96	0.83-1.12
Övriga	1 709	<0.01	1.57	1.23-2.02
Gender (male is ref.)	.	<0.01	0.89	0.83-0.96
Age (per year)	.	<0.01	0.98	0.97-0.98
Year of op. (per year)	.	0.60	1.00	0.99-1.02

OA / UKA	n	p–value	RR	95% CI
Link	1 331		ref.	
Genesis	158	0.10	1.44	0.94-2.21
MillerGalante	128	0.93	0.98	0.60-1.60
Oxford	4 315	0.61	1.06	0.84-1.33
Sigma PKR	154	0.36	0.66	0.27-1.62
Triathlon PKR	370	0.08	1.44	0.95-2.17
ZUK	906	0.81	1.04	0.77-1.40
Other	78	0.01	2.67	1.24-5.75
Gender (male is ref.)		0.81	0.98	0.82-1.17
Age (per year)		<0.01	0.97	0.96-0.98
Year of op. (per year)		<0.01	0.94	0.91-0.98

Red is significant difference with higher risk ratio.
Green is significant difference with lower risk ratio.

The risk of revision (RR) with 95% confidence interval for OA/TKA inserted respectively without and with a patellar button. PFC-Sigma MBT is used as reference.

Without patella button OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	21 268		ref.	
AGC Anatomic	1 104	0.38	1.15	0.84-1.57
Attune	114	0.12	2.17	0.81-5.80
Duracon	442	0.44	0.80	0.45-1.41
GenesisII	1 695	0.12	0.73	0.49-1.08
GenesisII/Legion	1 123	<0.01	1.69	1.18-2.42
Journey	174	<0.01	3.68	2.27-5.96
NexGen APT	2 191	<0.01	0.68	0.51-0.91
NexGen MBT	53 556	<0.01	0.83	0.75-0.92
NexGen TM	1 729	0.03	0.71	0.53-0.97
Persona	226	0.82	1.14	0.37-3.57
PFC-Sigma APT	10 376	<0.01	0.66	0.56-0.78
PFC-Sigma RP	522	<0.01	1.74	1.25-2.43
Profix	1 118	0.85	1.03	0.74-1.44
Triathlon MBT	12 361	0.95	1	0.88-1.15
Vanguard Finned	1 924	0.08	1.26	0.97-1.63
Vanguard I-beam	7 157	0.66	1.03	0.89-1.21
Other	1 647	<0.01	1.6	1.25-2.06
Gender (male is ref.)	.	<0.01	0.91	0.84-0.98
Age (per year)	.	<0.01	0.98	0.97-0.98
Op-år (per år)	.	0.47	1.01	0.99-1.02

With patella button OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	667		ref.	
AGC Anatomic	220	0.01	0.28	0.10-0.78
Attune	*0*	.	.	.
Duracon	72	0.6	0.74	0.24-2.29
GenesisII	25	0.22	2.46	0.58-10.47
GenesisII/Legion Pri	74	0.69	1.34	0.31-5.83
Journey	*5*	.	.	.
NexGen APT	38	0.4	0.42	0.05-3.19
NexGen MBT	806	0.26	0.72	0.41-1.27
NexGen TM	60	0.55	0.64	0.15-2.76
Persona	*3*	.	.	.
PFC-Sigma APT	436	0.08	0.5	0.23-1.08
PFC-Sigma RP	94	0.58	0.78	0.32-1.89
Profix	118	0.08	0.27	0.06-1.17
Triathlon MBT	213	0.12	0.46	0.17-1.23
Vanguard Finned	41	0.95	0.95	0.22-4.06
Vanguard I-beam	425	<0.01	0.03	0.00-0.26
Other	62	0.81	0.84	0.20-3.55
Gender (male is ref.)	.	<0.01	0.44	0.29-0.67
Age (per year)	.	0.02	0.98	0.95-1.00
Year of op. (per year)	.	0.11	0.93	0.84-1.02

Implants lacking sufficient numbers for analysis are shown in italics

have significantly higher risk than the PFC-MBT reference while this and last year, the difference was not significant. As the use of the Vanguard implant has halted in Sweden (no primary reported in 2018-19) this is mainly of historical interest.

Women have a reduced 10-year risk of revision (all types) as compared to men. This may be explained by the higher risk of men being revised for infection, which typically is an early postoperative complication. As last year, the risk of revision decreases with increasing age while it no longer increases with time (year of surgery). The reason for the latter may be that the number of insert exchanges in manifest or suspected infections no longer is increasing as it did in the start of the millennium. On the next page we have performed the same analyses but without considering such insert exchanges as being revisions.

With respect to UKA inserted for OA (table on the previous page) 2 models, Oxford and Link, account for 76% of the surgeries. None of the UKA models besides the combination of the few "other" UKAs had a significantly different risk as compared to the reference model Endo-Link. The risk diminishes with increasing age of patients at surgery as well as with increasing year of surgery.

Above, the TKA implants have been divided into those without (left) and with (right) a patellar button. This reduces the number of implants available for each of the analyses, especially for the group in which a patellar button was used.

In TKA's not using a patellar button, it are still the same models, as when all TKA's are analyzed (table on the previous page), that have a significantly higher or lower risk of revision as compared to the reference.

The number of TKA's using a patellar button, is small which makes it more difficult to show and even interpret significant differences. However, it is interesting to see that the AGC Anatomic and the Vanguard I-Beam have a lower risk than the reference when patella is resurfaced. The effect of gender, age and increasing year of surgery is little affected by if TKA's with or without patellar button are analyzed separately or not.

The relative risk for implants used in primary arthroplasty during 2009–2018 if the exchange of insert, in case of infection, is not considered to be a revision

The SKAR defines a revision being a secondary surgery (reoperation) in a resurfaced knee during which implant components are exchanged, added or removed. The reason for other types not being considered is that it had been noted that some surgeons did not report reoperations that they did not consider implant related which resulted in underreporting of soft tissue surgeries. Thus, the register decided to use a strict definition of revision, surely related to the implant.

It has been claimed that the strict definition may treat certain implants unfairly. The reason is that almost half of the revisions for infection are synovectomies during which the insert is also exchanged (defining them as revisions). However, a synovectomy in a knee with an implant in which the insert cannot be exchanged is not counted as a revision, which may favor the type. Thus, the argument has been made that an exchange of insert in infection should not be considered a revision but a synovectomy. On the opposite it can be claimed that infected TKA´s with fixed inserts will be treated with a complete exchange of components, as a comprehensive cleansing is not considered possible without removal of the insert. This could result in a reversed bias if the exchange of an insert is not considered being a revision.

Not being able to give a definite answer regarding what is the most reasonable, we decided to produce additional tables in which the exchange of insert (for infection) is not considered being revision. This way, 861 TKA/OA and 17 UKA/OA revisions were excluded during the 10-year period, although any later revisions of these knees will count instead. It has to be observed that such an exclusion reduces the number of revisions, which in turn reduces the sensitivity of the statistical calculations.

For TKA/OA, without considering patella resurfacing (table below), we see, in comparison to the table on page 48, that it is the same implants having a significantly increased risk with addition of the AGC Anatomic. In case of the AGC, PFC Sigma APT, the NexGen APT and the Monoblock NexGen TM (2/3 of the TMs) it is not possible to exchange the insert. These do not benefit from the exclusion of insert exchanges, why their risk as compared to the other implants will be negatively affected. Thus, AGC has become worse than the reference while NexGen APT, NexGen TM and PFC APT no longer are better.

Before the exclusion, the risk of revision was lower for women than for men but afterwards it has become higher. This could indicate that women have a higher risk of revision for other reasons than manifest or suspected early infection.

The risk of revision (RR) with 95% confidence interval. For TKA the reference is PFC-Sigma MBT and for UKA Link.
The exchange of insert, in case of infection is not considered to be a revision.

OA / TKA	n	p-value	RR	95% CI
PFC-Sigma MBT	21 935		ref.	
AGC Anatomic	1 324	0.03	1.41	1.04-1.90
Attune	114	0.90	0.88	0.12-6.27
Duracon	514	0.91	0.97	0.55-1.69
GenesisII	1 720	0.14	0.68	0.41-1.13
GenesisII/Legion	1 197	<0.01	2.08	1.38-3.13
Journey	179	<0.01	4.63	2.81-7.63
NexGen APT	2 229	0.54	0.91	0.68-1.23
NexGen MBT	54 362	<0.01	0.85	0.75-0.95
NexGen TM	1 789	0.10	0.77	0.56-1.05
Persona	229	0.52	1.59	0.39-6.38
PFC-Sigma APT	10 812	0.33	0.92	0.78-1.09
PFC-Sigma RP	616	<0.01	1.91	1.38-2.64
Profix	1 236	0.41	1.16	0.82-1.64
Triathlon MBT	12 574	0.69	0.97	0.82-1.14
Vanguard Finned	1 965	0.08	1.31	0.97-1.77
Vanguard I-beam	7 582	0.53	1.06	0.89-1.25
Other	1 709	0.01	1.46	1.08-1.97
Gender (male is ref.)	.	0.02	1.10	1.01-1.20
Age (per year)	.	<0.01	0.96	0.96-0.97
Year of op. (per year)	.	0.87	1.00	0.98-1.02

OA / UKA	n	p–value	RR	95% CI
Link	1 331		ref.	
Genesis	158	0.10	1.43	0.93-2.20
MillerGalante	128	0.89	0.97	0.59-1.58
Oxford	4 315	0.73	1.04	0.83-1.31
Sigma PKR	154	0.38	0.67	0.27-1.65
Triathlon PKR	370	0.08	1.45	0.96-2.19
ZUK	906	0.79	1.04	0.77-1.41
Other	78	0.04	2.36	1.03-5.37
Gender (male is ref.)		0.93	0.99	0.83-1.18
Age (per year)		<0.01	0.97	0.96-0.98
Year of op. (per year)		<0.01	0.94	0.91-0.98

Red is significant difference with higher risk ratio.
Green is significant difference with lower risk ratio.

The risk of revision (RR) with 95% confidence interval for OA/TKA inserted respectively without and with a patellar button. The exchange of insert in case of infection is not considered to be a revision

Without patella button OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	21 268		ref.	
AGC Anatomic	1 104	<0.01	1.56	1.13-2.14
Attune	114	0.90	0.89	0.12-6.32
Duracon	442	0.48	0.79	0.41-1.53
GenesisII	1 695	0.11	0.66	0.39-1.10
GenesisII/Legion	1 123	<0.01	2.22	1.47-3.33
Journey	174	<0.01	4.84	2.93-7.98
NexGen APT	2 191	0.62	0.93	0.69-1.25
NexGen MBT	53 556	<0.01	0.85	0.75-0.96
NexGen TM	1 729	0.10	0.77	0.56-1.06
Persona	226	0.49	1.64	0.41-6.60
PFC-Sigma APT	10 376	0.39	0.93	0.78-1.10
PFC-Sigma RP	522	<0.01	1.92	1.35-2.73
Profix	1 118	0.26	1.23	0.86-1.76
Triathlon MBT	12 361	0.88	0.99	0.84-1.16
Vanguard Finned	1 924	0.09	1.30	0.96-1.76
Vanguard I-beam	7 157	0.15	1.13	0.95-1.35
Other	1 647	0.02	1.46	1.07-1.98
Gender (male is ref.)	.	<0.01	1.13	1.03-1.23
Age (per year)	.	<0.01	0.96	0.96-0.96
Year of op. (per year)	.	0.65	1.00	0.99-1.02

With patella button OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	667		ref.	
AGC Anatomic	220	0.07	0.37	0.12-1.08
Attune	0	.	.	.
Duracon	72	0.98	0.99	0.31-3.19
GenesisII	25	0.50	2.01	0.26-15.26
GenesisII/Legion	74	.	.	.
Journey	5	0.99	<0.01	.
NexGen APT	38	0.56	0.54	0.07-4.24
NexGen MBT	806	0.93	0.97	0.51-1.84
NexGen TM	60	0.78	0.80	0.18-3.60
Persona	3	.	.	.
PFC-Sigma APT	436	0.48	0.74	0.33-1.68
PFC-Sigma RP	94	0.75	0.85	0.32-2.27
Profix	118	0.19	0.37	0.08-1.65
Triathlon MBT	213	0.08	0.26	0.06-1.16
Vanguard Finned	41	0.57	1.53	0.35-6.69
Vanguard I-beam	425	<0.01	0.05	0.01-0.37
Other	62	0.71	1.32	0.30-5.74
Gender (male is ref.)	.	0.01	0.55	0.35-0.87
Age (per year)	.	<0.01	0.96	0.94-0.99
Year of op. (per year)	.	0.05	0.90	0.80-1.00

Implants lacking sufficient numbers for analysis are shown in italics

In case of UKA (table previous page right), there were only 17 exchanges of inserts during the 10-year period for manifest or suspected infection (of which 11 later were revised for other reasons). Thus, the results are similar to those in the table on page 48.

Above, we have (as on page 49) divided the TKA for OA into those inserted with or without a patellar button.

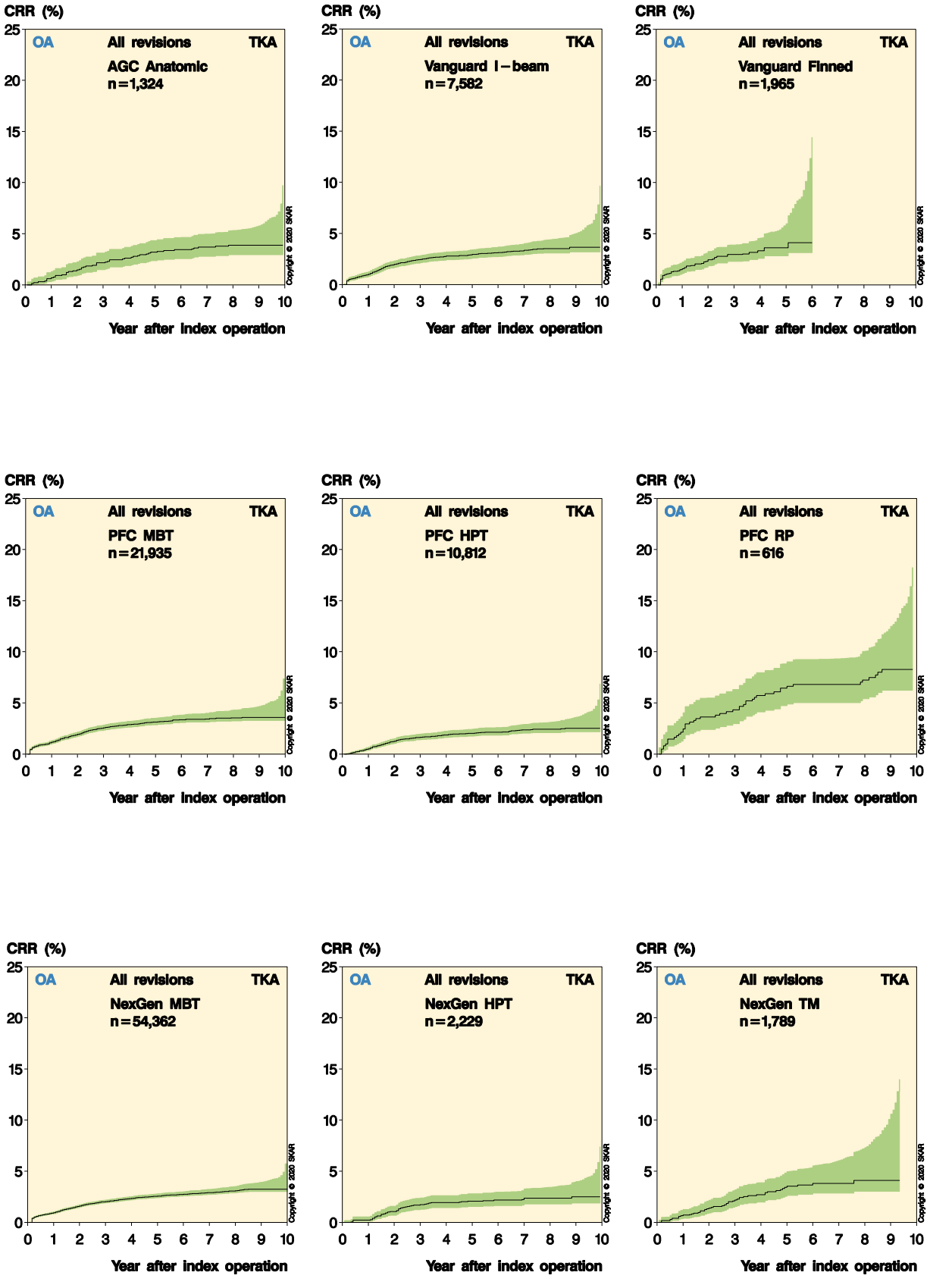
When the table above left (without a patella button) is compared to the table when all the TKA's were included (table to the left), we find no difference in what implants have a significantly higher revision rate than the reference PFC MBT and still it is only the NexGen MBT that has a significantly lower risk.

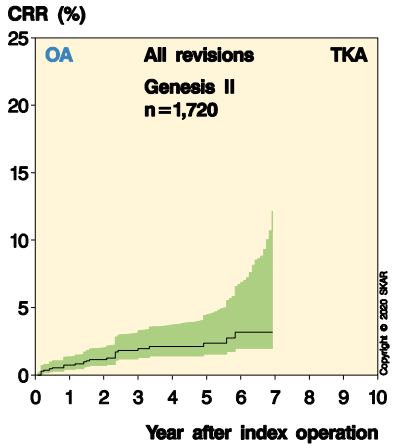
As compared to the table on page 49 in which change of inserts for infection were considered revisions the difference is that the NexGen APT, NexGen TM and the PFC-Sigma APT no longer are better than the reference while the AGC Anatomic has become significantly inferior. As when all TKA's were included (table to the left), women have significantly higher risk than men.

The table above concerns TKA's in which a patellar button was used. When this table is compared to the same table on page 49 the difference is that the AGC Anatomic no longer has significantly lower risk than the reference PFC MBT.
However, as has been mentioned, the number of TKA implants with patellar button is small making it difficult to show and even interpret significant differences.

In summary one can establish that excluding an exchange of insert in infected cases does affect the results and that the effect negatively affects non-modular implants as compared to modular ones. One explanation may be that a number of debridement's without exchange of inserts in non-modular TKA's have succeeded in curing the infection (if not cured, a later revision would probably have been performed). Another possibility is that the increased aggressiveness in opening the knee and performing debridement when an insert can be exchanged may have resulted in unnecessary surgeries.

CRR for commonly used TKA implants for OA 2009–2018




CRR (%)
OA
All revisions
TKA
Genesis II
n=1,720
Year after index operation
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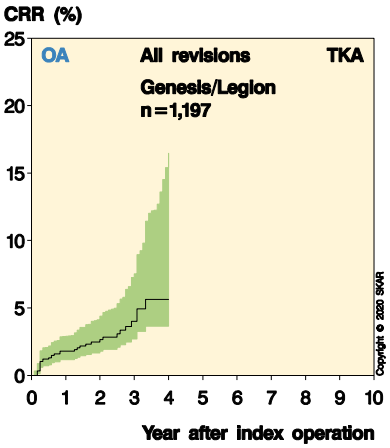
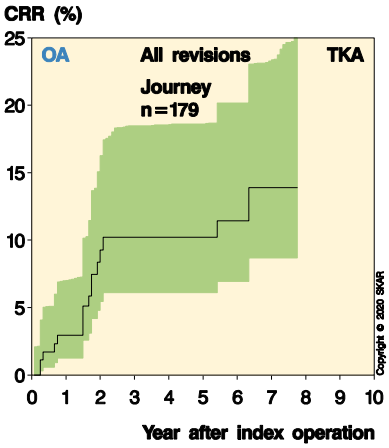
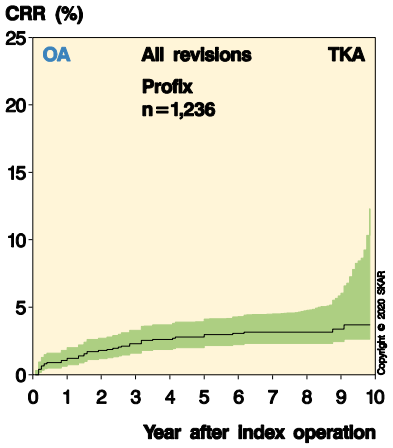
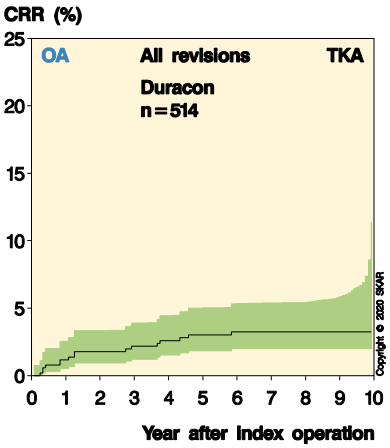
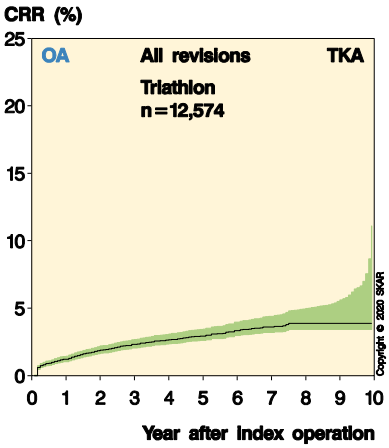

CRR (%)
OA
All revisions
TKA
Genesis/Legion
n=1,197
Year after index operation
Copyright © 2020 SKAR


CRR (%)
OA
All revisions
TKA
Journey
n=179
Year after index operation
Copyright © 2020 SKAR


CRR (%)
OA
All revisions
TKA
Profix
n=1,236
Year after index operation
Copyright © 2020 SKAR


CRR (%)
OA
All revisions
TKA
Duracon
n=514
Year after index operation
Copyright © 2020 SKAR


CRR (%)
OA
All revisions
TKA
Triathlon
n=12,574
Year after index operation
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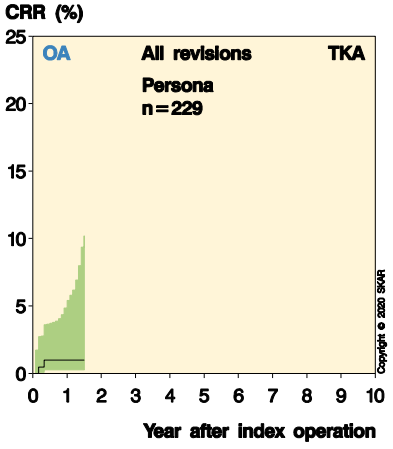
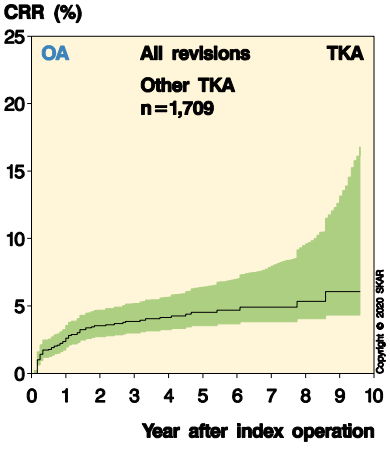
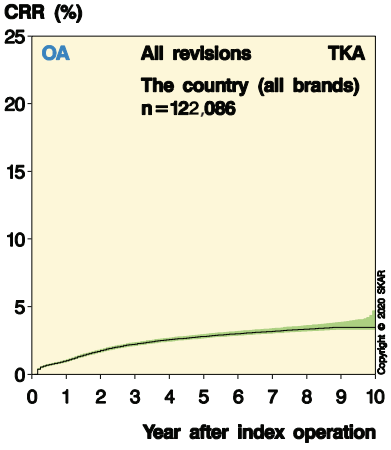

CRR (%)
OA
All revisions
TKA
Persona
n=229
Year after index operation
Copyright © 2020 SKAR


CRR (%)
OA
All revisions
TKA
Other TKA
n=1,709
Year after index operation
Copyright © 2020 SKAR


CRR (%)
OA
All revisions
TKA
The country (all brands)
n=122,086
Year after index operation
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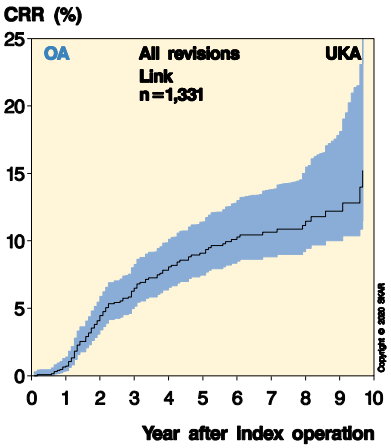
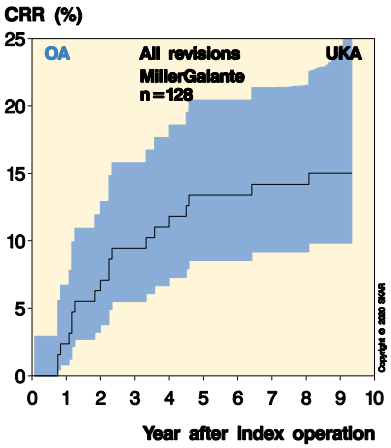
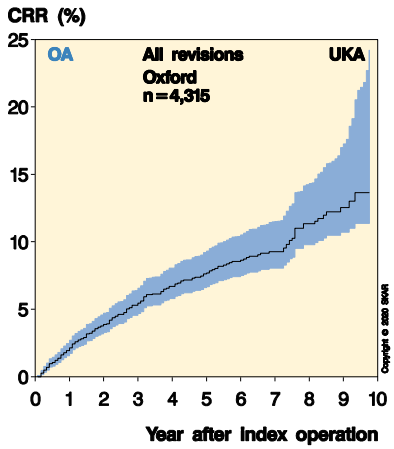
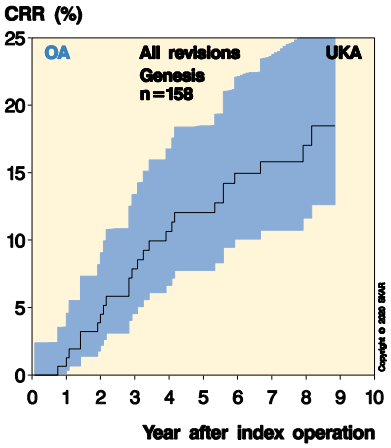
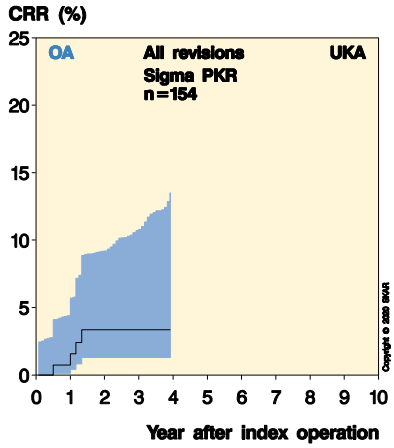
CRR for commonly used UKA implants for OA 2009–2018

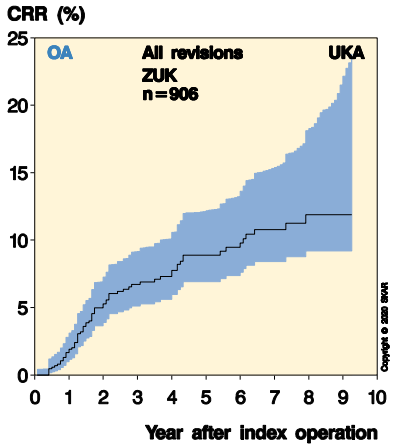


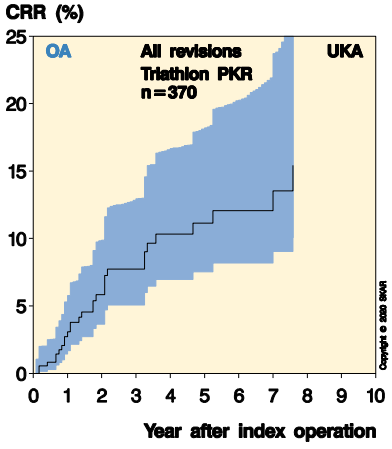


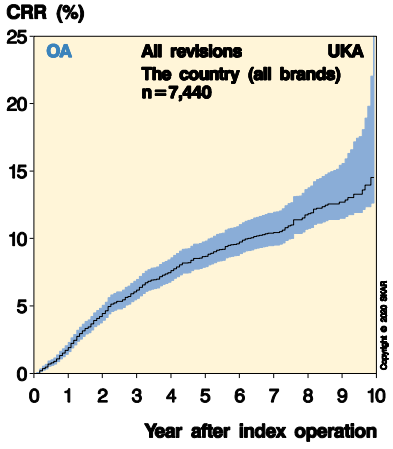












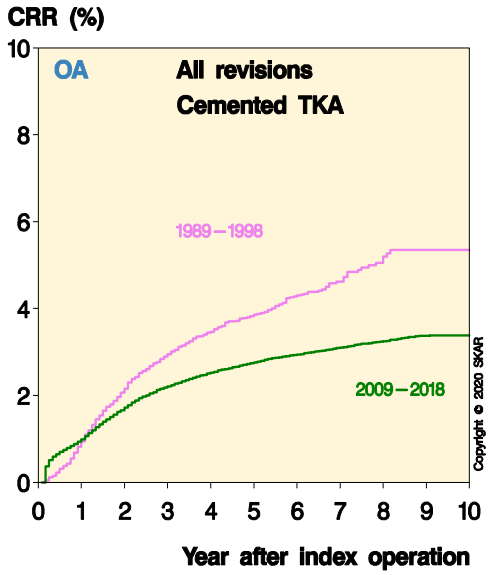
Changes in risk of revision over time (TKA for OA)

The figure below shows the overall risk of revision for the current 10-year period, 2009-2018, as compared to the period 1989-1998. It can be observed that the risk for the current period is considerably lower than for the earlier period.

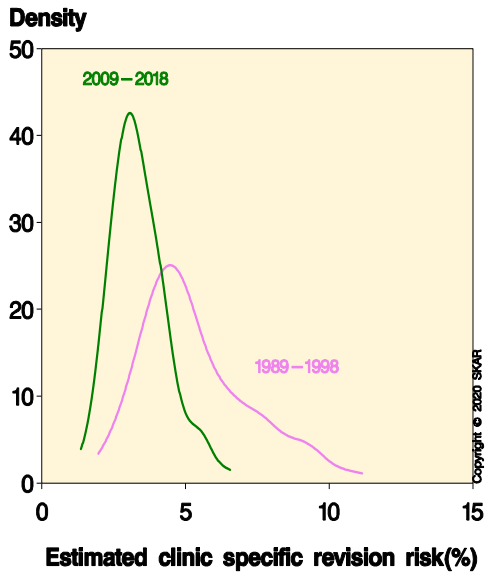
When the absolute specific risk of revision for the units is plotted for both periods (figure below left), it can be seen that the risk has become lower and the distribution has diminished. This implies that the results have improved overall and at the same time the results for the different units have become more similar (less variance in the results).

However, when looking on the relative specific risk of revision (figure below) it can be seen that the curves for the two periods are similar in shape. This implies that the relative difference between the units has not changed between the two periods and that some units still have a 1.5-2 times higher or lower risk than the average unit. The figures also illustrate the fact that irrespective of improvement, there will always be units with better, or worse, results than the average.

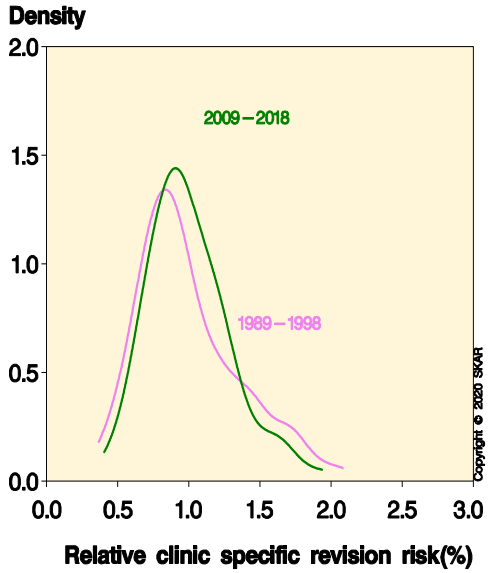
The register is requested to account for hospital specific results which can be found on the next pages. This year, there were 7 hospitals having significantly better results than the average hospital and 9 with inferior results. One can only speculate on the causes for these differences. An unfortunate choice of implants, methods or surgeons may be the explanation, as well as a selection of patients with a higher risk profile (case-mix). We find it appropriate to point out that the results are based on historical data in which the last implants were inserted 2 years ago and the first 12 years ago. Thus, the results do not necessarily reflect the current risk for patients undergoing surgery.



Total CRR for cemented TKA in OA during the 2 periods 1989–1998 and 2009–2018 shows a considerable reduction in CRR over time.



Plotting the estimated absolute hospital specific risk of revision shows that the absolute distribution has diminished between 1989-1998 and 2009–2018 (x-axis = absolute risk of revision)



Plotting the relative hospital specific risk of revision, as compared to the national mean, shows that the distribution of relative risk among the hospitals has not changed between 1989–1998 and 2009–2018 (x-axis = relative risk).

Relative risk of revision for hospitals 2009–2018 (cemented and uncemented TKA for OA)

The true average result of a certain treatment can only be determined for defined groups of previously treated patients. However, such results only reflect historical circumstances and cannot automatically be used to predict future results. The observed average result of a hospital treatment is not constant. Different selections of patients that get the same treatment have different average results. Thus, the hospital specific variability has to be taken into consideration if comparisons of hospitals are to be meaningful.

The table below shows the number of primary TKA for OA performed at each hospital during the analyzed period and how many of these were revised. The RR (relative risk of revision) is shown with its 95% confidence interval. The RR describes each hospital's deviation from the national average in multiplicative terms. It has been calculated using "the shared gamma frailty model" which takes into consideration that units performing few operations more easily suffer far too optimistic or pessimistic risk estimates. Thus, the method "shrinks" such estimates towards the national mean, relative to the amount of information they are based on. For further information; Glidden DV & Vittinghoff E. Modelling clustered survival data from multicenter clinical trials. Statistics in Medicine 2004; 23: 369-388.

Finally the observed rank for the hospital is shown together with a 95% confidence interval for its ranking, i.e. what rank places lie within the confidence interval. The calculations were performed using Monte Carlo simulation. For further information; Goldstein H, Spiegelhalter DJ. League tables and their limitations: statistical issues in comparisons of institutional performance. J R Statist Soc (A) 1996;159:384-43.

It is the location for the hospital that decides where the operation is registered. This implies that in spite of any name or ownership changes, the whole period is analyzed for the particular location.

Only units performing more than 50 TKAs for OA during the 10-year period were included (cemented and uncemented). The results are adjusted for differences in age and gender as well as for differences in use of a patellar button.

Units with significantly better or worse results than the national average are shown in green and red respectively.

Relative risk of revision for units

Code	Hospital	no. of TKA	Revised	RR	95% CI	Rank	95% CI
52012	Alingsås	1,891	16	0.43	0.28-0.64	1	1-9
11015	Nacka-Proxima	1,443	13	0.48	0.31-0.74	2	1-16
11002	Huddinge	1,141	13	0.54	0.35-0.84	3	1-26
10010	Sabbatsberg (Aleris)	711	10	0.59	0.37-0.94	4	1-36
10911	Capio Artro Clinic Sthlm.	553	1	0.64	0.33-1.23	5	1-61
25010	Kalmar	880	11	0.65	0.41-1.01	6	2-44
22405	Art Clinic Jönköping	273	0	0.67	0.33-1.34	7	1-66
50020	Ortho Center IFK klin.*	1,185	19	0.67	0.46-0.98	8	2-41
22012	Värnamo	1,384	21	0.68	0.47-0.99	9	3-42
22010	Jönköping	1,198	21	0.69	0.48-0.99	10	3-41
50480	Carlanderska	1,459	23	0.7	0.49-1.00	11	3-43
52013	Skene	1,012	16	0.71	0.47-1.05	12	3-48
11013	Ortho Center Sthlm (Löw.)**	4,274	76	0.71	0.57-0.89	13	6-31
61012	Hudiksvall	694	11	0.74	0.47-1.16	14	3-55
27011	Karlshamn	2,371	42	0.76	0.57-1.00	15	6-42
12481	Elisabethsjukhuset	289	6	0.77	0.45-1.30	16	2-65
11001	Karolinska	763	15	0.77	0.51-1.16	17	4-56
42011	Varberg	1,508	28	0.78	0.56-1.08	18	5-50
12010	Enköping	3,378	63	0.8	0.63-1.01	19	8-44
52011	Borås	822	15	0.8	0.53-1.21	20	4-59
42015	Halmstad Capio Movement	3,079	60	0.82	0.64-1.04	21	9-46
56010	Västerås	2,252	47	0.82	0.63-1.07	22	8-49
50498	Art Clinic Göteborg	306	2	0.82	0.44-1.54	23	2-72

(cont.)

Relative risk of revision for units (continued)

Code	Hospital	no. of TKA	Revised	RR	95% CI	Rank	95% CI
25011	Oskarshamn	2,681	52	0.83	0.64-1.07	24	9-49
65013	Piteå	2,489	50	0.84	0.65-1.09	25	10-50
42420	Spenshult	1,191	31	0.84	0.61-1.15	26	7-55
55011	Karlskoga	901	20	0.85	0.58-1.23	27	7-61
65090	Luleå-Sensia	62	0	0.87	0.43-1.74	28	2-76
13011	Nyköping	841	18	0.87	0.59-1.29	29	7-63
42010	Halmstad	1,870	43	0.9	0.69-1.19	30	12-58
10016	Ortopediska huset	4,703	105	0.9	0.75-1.09	31	17-51
41011	Trelleborg	6,942	152	0.91	0.77-1.06	32	18-49
55012	Lindesberg	2,283	43	0.91	0.69-1.20	33	12-58
10011	S:t Göran	3,539	79	0.92	0.74-1.14	34	17-54
28011	Ängelholm	1,973	42	0.92	0.70-1.22	35	13-60
57011	Mora	1,725	38	0.93	0.69-1.24	36	12-62
10015	Sophiahemmet	798	19	0.93	0.64-1.36	37	9-67
65012	Gällivare	663	15	0.94	0.62-1.42	38	8-69
62010	Sundsvall	684	18	0.95	0.64-1.40	39	10-68
28099	Ängelholm (Aleris)	63	0	0.95	0.47-1.91	40	3-77
62011	Örnsköldsvik	1,171	27	0.96	0.69-1.33	41	12-66
53010	Falköping	319	10	0.96	0.60-1.53	42	8-72
55010	Örebro	514	15	0.97	0.64-1.46	43	10-70
54010	Karlstad	1,609	40	0.98	0.73-1.30	44	16-65
21014	Motala	3,890	97	0.99	0.82-1.21	45	24-59
10013	Södersjukhuset	2,589	68	1	0.79-1.25	46	21-62
23010	Växjö	917	25	1.01	0.72-1.43	47	15-70
54012	Arvika	1,664	40	1.02	0.77-1.36	48	19-67
56012	Köping	73	3	1.06	0.58-1.92	49	6-77
22011	Eksjö (Höglandssjukh.)	1,774	43	1.06	0.81-1.40	50	22-69
51010	Uddevalla	1,950	51	1.09	0.84-1.41	51	26-69
24010	Västervik	914	25	1.11	0.79-1.56	52	20-73
54014	Torsby	1,056	30	1.12	0.81-1.54	53	24-73
11010	Danderyd	1,175	33	1.12	0.83-1.53	54	24-72
53011	Lidköping	1,744	48	1.14	0.87-1.48	55	30-71
50071	Frölunda Spec.	786	28	1.14	0.82-1.59	56	25-74
63010	Östersund	1,368	38	1.15	0.86-1.53	57	28-72
51011	Mölndal	2,847	77	1.15	0.93-1.42	58	35-70
21013	Norrköping	1,397	40	1.15	0.87-1.53	59	28-72
64010	Skellefteå	898	28	1.17	0.84-1.62	60	26-74
11011	Södertälje	1,191	36	1.21	0.90-1.62	61	33-74
57010	Falun	2,621	86	1.21	0.99-1.49	62	41-72
12001	Akademiska sjukhuset	884	33	1.22	0.89-1.65	63	32-75
64011	Lycksele	807	24	1.23	0.87-1.74	64	28-75
23011	Ljungby	1,059	34	1.23	0.91-1.67	65	33-75
26010	Visby	835	28	1.26	0.91-1.75	66	34-76
13012	Kullbergska sjukhuset	2,070	71	1.27	1.01-1.58	67	44-74
61011	Bollnäs	2,899	96	1.3	1.07-1.58	68	48-74
53013	Skövde	1,034	38	1.31	0.98-1.76	69	41-76
28012	Hässleholm	6,849	232	1.38	1.21-1.57	70	58-74
41012	Helsingborg	278	12	1.38	0.89-2.14	71	32-78
64001	Umeå	1,311	54	1.41	1.09-1.81	72	50-76
41001	Lund	319	14	1.46	0.96-2.21	73	39-78
13010	Eskilstuna	428	20	1.61	1.11-2.33	74	51-78
61010	Gävle	916	43	1.63	1.24-2.15	75	61-78
11012	Norrtälje	934	38	1.65	1.24-2.21	76	61-78
62013	Sollefteå	1,105	47	1.67	1.28-2.17	77	63-78
51012	Kungälv	1,537	80	1.94	1.57-2.40	78	73-78

* Gothenburg Medical Center was discontinued and OrthoCenter IFK kliniken was started in 2008.

** Löwenströmska was taken over by Stockholms Specialistvård in 2001 and by OrthoCenter Stockholm in 2008.

Only units that inserted more than 50 TKA for OA during the period are listed

Relative risk of revision for hospitals 2009–2018 (cemented and uncemented TKA for OA) if the exchange of insert, in case of infection, is not considered to be a revision

As described on page 4, the SKAR defines a revision as being a reoperation in which implant components are exchanged, added or removed.

The reason for this is that shortly after the start of the register it was noted that many surgeons did not report those reoperations which they did not interpret as directly related to the prior knee arthroplasty. This resulted in different types of soft tissue surgeries never being reported and therefore the register decided to use a stricter definition of revision which definitely was implant related.

As previously mentioned (page 50) it can be claimed that for infected cases this definition may be a disadvantage for certain implant brands and consequently those hospitals using these brands. The reason is that one third of all revisions for infection are debridement surgeries during which the insert is exchanged (classifying them as revisions). However, a debridement in a knee with a monobloc tibia, in which no insert can be exchanged, will not count as a revision which in turn may favor the type. Thus, the argument has been made that exchange of an insert, in the case of an infection, should not be considered a revision but a debridement. On the other hand it can be claimed that infected TKA´s with fixed inserts are generally treated with a complete exchange of components, as a comprehensive debridement is not considered possible without removal of an insert. This would result in a reversed bias if the exchange of an insert is not considered as a revision. However, on page 48-51 we saw that excluding exchange of the tibia insert affects the results of at least some implants with monobloc tibia.

Therefore, in the table below, we also provide risk calculations when an exchange of insert for infection is not, considered as being a revision. Comparing it to the table on the previous page, it can be seen that Sabbatsberg, OrthoCenter IFK klin. and Värnamo no longer are significant better than the average. However, of these only Värnamo used monobloc tibia components in any number (15%). Trelleborg, Piteå and Halmstad (Capio) have become better than the average, but two of the three used almost no monobloc components (Piteå 8%).

In the other end, Eskilstuna is no longer worse than the average while Lund has become worse. However, both used almost no monobloc tibia components (0% and 1%)).

Thus, the modularity of the tibia component and thereby if the insert can be exchanged or not, may have an effect on the risk of revision. However, the use of monobloc tibias has diminished from being 69% of cases in 1996 to 8% in 2018. If the trend continues, the problem with hospital results being biased by modularity will also diminish further.

Relative risk of revision for units. Exchange of insert, in case of infection, is not considered to be a revision.

Code	Hospital	no. of TKA	Revised	RR	95% CI	Rank	95% CI
52012	Alingsås	1,891	14	0.5	0.33-0.75	1	1-19
11015	Nacka-Proxima	1,443	10	0.52	0.33-0.83	2	1-25
22010	Jönköping	1,198	13	0.61	0.40-0.93	3	1-35
11002	Huddinge	1 141	12	0.63	0.41-0.97	4	1-39
25010	Kalmar	880	7	0.64	0.39-1.06	5	1-47
10010	Sabbatsberg (Aleris)	711	9	0.66	0.41-1.05	6	1-47
50020	Ortho Center IFK klin.*	1,185	14	0.68	0.45-1.03	7	2-45
41011	Trelleborg	6,942	85	0.69	0.56-0.84	8	4-28
50480	Carlanderska	1,459	16	0.7	0.47-1.03	9	2-45
65013	Piteå	2,489	30	0.71	0.51-0.97	10	3-40
24010	Västervik	914	9	0.71	0.44-1.13	11	2-53
52011	Borås	822	9	0.73	0.45-1.16	12	2-54
42015	Halmstad Capio Movement	3,079	39	0.73	0.55-0.97	13	4-40
42011	Varberg	1,508	19	0.73	0.50-1.06	14	3-47
54010	Karlstad	1,609	22	0.76	0.53-1.08	15	3-50
25011	Oskarshamn	2,681	35	0.77	0.57-1.04	16	5-45
22012	Värnamo	1,384	18	0.77	0.52-1.14	17	3-54
22405	Art Clinic Jönköping	273	0	0.78	0.40-1.52	18	1-71
12481	Elisabethsjukhuset	289	5	0.8	0.47-1.36	19	2-66
61012	Hudiksvall	694	9	0.81	0.50-1.29	20	3-63
42420	Spenshult	1,191	24	0.82	0.58-1.16	21	6-55
62010	Sundsvall	684	11	0.82	0.53-1.28	22	4-63
10911	Capio Artro Clinic Sthlm.	553	1	0.83	0.44-1.55	23	2-73

(cont.)

(Cont.)
Relative risk of revision for units. Exchange of insert, in case of infection, is not considered to be a revision

Code	Hospital	no. of TKA	Revised	RR	95% CI	Rank	95% CI
11001	Karolinska	763	13	0.83	0.54-1.27	24	4-62
52013	Skene	1,012	15	0.84	0.56-1.25	25	5-61
10015	Sophiahemmet	798	12	0.84	0.54-1.29	26	4-63
63010	Östersund	1,368	19	0.84	0.58-1.22	27	6-60
55011	Karlskoga	901	15	0.84	0.56-1.26	28	5-61
62011	Örnsköldsvik	1,171	17	0.85	0.58-1.25	29	5-60
57010	Falun	2,621	45	0.85	0.65-1.11	30	10-52
55012	Lindesberg	2,283	28	0.86	0.62-1.19	31	8-58
50498	Art Clinic Göteborg	306	1	0.88	0.47-1.65	32	2-74
42010	Halmstad	1,870	32	0.89	0.65-1.21	33	10-59
56010	Västerås	2,252	40	0.9	0.68-1.20	34	12-58
11013	Ortho Center Sthlm (Löw.)**	4,274	76	0.91	0.73-1.13	35	16-53
65090	Luleå-Sensia	62	0	0.92	0.47-1.79	36	2-76
54014	Torsby	1,056	17	0.92	0.63-1.36	37	8-66
64010	Skellefteå	898	16	0.94	0.63-1.40	38	9-68
12010	Enköping	3,378	56	0.94	0.74-1.21	39	17-58
57011	Mora	1,725	29	0.96	0.69-1.32	40	13-64
27011	Karlshamn	2,371	41	0.96	0.73-1.28	41	16-62
53010	Falköping	319	8	0.97	0.60-1.56	42	7-72
55010	Örebro	514	12	0.97	0.63-1.49	43	8-70
51011	Mölndal	2,847	49	0.98	0.76-1.27	44	19-62
12001	Akademiska sjukhuset	884	21	0.99	0.69-1.42	45	13-68
28099	Ängelholm (Aleris)	63	0	0.99	0.51-1.93	46	3-77
22011	Eksjö (Höglandssjukh.)	1,774	30	1.02	0.74-1.40	47	18-68
13011	Nyköping	841	17	1.02	0.69-1.51	48	13-72
53011	Lidköping	1,744	32	1.03	0.75-1.40	49	19-68
28011	Ängelholm	1,973	36	1.03	0.77-1.39	50	20-67
65012	Gällivare	663	13	1.04	0.68-1.59	51	12-73
21014	Motala	3,890	78	1.05	0.85-1.30	52	27-64
56012	Köping	73	3	1.1	0.62-1.96	53	8-77
10016	Ortopediska huset	4,703	100	1.11	0.91-1.34	54	34-66
11010	Danderyd	1,175	25	1.13	0.80-1.59	55	23-73
10013	Södersjukhuset	2,589	61	1.14	0.89-1.44	56	32-70
54012	Arvika	1,664	34	1.14	0.84-1.54	57	28-72
10011	S:t Göran	3,539	76	1.14	0.92-1.42	58	34-69
23010	Växjö	917	24	1.19	0.84-1.68	59	27-75
23011	Ljungby	1,059	25	1.2	0.85-1.68	60	28-75
51010	Uddevalla	1,950	43	1.21	0.92-1.59	61	34-73
21013	Norrköping	1,397	33	1.23	0.91-1.67	62	33-75
11011	Södertälje	1,191	29	1.23	0.89-1.70	63	32-75
28012	Hässleholm	6,849	159	1.26	1.07-1.47	64	48-71
53013	Skövde	1,034	29	1.29	0.94-1.78	65	36-76
41012	Helsingborg	278	9	1.31	0.82-2.09	66	26-78
13010	Eskilstuna	428	12	1.32	0.85-2.03	67	29-78
64011	Lycksele	807	20	1.33	0.92-1.92	68	35-77
50071	Frölunda Spec.	786	28	1.35	0.98-1.87	69	40-77
13012	Kullbergska sjukhuset	2,070	60	1.37	1.08-1.74	70	49-76
26010	Visby	835	25	1.39	0.99-1.95	71	40-78
51012	Kungälv	1,537	45	1.45	1.11-1.90	72	51-77
61011	Bollnäs	2,899	87	1.53	1.25-1.87	73	60-77
41001	Lund	319	13	1.56	1.03-2.39	74	45-78
64001	Umeå	1,311	50	1.58	1.22-2.04	75	59-78
61010	Gävle	916	33	1.58	1.16-2.14	76	55-78
11012	Norrtälje	934	29	1.65	1.19-2.27	77	58-78
62013	Sollefteå	1,105	41	1.83	1.38-2.42	78	67-78

* Gothenburg Medical Center was discontinued and OrthoCenter IFK kliniken was started in 2008.

** Löwenströmska was taken over by Stockholms Specialistvård in 2001 and by OrthoCenter Stockholm in 2008.

Only units that inserted more than 50 TKA for OA during the period are listed

Patient characteristics and case-mix at knee arthroplasty surgery

The table shows what was reported for primary knee arthroplasties in 2019. Topmost is the average for the country as a whole after which the hospitals are classified as being university hospitals, private hospitals or "other" based on if their reported number of surgeries was less than 100, 100-300 or more than 300. The first column shows the total number reported and the second column the proportion of complete reports. The rest of the information is based only on complete reports and shows the proportion of patients having their surgery for OA, of women, of those younger than 55, those with BMI of 35 and over and those having been classified with ASA III or higher. Please note that the percentages may be misleading for units having reported few surgeries.

Among the university hospitals we can see that some units have a higher proportion of surgeries for other diagnoses than OA and of sicker patients (ASA ≥3) while other university hospitals do not seem to differ so much from the national average. Overall, the university hospitals have a higher proportion of patients younger than 55 years.

The private hospitals generally report a lower proportion of patients with ASA ≥3, Motala-Aleris and S:t Görans being the exemptions.

The County hospitals, not classified as university hospitals, do not differ from the national average with a few exceptions. The proportion of patients with BMI of 35 and over is almost twice the national average in Borås, Gävle and Södertälje. The proportion of patients with ASA ≥3 is twice the national average in Borås, Danderyd, , Gävle and Södersjukhuset while it is less than half in the Kullbergska hospital.

The variation in patient characteristics is large and it does not seem to be possible to generalize based on if the unit is a university or private hospital or by the number of reported surgeries.

Patient characteristics and case-mix

Hospital 2019	Number of reports	Complete reports %	% OA	% Women	% <55 years	% BMI 35+	% ASA ≥3
Country	**16,975**	**99.9**	**97.2**	**56.5**	**6.4**	**9.3**	**17.9**
University hospitals							
Akademiska	85	100	91.8	51.8	10.6	8.2	40.0
Huddinge	182	99.9	92.3	57.7	6.0	12.6	56.0
Karolinska Solna	21	100	61.9	52.4	23.8	14.3	61.9
Lund	23	100	78.3	47.8	4.4	30.4	78.3
Umeå	160	99.5	91.3	66.3	6.9	17.5	26.9
Örebro	2	100	50.0	50.0	0.0	50.0	100
Private units							
Art Clinic Göteborg	109	100	98.2	56.9	8.3	3.7	0.9
Art Clinic Jönköping	265	100	99.3	54.3	9.1	6.8	3.0
Bollnäs Aleris	389	100	95.9	55.8	5.4	3.3	14.1
Capio Artro Clinic	490	99.9	96.9	53.7	9.0	3.7	2.2
Carlanderska	429	99.8	99.5	49.7	11.2	9.1	4.4
Hermelinen-Luleå	14	100	100	21.4	7.1	14.3	0.0
Motala Aleris	631	100	97.0	55.6	6.8	6.5	22.0
Movement Halmstad	452	100	99.8	54.2	6.4	10.6	16.8
Nacka Aleris	205	100	100	63.4	8.3	4.4	4.9
Ortho Center IFK-kliniken	240	100	96.7	43.3	12.5	3.8	5.8
Ortho Center Sthlm (Löw.)	701	99.9	97.0	57.1	7.4	5.3	1.3
Ortopediska huset	671	100	99.6	55.9	7.5	4.0	0.5
Sophiahemmet	186	100	100	30.1	16.1	9.1	12.9
Specialistcenter Scandinavia	12	96.7	100	41.7	8.3	0.0	0.0
St Göran	546	100	98.0	57.7	4.2	9.5	43.6
Ängelholm Aleris	212	100	95.8	54.3	6.1	8.0	10.4

A previous surgery of the index knee (not shown in the table) was reported for 18% of the patients. Meniscal surgery was most common (6.7%) followed by arthroscopy (4.2%), cruciate ligament surgery (2.4%), osteotomy (1.1%), osteosynthesis (0.7%) and "other" (1.4%). For 3% of the surgeries, more than one previous surgery was stated.

The previous surgeries reported are not comprehensive but illustrate what the surgeon knew at the time of the primary arthroplasty.

Patient characteristics and case-mix

Hospital 2019	Number of reports	Complete reports %	% OA	% Women	% <55 years	% BMI 35+	% ASA ≥3
< 100 operations/year							
Eskilstuna	66	100	93.9	59.1	12.1	12.1	34.9
Falköping	38	100	94.7	65.8	13.2	18.4	10.5
Helsingborg	19	100	94.7	52.6	5.3	52.6	73.7
Hudiksvall	63	100	92.1	57.1	7.9	11.1	23.8
Karlskoga	1						
Skövde	29	100	93.1	69.0	10.3	34.5	20.7
Sundsvall	56	100	94.6	48.2	1.8	5.4	25.0
Växjö	97	100	97.9	55.7	7.2	7.2	27.8
100-300 operations/year							
Alingsås	208	100	100.0	60.6	7.7	16.8	21.2
Arvika	276	100	98.9	51.8	6.9	7.3	19.6
Borås	113	100	95.6	54.0	4.4	23.9	46.0
Danderyd	168	100	92.3	58.9	4.8	11.3	46.4
Falun	179	100	95.0	57.5	7.3	15.6	22.4
Gällivare	104	99.8	96.2	55.8	10.6	8.7	23.1
Gävle	147	100	93.2	55.8	3.4	27.9	36.7
Halmstad	192	100	97.4	60.4	13.5	10.9	22.4
Kalmar	112	100	92.9	58.0	2.7	7.1	21.4
Karlshamn	263	100	97.7	51.3	4.2	8.4	17.1
Karlstad	125	100	98.4	62.4	4.8	8.8	23.2
Kullbergska sjukhuset	295	100	99.3	57.3	5.8	12.9	4.4
Kungälv	233	100	97.4	64.8	7.3	15.0	12.9
Lidköping	231	100	96.1	57.1	5.6	17.8	22.9
Ljungby	178	100	94.9	56.2	5.6	11.2	18.0
Lycksele	102	100	96.1	63.7	11.8	16.7	9.8
Mora	216	100	99.5	55.1	3.2	11.1	16.2
Norrköping	145	100	97.9	55.9	2.8	6.2	18.6
Norrtälje	197	100	97.0	53.8	5.1	6.6	25.4
Nyköping	154	99.7	96.1	53.9	5.8	6.5	14.3
Skellefteå	119	100	100.0	54.6	5.9	8.4	16.8
Skene	174	100	97.7	52.0	5.8	2.3	8.6
Sollefteå	218	100	99.5	60.6	2.3	5.1	12.8
Södersjukhuset	221	100	97.3	52.5	5.4	11.8	50.2
Södertälje	155	99.6	97.4	63.2	9.0	21.9	47.1
Torsby	132	100	100.0	60.6	6.8	15.2	18.2
Uddevalla	280	100	96.1	58.2	2.9	9.6	30.7
Varberg	173	99.8	97.1	55.5	5.2	9.3	20.8
Visby	117	100	93.2	53.9	6.0	9.4	19.7
Värnamo	198	100	94.4	61.1	4.6	13.6	28.3
Västervik	106	100	97.2	60.4	1.9	9.4	12.3
Ängelholm	224	99.9	96.0	68.8	9.4	11.6	17.4
Örnsköldsvik	119	99.8	100.0	50.4	5.9	11.8	22.7
Östersund	208	100	95.7	60.6	4.3	6.3	21.6
> 300 operations/year							
Eksjö-Nässjö	331	99.9	98.2	54.4	7.9	5.4	14.8
Enköping	434	100	98.4	62.9	3.5	8.1	14.1
Hässleholm	878	100	96.8	52.3	5.2	5.4	10.0
Lindesberg	423	100	96.0	53.4	5.2	7.1	20.1
Mölndal	404	99.9	95.3	68.1	5.9	7.7	15.8
Oskarshamn	397	100	97.7	51.4	3.0	10.6	11.8
Piteå	422	100	95.7	56.6	7.1	12.1	22.5
Trelleborg	823	100	99.4	65.3	6.1	13.4	19.0
Västerås	387	100	97.4	55.6	3.9	13.2	23.7

Prophylactic antibiotics for knee arthroplasties

The table shows what was reported for primary knee arthroplasties in 2019.

Topmost is the average for the country as a whole after which the hospitals are classified as being university hospitals, private hospitals or "other" based on if their reported number of surgeries was less than 100, 100-300 or more than 300.

The first column shows the total number reported and the second the proportion of complete reports. The rest of the information is based only on complete reports. Please note that the percentages may be misleading for units having reported only few surgeries. The choice of the variables shown in the other columns is based on the 2019 recommendations by the PRISS project (Prosthetic Related Infections Shall be Stopped). As a Swedish study (Robertsson et al. 2017) found that patients recieving Clindamycin had a higher risk of revision for infection than those receiving Cloxacillin, the recommendations were revised. They can be found at www. patientforsakringen.se.

The columns "% having Cloxacilline, Cefotaxim or Clindamycin", "% with dose 2g x 3, 2g x 2 or 600mg x 2" and "% having AB within 45-30 min" show the proportion of surgeries in which antibiotics are given according to the current PRISS routines. The column "% having AB within 45-15 min" shows the proportion for which the dose was given within the previously recommended time interval which has been shown in earlier reports.

All the hospitals now report that they use Cloxacillin as their first choice. The reduction between 2017 and 2019 in the use of Clindamicin for prophylaxis has been marginal (7.5% to 5.4%). Cefotaxim was reported being used in 1.1% of surgeries.

At the start of surgery a reasonable tissue concentration of the antibiotic should have been reached in order to counteract any bacteria in the field. Due to the short half-life of Cloxacilline it is important that it is administrated within a correct time interval. However, an earlier study from the register found imperfect routines concerning prophylactic antibiotics in 2007 (Stefánsdóttir A et al. 2009).

The SKAR started to register the time for delivery of the first dose in 2009. A successive improvement was noted in the routines in 2011 with 87% of patients being reported to having received the dose within

Prophylactic antibiotics

Hospital 2019	Number of reports	Complete reports %	% having Cloxacillin Cefotaxim or Clindamycin	% with dose 2g x 3, 2g x 2 or 600mg x 2	% having AB within 45-15 min	% having AB within 45-30 min
Country	**16,975**	**99.7**	**99.9**	**95.9**	**80.2**	**45.3**
University hospitals						
Akademiska	85	99.6	100	90.6	22.3	0.0
Huddinge	182	98.7	99.5	86.3	68.7	35.2
Karolinska Solna	21	100	100	100	85.7	81.0
Lund	23	98.6	100	95.7	69.6	43.5
Umeå	160	98.3	100	91.3	74.4	36.9
Örebro	2	100	100	100	50.0	50.0
Private units						
Art Clinic Göteborg	109	100	100	98.2	86.2	6.4
Art Clinic Jönköping	265	99.6	99.6	98.1	97.0	21.9
Bollnäs Aleris	389	99.8	100	99.7	90.0	33.7
Capio Artro Clinic	490	99.9	100	97.4	88.6	50.2
Carlanderska	429	99.1	100	98.6	86.3	44.1
Hermelinen-Luleå	14	100	100	100	85.7	0.0
Motala Aleris	631	99.9	100	96.0	89.9	54.5
Movement Halmstad	452	99.5	100	90.3	83.0	23.0
Nacka Aleris	205	99.8	100	94.2	93.7	60.0
Ortho Center IFK-kliniken	240	99.4	100	95.4	92.1	79.2
Ortho Center Sthlm (Löw.)	701	99.8	100	98.2	92.7	65.1
Ortopediska huset	671	99.6	99.9	96.3	83.6	31.9
Sophiahemmet	186	99.1	100	94.6	69.4	51.1
Specialistcenter Scandinavia	12	86.1	100	83.3	58.3	25.0
St Göran	546	99.8	100	98.5	87.4	41.0
Ängelholm Aleris	212	99.8	99.5	96.2	92.0	26.4

the recommended 45-15 minutes. However during 2013-2019 the proportion has lessened to 80%. Only Orthocenter-IFK has implemented the latest PRISS recommendation and in 2019 only 45% of the patients had their preoperative dose 45-30 min. prior to surgery. The adaption of the prior and present recommendation is still low at the Akademiska sjukhuset.

Prophylactic antibiotics

Hospital 2019	Number of reports	Complete reports %	% having Cloxacillin Cefotaxim or Clindamycin	% with dose 2g x 3, 2g x 2 or 600mg x 2	% having AB within 45-15 min	% having AB within 45-30 min
< 100 operations/year						
Eskilstuna	66	100	100	86.4	72.7	39.4
Falköping	38	99.1	99.5	89.5	52.6	47.4
Helsingborg	19	98.2	100	89.5	73.7	31.6
Hudiksvall	63	100	100	98.4	76.2	49.2
Karlskoga	1					
Skövde	29	100	100	96.6	48.3	27.6
Sundsvall	56	100	100	98.2	69.6	51.8
Växjö	97	99.7	100	100	84.5	32.0
100-300 operations/year						
Alingsås	208	100	100	96.6	75.5	62.5
Arvika	276	99.2	100	97.8	66.3	53.6
Borås	113	99.4	100	92.0	63.7	38.9
Danderyd	168	99.6	100	87.5	64.9	36.9
Falun	179	99.8	99.4	98.3	83.8	47.5
Gällivare	104	100	100	99.0	78.9	33.7
Gävle	147	99.8	98.0	88.4	83.0	29.3
Halmstad	192	98.8	100	90.1	76.0	42.7
Kalmar	112	100	100	99.1	83.9	29.5
Karlshamn	263	99.9	100	97.7	68.8	36.4
Karlstad	125	99.7	100	99.2	66.4	51.2
Kullbergska sjukhuset	295	99.8	100	99.3	86.1	43.4
Kungälv	233	99.6	99.6	97.0	77.3	58.8
Lidköping	231	100	100	93.5	94.4	56.3
Ljungby	178	99.8	100	96.1	96.1	83.2
Lycksele	102	99.3	100	97.1	71.6	36.3
Mora	216	99.8	100	95.4	82.4	57.4
Norrköping	145	99.8	100	95.9	65.5	49.0
Norrtälje	197	99.8	100	96.5	81.2	42.6
Nyköping	154	99.8	100	96.1	71.4	47.4
Skellefteå	119	100	100	95.0	74.8	47.9
Skene	174	100	100	98.9	53.5	42.5
Sollefteå	218	99.5	99.5	97.3	83.9	56.0
Södersjukhuset	221	99.5	99.6	96.8	52.9	40.3
Södertälje	155	97.0	100	87.7	74.2	43.9
Torsby	132	100	100	97.0	86.4	79.6
Uddevalla	280	100	100	97.5	68.6	53.2
Varberg	173	99.6	100	86.1	58.4	40.5
Visby	117	100	100	95.7	76.9	33.3
Värnamo	198	99.8	100	96.5	90.4	45.5
Västervik	106	99.7	100	98.1	66.0	52.8
Ängelholm	224	99.9	100	95.5	79.5	48.2
Örnsköldsvik	119	99.7	99.2	95.0	88.2	58.8
Östersund	208	100	100	98.6	88.5	51.4
> 300 operations/year						
Eksjö-Nässjö	331	99.6	100	96.7	84.9	66.8
Enköping	434	99.9	99.8	97.5	83.2	54.8
Hässleholm	878	99.8	100	96.8	63.3	14.9
Lindesberg	423	99.8	100	94.8	83.0	51.5
Mölndal	404	99.9	100	95.3	76.7	44.1
Oskarshamn	397	99.7	100	95.0	76.6	61.7
Piteå	422	99.8	100	92.9	88.9	64.2
Trelleborg	823	99.7	99.9	97.2	84.1	36.5
Västerås	387	99.4	100	94.6	79.1	50.4

Antithrombotic prophylaxis for knee arthroplasties

The table ”Antithrombotic prophylaxis” shows what the hospitals reported having administrated for primary knee arthroplasties in 2019.

Topmost is the average for the country as a whole after which the hospitals are classified as being university hospitals, private hospitals or "other" based on if their reported number of surgeries was less than 100, 100-300 or more than 300.

The first column shows the total number reported and the second the proportion of complete reports. The rest of the information is based only on complete reports. Please note that the percentages may be misleading for units having reported only few surgeries. As there is no national or international consensus concerning the "best practice" for drug selection, or when to start or end the treatment, we only show what is most commonly reported.

The choice of variables in the three next columns is based on what was reported as being the most common routines. They show respectively the proportion of primary knee arthroplasties in which it was planned to start the prophylaxis postoperatively, the proportion in which an injection was used (Fragmin, Innohep och Klexane) and the proportion for which the planned duration for the treatment was 8-14 days.

As it can be seen in the table, it is most common to start the antithrombotic prophylaxis postoperatively and only few units report that they more commonly start preoperatively.

For 43% of the surgeries it was reported that the intention was to use injectable drugs, which is lower than in recent years when the proportion has varied between 63% and 83%. In some cases (7.4%) the intention was reoprted to use a combination of both injectable and per-oral drugs.

The duration of the planned prophylaxis has been relatively constant since SKAR started registering this variable in 2009 with 73-79% of the surgeries having a planned duration of 8-14 days (see previous reports). However, during the last couple of years we have observed a shorter prophylaxis (1-7 days) being planned for a larger proportion of the patients (ca 19%) as well as no prophylaxis at all being planned (3.6%).

Antithrombotic prophylaxis

Hospital 2019	Number of reports	Complete reports %	Percent starting postoperatively	Percent having injection	Percent treated for 8-14 days
Country	**16,975**	**99.8**	**89.4**	**43.4**	**74.4**
University hospitals					
Akademiska	85	99.6	88.2	6.0	88.6
Huddinge	182	99.5	95.1	95.6	82.0
Karolinska Solna	21	96.8	61.9	95.2	4.8
Lund	23	97.1	87.0	100	47.6
Umeå	160	98.8	96.9	5.0	96.9
Örebro	2	100	50.0	50.0	100
Private units					
Art Clinic Göteborg	109	100	89.0	0.9	95.4
Art Clinic Jönköping	265	100	98.1	0.0	98.5
Bollnäs Aleris	389	100	96.9	1.0	97.6
Capio Artro Clinic	490	99.9	92.0	10.0	94.1
Carlanderska	429	99.8	92.3	3.8	96.0
Hermelinen-Luleå	14	100	100	0.0	0.0
Motala Aleris	631	99.7	96.4	98.6	95.2
Movement Halmstad	452	100	97.6	95.8	0.9
Nacka Aleris	205	99.8	98.5	96.1	98.5
Ortho Center IFK-kliniken	240	100	95.4	4.6	94.6
Ortho Center Sthlm (Löw.)	701	100	94.7	0.1	93.0
Ortopediska huset	671	100	99.0	0.8	98.7
Sophiahemmet	186	98.0	95.7	90.3	58.1
Specialistcenter Scandinavia	12	100	91.7	8.3	91.7
St Göran	546	99.9	86.1	27.2	65.3
Ängelholm Aleris	212	99.6	92.9	1.9	93.2

Antithrombotic prophylaxis

Hospital 2019	Number of reports	Complete reports %	Percent starting postoperatively	Percent having injection	Percent treated for 8-14 days
< 100 operations/year					
Eskilstuna	66	100	95.5	6.1	92.2
Falköping	38	100	97.4	2.6	100
Helsingborg	19	100	100	94.7	89.5
Hudiksvall	63	100	88.9	96.8	96.8
Karlskoga	1				
Skövde	29	100	96.6	3.5	100
Sundsvall	56	100	94.6	0.0	96.2
Växjö	97	99.0	88.7	10.3	92.6
100-300 operations/year					
Alingsås	208	99.7	93.3	99.0	98.1
Arvika	276	99.9	94.2	4.7	95.6
Borås	113	100	92.0	2.7	88.9
Danderyd	168	99.6	90.5	97.6	87.7
Falun	179	100	93.3	99.4	5.1
Gällivare	104	100	96.2	1.0	74.3
Gävle	147	100	89.8	10.9	82.8
Halmstad	192	100	90.1	99.5	1.1
Kalmar	112	99.7	59.8	91.7	91.0
Karlshamn	263	100	96.2	95.4	94.9
Karlstad	125	100	96.0	4.8	93.5
Kullbergska sjukhuset	295	99.9	97.3	1.4	96.8
Kungälv	233	99.7	93.6	2.2	92.5
Lidköping	231	99.9	96.5	2.6	95.2
Ljungby	178	99.8	93.3	2.3	96.5
Lycksele	102	98.0	14.7	100	92.0
Mora	216	100	90.3	0.9	96.6
Norrköping	145	99.3	78.6	96.8	96.0
Norrtälje	197	99.8	86.3	20.8	62.4
Nyköping	154	100	91.6	0.0	98.7
Skellefteå	119	100	99.2	100	99.2
Skene	174	100	91.4	0.0	98.9
Sollefteå	218	98.5	94.5	98.6	90.3
Södersjukhuset	221	99.8	92.8	73.8	90.7
Södertälje	155	99.6	88.4	94.7	58.3
Torsby	132	100	93.2	9.9	86.2
Uddevalla	280	100	94.3	55.0	95.4
Varberg	173	100	93.1	100	32.0
Visby	117	99.4	95.7	0.9	43.6
Värnamo	198	100	43.4	98.9	89.0
Västervik	106	100	66.0	98.6	93.1
Ängelholm	224	100	92.9	97.3	87.5
Örnsköldsvik	119	99.7	88.2	5.9	85.2
Östersund	208	100	90.4	96.6	93.0
> 300 operations/year					
Eksjö-Nässjö	331	100	22.4	100	75.0
Enköping	434	99.8	95.6	3.7	90.8
Hässleholm	878	99.8	99.0	99.7	10.2
Lindesberg	423	99.9	83.5	13.1	53.9
Mölndal	404	99.1	93.3	100	94.5
Oskarshamn	397	100	48.9	27.4	95.5
Piteå	422	100	71.8	5.8	47.8
Trelleborg	823	100	97.0	98.4	3.3
Västerås	387	100	93.3	99.7	95.9

Surgical technique for knee arthroplasties

The table ”Surgical technique” shows what the hospitals reported for having used in their primary knee arthroplasties in 2019.

Topmost is the average for the country as a whole after which the results for the respective hospitals are shown. They have been classified depending on if they are university hospitals, private hospitals or for the others depending on if their reported number of surgeries was less than 100, 100-300 or more than 300.

The first column shows the total number reported and the second the proportion of complete reports. The rest of the information is based only on complete reports. Please note that the percentages may be misleading for units having reported only few surgeries.

There are no national guidelines or "best practice" concerning the use of the "surgical techniques" we register.

For other variables than the median operating time the table shows the proportion of surgeries performed using the method.

Spinal anesthesia is most common (66.7%) while the increase that we have seen in the proportion having general anesthesia in recent years seems to have stagnated (31.6% in 2017, 32.8% in 2019). Ten hospitals reported having performed more than 80% of their arthroplasties using general anesthesia.

The use of drains has decreased from 26% in 2011 to less than 1 % in 2019. The proportion of surgeries performed using tourniquet has also continued to decrease from 90% in 2011 to 32% in 2019.

LIA, with or without a catheter being left in the knee, was used in the majority of the surgeries.

The median time for performing a primary varied between units from 38 to 111 minutes. For TKA's it was overall 69 min., for UKA's 59 min., for femoropatellar arthroplasties 56 min., for linked implants 130 min. and for partial implants 65 min. Since 2009, the median operating time for TKA's has varied between 69 and 82 min. and for UKA's between 59 and 80 min..

Bone transplantation is uncommon in primary arthroplasty and almost exclusively using auto transplantation. It was reported in 1% of the primaries and was slightly more commonly used in the tibia (63%) than in the femur (44%).

Computer aided surgery (CAS) was only reported for 10 cases by 6 units (4 in 2018).
No UKA's were reported using CAS.

Surgical technique

Hospital 2019	Number of reports	Complete reports %	Percent having General anesthesia	Percent Drainage	Percent Tourniquet	Percent LIA	Median Op-time
Country	**16,975**	**99.8**	**32.4**	**0.5**	**32.5**	**96**	**68**
University Hospitals							
Akademiska	85	99.5	20.0	0.0	70.6	91.8	87
Huddinge	182	98.8	12.6	0.0	24.5	78.6	105
Karolinska Solna	21	98.1	38.1	28.6	95.2	81.0	90
Lund	23	98.3	21.7	0.0	17.4	95.7	88
Umeå	160	98.1	25.6	2.5	46.9	79.4	81
Örebro	2	100	100	0.0	0.0	50.0	111
Private units							
Art Clinic Göteborg	109	99.8	100	0.0	3.7	98.2	63
Art Clinic Jönköping	265	100	99.6	0.0	3.4	99.6	71
Bollnäs Aleris	389	100	92.0	0.0	60.2	97.9	53
Capio Artro Clinic	490	99.7	79.0	0.0	1.2	92.0	58
Carlanderska	429	99.8	17.0	0.2	3.7	96.5	63
Hermelinen-Luleå	14	100	7.1	0.0	0.0	100	64
Motala Aleris	631	99.8	3.7	0.5	36.0	99.2	41
Movement Halmstad	452	99.9	0.9	0.4	7.5	98.9	54
Nacka Aleris	205	100	100	0.0	0.5	98.1	53
Ortho Center IFK-kliniken	240	99.9	6.3	0.0	0.4	94.2	80
Ortho Center Sthlm (Löw.)	701	99.9	3.7	0.0	6.6	98.3	62
Ortopediska huset	671	99.9	10.0	0.0	40.7	99.3	50
Sophiahemmet	186	99.2	78.0	19.9	50.0	90.3	70
Specialistcenter Scandinavia	12	98.3	0.0	0.0	16.7	91.7	77
St Göran	546	99.2	15.9	0.2	89.9	94.7	65
Ängelholm Aleris	212	99.6	87.3	0.0	1.9	97.6	51

The number of cases using custom made instruments/cutting blocks was 64 (<0,5%) or approximately the same number as in 2018. Use of such instruments was reported by 17 units (16 in 2018). Most of those only performed a few surgeries each while Kungälv reported 35 cases..

Surgical technique

Hospital 2019	Number of reports	Complete reports %	Percent having General anaesthesia	Percent Drainage	Percent Tourniquet	Percent LIA**	Median Op-time
< 100 operations/year							
Eskilstuna	66	100	4.6	0.0	0.0	98.5	90
Falköping	38	100	26.3	0.0	0.0	92.1	79
Helsingborg	19	100	10.5	0.0	0.0	89.5	87
Hudiksvall	63	100	19.1	0.0	25.4	85.7	82
Karlskoga	1						
Skövde	29	100	10.3	0.0	24.1	75.9	88
Sundsvall	56	99.6	1.8	0.0	3.6	96.4	108
Växjö	97	99.8	27.8	0.0	12.4	92.8	79
100-300 operations/year							
Alingsås	208	100	12.5	0.5	0.0	96.6	82
Arvika	276	100	6.5	0.0	7.3	98.9	56
Borås	113	100	15.0	0.9	78.8	94.7	91
Danderyd	168	99.8	22.6	0.6	69.1	94.1	92
Falun	179	99.8	24.0	1.1	97.2	98.9	74
Gällivare	104	100	10.6	0.0	25.0	100	105
Gävle	147	100	35.4	1.4	95.2	94.6	66
Halmstad	192	98.8	13.0	0.0	66.7	95.8	87
Kalmar	112	100	7.1	0.0	0.0	96.4	79
Karlshamn	263	100	94.7	0.0	89.0	94.7	72
Karlstad	125	99.7	23.2	0.0	0.0	99.2	78
Kullbergska sjukhuset	295	99.9	5.4	0.0	30.5	97.0	63
Kungälv	233	100	25.8	0.0	20.6	96.6	84
Lidköping	231	100	10.8	0.0	2.6	99.1	83
Ljungby	178	99.8	78.1	0.6	33.2	97.8	59
Lycksele	102	99.4	7.8	2.0	95.1	98.0	92
Mora	216	99.9	13.4	0.0	98.2	96.3	53
Norrköping	145	100	16.6	0.0	4.8	95.2	86
Norrtälje	197	100	53.8	0.0	82.2	93.4	78
Nyköping	154	99.9	8.4	0.7	31.2	94.2	80
Skellefteå	119	100	3.4	0.0	100	100	85
Skene	174	100	31.0	0.6	44.3	98.9	84
Sollefteå	218	99	28.4	0.9	67.9	89.0	72
Södersjukhuset	221	100	19.5	0.5	0.9	91.0	81
Södertälje	155	100	94.8	1.9	0.7	95.5	67
Torsby	132	99.8	8.3	0.8	13.6	99.2	78
Uddevalla	280	100	10.4	0.0	3.9	98.6	88
Varberg	173	100	20.2	0.0	0.6	98.3	88
Visby	117	99.8	14.5	0.0	1.7	98.3	110
Värnamo	198	100	10.6	1.5	0.0	88.9	85
Västervik	106	100	31.1	0.9	1.9	97.2	88
Ängelholm	224	100	80.4	2.2	23.7	94.2	73
Örnsköldsvik	119	99.7	10.1	0.0	93.3	100	84
Östersund	208	100	13.9	0.5	56.3	97.6	87
> 300 operations/year							
Eksjö-Nässjö	331	100	27.2	0.0	23.0	98.5	67
Enköping	434	99.6	11.3	0.0	88.7	99.1	75
Hässleholm	878	99.9	88.6	0.0	0.2	99.4	38
Lindesberg	423	100	98.6	0.0	0.0	98.1	70
Mölndal	404	99.3	18.8	0.3	1.5	88.9	79
Oskarshamn	397	99.9	13.4	0.0	77.1	87.4	73
Piteå	422	99.7	4.7	0.0	97.2	98.8	59
Trelleborg	823	100	30.6	0.0	40.5	99.2	66
Västerås	387	99.7	11.1	0.5	0.3	91.0	68

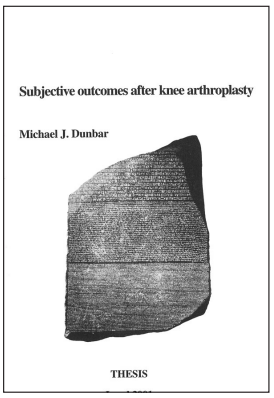
Patient reported outcome before and after knee arthroplasty

History

The SKAR started early on to ask patients about their opinion of their knee surgery. In 1997, 94% of all living patients that had undergone a knee arthroplasty answered a mail survey concerning non-reported revisions and patient satisfaction (Robertsson 2000).

In 1998, different patient questionnaires were tested in order to find the most suitable for use after knee arthroplasty and the SF-12 and Oxford-12 were found to be the most relevant. (Dunbar 2001).

We also found that the number of questions affected the response rate and the proportion of complete answers. Further, non-responders were more often unsatisfied than responders.



PROM was the subject for a dissertation in 2001 based on data from the knee register.

Using self-administrated disease specific or general health questionnaires to evaluate results of surgery turned out to be more complicated than expected. There are many reasons for this, including among others that there is no clear definition of what outcome can be expected after knee arthroplasty (the aim of the surgery may vary), the initial health status and the expectations of the patients differ and observed changes in health over time need not be related to the surgery of the joint. We have also found that the observed proportion as well as which patients do not experience pain relief one year after total knee arthroplasty is dependent on the type of questionnaire used (W-Dahl et al 2014).

A national pre- as well as post-operative registration of PROM requires a large amount of resources both at a hospital and register level. Without a well-defined purpose it is difficult to choose a fitting instrument as well as decide if the response rate can be expected to be adequate. Therefore the SKAR has awaited international consensus on the matter.

The pilot project

The project started within the Region of Skåne where PROMs are used as a quality measure of the care provided. In the 2011 report we accounted for PROM data gathered 2008-2009 for TKA patients operated at the arthroplasty center in Trelleborg, which is jointly used by the university hospitals in Lund and Malmö. In 2012 Hässleholm was included and in 2013 the remaining hospitals in Skåne (Lund, Malmö, Helsingborg and Ängelholm). At the turn of the year 2012/2013, Norrköping, Motala and Oskarshamn joined the project and since then 23 additional hospitals.

On the following pages, there is a compilation of PROM data for each of the participating hospitals.

The PROM-project

More and more units have joined the pilot project which now can be considered permanent. In 2014 Kalmar, Karolinska sjukhuset in Solna and Ortho-Center in Stockholm joined as well as Kungälv, Mölndal and Piteå at the turn of the year 2014/2015. In 2016 Alingsås, Bollnäs, Eksjö, Karlskoga, Lindesberg and Södertälje joined, in 2017 Norrtälje and Ortopediska huset, in 2018 Hudiksvall, Nacka and Västervik and in 2019 additional 5 hospitals. Mölndal, Ortopediska huset and St. Göran have chosen not to register the disease specific KOOS but only the EQ-5D VAS pain and satisfaction with the surgery one year postoperatively. Helsingborg and Ängelholm decided to stop registering KOOS in 2018. Additional units have however expressed their interest and initiated the task of engaging their hospitals in the project and finding resources for the data gathering. During 2019 PROM data were registered for approximately 50% of the primary surgeries.

Instruments used for the evaluation

EQ-5D is a general health instrument measuring general health based on the answers of 5 different questions (mobility, usual activities, self-care, pain/discomfort, anxiety/depression). Each of the questions can be answered by 1= no problem, 2= moderate problem and 3= extreme problem.

The EQ-5D index is calculated from the answers by use of a tariff for the normal population to weight the answers. However, lacking a Swedish tariff the British has been used instead. The lowest value is -0.594 and the highest 1.0 which represents a fully healthy individual. The index is intended to be used

for health economic calculations although it has also been used to estimate quality of care which has proved to be somewhat problematic because of the lack of a normal distribution as was reported in the Läkartidningen (36, 2011). If one wants to perform statistical analyses using a single value as a measure of general health status it is possible to use the EQ-VAS. It measures the self-perceived general health of the patient on a scale (0-100) from the worst imaginable health status (0) to the best imaginable health status (100) (www.euroqol.org).

KOOS is a disease specific questionnaire consisting of 42 questions and is designed to be used for short and long time follow-up after knee trauma or osteoarthritis. KOOS consists of 5 subscales; Pain, other Symptoms, Activity in Daily Life function (ADL), Sport and Recreation function (Sport/Rec) and knee related Quality of life (QoL). Standardized answer options are given (5 Likert boxes) and each question gets a score from 0 to 4. A normalized score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated for each subscale (www.koos.nu).

OMERACT-OARSI criteria. As a PROM mean value conceals both good and bad results, these criteria can be used to evaluate the proportion of patients that improved from before, to 1 year after surgery. They are based on the combination of absolute and releatve change in WOMAC pain, function and total score at 1 year after surgery (Pham et al. 2004). A responder (high) is a patient that has improved 50% or more and has an improvement of 20 points or more in WOMAC pain or function. In case of the patient not achieving this, he can still be classified as a responder (low) if the improvement is 20% or more and there is an improvement of 10 points or more in two of the WOMAC pain, function or total score.
We converted KOOS to WOMAC before classifying each patient according to the OMERACT-OARSI criteria one year after surgery into responders (high and low) or non-responders. The proportions are presentet as percentage. Please note that percentages for units with few surgeries may be misleading.

The Visual Analog Scale (VAS) is used to have the patients to estimate their knee pain by marking their pain score on a 0-100 scale (VAS) in which 0 = no pain and 100 = worst imaginable pain.

Patient satisfaction with the arthroplasty surgery one year postoperatively was also evaluated using a 0-100 scale (VAS) in which 0 = the highest imaginable satisfaction and 100 = the worst imaginable satisfaction. The satisfaction (VAS) score was categorized into 5 groups; very satisfied (0-20), satisfied (21-40), moderately satisfied (41-60), unsatisfied (61-80) and very unsatisfied (81-100).

The Charnley classification is a simple method for judging comorbidity. The modified Charnley classification consists of four classes; class A which stands for a unitlateral knee disease, class B means bilateral disease which is divided into B1 if the knee which is not subject for the present surgery is not healthy and has not been resurfaced with an arthroplasty and B2 if it has been operated with an arthroplasty. Class C stands for multiple joint diseases and/or another disease that affects the walking ability. The patients answer four questions that the classification is based on. The proportion of patients with Charnley class C is shown for each hospital in the table on page 74-75.

Patient selection
Only primary TKA's are included. Diagnoses other than OA are excluded as well as the second knee in case of both knees having had an arthroplasty during the one year follow-up period (left knee in case of simultaneous bilateral arthroplasty). Additionally only patients with complete pre- and one year postoperative data (EQ-5D, EQ-VAS and KOOS) were included. The number of TKA's reported as well as the number of available PROM reports is shown in the tables on page 71, 74 and 75.
A corresponding selection was used for UKA although we on pages 76-77 only account for units having reported PROMs for 10 or more UKAs.

Case-mix
A summary of case-mix factors such as gender, age, diagnosis, BMI and comorbidity is shown for the respective hospitals on page 60-61.

Logistics
The patients filled in the questionnaires at the outpatient visit approximately 2-6 weeks prior to surgery. One year postoperatively the same questionnaire was mailed to the patients together with the question on satisfaction with the knee arthroplasty.

Results

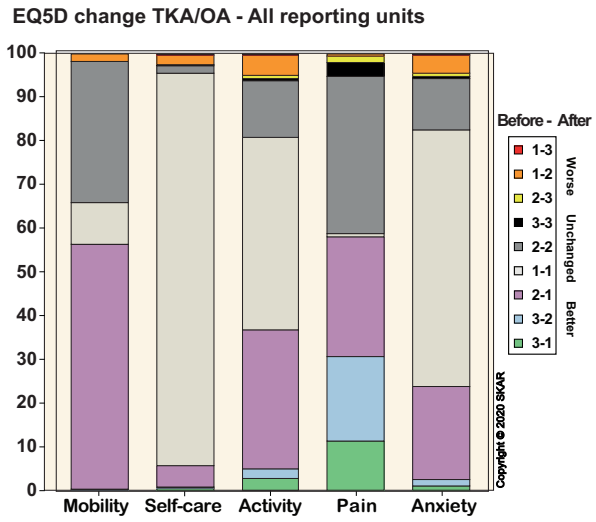
EQ5D

In order to visualize the change in general health from surgery until one year postoperatively we have classified 9 combinations of pre- and postoperative EQ-5D answers that are possible for the instrument.

A preoperative answer of extreme problems can be unchanged at the follow-up (3-3) or there can be an improvement from extreme to moderate (3-2) or from extreme to none (3-1).

Moderate problems can stay unchanged (2-2), worsen into extreme (2-3) or improve to none (2-1). Finally no problems preoperatively can stay unchanged (1-1), worsen to moderate (1-2) or become extreme (1-3).

The figure below shows for each of the 9 possible combinations the change from before surgery until one year after. It can be seen that just over half of the patients improved their mobility and experienced pain relief while only a third improved in their daily activities, a fifth had reduced anxiety and only a few improved in self-care. The results are similar to those of previous years.



The distribution (%) i for the different combinations of pre- and postoperatve (1-year) change for each of the EQ-5D questions. (1=no problem, 2=some or moderate problems 3=extreme problems)

Clinically relevant differences

In order for changes in points to be considered clinically relevant, the change on the VAS scale has to be 15-20 points and 8-10 points for each of the KOOS 5 subscales.

EQ-VAS

When patients operated in 2018 estimated their general health, both pre- and postoperatively, there was some difference between units. For those with a relatively high (≥75%) response rate (Bollnäs, Hässleholm, Kalmar, Kungälv, OrthoCenter Stockholm, Oskarshamn and Trelleborg) the difference was small (0-8 points) but higher for units having few patients and/or low response rate. The EQ-VAS for the units can be found in the table to the right.

VAS – Knee pain

When patients operated in 2018 estimated their knee pain, both pre- and postoperatively, the differnce between the units that had a relatively high response rate (see EQ-VAS above) was also relatively small both preoperatively (0-4 points) as well as 1 year postoperatively (0-7 points). For the other units the differences between the units were 0-24 points preoperatively and 0-32 points one year postoperatively.

The table to the right shows the VAS knee pain and EQ-VAS with both pre- and postoperative values for patients operated in 2018. For patients operated in 2019 only the preoperative values are availiable.

VAS – Satisfaction with the surgery

One year postoperatively, 68 % of the patients operated in 2018 had reported their satisfaction with their arthroplasty surgery.

The table on page 72 shows the number of complete reports, together with the mean and standard deviation (SD) for the satisfaction with the surgery one year postoperatively.

As described on page 69, the patient satisfaction one year after surgery was categorized into 5 groups based on the VAS scale marking. Using this definition, 86% of the patients operated in 2018 reported that they were satisfied or very satisfied with the surgery.

The figure on page 72 shows that among the hospitals with a relatively complete reporting, the highest proportion of satisfied patients was in Kalmar (92%) Oskarshamn (91%), and OrthoCenter Stockholm (90%) followed by Bollnäs (87%), Kungälv (84%), Trelleborg (84%) and Hässleholm (81%). For the other hospitals the proportion of satisfied patients varied from 40-100%

TKA/OA - Results for VAS–pain and EQ–VAS preoperatively and 1 year postoperatively.

			VAS pain 0–100 (best - worst)		EQ-VAS 0–100 (worst - best)	
Group	Patients n	Complete reports	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)
Participating hospitals						
All 2018	6,279	69	64 (20)	17 (20)	64 (22)	78 (19)
All 2019	7,577	78	62 (21)		63 (23)	
Individual hospitals :						
Alingsås 2018	172	69	62 (20)	20 (21)	67 (21)	76 (19)
Alingsås 2019	196	87	60 (19)		61 (21)	
Art Clinic Göteborg 2019	100	71	66 (15)		64 (25)	
Art Clinic Jönköping 2019	235	91	66 (17)		64 (22)	
Bollnäs 2018	313	87	67 (18)	17 (20)	63 (23)	79 (18)
Bollnäs 2019	273	98	66 (16)		59 (23)	
Borås 2019	99	64	66 (20)		61 (22)	
Eksjö 2018	248	70	61 (19)	19 (21)	66 (20)	76 (18)
Eksjö 2019	295	88	61 (18)		65 (20)	
Helsingborg 2018	15	67	81 (9)	46 (36)	60 (25)	69 (14)
Helsingborg 2019	17	0				
Huddinge 2018	80	18	76 (17)	24 (27)	53 (29)	70 (25)
Huddinge 2019	138	60	68 (17)		63 (21)	
Hudiksvall 2018	58	52	64 (16)	17 (21)	66 (21)	77 (20)
Hudiksvall 2019	54	94	65 (18)		57 (20)	
Hässleholm 2018	696	84	65 (18)	20 (19)	66 (22)	77 (20)
Hässleholm 2019	686	96	61 (19)	18(21)	66 (22)	
Kalmar 2018	79	75	67 (19)	16 (18)	63 (24)	73 (18)
Kalmar 2019	99	100	65 (17)		61 (20)	
Karolinska 2018	32	53	59 (22)	29 (24)	55 (14)	60 (23)
Karolinska 2019	13	77	58 (16)		50 (28)	
Kungälv 2018	149	79	68 (18)	16 (19)	63 (23)	76 (21)
Kungälv 2019	173	90	68 (17)		60 (23)	
Lindesberg 2018	439	33	65 (18)	16 (19)	62 (22)	76 (17)
Lindesberg 2019	382	42	64 (17)		65 (23)	
Lund 2018	24	13	69 (15)	33 (29)	61 (26)	82 (3)
Lund 2019	15	47	77 (18)		51 (27)	
Motala 2018	372	74	69 (16)	16 (19)	62 (22)	77 (19)
Motala 2019	368	86	70 (16)		58 (23)	
Mölndal 2018	340	68	61 (20)	17 (20)	65 (22)	74 (21)
Mölndal 2019	353	77	64 (20)		61 (24)	
Nacka 2019	182	81	72 (18)	24 (23)	61 (23)	72 (21)
Norrköping 2018	135	74	70 (15)	27 (25)	62 (23)	72 (21)
Norrköping 2019	129	81	71 (16)		58 (23)	
Norrtälje 2018	149	62	61 (18)	14 (19)	66 (20)	78 (16)
Norrtälje 2019	175	77	61 (17)		63 (20)	
Ortho Center Sthlm 2018	559	78	64 (18)	13 (17)	65 (21)	80 (16)
Ortho Center Sthlm 2019	507	91	66 (19)		64 (22)	
Ortopediska huset 2018	614	72	59 (22)	15 (19)	65 (22)	80 (18)
Ortopediska huset 2019	605	92	62 (18)		66 (22)	
Oskarshamn 2018	345	86	64 (18)	14 (17)	65 (22)	81 (17)
Oskarshamn 2019	373	92	63 (18)		65 (22)	
Piteå 2018	272	57	69 (17)	20 (24)	62 (22)	78 (17)
Piteå 2019	277	62	68 (17)		60 (23)	
St. Göran 2019	337	7	72 (21)		70 (20)	
Södertälje 2018	136	55	69 (19)	26 (25)	69 (19)	70 (21)
Södertälje 2019	145	73	66 (19)		62 (23)	
Trelleborg 2018	691	78	66 (18)	19 (20)	67 (22)	79 (20)
Trelleborg 2019	697	91	65 (18)		67 (22)	
Värnamo 2019	185	81	61 (21)		60 (23)	
Västervik 2018	92	51	73 (16)	16 (17)	52 (20)	76 (17)
Västervik 2019	97	78	69 (15)		50 (23)	
Ängelholm Aleris 2018	109	42	70 (16)	20 (21)	63 (22)	79 (17)
Ängelholm Aleris 2019	138	73	72 (17)		64 (25)	
Ängelholm 2018	160	31	57 (31)	22 (21)	60 (26)	75 (16)
Ängelholm 2019	207	2	65 (17)		63 (24)	

TKA/OA - Satisfaction one year after surgery (2018)
VAS (0-100) (best - worst)

Hospital 2018	Number of reports	Complete reports (%)	Postop Mean (SD)
All reporting units	6,279	68	17 (23)
Alingsås	172	69	19 (24)
Bollnäs	313	87	16 (23)
Eksjö	248	69	16 (24)
Helsingborg	15	33	63 (41)
Huddinge	80	18	26 (32)
Hudiksvall	58	52	13 (20)
Hässleholm	696	83	21 (23)
Kalmar	79	75	15 (20)
Karolinska	32	53	35 (33)
Kungälv	149	78	16 (26)
Lindesberg	439	33	15 (22)
Lund	24	13	18 (16)
Motala	372	74	14 (22)
Mölndal	340	68	21 (28)
Norrköping	135	73	27 (30)
Norrtälje	149	62	18 (24)
Ortho Center Sthlm	559	78	13 (21)
Ortopediska huset	614	72	15 (23)
Oskarshamn	345	86	13 (19)
Piteå	272	56	15 (23)
Södertälje	136	55	7 (15)
Trelleborg	691	76	20 (23)
Västervik	92	51	13 (18)
Ängelholm Aleris	109	40	20 (27)
Ängelholm	160	27	24 (2)

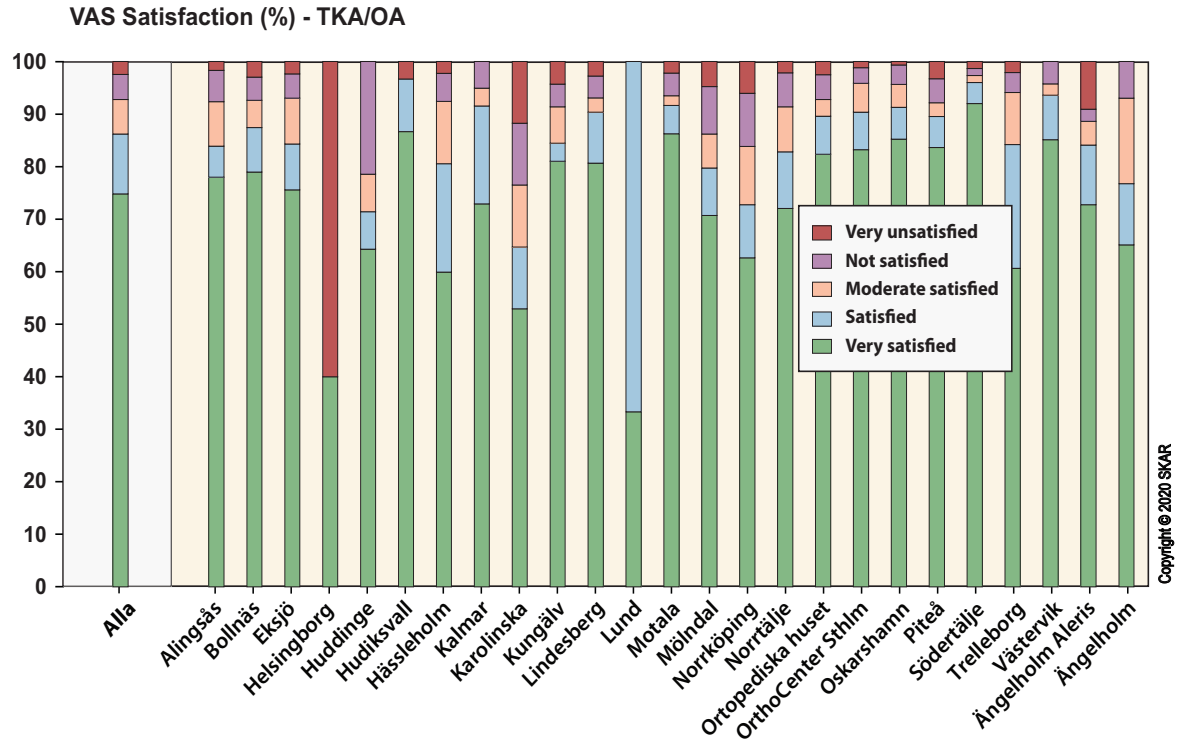
KOOS

The differences were small between those units having a relatively high response rate in 2018 (Bollnäs, Eksjö, Hässleholm, Kalmar, Kungälv, OrthoCenter Stockholm, Oskarshamn and Trelleborg). For units with few patients and/or low response rate the results vary and are difficult to interpret. The preoperative KOOS values in 2019 are similar to those reported in 2018.

The results for the KOOS 5 subscales are shown as mean and standard deviation for all patients as well as for the respective hospitals. For patients operated in 2018 both the pre- and postoperative results are shown but for patients operated in 2019 only preoperative results are available (see table on page 74-75).

OMERACT-OARSI responders

In 89% of the reported surgeries in 2018, the patients became classified as responders acting to the OMERACT-OARSI criteria with 78% being high responders (see figure below). For the units with relatively high response rate the proportion of responders was 85-92%. In i Kungälv, Ortho-



Proportion (%) of satisfied patients one year after surgery (in 2018) for all reporting units together (to the left) as well as for each unit seperately.

Center Stockholm and Oskarshamn 91-92% were responders of which respectively 79-81% were high responders. In Bollnäs, Hässleholm, Kalmar and Trelleborg, the corresponding results were 85-88%% with 75-78% being high responders. For units with few surgeries and/or low response rate the proportion of responders ranged between 70-98% of which high responders were 47-87%.

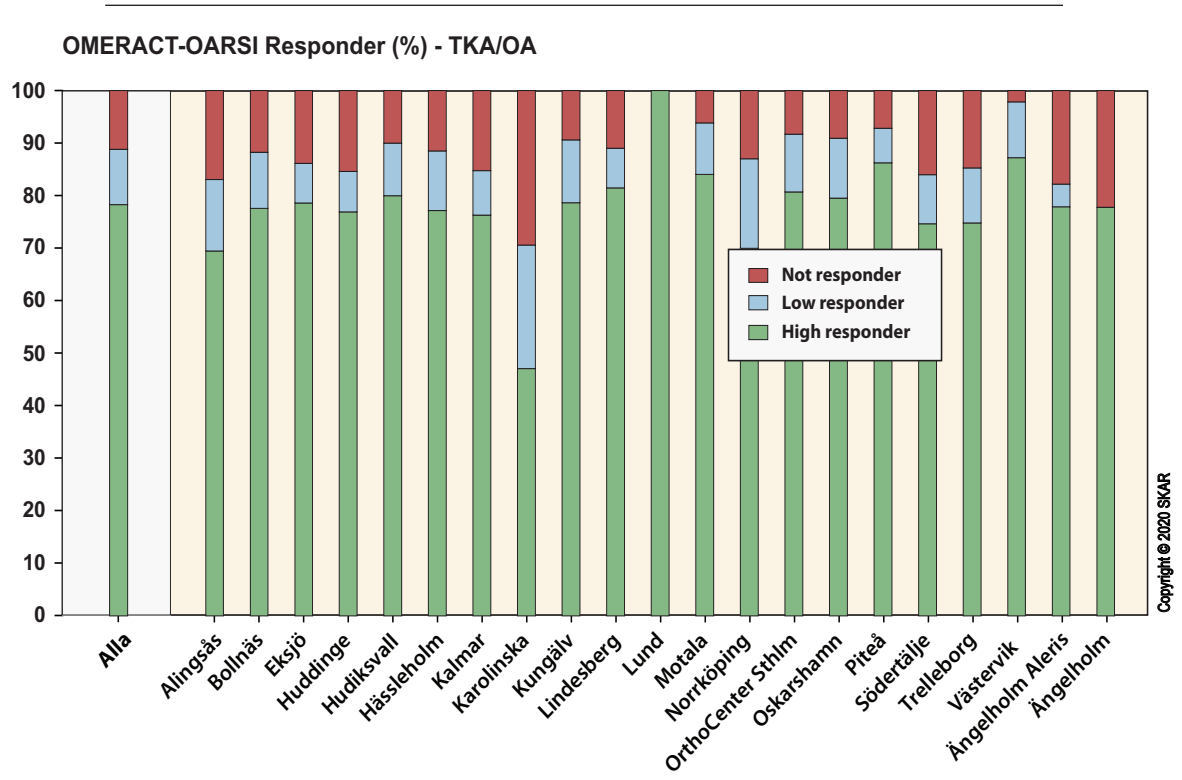
Summary

The result of the compilations showed again small variations between groups in spite of some differences in case-mix. However, it is worthwhile to point out that 92% of the patients in Kalmar and 91% of those in Oskarshamn and OrthoCenter Stockholm reported that they were very satisfied or satisfied one year after their knee arthroplasty surgery. Additionally, 92% of the patients in Kalmar and 91% of those in Oskarshamn and OrthoCenter Stockholm were classified as OMERACT-OARSI responders.

The results vary for units performing few surgeries as well as those with low response rate which makes it difficult to interpret and compare results between units as well as between different years of surgery.

The reasons for a low response rate vary. Further, the data entering requires carfulness and accuracy. In 2016, the register became able to automatically link the PROM data to the SKAR database.However, in order for a PROM to become linked to a specific surgery, the ID and the side operated have to match and the answering date has to be within a specified time interval before and after the date of surgery.

This year, additional hospitals have started registrating PROM in the common database. However, gathering a representative material with one year follow-up will take more than 2 years. Only then, the participating units can begin comparing their results to that of others. Still, the PROM project will serve as a basis for continued discussion regarding evaluation of patient reported outcomes in registers and hospitals and how the results can be used for clinical improvement.



Proportion (%) of OMERACT-OARSI responders one year after surgery (in 2018) for all reporting units together (to the left) as well as for each unit seperately.

TKA/OA - Results for KOOS preoperatively (surgeries 2018 & 2019) as well as 1 year postoperatively (surgeries 2018)

				Pain		Symtoms		ADL		Sports/Rec.		QoL	
Group	Patients n	Complete reports %	Charnley C patients %	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)
All *													
2018	5,150	70	43,1	41 (15)	81 (19)	45 (18)	77 (17)	47 (16)	80 (19)	12 (15)	38 (28)	22 (14)	65 (24)
2019	6,056	78	43	40 (16)		47 (18)		46 (17)		11 (14)		22 (14)	
Sjukhus													
Alingsås													
2018	172	69	45,3	43 (15)	79 (20)	46 (18)	76 (18)	49 (16)	78 (21)	13 (13)	35 (26)	23 (14)	62 (22)
2019	196	87	50,6	41 (14)		46 (16)		46 (15)		12 (15)		22 (14)	
Art Clinic Göteborg													
2019	100	71	31,4	43 (15)		49 (18)		47 (16)		10 (13)		21 (13)	
Art Clinic Jönköping													
2019	235	91	34,7	41 (15)		47 (16)		47 (16)		10 (14)		20 (14)	
Bollnäs													
2018	313	87	41,3	41 (15)	82 (19)	46 (17)	77 (17)	47 (16)	82 (18)	13 (15)	45 (27)	22 (13)	66 (25)
2019	273	98	40,6	41 (14)		46 (17)		47 (16)		13 (16)		23 (13)	
Borås													
2019	99	64	51,7	40 (17)		50 (18)		45 (17)		11 (16)		20 (14)	
Eksjö													
2018	248	70	41,9	42 (14)	82 (18)	48 (16)	80 (16)	49 (15)	80 (19)	15 (17)	39 (27)	25 (14)	65 (24)
2019	295	88	45,6	42 (15)		49 (18)		48 (15)		14 (14)		25 (13)	
Helsingborg													
2018	15	67	70										
2019	17	0											
Huddinge													
2018	80	18	50	39 (14)	72 (21)	46 (17)	71 (19)	39 (14)	68 (22)	7 (11)	21 (29)	17 (15)	50 (27)
2019	138	60	45,8	40 (15)		44 (15)		42 (15)		9 (14)		21 (13)	
Hudiksvall													
2018	58	52	50	39 (12)	80 (18)	47 (16)	74 (22)	45 (15)	76 (23)	7 (10)	35 (30)	17 (15)	61 (24)
2019	54	94	31,4	38 (16)		39 (16)		44 (19)		10 (16)		17 (13)	
Hässleholm													
2018	696	84	44,3	40 (15)	80 (18)	46 (18)	75 (17)	45 (16)	78 (19)	10 (13)	33 (27)	22 (14)	62 (24)
2019	686	96	43,8	42 (16)		48 (16)		47 (16)		12 (14)		23 (14)	
Kalmar													
2018	79	75	55,9	44 (15)	81 (19)	53 (19)	80 (17)	45 (14)	78 (17)	11 (12)	35 (26)	23 (14)	66 (24)
2019	99	100	38,4	43 (14)		50 (16)		50 (14)		12 (14)		24 (14)	
Karolinska													
2018	32	53	47,1	45 (22)	67 (25)	51 (24)	67 (23)	49 (22)	66 (23)	15 (21)	29 (31)	22 (12)	47 (23)
2019	13	77	70	45 (19)		52 (19)		41 (12)		13 (14)		28 (22)	
Kungälv													
2018	149	79	52,6	40 (17)	79 (17)	47 (19)	78 (17)	46 (18)	82 (19)	10 (14)	38 (27)	21 (14)	67 (24)
2019	173	90	51,3	40 (16)		46 (18)		44 (16)		11 (12)		20 (13)	
Lindesberg													
2018	439	33	42,6	39 (15)	79 (17)	45 (18)	75 (17)	47 (16)	78 (18)	10 (14)	35 (25)	20 (13)	63 (23)
2019	382	42	39,4	40 (15)		46 (17)		47 (16)		11 (13)		23 (13)	
Lund													
2018	24	13	33,3	36 (12)	76 (21)	55 (15)	87 (13)	39 (16)	75 (23)	2 (3)	32 (28)	10 (7)	63 (33)
2019	15	47	54,1	29 (17)		25 (9)		26 (11)		2 (3)		13 (8)	

TKA/OA - Results for KOOS preoperatively (surgeries 2018 & 2019) as well as 1 year postoperatively (surgeries 2018)

				Pain		Symtoms		ADL		Sports/Rec.		QoL	
Group	Patients n	Complete reports %	Charnley C patients %	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)
Hospital (cont.) :													
2018	372	74	44,7	38 (14)	83 (18)	42 (16)	81 (15)	44 (15)	81 (19)	10 (14)	37 (27)	20 (14)	66 (22)
2019	368	86	45,6	38 (15)		44 (18)		43 (16)		8 (12)		19 (13)	
Mölndal													
2018	340	68	42										
2019	353	77	43										
Nacka													
2019	182	81	44,1	38 (17)		43 (18)		46 (17)		11 (16)		21 (13)	
Norrköping													
2018	135	74	45	37 (14)	73 (21)	43 (18)	70 (19)	43 (16)	72 (20)	9 (13)	30 (29)	19 (11)	55 (25)
2019	129	81	45,6	35 (15)		42 (18)		40 (16)		8 (14)		18 (12)	
Norrtälje													
2018	149	62	44	45 (14)	84 (17)	54 (18)	79 (18)	52 (15)	83 (17)	12 (13)	45 (30)	26 (13)	68 (24)
2019	175	77	39,2	43 (15)		49 (19)		50 (16)		14 (16)		25 (14)	
Ortho Center Sthlm													
2018	559	78	38,9	43 (15)	84 (16)	47 (18)	79 (16)	49 (16)	83 (16)	13 (15)	43 (27)	21 (15)	66 (22)
2019	507	91	35,7	43 (17)		45 (17)		50 (16)		12 (14)		22 (14)	
Ortopediska huset													
2018	614	72	34,7										
2019	605	92	32,4										
Oskarshamn													
2018	345	86	48,1	43 (15)	84 (17)	48 (17)	80 (17)	47 (16)	82 (18)	13 (16)	42 (28)	23 (13)	66 (23)
2019	373	92	46,7	43 (14)		50 (18)		48 (16)		12 (14)		23 (13)	
Piteå													
2018	272	57	41,6	38 (14)	83 (17)	44 (17)	79 (16)	43 (15)	81 (19)	10 (13)	44 (29)	19 (12)	67 (25)
2019	277	62	49,4	38 (14)		42 (16)		43 (14)		10 (15)		19 (13)	
St. Göran													
2019	337	7	83,3										
Södertälje													
2018	136	55	60,8	38 (16)	74 (22)	43 (17)	70 (21)	43 (18)	71 (21)	10 (15)	29 (25)	20 (14)	55 (21)
2019	145	73	48	40 (16)		46 (20)		43 (17)		11 (13)		20 (13)	
Trelleborg													
2018	691	78	42,2	42 (16)	81 (20)	48 (18)	77 (18)	48 (18)	79 (21)	12 (17)	37 (27)	23 (13)	66 (24)
2019	697	91	47,4	41 (16)		48 (18)		46 (18)		10 (13)		23 (14)	
Värnamo													
2019	185	81	51,7	39 (16)		46 (18)		44 (17)		10 (15)		21 (14)	
Västervik													
2018	92	51	45,7	35 (14)	85 (14)	45 (20)	81 (14)	41 (16)	82 (16)	11 (17)	36 (26)	19 (10)	66 (20)
2019	97	78	56,6	36 (14)		42 (17)		41 (13)		7 (9)		20 (11)	
Ängelholm Aleris													
2018	109	42	43,2	41 (16)	79 (22)	45 (17)	76 (19)	45 (17)	80 (20)	14 (16)	39 (32)	20 (15)	63 (29)
2019	138	73	43,9	36 (15)		41 (16)		43 (18)		9 (14)		20 (14)	
Ängelholm													
2018	160	31	51,1										
2019	207	2	39,5										

* All except St. Göran, Mölndal and Ortopediska huset which do not report KOOS but Charnley class

UKA

Patient repored result for UKAs are presented on this and next page for those units reporting. The number of UKAs varies between units as well as for the different years, from 0 to little more than 200 cases with a varying response rate between 0-96%. Motala accounts for approximately 60% of the reported UKA results. The outcome is similar as that for TKAs with small differences between units pre- and postoperatively. 90% of the UKA patients reported that they were satisfied or very satisfied with the surgery and 90% were classified as OMERACT-OARSI responders of which 81% were high responders.

UKA/OA - Satisfaction one year after surgery (2018)
Proportion of very satisfied or satisfied (VAS 0-40)

Hospital	Number of reports	Complete reports (%)	Postop: very satisfied or satisfied (%)
All reporting units	378	66	90
Bollnäs	26	96	80
Eksjö-Nässjö	22	77	76
Huddinge	11	18	100
Hässleholm	12	50	83
Kungälv	42	71	93
Lindesberg	20	0	
Motala	219	72	94
Mölndal	13	77	80
OrthoCenter Sthlm	68	75	96
Ortopediska huset	13	54	86
Piteå	69	57	97
Trelleborg	33	88	72
Ängelholm Aleris	28	43	75

UKA/OA - Results for VAS–pain and EQ–VAS preoperatively and 1 year postoperatively.

			VAS pain 0–100 (best - worst)		EQ-VAS 0–100 (worst - best)	
Group	Patients n	Complete reports %	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)
All reporting units :						
All 2018	378	66	64 (20)	16 (20)	63 (22)	78 (18)
All 2019	919	80	62 (22)		64 (22)	
Individual hospitals :						
Eksjö 2018	22	77	63 (16)	23 (21)	60 (26)	76 (17)
Eksjö 2019	17	100	59 (14)		69 (18)	
Huddinge 2018	11	18	80	17 (2)	47 (4)	58 (25)
Huddinge 2019	19	58	64 (21)		57 (19)	
Hässleholm 2018	12	50	54 (28)	16 (20)	77 (20)	74 (18)
Hässleholm 2019	27	96	60 (18)		73 (19)	
Kungälv 2018	42	71	61 (18)	15 (18)	64 (19)	77 (22)
Kungälv 2019	41	90	72 (14)		55 (22)	
Lindesberg 2018	20	0				
Motala 2018	219	72	68 (16)	14 (17)	65 (21)	77 (18)
Motala 2019	199	82	67 (16)		62 (22)	
Mölndal 2018	13	77	71 (11)	29 (26)	62 (14)	73 (23)
Mölndal 2019	13	92	64 (15)		63 (19)	
Nacka Aleris 2019	12	83	61 (17)	29 (26)	67 (17)	73 (23)
Norrköping 2019	10	80	74 (9)	29 (26)	57 (26)	73 (23)
Ortho Center Sthlm 2018	68	75	67 (15)	12 (22)	65 (22)	82 (16)
Ortho Center Sthlm 2019	134	95	65 (16)		65 (21)	
Ortopediska huset 2018	13	54	38 (27)	18 (26)	74 (14)	84 (13)
Ortopediska huset 2019	24	92	70 (17)		63 (25)	
Piteå 2018	69	57	72 (17)	18 (23)	56 (23)	80 (16)
Piteå 2019	103	45	68 (17)		62 (21)	
St. Göran 2019	157	66	62 (21)	18 (23)	65 (21)	80 (16)
Trelleborg 2018	33	88	62 (22)	28 (24)	66 (16)	73 (23)
Trelleborg 2019	56	95	63 (15)		68 (23)	
Ängelholm Aleris 2018	28	43	62 (24)	25 (22)	62 (17)	75 (23)
Ängelholm Aleris 2019	57	81	73 (19)		63 (22)	

UKA/OA - Results for KOOS preoperatively (surgeries 2018 & 2019) as well as 1 year postoperatively (surgeries 2018)

				Pain		Symtoms		ADL		Sports/Rec.		QoL	
Group	Patients n	Complete reports %	Charnley C patients %	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)	Preop mean (SD)	Postop mean (SD)
All* 2018	378	66	30,2	42 (15)	84 (18)	49 (18)	81 (17)	47 (15)	84 (17)	12 (15)	42 (28)	21 (13)	65 (29)
All* 2019	919	80	39,6	41 (15)		48 (18)		48 (17)		12 (14)		21 (13)	
Individual hospitals :													
Bollnäs													
2018	26	96	20,8	47 (12)	80 (19)	53 (14)	80 (15)	51 (11)	83 (18)	18 (13)	53 (30)	22 (11)	65 (28)
2019	50	98	32,7	42 (16)		47 (20)		50 (18)		21 (14)		21 (14)	
Eksjö-Nässjö													
2018	22	77	58,8	44 (16)	77 (26)	46 (16)	73 (25)	48 (17)	80 (23)	13 (11)	33 (28)	24 (15)	55 (27)
2019	17	100	29,4	41 (14)		49 (15)		54 (17)		14 (13)		23 (13)	
Huddinge													
2018	11	18	100	43 (1)	86 (0)	66 (8)	82 (0)	47 (6)	81 (19)	13 (11)	43 (46)	22 (22)	69 (9)
2019	19	58	54,6	48 (18)		55 (16)		51 (18)		9 (11)		23 (12)	
Hässleholm													
2018	12	50	33,3	40 (18)	84 (15)	58 (21)	82 (17)	57 (24)	86 (16)	22 (13)	42 (30)	22 (13)	61 (27)
2019	27	96	61,5	41 (13)		44 (14)		50 (13)		9 (11)		21 (14)	
Kungälv													
2018	42	71	41,4	44 (17)	84 (17)	53 (18)	80 (18)	46 (16)	84 (17)	13 (17)	44 (29)	21 (16)	66 (27)
2019	41	90	38,9	38 (14)		43 (14)		45 (12)		12 (18)		20 (14)	
Lindesberg													
2018	20	0											
Motala													
2018	219	72	36,1	40 (14)	85 (17)	46 (17)	83 (16)	46 (15)	84 (16)	10 (14)	37 (27)	20 (12)	66 (21)
2019	199	82	45,7	39 (15)		45 (17)		45 (16)		9 (12)		21 (12)	
Mölndal													
2018	13	77	30										
2019	13	92	18,2										
Nacka Aleris													
2019	12	83	50	46 (16)		49 (17)		44 (7)		14 (16)		21 (16)	
Norrköping													
2019	10	80	0	34 (12)		47 (12)		44 (12)		4 (4)		20 (17)	
Ortho Center Sthlm													
2018	68	75	28,6	39 (13)	88 (14)	48 (17)	85 (12)	46 (14)	86 (14)	11 (11)	48 (23)	19 (12)	69 (24)
2019	134	95	29,4	45 (16)		53 (19)		53 (17)		15 (16)		23 (13)	
Ortopediska huset													
2018	13	54	60										
2019	24	92	45,5										
Piteå													
2018	69	57	32,1	45 (16)	76 (22)	55 (17)	73 (20)	50 (19)	76 (22)	20 (20)	34 (28)	25 (18)	56 (23)
2019	103	45	45,7	37 (14)		44 (20)		43 (20)		13 (16)		16 (13)	
St. Göran													
2019	157	66	47,6										
Trelleborg													
2018	33	88		45 (16)	76 (22)	55 (17)	73 (20)	50 (19)	76 (22)	20 (20)	36 (28)	25 (18)	31 (26)
2019	56	95	26,4	46 (16)		57 (18)		51 (17)		14 (14)		25 (15)	
Ängelholm Aleris													
2018	28	43	30	47 (20)	83 (19)	58 (15)	76 (15)	55 (14)	82 (16)	17 (13)	41 (28)	24 (11)	59 (19)
2019	57	81	40	40 (16)		47 (17)		44 (15)		12 (11)		21 (12)	

* All except St. Göran, Mölndal and Ortopediska Huset which do not report KOOS but Charnley class

The knee osteotomy register

Joint preserving surgery – Knee osteotomy

High tibial osteotomy was introduced in Sweden in 1969 as a standard treatment for unicompartmental osteoarthritis by Göran Bauer Professor in Lund. However, after the modern knee implants were introduced in the seventies they quickly became the most common surgical option for osteoarthritis. Since then, the number of osteotomies has constantly diminished. Björn Tjörnstrand estimated 1981 in his thesis; ”Osteotomy for medial gonarthrosis”, that that one third of the surgical knee reconstructions were osteotomies while the SKAR in 1994 estimated that they accounted for 20%.

Of the osteotomies performed around the knee joint, Tibia osteotomy is the most common, most often being used for medial osteoarthritis while its use for lateral arthritis is less common. Osteotomies of the femur are more infrequent and are used mostly for serious congenital or acquired deformities as well as sometimes for lateral osteoarthritis.

There are several osteotomy methods and there are different types of fixation which often depend on the method used.

The ”closed wedge” osteotomy is a ”minus osteotomy” in which a bone wedge, of a size that relates to the correction needed, is removed. The osteotomy can be fixed with one or more staples, a plate and screws or with an external frame.

Closed wedge osteotomy using a staple for fixation.. The inserted picture above shows the wedge that is removed before the osteotomy is closed..

The open wedge osteotomy is a ”plus osteotomy” in which a wedge is opened up in order to gain the decided amount of correction. The osteotomy can be fixed internally, most commonly with plate and screws, with staples or with an external frame. When the osteotomy is opened up during surgery a bone autograft or synthetic bone substitute may be used to fill the gap (see the left figure below). If an external frame is used for fixation it is possible to gradually open the osteotomy over a few weeks which is the biological procedure used for bone lengthening which has the name hemicallostasis (see figure to the right below).

Finally there is also the curved or dome osteotomy which is rarely used in Sweden.

Open wedge osteotomy with staple fixation

Open wedge osteotomy with external fixation

The results after osteotomy are related to how the surgery gains and maintains the optimal correction. Thus the operation demands careful preoperative planning with respect to the correction needed, that the correction aimed for is achieved during surgery and that the fixation is stable so it can preserve the level of correction during bone healing.

Each of the different techniques has their pros and cons and there has been a continuing development of the procedures and the postoperative care with the aim of improving results.

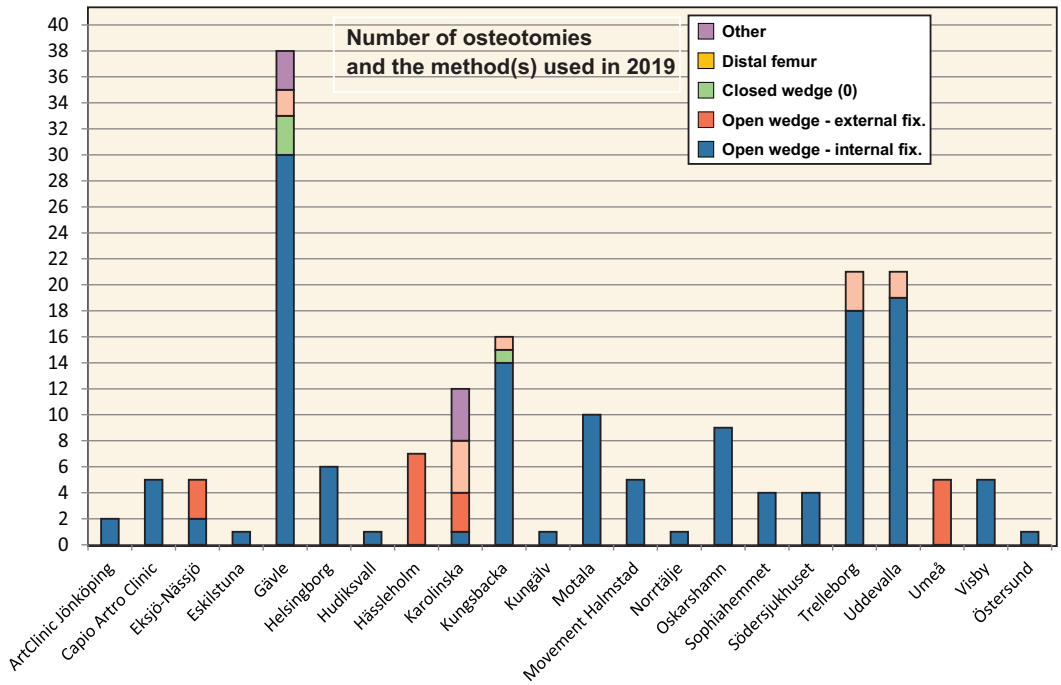
The choice of method and technique may have an effect on the short- and long-term risk for complications as well as influence a later knee replacement with respect to techniques used and outcome. The health economical perspective is also important for the health providers, the society and not least the patients.

Sweden became the first country in the world to start a national osteotomy registration as a complement to the knee arthroplasty registry (W-Dahl et al. 2014).

Australia started registering osteotomies in 2016 and New Zealand has plans of analogous registration together with their respective arthroplasty registries. They have harmonized their reporting form with the Swedish form which facilitates future cooperation and comparisons. In Great Britain a separate register of osteotomies was initiated in 2014 with a financial help from the industry (Elson et al. 2015).

In 2019, 176 osteotomies were reported from 22 hospitals. As the figure below shows, only 6 hospitals reported having performed 10 or more osteotomies during the year. The hospital performing most was Gävle that did 38. As compared to 2018 the number of reported osteotomies was 13 more from somewhat fewer hospitals.

It is difficult to know how many of the osteotomies performed in the country are captured by the register. The surgical codes NGK59 and NFK59, which are used for osteotomies performed on the femur and tibia, also apply to osteotomies performed for other reasons than disease or damage in the knee. According to information from the Health Authorities, the Patient Register found approx. 400 different diagnoses that had been used in combination with these surgical codes. Of these, 148 were main diagnoses used in combination with the surgical code NGK59. Sixty five percent of the surgeries had main diagnoses that could be attributed to osteoarthritis or instability. We collected the number of NGK59 from the Health Authority statistics for the years 2014-2018 for which the surgeries were made for osteoarthritis or instability. Assuming that the osteotomy register mainly captures these diagnoses, we estimate the completeness in the osteotomy register to have been 76-87% during 2014-2018.



Patient characteristics and case-mix in knee osteotomy surgery

Results

The following pages show the results for the knee osteotomies that were reported in 2019.

The knee osteotomy register gathers similar information as the knee arthroplasty register concerning the patients (BMI, ASA and previous surgeries), the use of antibiotics, antithrombotic prophylaxis as well as the surgical technique.

Patient characteristics

69% of the patients were males and the median age was 48 years that can be compared to the median age in 2019 for TKA patients (69.8) and UKA (66.9).
A good half of the patients were reported as beging healthy (ASA class I) and having a mean BMI of 27. The majority had medial osteoarthritis of grade 1-2 according to the Ahlbäck classification and the median axis deviation was 7 degrees. Patients having distal femur osteotomy were younger, most were women and the axis deviation was somewhat greater than for those having proximal tibia osteotomy (see below).

Patient characteristics - osteotomies

	All n=176	Prox. Tibia n=159 (93%)	Dist. Femur n=11 (7%)
Age (years)			
median (range)	48 (18-74)	49 (18-74)	28 (18-47)
Gender			
Men - n (%)	122 (69)	114 (72)	4
Women - n (%)	54 (31)	45 (28)	7
Preop HKA angle, n=174			
median (range)	77 (0-20)	7 (0-20)	10 (5-20)
ASA classification, n=176			
ASA I - n (%)	105 (60)	97 (61)	7
ASA II - n (%)	61 (34)	53 (33)	3
ASA III-IV - n (%)	10 (6)	9 (6)	1
Compartment affected, n=174			
Medial	152 (87)	147 (92)	2
Lateral n (%)	22 (13)	12 (8)	7
Diagnosis OA:	141 (81)	136 (86)	3
OA grade, n=140			
Ahlbäck 1 - n (%)	66 (47)	73 (50)	2
Ahlbäck 2 - n (%)	53 (38)	52 (35)	1
Ahlbäck 3-4 - n (%)	21 (15)	21 (15)	

Body Mass Index

BMI group	Number	Percent
<25	45	26
25-29,9	83	47
30-34,9	32	18
35-39,9	13	7
40+	2	1
Missing	1	<1
Total	176	100

Previous surgery

When reporting previous surgery of the index knee, it is possible to mark more than one alternative. Previous surgery was reported for 61% of the patients and more than one surgery for 14%. This can be compared to the knee arthroplasty patients of which 20% were reported to have had previous surgery and 3% more than one. What is reported cannot be considered a comprehensive description of previous surgeries but illustrates what was known at the time of the primary osteotomy.

Previous surgery in the index knee

Surgery	Number	Percent
None	69	39.2
Fracture surgery	5	2.8
Meniscal surgery	33	18.8
Cruciate surgery	22	12.5
Arthroscopy	31	17.6
Other	15	8.5
Missing	1	0.6
Total	176	100

Reason for and type of osteotomy

The majority of the surgeries (80%) were performed for osteoarthritis. The most common method was open wedge with internal fixation followed by open wedge with external fixation. Four closed wedge osteotomies were reported in 2019 but for a long time this was the standard treatment for osteoarthritis in Sweden.

Reason for the osteotomy

Diagnosis	Number	Percent
Osteoarthritis	141	80.2
Acquired deformity	15	8.5
Congenital deformity	7	4
Local cartilage injury	5	2.8
Osteonecrosis	2	1.1
Other	5	2.8
Missing	1	0.6
Total	176	100

Type of osteotomy

Type	Number	Percent
Open wedge internal fixation	139	79
Open wedge external fixation	15	8.5
Closed wedge	4	2.3
Curved/Dome	1	0.6
Distal femur	11	6.2
Double osteotomy	6	3.4
Missing	0	0
Total	176	100

Technique and prophylaxis for knee osteotomies

Open wedge osteotomy with internal fixation

Several different plates were reported for fixation of the osteotomies. The Tomofix plate was the most commonly used plate for open wedge osteotomies, but three types of plates were used fore more than 90% of the osteotomies using this technique (see below).

Type of fixation in open wedge osteotomy with internal fixation

Type	Number	Percent
Tomofix	94	67.6
Puddu	26	18.7
Peek power	9	6.5
iBalance	8	5.8
Other	1	0.7
Missing	1	0.7
Total	139	100

Transplantation of bone

No bone transplantation was reported in two thirds of the open wedge osteotomies that used internal fixation. In case of bone transplantation, synthetic bone was most commonly reported followed by auto transplantation and bank bone (see table). ChronOS from DePuy was the most commonly reported synthetic bone.

Transplantation of bone in open wedge osteotomy with internal fixation

Bone transplantate	Number	Percent
None	93	66.9
Auto transplantation	8	5.7
Bank bone	4	2.9
Synthetic bone	34	24.5
Missing	0	0
Total	139	100
Synthetic bone:		
DePuy/Synthes ChronOS	13	
Osferion	7	
Quickset	5	
Innotere	3	
Other	4	
Missing	2	

Open wedge osteotomy with external fixation

For this type of osteotomies, the Orthofix external fixation was used for the majority of surgeries (see below).

Type of fixation in open wedge osteotomy with external fixation

Type	Number
Orthofix	12
Taylor Spatial frame	3
Missing	0
Total	15

Distal femur osteotomy

Different methods and techniques were used for this relatively uncommon osteotomy (see below).

Type of fixation for distal femur osteotomy

Type	Number
Tomofix	4
Puddu	4
Intramedullary nail	3
Missing	0
Total	11

Simultaneous surgery

An additional simultaneous surgery was reported to have been performed together with the osteotomy in 48 (27%) cases. Arthroscopy was the most common simultaneous procedure (see below).

Simultaneous surgery with the osteotomy

Surgery	Number	Percent
None	123	69.9
Arthroscopy	28	15.9
Cruciate surgery	3	1.7
Meniscal surgery	2	1.2
Other	15	8.5
Missing	5	2.8
Total	176	100

Type of anesthesia

General anesthesia which was used in 76% of cases was the most common method (see table).

Type of anesthesia

Type	Number	Percent
General	133	75.6
Epidural	1	0.6
Spinal	40	22.7
Missing	2	1.1
Total	176	100

Operating time

After excluding osteotomies performed with another simultaneous surgery, the median operating time was shorter for open wedge osteotomies with internal fixation (56 min, 20-136) than for those with external fixation (68 min, 27-243). The median time for distal femur osteotomies was 132 min, 55-280). The table below shows the median operating times including those osteotomies done with simultaneous surgeries.

Operating time

Type of osteotomy	Median (min)	Range (Min)
Open wede intern	61	(20-187)
Open wedge extern	68	(27-243)
Distal femur	145	(55-280)
Closed wedge	67	(52-84)
Curved/Dome	180	
Double osteotomy	198	(103-319)

Computer aided surgery (CAS)

No osteotomies were reported to have ben performed with the help of navigation.

Antithrombotic prophylaxis

Innohep and Fragmin were the most commonly used antithrombotic prophylaxis. When Fragmin, Innohep or Klexane was used, the prophylaxis more often started postoperatively (see table).

Thromboprophylaxis

Substance - time	Number	Percent
No prophylaxis	5	2.8
Fragmin preop	17	9.6
Fragmin postop	60	34.1
Innohep preop	10	5.7
Innohep postop	54	30.7
Klexane preop	1	0.6
Klexane postop	20	11.4
Eliqvis	7	4
Xarelto	2	1.1
Missing	0	0
Total	176	100

Tromboprophylaxis - length of treatment

The planned length of treatment varied but 76% of the patients were planned to have 8-14 days of treatment (see table).

Thromboprophylaxis - length of treatment

Days	Number	Percent
No prophylaxis	5	2.8
1-7	9	5.2
8-14	147	83.5
15-21	6	3.4
22-28	5	2.8
29-35	4	2.3
>35	0	0
Missing	0	0
Total	176	100

Antibiotic drugs

Cloxacillin or Clindamycin were used in all the surgeries for which a substance name was reported. Clindamycin was used in 4.5% of the surgeries which is somewhat lower proportion than seen for knee arthroplasties (5.4%). As use of Clindamycin has been found to be linked to higher risk of infection in total knee arthroplasty (Robertsson et al. 2017), the PRISS recommandations were updated in April 2018 (www.patientforsakringen.se).

Antibiotic drug

Substance	Number	Percent
Cloxacillin	168	95.5
Clindamycin	8	4.5
Missing	0	0.0
Total	176	100

Cloxacillin dosage

For half of the osteotomies it was reported that the intention was to use 2g x 3 within 24 hours while 29% were planned having a single 2g dose (see below).

Cloxacillin dose

Dose	Number	Percent
Cloxacillin 2gx1	48	28,6
Cloxacillin 2gx2	29	17.3
Cloxacillin 2gx3	85	50.5
Cloxacillin 2gx4	1	0.6
Other	4	2.4
Missing	1	0.6
Total	168	100

Antibiotic - time of administration

At the start of surgery a reasonable tissue concentration of the antibiotic should have been reached in order to counteract any bacteria in the field. Due to the short half-life of Cloxacillin it is important that it is administrated within a correct time interval.

In November 2017 updated PRISS recommendations were published (see page 62 and www.patientförsakringen.se) which considered the optimal time interval being 45-30 min before start of surgery which was a narrower interval than the 45-15 min. previously recommended.

For half of the osteotomies it was reported that the preoperative dose had been given within the currently PRISS recommended time interval (table below) while 68% lied within the previously recommended time interval.

Antibiotic - time of administration (PRISS recommendation)

Min. before surgery	Number	Percent
0-29	33	18.8
30-45	89	50.5
>45	40	22.7
Start after surgery	8	4.6
No antibiotic administered	0	0
Missing	6	3.4
Total	176	100

Tourniquet and drainage

The use of tourniquet has diminished in Sweden but its use was slightly more common in osteotomies (62%) (table below) as compared to knee arthroplasty (32%). Use of drainage has become uncommon and it was reported in none of the osteotomies and in less than 1% of the knee arthroplasties.

Tourniquet and drainage

Tourniquet	Number	Percent
Yes	110	62.5
No	64	36.4
Missing	2	1.1
Total	176	100

Drainage	Number	Percent
Yes	0	0
No	174	98.9
Missing	2	1.1
Total	176	100

Re-operations

Since the start of the osteotomy register in 2013, more than 70 re-operations have been reported. The main reasons for the additional surgery have been pain/irritation from the plate, pseudarthrosis/late healing and over- or under correction.

Instructions for filling out the SKAR form;

Patient ID:
12 digits (preferably stamp or stickers)

Hospital and hospital number:
Should be pre-printed upper left.
This implies the hospital were the operation was performed

/The hospital which is responsible
Specified only if necessary beside the Hospital name.
Only in the case of the operation being performed by the assignment of another hospital (to which the patients and surgeons belong to).

Date of surgery:
Year-month-day

Side:
Mark the side operated. If both knees are operated on, use two forms, one for each knee.

Primary arthroplasty:
Mark "Yes" or "No".
Revision is defined as a surgery in which implant components are exchanged, added or removed. Note that this includes arthrodesis and amputation during which a previously inserted implant is removed.

Type of primary arthroplasty:
Mark one alternative with the exception if more than one type of surgery is performed in the same knee (e.g. medial and lateral UKA).

Reason for primary arthroplasty:
Mark the reason for the surgery or write the reason as free text. (OA = Osteoarthritis, RA = Rheumatoid arthritis)
In the case of more than one reason, then indicate the main reason for the operation (e.g. underlining)

Previous surgery of the index knee (for primaries only):
Mark "No" or specify the type of surgery. Note that only previous surgeries, known by the surgeon at the time, are to be specified. It is not the intention that information is to be searched in old patient charts.

Type of revision:
What has been performed during surgery. More than one alternative can be chosen, or if necessary, written as a free text.

Reason for the revision:
Mark the type of revision or write as free text.
In the case of more than one reason, then indicate the main reason for the operation (e.g. underlining).

Implant name:
Does not have to be specified if the implant stickers are attached to the back of the form.

Cemented parts
Mark the use of cement for relevant parts. Note that "stem" includes both fixed and modular stems.

Cement name:
Instead of the name of the cement we prefer the stickers for the cement to be attached to the lower back of the form. If separate stickers are avialable for the mixing system please include them.

Bone transplantation:
Mark "No" or use the relevant alternatives for the type of bone that has been use. Further mark the location in which the bone transplant was placed.

Navigation:
Mark "Yes" or "No". If Yes, specify what system was used (e.g. Aesculap, Brain Lab). Preferably the model, if available.

Custom made instruments
Mark "Yes" or "No" if the operation has been using instruments or saw blocks specially made for the patient based on MRI or CT.

MIS (Minimal Invasive Surgery):
This implies a (small) arthrotomy used to gain access to the joint without the patella having to be everted. This is to be filled in for both TKA and UKA.

Drainage:
Mark "Yes" or "No", specifying if a surgical drain has been left in the knee or not.

Surgeon:
The initials of the surgeon or his code. (Voluntary)

Anesthesia:
Mark the type of anesthesia used (more than one is allowed if relevant)

Tourniquet:
Mark "Yes" or "No", specifying if a tourniquet was used during the whole, or a part of the operation.

LIA (local infiltration analgesia):
Mark "Yes" or "No". If Yes, specify if a catheter was left in the knee for a later injection.

Antithrombotic prophylaxis:
Mark one of the three alternatives. If Yes, then also inform of the drug used, the dose (e.g. Klexane 40 mg x 1) as well as the planned length of treatment (e.g. 10 days).

Antibiotic prophylaxis:
Mark "Yes" or "No". In case of a prophylaxis being used, specify the name of the drug (e.g. Ekvacillin), the dose (e.g. 2g) and the number of times per day it is to be given.
Specify the exact time at which the preoperative injection was started (e.g. 07:45). In case the injection was given after the operation started, then also specify the time.
Finally, always state the planned length of treatment (e.g. 2 days).

ASA classification (American Society of Anaesthesiologists classification):
State the ASA class which the anesthesia staff recorded for the patient in the charts, prior to surgery.

Weight of the patient:
State in kg.

Height of the patient:
State in cm.

Start of surgery:
The time when the knife goes through the skin (e.g. 11:35)

End of surgery:
The time when closing of the skin was completed (ex. 13:15).

On the reverse side:
Attach the stickers at their intended spot:
The uppermost for the femoral components (e.g. stem, augments, ..)
The middle part for the tibial components (e.g. insert, stem, ..)
The bottom part for cement and other components (patellar button, ..)

IN CASE OF REVISION:
Do not forget to enclose a copy of the operation report and the discharge letter.

The Swedish Knee Arthroplasty Register
Remissgatan 4, Wigerthuset, floor 1
Lund University Hospital
SE-221 85, Lund
Phone. +46-(0)46-171345

Patient ID: 19 _____-____
(Unique social security number which includes date of birth)

From: Hospital name (institution No.) /

To be used when implant components are inserted, added, exchanged or removed

Date of surgery (y.m.d) 20 __ __ __ __ __

Side (in case of bilateral operation please use 2 forms, one for each side)
☐ 1 Left ☐ 2 Right

Primary arthroplasty ☐ 1 Yes ☐ 2 No

Type of primary arthroplasty:
☐ 1 TKA incl. patella ☐ 2 TKA excl. patella
☐ 3 UKA Medial ☐ 4 UKA Lateral
☐ 5 Patello-femoral ☐ 6 Other (what).....

Reason for primary arthroplasty:
If more than one reason, mark the main reason
☐ 1 OA
☐ 2 RA
☐ 3 Fracture (recent (not older than 3 months))
☐ 4 Fracture sequelae (damage by earlier fracture)
☐ 5 Osteonecrosis
☐ 6 Other (what) .....

Previous surgery of the index knee:
☐ 0 No ☐ 1 Osteosynthesis
☐ 2 Osteotomy ☐ 3 Menisceal surgery
☐ 4 Cruciate lig. surgery ☐ 5 Arthroscopy
☐ 6 Other (what) .....

Implant name: .....
(not needed when implant stickers are provided on the other side)

Cemented parts:

Femur	☐ 1 **Cemented**	☐ 2 **Not Cemented**
Tibia	☐ 1 **Cemented**	☐ 2 **Not Cemented**
Patella	☐ 1 **Cemented**	☐ 2 **Not Cemented**
Femoral stem	☐ 1 **Cemented**	☐ 2 **Not Cemented**
Tibial stem	☐ 1 **Cemented**	☐ 2 **Not Cemented**

Cement / mixing system .....
(not needed when sticker(s) for the cement are provided on the other side)

Bone transplantation:
☐ 0 **No** ☐ 1 **Pat. own** ☐ 2 **Biobank** ☐ 3 **Synthetic bone** (what) .....
When used, the bone was used in the :

Femur	☐ 0 No	☐ 1 Yes
Tibia	☐ 0 No	☐ 1 Yes
Patella	☐ 0 No	☐ 1 Yes

Navigation: ☐ 0 No ☐ 1 Yes system used: .....

Custom Made Instruments: ☐ 0 No ☐ 1 Yes

MIS: (minimally invasive surgery) ☐ 0 No ☐ 1 Yes

Drainage: ☐ 0 No ☐ 1 Yes

Surgeon (initials or code) : .....

Type of revision:
☐ 1 Total exchange (all previously inserted components exchanged)
☐ 2 Exchange of Femoral component
☐ 3 Exchange of Tibial component
☐ 4 Exchange of Patellar button
☐ 5 Exchange of poly/insert
☐ 6 Total implant removal (all previously inserted components)
☐ 7 Removal of component(s) (what) .....
☐ 8 Addition of component(s) (what) .....
☐ 9 Arthrodesis
☐ 10 Amputation
☐ 11 Other (what) .....

Reason for the revision:
If more than one reason, mark the main reason
☐ 1 Loosening (where) .....
☐ 2 Poly wear (where) .....
☐ 3 Fracture (periprosthetic)
☐ 4 Deep infection
☐ 5 Suspected infection
☐ 6 Instability (not of the patella)
☐ 7 Femoropatellar problem (pain, disclocation etc.)
☐ 8 Suboptimal situs of the previous implant
☐ 9 Other (what) .....

Anesthesia:
☐ 1 General ☐ 2 Epidural ☐ 3 Spinal ☐ 4 Other .....

Tourniquet: ☐ 0 No ☐ 1 Yes

LIA: (local infiltration analgesia)
☐ 0 No ☐ 1 Yes ☐ 2 Catheter left in knee (for later injection)

Antithrombotic prophylaxis:
☐ 0 No ☐ 1 Yes start pre-op. ☐ 2 Yes start post-op.
Name:..... dose:..... no. per day:.....
Planned length of treatment (days): .....

Prophylactic antibiotics:
☐ 0 No
☐ 1 Yes: Name:..... dose:..... no. per day:.....
Start Preop. ☐ 0 No ☐ 1 Yes **Time:** ..... : .....
Planned length of treatment (days): .....

ASA classification: (according to anesthesiologist)
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Weight (kg): ..... **Height:** (cm): .....

Start of surgery (skin incision) **Time:** ..... : .....

End of surgery (skin closed) **Time:** ..... : .....

Remember to put stickers on the back !!!

Put stickers for parts used on femur here
(femoral component, stem, augments ....)

Put stickers for parts used on tibia here
(tibia component, insert, stem, augments ....)

remember the cement sticker!

Put other stickers here
(cement, patellar button ....)

<u>In case of revision:</u>
Send a copy of op. report and discharge letter

Instructions for filling out the Knee Osteotomy Register form;

Patient ID:
12 digits (preferably stamp or stickers)

Hospital and hospital number:
Should be pre-printed upper left.
This implies the hospital were the operation was performed

/The hospital which is responsible
Specified only if necessary beside the Hospital name.
Only in the case of the operation being performed by the assignment of another hospital (to which the patients and surgeons belong to).

Date of surgery:
Year-month-day

Side:
Mark the side operated. If both knees are operated on, use two forms, one for each knee.

Primary Osteotomy:
Mark "Yes" or "No".
Revision is defined as a re-operation of a prevous osteotomy. However, knee arthroplasty is not to be reported on this form but on the arthroplasty form.

Type of primary knee osteotomy:
Mark an alternative för the method/technique used.

Reason for the primary osteotomy:
Mark the reason for the surgery or write the reason as free text. OA = Osteoarthritis. In the case of more than one reason, then indicate the main reason for the operation (e.g. underlining).

Preoperative HKA angle:
Note the varus, respektive the valgus hip-kne-ankle angle as measured preoperatively on long X-rays.

Preoperative X-ray grading of OA:
Note the preoperative X-ray grading of the osteoarthritis stage according to the Ahlbäck system.

Previous surgery of the index knee (for primaries only):
Mark "No" or specify the type of surgery. Note that only previous surgeries, known by the surgeon at the time, are to be specified. It is not the intention that information is to be searched in old patient charts.

Type of re-operation:
Mark if the re-operation was re-osteotomy or removal of osteosynthesismaterial and/or write som other surgery as a free text..

Reason for the revision:
Mark the type of re-operation or write as free text.
In the case of more than one reason, then indicate the main reason for the operation (e.g. underlining).

Name of the fixation:
For external fixation provide the name of the intstrument and place any stickers concerning the pins on the back of the form.
For nternal fixation a neme does not have to be specified if the iimplant stickers are attached to the back of the form.

Bone transplantation:
Mark "No" or use the relevant alternatives for the type of bone that has been use. If a synthetic bone was used place any enclosed stickers on the back of the form.

Navigation:
Mark "Yes" or "No". If Yes, specify what system was used (e.g. Aesculap, Brain Lab). Preferably the model, if available.

Angulation gauge/meter
Write the name of any mechanical gauge that was used to evaluate the amount of correction during surgery

Drainage:
Mark "Yes" or "No", specifying if a surgical drain has been left in the knee or not.

Other coincident surgery during the osteotomy:
State what other surgery was performed at the same time as the osteotomy (e.g. arthroscopy, cruciat ligament reconstruction).

Surgeon:
The initials of the surgeon or his code. (Voluntary)

Anesthesia:
Mark the type of anesthesia used (more than one is allowed if relevant)

Tourniquet:
Mark "Yes" or "No", specifying if a tourniquet was used during the whole, or a part of the operation.

Antithrombotic prophylaxis:
Mark one of the three alternatives. If Yes, then also inform of the drug used, the dose (e.g. Klexane 40 mg x 1) as well as the planned length of treatment (e.g. 10 days).

Antibiotic prophylaxis:
Mark "Yes" or "No". In case of a prophylaxis being used, specify the name of the drug (e.g. Ekvacillin), the dose (e.g. 2g) and the number of times per day it is to be given.
Specify the exact time at which the preoperative injection was started (e.g. 07:45). In case the injection was given after the operation started, then also specify the time.
Finally, always state the planned length of treatment (e.g. 2 days).

ASA classification (American Society of Anaesthesiologists classification):
State the ASA class which the anesthesia staff recorded for the patient in the charts, prior to surgery.

Weight of the patient:
State in kg.

Height of the patient:
State in cm.

Start of surgery:
The time when the knife goes through the skin (e.g. 11:35)

End of surgery:
The time when closing of the skin was completed (ex. 13:15).

On the reverse side:
For any ostesynthesis material, pins and synthetic bone that was used during surgery, place enclosed stickers on the back of the form.

IN CASE OF REVISION:
Do not forget to enclose a copy of the operation report and the discharge letter.

The Swedish
Knee Osteotomy Register
Remissgatan 4, Wigerthuset, floor 1
Lund University Hospital
SE-221 85, Lund
Phone. +46-(0)46-171345

Patient ID: |1|9|_|_|_|_|_|_|-|_|_|_|_|
(Unique social security number which includes date of birth)

From: Hospital name (institution No.) /

To be used for osteotomies around the knee

Date of surgery (y.m.d) |2|0|_|_| |_|_| |_|_|

Side (in case of bilateral operation please use 2 forms, one for each side)
☐ 1 Left ☐ 2 Right

Primary osteotomy ☐ 1 Yes ☐ 2 No

Type of primary knee osteotomy
☐ 1 Open wedge HTO - internal fixation
☐ 2 Open wedge HTO - external fixation
☐ 3 Closed wedge HTO
☐ 4 Curved / Dome HTO
☐ 5 Distal femur osteotomy
☐ 6 Other (what).....

Reason for the primary knee osteotomy
If more than one reason, mark the main reason
☐ 1 OA medially
☐ 2 OA laterally
☐ 3 Congenital deformity
☐ 4 Acquired deformity (not OA)
☐ 5 Osteonecrosis.
☐ 6 Other (what) .....

Preoperative HKA angle:
..... º Varus ..... º Valgus

Preoperative X-ray grading of OA:
☐ 0 Ahlbäck 1 ☐ 1 Ahlbäck 2
☐ 2 Ahlbäck 3 ☐ 3 Ahlbäck 4
☐ 4 Ahlbäck 5

Previous surgery of the index knee:
☐ 0 Nej ☐ 1 Osteosynthesis
☐ 2 Fracture surgery ☐ 3 Menisceal surgery
☐ 4 Cruciate lig. surgery ☐ 5 Arthroscopy
☐ 6 Other (what) .....

Type of re-operation:
☐ 1 Re-osteotomi
☐ 2 Removal of osteosynthesis material
☐ 3 Other type (what) .....

Reason for re-operation:
If more than one reason, mark the main reason
☐ 1 Loss of correction
☐ 2 Correction was to small
☐ 3 Correction was to large
☐ 4 Delayed healing
☐ 5 Pseudarthrosis
☐ 6 Other (what) .....

Name of the fixation: .....
(ot needed when implant stickers are provided on the other side)

Bone transplantation:
☐ 0 **No** ☐ 1 **Pat. own** ☐ 2 **Biobank** ☐ 3 **Synthetic bone** (whatt)
.....

Navigation: ☐ 0 Yes ☐ 1 No what system .....

Angulation guide: ☐ 0 Nej ☐ 1 Ja what.....

Drainage: ☐ 0 No ☐ 1 Yes

Other coincident surgery
☐ 1 Arthroscopy
☐ 2 Cruciate ligament reconstruction
☐ 3 Other (what) .....

Surgeon (initials or code) :.....

Anesthesia:
☐ 1 General ☐ 2 Epidural ☐ 3 Spinal ☐ 4 Other .....

Tourniquet: ☐ 0 No ☐ 1 Yes

Antithrombotic prophylaxis:
☐ 0 No ☐ 1 Yes start pre-op. ☐ 2 Yes start post-op.
Name:..... dose:..... no. per day:.....
Planned length of treatment (days): .....

Prophylactic antibiotics:
☐ 0 No
☐ 1 Yes: Name:..... dose:..... no. per day:.....
Start Preop. ☐ 0 No ☐ 1 Yes **Time:**..... : .....
Planned length of treatment (days): .....

ASA classification: (according to anesthesiologist)
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Weight (kg): ..... **Height:** (cm): .....

Start of surgery (skin incision) **Time:** ..... : .....

End of surgery (skin closed) **Time:** ..... : .....

Remember
stickers on the back side !!

In case of revision:
Send a copy of the op.report & discharge letter

Put stickers for inserted parts here
(plates, screws bone substitute ....)

ICD10- and NOMESCO codes used for definition of unwanted events

DA - Surgical diagnoses

If the codes occur as a main- or secondary diagnosis during the first admission or as the main diagnosis at a later admission

Exact code	Exact code
G978	T840
G979	T840G
M966G	T843
M968	T843G
M969	T844
T810	T844G
T812	T845
T813	T845G
T814	T847
T815	T847G
T816	T848
T817	T848G
T818	T849
T818W	T888
T819	T889

DB - Diagnoses for knee related events

If the codes occur as a main- or secondary diagnosis during the first admission or as a secondary diagnosis at a later admission	If the codes occur as the main diagnosis after the first admission
Exact code	Exact code
G573	M235
G574	M240
M000	M245
M000G	M246
M002G	M256
M008G	M659G
M009G	M860G
M220	M861G
M221	M866
M236	M866G
M244G	M895G
M621G	
M662G	
M663G	
M843G	
S342	
S800	
S810	
S830	
S831	
S834L	
S834M	
S835R	
S835S	
S835X	
S840	
S841	

DC - Cardiovascular diagnoses

If the codes occur as a main- or secondary diagnosis during the first admission or as the main diagnosis at a later admission

Exact code	Starts with
I260	I21..
I269	I24..
I460	I60..
I461	I61..
I469	I62..
I490	I63..
I649	I65..
I770	I66..
I771	I72..
I772	I74..
I819	I82..
I978	
I979	
J809	
J819	
T811	

A - Surgical intervention codes

If the codes occur during the first admission at a date ofter the primary surgery date or as the main intervention code at a later date

Exact code	Starts with
NFQ09	NGA..
NFQ19	NGC..
NFQ99	NGE..
NGB59*	NGG..
NGF01	NGH..
NGF02	NGJ..
NGF10	NGL..
NGF11	NGS..
NGF12	NGU..
NGF91	NGW..
NGF92	QDB..
NGK09	QDG..
NGK19	
NGM09	
NGQ09	
NGT09	
NGT19	
QDA10	
QDE35	
TNG05	
TNG10	

*enbart vid återinläggning

DM - Diagnoses for other medical events

If the codes occur as a main- or secondary diagnosis during the first admission or as a secondary diagnosis at a later admission		If the codes occur as the main diagnosis after the first admission	
Exact code	Börjar på	Exact code	Börjar på
J952	L89	K590	J20..
J953	I80	N991	J21..
J955	J13		J22..
J958	J14		K29..
J959	J15		
J981	J16		
N990	J17		
N998	J18		
N999	K25		
R339	K26		
	K27		
	N17		

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