The Swedish Knee Arthroplasty Register – Annual report 2019

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Annual Report 2019

Swedish Knee Arthroplasty Register

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

Primary knee arthroplasties 1975-2018
Revision knee arthroplasties 1975-2017
Knee osteotomies 2013-2018

To our contact surgeons

Besides the annual report which the register has produced for decades, we have for the last years also provided the profession and patients with data on the internet. It is gratifying that our websites seem to be quite popular. Our patient website (www.gangbar.se) was most popular having 25,000 unique visits during the first half of 2019. The register website (www.knee.se) attracted almost 5,000 unique visitors during the same period, of which half were from other countries than Sweden. The statistics webpage which was completed in 2017 and includes both perioperative- as well as PROM-data had 2,300 unique 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.

In 2020, new stricter rules will take effect in the EU 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 18 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 19 years shows its engagement concerning patient safety.

For the fourth 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 :

The first part summarizes the register procedures, the epidemiology, and the 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 2008-2017.

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 2018 (sorted by ID and date of surgery) and it is our hope that this information will be compared to other available hospital information in order to identify and correct any registration 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.

As from 2020, the plan is to start the process of combining the Swedish knee and hip register in a common register (the Swedish Arthroplasty Register is the working name). This means that the routines for reporting to and from the register will be reviewed although it is not expected that major changes will happen during the first year.

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 presented.

Lund, September 6th, 2019.

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 2017, 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, in 2013-15 the number diminished slightly to increase again in 2016 by 9%, by 6.5% in 2017 and by 3.2% in 2018 to 15,430 primaries. 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, 21 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 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 2018). Analyses concerning the revision rate end one year earlier (2017). 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 is already affecting the register activity and will probably result in future structural changes of the register.

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 2017

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 97.0% of all admissions and the NPR 91.4%.

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. Those who do not reach 96% completeness 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 2017	Number	SKAR-percent	NPR percent
Akademiska	90	94.4	98.9
Alingsås	194	99.5	97.9
Art Clinic Göteborg	108	99.1	36.1
Art Clinic Jönköping	90	100.0	38.9
Arvika	190	92.6	97.9
Blekingesjukhuset*	299	98.7	99.0
Bollnäs (Aleris)	326	99.7	95.7
Capio Artro Clinic Sth.	242	100.0	99.6
Carlanderska	223	100.0	0.0
Danderyd	195	94.9	98.5
Eksjö	211	99.5	100.0
Elisabethsjukhuset	6	100.0	100.0
Enköping	368	99.2	99.2
Eskilstuna Mälarsjh.	68	100.0	97.1
Falun	216	99.5	21.3
Gällivare	58	93.1	100.0
Gävle	88	96.6	95.5
Hallands sjukhus**	17	0.0	100.0
Halmstad	185	100.0	99.5
Halmstad Capio Movement	434	100.0	0.9
Helsingborg	20	95.0	100.0
Huddinge	117	94.9	100.0
Hudiksvall	56	98.2	92.9
Hässleholm	773	99.0	99.6
Kalmar	103	97.1	99.0
Karlskoga	39	100.0	100.0
Karlstad	116	100.0	99.1
Karolinska Solna	66	87.9	98.5
Kullbergska	246	98.0	98.8
Kungälv	208	99.0	97.1
Lindesberg	416	100.0	100.0
Ljungby	149	90.6	98.0
Luleå-Hermelinen	19	100.0	0.0
Lund	45	95.6	97.8
Lycksele	155	96.8	98.7
Löwenströmska (Ortho Center)	465	99.4	98.9

Hospital 2017	Number	SKAR-percent	NPR percent
Mora	197	99.0	98.0
Motala	603	99.3	99.7
Nacka	179	96.6	95.5
Norrköping Vrinnevisjh.	176	99.4	100.0
Norrtälje	158	96.2	99.4
NU-sjukvården***	252	98.0	98.8
Nyköping	106	96.2	98.1
Ortho Center IFK-Kliniken	157	99.4	52.2
Ortopediska Huset	734	98.0	92.0
Oskarshamn	372	99.5	99.7
Piteå	306	98.4	98.0
Ryhov	13	84.6	100.0
S:t Göran	542	95.8	96.9
Sahlgrenska****	504	74.8	98.6
Skaraborgs sjukhus*****	334	96.7	97.6
Skellefteå	79	97.5	98.7
Sollefteå	210	98.1	99.5
Sophiahemmet	226	97.3	98.7
Sundsvall	5	100.0	100.0
Södersjukhuset	286	98.6	100.0
Södertälje	150	98.0	97.3
Södra Älvsborgs sjukhus**	205	95.6	97.1
Torsby	133	95.5	98.5
Trelleborg	791	99.2	99.6
Umeå	130	92.3	95.4
Varberg	213	100.0	99.1
Visby	103	94.2	92.2
Värnamo	199	96.5	98.5
Västervik	84	96.4	100.0
Västerås	292	91.8	95.2
Växjö	77	100.0	100.0
Ängelholm	350	98.0	98.9
Örebro	11	72.7	100.0
Örnsköldsvik	172	99.4	98.8
Östersund	173	94.8	96.5
Övriga vårdenheter	5	20.0	100.0

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

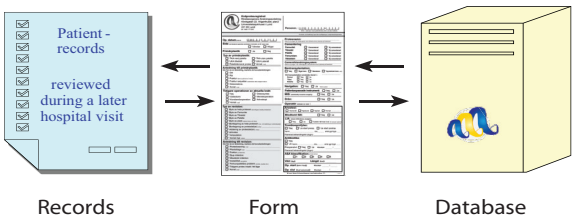
Method of validation at the hospital level

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 2 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 15 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 2018, almost 15,500 primary knee arthroplasties were performed to the cost of more than 1 billion SEK. Additionally almost 1,000 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 the 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 the first 6 months of 2018, the website had almost 27,000 visits by 19,000 users which indicates 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 obviously is 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 2015-2017

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 2015-2017 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.

Error sources

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	412	5	12.1
Dalarna	672	24	35.7
Gotland	121	3	24.8
Gävleborg	772	12	15.5
Halland	1,175	31	26.4
Jämtland	232	9	38.8
Jönköping	759	18	23.7
Kalmar	801	27	33.7
Kronoberg	286	14	49.0
Norrbotten	479	9	18.8
Skåne	2,981	63	21.1
Stockholm	4,274	112	26.2
Sörmland	486	14	28.8
Uppsala	756	21	27.8
Värmland	659	23	34.9
Västerbotten	491	31	63.1
Västernorrland	484	18	37.2
Västmanland	365	10	27.4
Västra Götaland	2,972	68	22.9
Örebro	651	15	23.0
Östergötland	816	41	50.2
The Country	20,644	568	27.5

MEN in the counties

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

County	Surgeries	Events	Risk/1000
Blekinge	357	13	36.4
Dalarna	553	20	36.2
Gotland	107	6	56.1
Gävleborg	621	9	14.5
Halland	972	30	30.9
Jämtland	158	4	25.3
Jönköping	634	21	33.1
Kalmar	647	28	43.3
Kronoberg	247	5	20.2
Norrbotten	402	12	29.9
Skåne	2,155	62	28.8
Stockholm	3,226	100	31.0
Sörmland	387	9	23.3
Uppsala	554	20	36.1
Värmland	538	22	40.9
Västerbotten	385	31	80.5
Västernorrland	361	15	41.6
Västmanland	234	6	25.6
Västra Götaland	2,409	77	32.0
Örebro	482	19	39.4
Östergötland	621	23	37.0
The Country	16,050	532	33.1

Adverse cardiovascular events within 90 days (DC)

County	Surgeries	Events	Risk/1000
Blekinge	412	2	4.9
Dalarna	672	8	11.9
Gotland	121	0	0.0
Gävleborg	772	10	13.0
Halland	1,175	4	3.4
Jämtland	232	4	17.2
Jönköping	759	2	2.6
Kalmar	801	2	2.5
Kronoberg	286	2	7.0
Norrbotten	479	1	2.1
Skåne	2,981	21	7.0
Stockholm	4,274	21	4.9
Sörmland	486	0	0.0
Uppsala	756	7	9.3
Värmland	659	1	1.5
Västerbotten	491	3	6.1
Västernorrland	484	5	10.3
Västmanland	365	7	19.2
Västra Götaland	2,972	22	7.4
Örebro	651	2	3.1
Östergötland	816	4	4.9
The Country	20,644	128	6.2

Adverse cardiovascular events within 90 days (DC)

County	Surgeries	Events	Risk/1000
Blekinge	357	3	8.4
Dalarna	553	3	5.4
Gotland	107	1	9.3
Gävleborg	621	10	16.1
Halland	972	3	3.1
Jämtland	158	3	19.0
Jönköping	634	1	1.6
Kalmar	647	5	7.7
Kronoberg	247	3	12.1
Norrbotten	402	4	10.0
Skåne	2,155	19	8.8
Stockholm	3,226	20	6.2
Sörmland	387	2	5.2
Uppsala	554	4	7.2
Värmland	538	9	16.7
Västerbotten	385	3	7.8
Västernorrland	361	4	11.1
Västmanland	234	3	12.8
Västra Götaland	2,409	18	7.5
Örebro	482	5	10.4
Östergötland	621	6	9.7
The Country	16,050	129	8.0

Other adverse medical events within 90 days. (DM)

County	Surgeries	Events	Risk/1000
Blekinge	412	2	4.9
Dalarna	672	3	4.5
Gotland	121	1	8.3
Gävleborg	772	5	6.5
Halland	1,175	6	5.1
Jämtland	232	5	21.6
Jönköping	759	8	10.5
Kalmar	801	11	13.7
Kronoberg	286	2	7.0
Norrbotten	479	2	4.2
Skåne	2,981	27	9.1
Stockholm	4,274	62	14.5
Sörmland	486	2	4.1
Uppsala	756	7	9.3
Värmland	659	6	9.1
Västerbotten	491	12	24.4
Västernorrland	484	6	12.4
Västmanland	365	2	5.5
Västra Götaland	2,972	26	8.7
Örebro	651	4	6.1
Östergötland	816	10	12.3
The Country	20,644	209	10.1

Other adverse medical events within 90 days. (DM)

County	Surgeries	Events	Risk/1000
Blekinge	357	7	19.6
Dalarna	553	3	5.4
Gotland	107	0	0.0
Gävleborg	621	6	9.7
Halland	972	6	6.2
Jämtland	158	5	31.6
Jönköping	634	2	3.2
Kalmar	647	29	44.8
Kronoberg	247	2	8.1
Norrbotten	402	0	0.0
Skåne	2,155	34	15.8
Stockholm	3,226	64	19.8
Sörmland	387	4	10.3
Uppsala	554	6	10.8
Värmland	538	6	11.2
Västerbotten	385	23	59.7
Västernorrland	361	10	27.7
Västmanland	234	3	12.8
Västra Götaland	2,409	34	14.1
Örebro	482	3	6.2
Östergötland	621	8	12.9
The Country	16,050	255	15.9

WOMEN in the counties
Death within 90 days

County	Surgeries	Events	Risk/1000
Blekinge	412	1	2.4
Dalarna	672	0	0.0
Gotland	121	1	8.3
Gävleborg	772	0	0.0
Halland	1,175	1	0.9
Jämtland	232	0	0.0
Jönköping	759	0	0.0
Kalmar	801	0	0.0
Kronoberg	286	0	0.0
Norrbotten	479	0	0.0
Skåne	2,981	2	0.7
Stockholm	4,274	1	0.2
Sörmland	486	1	2.1
Uppsala	756	0	0.0
Värmland	659	0	0.0
Västerbotten	491	1	2.0
Västernorrland	484	1	2.1
Västmanland	365	0	0.0
Västra Götaland	2,972	2	0.7
Örebro	651	0	0.0
Östergötland	816	4	4.9
The Country	20,644	15	0.7

MEN in the counties
Death within 90 days

County	Surgeries	Events	Risk/1000
Blekinge	357	1	2.8
Dalarna	553	2	3.6
Gotland	107	0	0.0
Gävleborg	621	1	1.6
Halland	972	1	1.0
Jämtland	158	1	6.3
Jönköping	634	1	1.6
Kalmar	647	3	4.6
Kronoberg	247	0	0.0
Norrbotten	402	2	5.0
Skåne	2,155	7	3.2
Stockholm	3,226	2	0.6
Sörmland	387	0	0.0
Uppsala	554	1	1.8
Värmland	538	1	1.9
Västerbotten	385	0	0.0
Västernorrland	361	1	2.8
Västmanland	234	1	4.3
Västra Götaland	2,409	4	1.7
Örebro	482	2	4.1
Östergötland	621	0	0.0
The Country	16,050	31	1.9

All adverse events within 90 days (incl. death)

County	Surgeries	Events	Risk/1000
Blekinge	412	10	24.3
Dalarna	672	32	47.6
Gotland	121	4	33.1
Gävleborg	772	24	31.1
Halland	1,175	40	34.0
Jämtland	232	17	73.3
Jönköping	759	27	35.6
Kalmar	801	39	48.7
Kronoberg	286	17	59.4
Norrbotten	479	12	25.1
Skåne	2,981	102	34.2
Stockholm	4,274	179	41.9
Sörmland	486	16	32.9
Uppsala	756	35	46.3
Värmland	659	30	45.5
Västerbotten	491	45	91.6
Västernorrland	484	27	55.8
Västmanland	365	17	46.6
Västra Götaland	2,972	115	38.7
Örebro	651	20	30.7
Östergötland	816	55	67.4
The Country	20,644	863	41.8

All adverse events within 90 days (incl. death)

County	Surgeries	Events	Risk/1000
Blekinge	357	22	61.6
Dalarna	553	27	48.8
Gotland	107	7	65.4
Gävleborg	621	25	40.3
Halland	972	39	40.1
Jämtland	158	13	82.3
Jönköping	634	25	39.4
Kalmar	647	57	88.1
Kronoberg	247	9	36.4
Norrbotten	402	17	42.3
Skåne	2,155	116	53.8
Stockholm	3,226	174	53.9
Sörmland	387	15	38.8
Uppsala	554	30	54.2
Värmland	538	37	68.8
Västerbotten	385	54	140.3
Västernorrland	361	28	77.6
Västmanland	234	13	55.6
Västra Götaland	2,409	128	53.1
Örebro	482	27	56.0
Östergötland	621	34	54.8
The Country	16,050	897	55.9

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.

It can be seen that 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 number of events is fewer in all the groups. Surgical events which may include aspirations, wound problems, manipulation under anesthesia, hematoma etc. occur in 3.0% of the patients. The "true revisions" in which implant components are added, removed or exchanged, and which the SKAR focuses on, account for less than one fifth of the adverse events the first three months. Cardiovascular events occur in 0.7% and other adverse medical events in 1.3% while only 0.13% die within the first 90 days. The overall risk for a patient for experiencing a least one adverse event during this time is 4.8%.

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	769	2	2.4
Dalarna	1,225	2	1.5
Gotland	228	1	4.8
Gävleborg	1,393	1	0.8
Halland	2,147	2	1.0
Jämtland	390	1	2.5
Jönköping	1,393	1	0.6
Kalmar	1,448	3	2.2
Kronoberg	533	0	0.0
Norrbotten	881	2	2.0
Skåne	5,136	9	1.7
Stockholm	7,500	3	0.5
Sörmland	873	1	1.2
Uppsala	1,310	1	0.9
Värmland	1,197	1	1.0
Västerbotten	876	1	1.2
Västernorrland	845	2	2.1
Västmanland	599	1	1.5
Västra Götaland	5,381	6	1.1
Örebro	1,133	2	2.0
Östergötland	1,437	4	2.6
The Country	36,694	46	1.3

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

County	Surgeries	Events	Risk/1000
Blekinge	769	31	39.9
Dalarna	1,225	58	47.8
Gotland	228	12	53.0
Gävleborg	1,393	48	34.8
Halland	2,147	79	36.9
Jämtland	390	30	76.5
Jönköping	1,393	51	36.6
Kalmar	1,448	98	67.6
Kronoberg	533	26	49.5
Norrbotten	881	28	32.2
Skåne	5,136	216	42.0
Stockholm	7,500	364	48.5
Sörmland	873	31	35.4
Uppsala	1,310	65	49.8
Värmland	1,197	68	56.5
Västerbotten	876	100	113.8
Västernorrland	845	55	64.5
Västmanland	599	30	49.3
Västra Götaland	5,381	245	45.5
Örebro	1,133	46	40.9
Östergötland	1,437	89	61.6
The Country	36,694	1,760	48.0

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	251	19	75.7
Alingsås	539	15	27.8
Art Clinic Gbg	169	2	11.8
Art Clinic Jönköping	119	0	0.0
Arvika	490	17	34.7
Bollnäs	896	10	11.2
Borås	198	8	40.4
Capio Artro Clinic	214	3	14.0
Carlanderska	496	2	4.0
Danderyd	317	10	31.5
Eksjö-Nässjö	561	17	30.3
Enköping	1,059	22	20.8
Eskilstuna	152	10	65.8
Falun	654	22	33.6
Frölunda Spec.	123	1	8.1
Gällivare	148	4	27.0
Gävle	289	6	20.8
Halmstad	520	29	55.8
Halmstad Capio	1,200	18	15.0
Helsingborg	124	2	16.1
Huddinge	325	15	46.2
Hudiksvall	208	5	24.0
Hässleholm	1,910	64	33.5
Jönköping	272	5	18.4
Kalmar	255	6	23.5
Karlshamn	769	18	23.4
Karlskoga	239	5	20.9
Karlstad	394	19	48.2
Karolinska	171	10	58.5
Kullbergska sjukhuset	503	12	23.9
Kungälv	480	19	39.6
Lidköping	694	25	36.0
Lindesberg	832	28	33.7
Ljungby	307	13	42.3
Luleå-Hermelinen	34	1	29.4
Lund	162	4	24.7
Lycksele	290	17	58.6
Mora	571	22	38.5
Motala	1,010	47	46.5
Mölndal	1,142	32	28.0
Nacka-Proxima/Aleris	470	5	10.6
Norrköping	427	17	39.8
Norrtälje	339	19	56.0
Nyköping	218	1	4.6
Ortho Center Stockh.(Löw)	1 251	11	8.8
OrthoCenter IFK Klin	383	3	7.8
Ortopediska huset	1,728	21	12.2
Oskarshamn	927	33	35.6
Piteå	699	16	22.9
S:t Göran	1,201	49	40.8
Sabbatsberg	23	0	0.0
Skellefteå	265	11	41.5
Skene	298	6	20.1
Skövde	289	12	41.5
Sollefteå	388	18	46.4
Sophiahemmet	289	8	27.7
Sundsvall	55	1	18.2
Södersjukhuset	763	47	61.6
Södertälje	409	14	34.2
Torsby	313	9	28.8
Trelleborg	2,163	33	15.3
Uddevalla	570	20	35.1
Umeå	321	34	105.9
Varberg	427	14	32.8
Visby	228	9	39.5
Värnamo	441	17	38.5
Västervik	266	16	60.2
Västerås	599	16	26.7
Växjö	226	6	26.5
Ängelholm	776	22	28.4
Örebro	62	1	16.1
Örnsköldsvik	402	14	34.8
Östersund	390	13	33.3
The Country	36,694	1,100	30.0

Adverse cardiovascular events within 90 days (DC)

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	251	2	8.0
Alingsås	539	2	3.7
Art Clinic Gbg	169	1	5.9
Art Clinic Jönköping	119	0	0.0
Arvika	490	4	8.2
Bollnäs	896	13	14.5
Borås	198	5	25.3
Capio Artro Clinic	214	2	9.3
Carlanderska	496	4	8.1
Danderyd	317	3	9.5
Eksjö-Nässjö	561	1	1.8
Enköping	1,059	9	8.5
Eskilstuna	152	0	0.0
Falun	654	6	9.2
Frölunda Spec.	123	2	16.3
Gällivare	148	0	0.0
Gävle	289	5	17.3
Halmstad	520	2	3.8
Halmstad Capio	1,200	3	2.5
Helsingborg	124	2	16.1
Huddinge	325	1	3.1
Hudiksvall	208	2	9.6
Hässleholm	1,910	14	7.3
Jönköping	272	2	7.4
Kalmar	255	2	7.8
Karlshamn	769	5	6.5
Karlskoga	239	0	0.0
Karlstad	394	5	12.7
Karolinska	171	1	5.8
Kullbergska sjukhuset	503	1	2.0
Kungälv	480	5	10.4
Lidköping	694	7	10.1
Lindesberg	832	7	8.4
Ljungby	307	5	16.3
Luleå-Hermelinen	34	1	29.4
Lund	162	3	18.5
Lycksele	290	3	10.3
Mora	571	5	8.8
Motala	1,010	7	6.9
Mölndal	1,142	11	9.6
Nacka-Proxima/Aleris	470	2	4.3
Norrköping	427	3	7.0
Norrtälje	339	1	2.9
Nyköping	218	1	4.6
Ortho Center Sth.(Löw)	1,251	3	2.4
OrthoCenter IFK Klin	383	1	2.6
Ortopediska huset	1,728	3	1.7
Oskarshamn	927	3	3.2
Piteå	699	4	5.7
S:t Göran	1,201	14	11.7
Sabbatsberg	23	0	0.0
Skellefteå	265	3	11.3
Skene	298	0	0.0
Skövde	289	0	0.0
Sollefteå	388	5	12.9
Sophiahemmet	289	0	0.0
Sundsvall	55	2	36.4
Södersjukhuset	763	7	9.2
Södertälje	409	4	9.8
Torsby	313	1	3.2
Trelleborg	2,163	16	7.4
Uddevalla	570	2	3.5
Umeå	321	0	0.0
Varberg	427	2	4.7
Visby	228	1	4.4
Värnamo	441	0	0.0
Västervik	266	2	7.5
Västerås	599	10	16.7
Växjö	226	0	0.0
Ängelholm	776	4	5.2
Örebro	62	0	0.0
Örnsköldsvik	402	2	5.0
Östersund	390	7	17.9
The Country	**36,694**	**257**	**7.0**

Other adverse medical events within 90 days. (DM)

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	251	4	15.9
Alingsås	539	5	9.3
Art Clinic Gbg	169	0	0.0
Art Clinic Jönköping	119	0	0.0
Arvika	490	3	6.1
Bollnäs	896	8	8.9
Borås	198	5	25.3
Capio Artro Clinic	214	0	0.0
Carlanderska	496	4	8.1
Danderyd	317	20	63.1
Eksjö-Nässjö	561	5	8.9
Enköping	1,059	9	8.5
Eskilstuna	152	1	6.6
Falun	654	5	7.6
Frölunda Spec.	123	0	0.0
Gällivare	148	0	0.0
Gävle	289	2	6.9
Halmstad	520	5	9.6
Halmstad Capio	1,200	4	3.3
Helsingborg	124	2	16.1
Huddinge	325	14	43.1
Hudiksvall	208	1	4.8
Hässleholm	1,910	30	15.7
Jönköping	272	2	7.4
Kalmar	255	8	31.4
Karlshamn	769	9	11.7
Karlskoga	239	1	4.2
Karlstad	394	6	15.2
Karolinska	171	7	40.9
Kullbergska sjukhuset	503	1	2.0
Kungälv	480	9	18.8
Lidköping	694	10	14.4
Lindesberg	832	6	7.2
Ljungby	307	4	13.0
Luleå-Hermelinen	34	0	0.0
Lund	162	7	43.2
Lycksele	290	4	13.8
Mora	571	1	1.8
Motala	1,010	7	6.9
Mölndal	1,142	7	6.1
Nacka-Proxima/Aleris	470	0	0.0
Norrköping	427	11	25.8
Norrtälje	339	6	17.7
Nyköping	218	4	18.3
Ortho Center Sth.(Löw)	1,251	5	4.0
OrthoCenter IFK Klin	383	4	10.4
Ortopediska huset	1,728	10	5.8
Oskarshamn	927	28	30.2
Piteå	699	2	2.9
S:t Göran	1,201	19	15.8
Sabbatsberg	23	0	0.0
Skellefteå	265	10	37.7
Skene	298	3	10.1
Skövde	289	5	17.3
Sollefteå	388	6	15.5
Sophiahemmet	289	2	6.9
Sundsvall	55	0	0.0
Södersjukhuset	763	29	38.0
Södertälje	409	14	34.2
Torsby	313	3	9.6
Trelleborg	2,163	19	8.8
Uddevalla	570	8	14.0
Umeå	321	21	65.4
Varberg	427	3	7.0
Visby	228	1	4.4
Värnamo	441	3	6.8
Västervik	266	4	15.0
Västerås	599	5	8.3
Växjö	226	0	0.0
Ängelholm	776	3	3.9
Örebro	62	0	0.0
Örnsköldsvik	402	10	24.9
Östersund	390	10	25.6
The Country	**36,694**	**464**	**12.6**

Death within 90 days

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	251	1	4.0
Alingsås	539	2	3.7
Art Clinic Gbg	169	0	0.0
Art Clinic Jönköping	119	0	0.0
Arvika	490	1	2.0
Bollnäs	896	0	0.0
Borås	198	1	5.1
Capio Artro Clinic	214	0	0.0
Carlanderska	496	0	0.0
Danderyd	317	0	0.0
Eksjö-Nässjö	561	0	0.0
Enköping	1,059	0	0.0
Eskilstuna	152	0	0.0
Falun	654	1	1.5
Frölunda Spec.	123	0	0.0
Gällivare	148	0	0.0
Gävle	289	1	3.5
Halmstad	520	1	1.9
Halmstad Capio	1,200	1	0.8
Helsingborg	124	1	8.1
Huddinge	325	0	0.0
Hudiksvall	208	0	0.0
Hässleholm	1,910	4	2.1
Jönköping	272	1	3.7
Kalmar	255	1	3.9
Karlshamn	769	2	2.6
Karlskoga	239	0	0.0
Karlstad	394	0	0.0
Karolinska	171	0	0.0
Kullbergska sjukhuset	503	0	0.0
Kungälv	480	0	0.0
Lidköping	694	1	1.4
Lindesberg	832	2	2.4
Ljungby	307	0	0.0
Luleå-Hermelinen	34	0	0.0
Lund	162	2	12.3
Lycksele	290	1	3.4
Mora	571	1	1.8
Motala	1,010	2	2.0
Mölndal	1,142	0	0.0
Nacka-Proxima/Aleris	470	0	0.0
Norrköping	427	2	4.7
Norrtälje	339	0	0.0
Nyköping	218	1	4.6
Ortho Center Sth.(Löw)	1,251	0	0.0
OrthoCenter IFK Klin	383	0	0.0
Ortopediska huset	1,728	0	0.0
Oskarshamn	927	2	2.2
Piteå	699	2	2.9
S:t Göran	1,201	1	0.8
Sabbatsberg	23	0	0.0
Skellefteå	265	0	0.0
Skene	298	1	3.4
Skövde	289	0	0.0
Sollefteå	388	1	2.6
Sophiahemmet	289	0	0.0
Sundsvall	55	0	0.0
Södersjukhuset	763	2	2.6
Södertälje	409	0	0.0
Torsby	313	0	0.0
Trelleborg	2,163	1	0.5
Uddevalla	570	1	1.8
Umeå	321	0	0.0
Varberg	427	0	0.0
Visby	228	1	4.4
Värnamo	441	0	0.0
Västervik	266	0	0.0
Västerås	599	1	1.7
Växjö	226	0	0.0
Ängelholm	776	0	0.0
Örebro	62	0	0.0
Örnsköldsvik	402	1	2.5
Östersund	390	1	2.6
The Country	**36,694**	**46**	**1.3**

All adverse events within 90 days (incl. death)

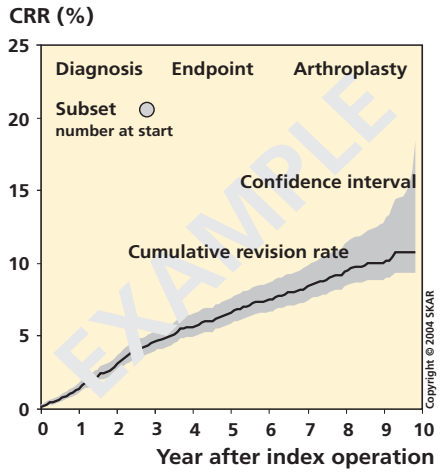
Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	251	25	99.6
Alingsås	539	23	42.7
Art Clinic Gbg	169	3	17.8
Art Clinic Jönköping	119	0	0.0
Arvika	490	25	51.0
Bollnäs	896	28	31.3
Borås	198	19	96.0
Capio Artro Clinic	214	5	23.4
Carlanderska	496	10	20.2
Danderyd	317	32	100.9
Eksjö-Nässjö	561	23	41.0
Enköping	1,059	40	37.8
Eskilstuna	152	11	72.4
Falun	654	32	48.9
Frölunda Spec.	123	3	24.4
Gällivare	148	4	27.0
Gävle	289	14	48.4
Halmstad	520	36	69.2
Halmstad Capio	1,200	25	20.8
Helsingborg	124	6	48.4
Huddinge	325	29	89.2
Hudiksvall	208	7	33.7
Hässleholm	1,910	104	54.5
Jönköping	272	9	33.1
Kalmar	255	14	54.9
Karlshamn	769	32	41.6
Karlskoga	239	6	25.1
Karlstad	394	30	76.1
Karolinska	171	16	93.6
Kullbergska sjukhuset	503	14	27.8
Kungälv	480	31	64.6
Lidköping	694	40	57.6
Lindesberg	832	40	48.1
Ljungby	307	20	65.1
Luleå-Hermelinen	34	2	58.8
Lund	162	13	80.2
Lycksele	290	22	75.9
Mora	571	27	47.3
Motala	1,010	60	59.4
Mölndal	1,142	49	42.9
Nacka-Proxima/Aleris	470	7	14.9
Norrköping	427	29	67.9
Norrtälje	339	24	70.8
Nyköping	218	6	27.5
Ortho Center Sth.(Löw)	1,251	19	15.2
OrthoCenter IFK Klin	383	7	18.3
Ortopediska huset	1,728	32	18.5
Oskarshamn	927	60	64.7
Piteå	699	23	32.9
S:t Göran	1,201	78	64.9
Sabbatsberg	23	0	0.0
Skellefteå	265	24	90.6
Skene	298	10	33.6
Skövde	289	17	58.8
Sollefteå	388	28	72.2
Sophiahemmet	289	10	34.6
Sundsvall	55	3	54.5
Södersjukhuset	763	69	90.4
Södertälje	409	32	78.2
Torsby	313	12	38.3
Trelleborg	2,163	66	30.5
Uddevalla	570	31	54.4
Umeå	321	53	165.1
Varberg	427	18	42.2
Visby	228	11	48.2
Värnamo	441	20	45.4
Västervik	266	22	82.7
Västerås	599	30	50.1
Växjö	226	6	26.5
Ängelholm	776	28	36.1
Örebro	62	1	16.1
Örnsköldsvik	402	24	59.7
Östersund	390	30	76.9
The Country	**36,694**	**1 760**	**48.0**

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.

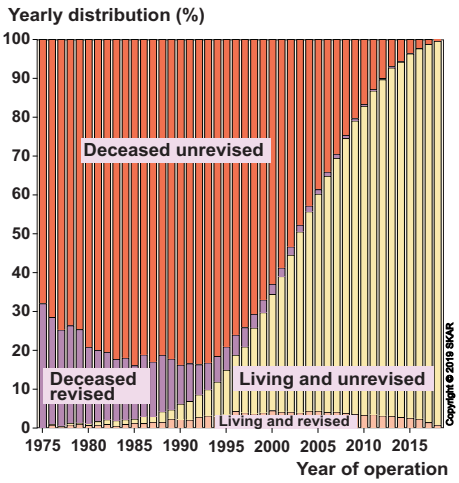
Cox regression allows for taking into account different factors that may vary within groups. The results are expressed as risk ratios (RR) between factors. If a factor is a category (e.g. implant model), one category is defined as a reference with a risk of 1 to which the other categories are compared. 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 at are unable to take into account, may influence the risk of revision and thus the results of individual units.



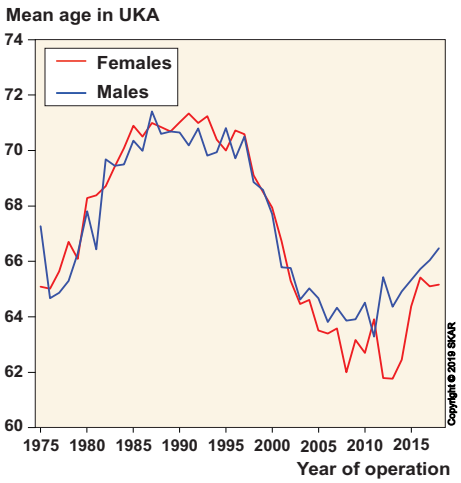
The present status for each yearly batch of patients operated since 1975.

Gender and age distribution

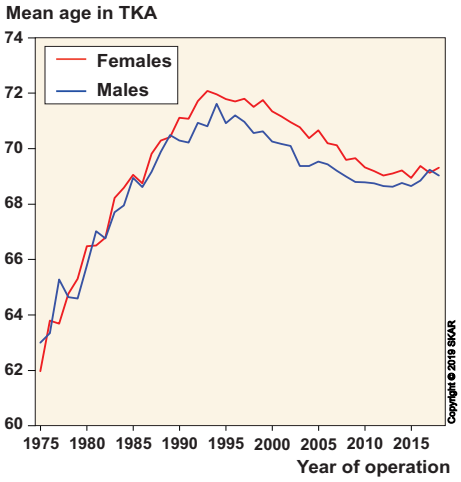
Between 1975 and 1994, the mean age at primary operation increased from 65 years to almost 72 years. The main reason was a relatively large increase in number of operations among the older age groups. Probable explanations are improvements in anesthetic techniques as well as a changed age distribution 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 2018 was 68.8 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.

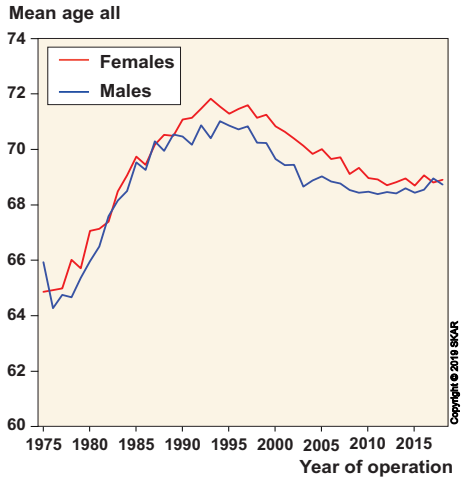
When comparing a series of patients operated on during different periods, the changes in the mean age make it necessary to account for age by use of regression or to analyze different age groups separately.



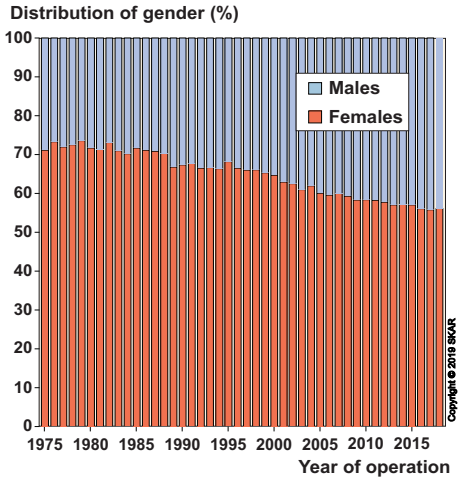
For UKA, the mean age of patients at surgery has decreased sharply in recent years coinciding with the introduction of mini-invasive surgery.



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.



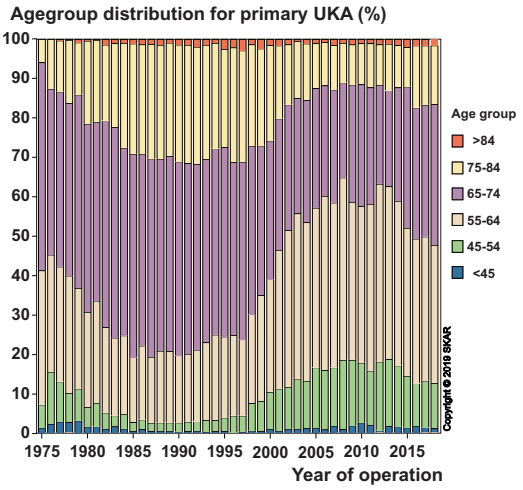
The proportion of males has increased slightly over the years.

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 2018 they accounted for 44%. 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.

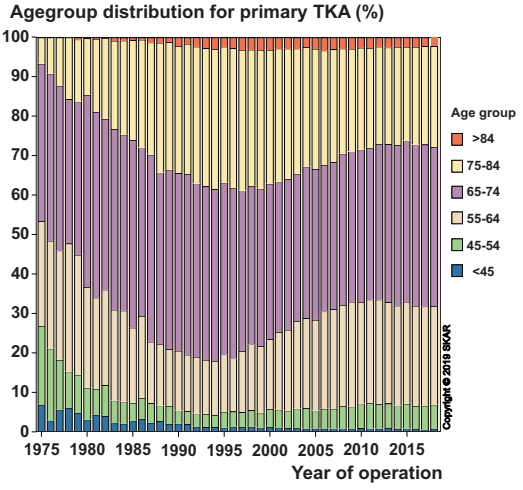
The figure to the right shows the relative number of operations performed in the different age groups over a period of thirty five years. In a somewhat different manner than the mean age (previous page) it shows how the relative proportion of the older groups increased until the mid-nineties after which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

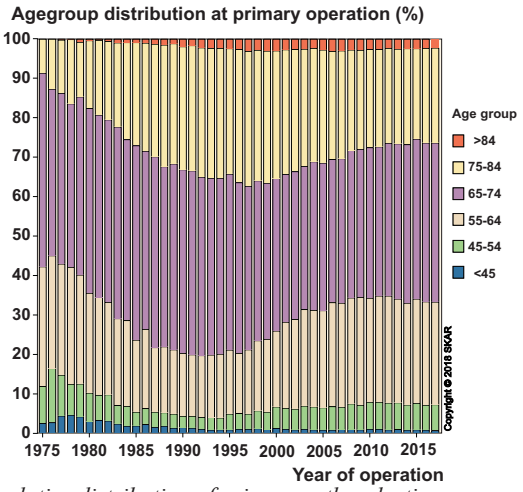
In UKA the relative proportion of patients less than 65 years of age doubled during 1998-2002, i.e. during the time when mini-invasive surgery caught on in Sweden. However, it has to be kept in mind that the actual number of UKA´s has diminished since 1993 in contrast to the TKA´s where it has increased 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 2018, of TKA patients, younger than 65 years of age, had increased 7.8 times as compared to 1993 while the number of UKA patients under 65 only had increased 1.8 times during the same period.



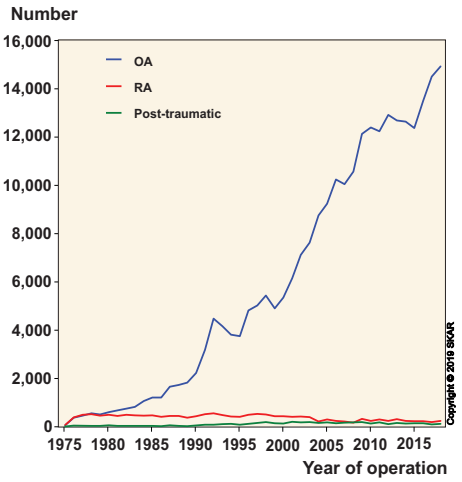
The relative distribution of primary UKA arthroplasties among different age groups.



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



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



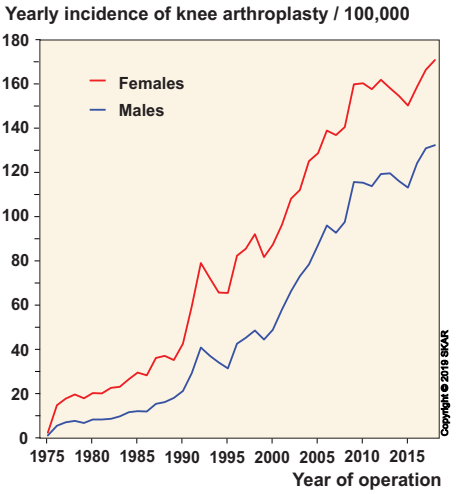
The yearly number of arthroplasties for different diagnoses

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.

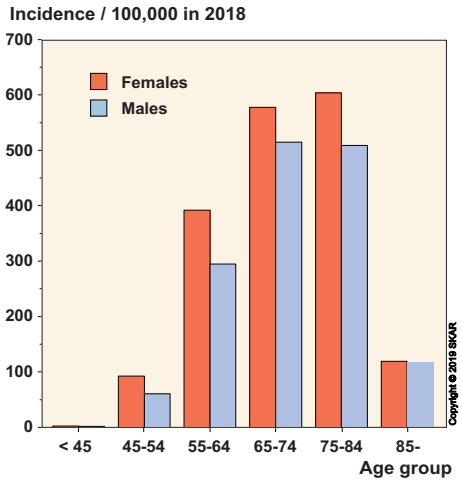
Incidence and prevalence

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.

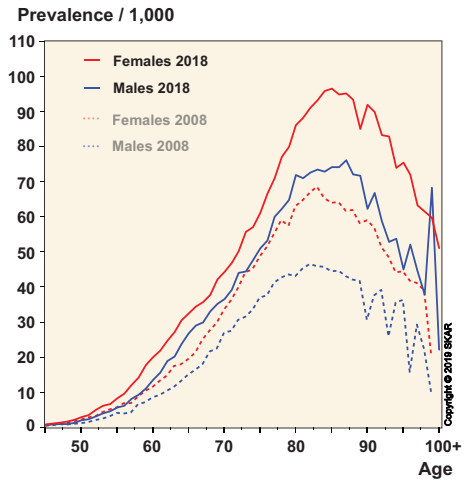
The figure below shows the incidence among different age groups during 2018. It is highest in the group of with those 65-84 years of age. At this age, knee arthroplasty is 7 times more common than among those 45-54 years old and 5 times more common than among those 85 years or older. In 2018, as well as 2017, women were 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 2018 per 100,000 inhabitants (males and females) in the different age groups.



The prevalence of knee arthroplasty in 2008 and 2018. 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.

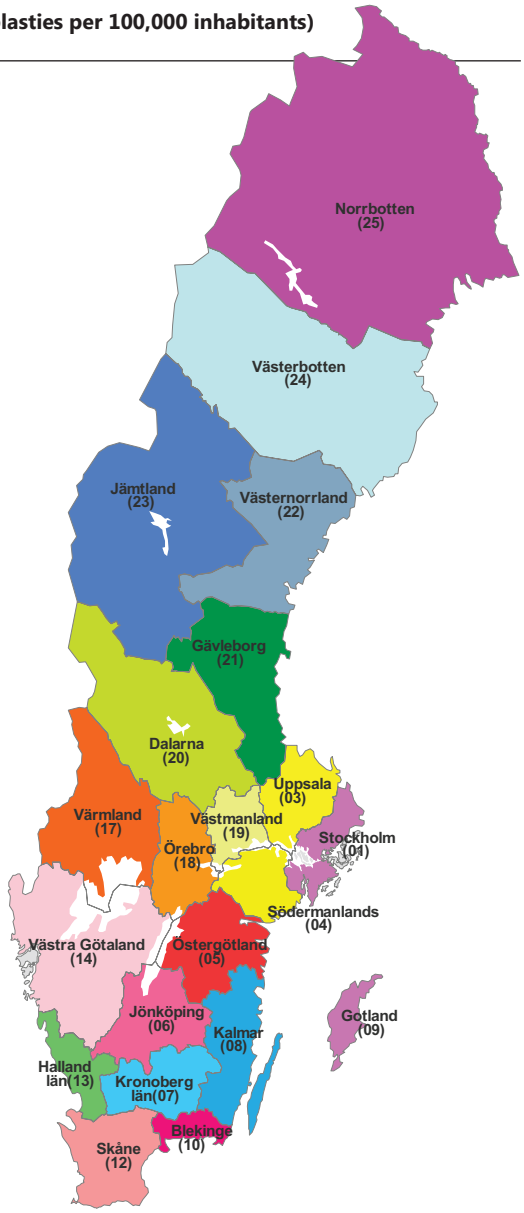
For both men and women in 2018, the prevalence peaks around 80-85 years of age at which almost 10% of the women and almost 8% of the men had at least one knee arthroplasty. Comparing the prevalence in 2018 with that in 2008, it can be seen that it has increased in all age groups. The fact that a large 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 2012-2018 (knee arthroplasties per 100,000 inhabitants)

County and number of inhabitants 2018

No	County	Inhabitants
01	Stockholm	2,326,134
03	Uppsala	372,663
04	Södermanland	293,018
05	Östergötland	459,540
06	Jönköping	359,031
07	Kronoberg	198,703
08	Kalmar	244,103
09	Gotland	58,922
10	Blekinge	159,528
12	Skåne	1,353,427
13	Halland	327,089
14	Västra Götaland	1,700,298
17	Värmland	280,941
18	Örebro	300,580
19	Västmanland	272,512
20	Dalarna	286,678
21	Gävleborg	286,092
22	Västernorrland	245,711
23	Jämtland	130,043
24	Västerbotten	269,310
25	Norrbotten	250,896

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



Knee arthroplasties per 100,000 inhabitants

County	2012	2013	2014	2015	2016	2017	2018
01 Stockholm	103.9	104.9	99.4	93.2	111.4	124.1	124.6
03 Uppsala	154.9	174.8	142.9	161.6	123.3	131.2	136.3
04 Södermanland	151.7	157.2	161.9	145.6	140.3	189.8	175.1
05 Östergötland	157.5	154.2	135.0	132.9	137.0	151.9	153.0
06 Jönköping	168.4	147.6	172.4	153.7	150.2	131.3	168.0
07 Kronoberg	158.7	115.3	150.4	154.5	175.1	155.0	165.1
08 Kalmar	168.4	175.9	167.0	172.4	174.6	196.0	199.9
09 Gotland	165.9	178.3	134.6	106.4	150.8	178.4	218.9
10 Blekinge	178.8	177.7	161.6	165.6	206.5	196.3	185.5
12 Skåne	125.8	137.3	142.6	144.4	158.4	167.8	159.5
13 Halland	177.3	165.6	168.4	155.4	177.0	199.6	192.0
14 Västra Götaland	132.0	130.7	125.6	127.8	126.0	124.1	133.8
17 Värmland	179.9	180.3	195.4	184.5	181.5	184.0	193.6
18 Örebro	146.3	120.3	116.8	104.6	152.6	126.6	109.5
19 Västmanland	156.7	125.4	134.8	109.1	118.4	144.4	161.1
20 Dalarna	217.0	231.4	199.5	174.7	199.8	171.4	180.3
21 Gävleborg	191.4	188.6	213.6	206.1	202.3	174.3	211.1
22 Västernorrland	145.4	141.3	132.3	141.3	155.3	199.4	148.5
23 Jämtland	175.0	138.5	95.6	120.4	145.3	171.8	187.6
24 Västerbotten	123.1	126.2	118.1	117.9	120.5	146.7	139.2
25 Norrbotten	165.7	150.2	131.0	120.9	144.3	157.4	193.3
The whole country	140.8	139.1	135.5	131.8	141.5	148.7	151.6

Information on domicile is by the Swedish Tax Agency

For age-standardized incidence see page 37

The incidence in the counties 2012-2018 (knee arthroplasties per 100,000 inhabitants)

Incidence for women

County	2012	2013	2014	2015	2016	2017	2018
01 Stockholm	130.4	123.0	113.3	106.4	126.9	145.5	147.1
03 Uppsala	178.6	193.1	170.6	186.2	134.5	155.9	143.8
04 Södermanland	176.8	180.4	184.5	154.4	159.7	209.7	203.4
05 Östergötland	182.6	172.5	159.9	156.9	154.1	165.7	184.5
06 Jönköping	202.3	174.4	202.1	176.1	164.5	143.9	178.1
07 Kronoberg	183.1	148.4	166.7	168.3	186.1	166.9	181.3
08 Kalmar	209.0	201.2	193.1	199.7	206.7	205.3	227.5
09 Gotland	162.7	208.1	128.5	114.5	169.2	171.1	254.1
10 Blekinge	188.9	187.5	182.3	168.9	235.6	219.5	186.8
12 Skåne	140.1	154.4	166.0	169.6	177.9	188.5	176.0
13 Halland	197.8	188.4	186.6	173.0	190.2	227.9	204.0
14 Västra Götaland	146.9	148.2	140.7	146.4	140.8	137.6	154.3
17 Värmland	202.9	190.1	233.5	204.5	194.4	197.5	219.8
18 Örebro	157.7	129.6	135.7	127.0	176.9	137.7	119.4
19 Västmanland	173.6	140.3	157.5	128.1	148.0	165.1	173.0
20 Dalarna	242.1	260.7	222.4	195.0	217.1	186.4	187.0
21 Gävleborg	207.7	206.4	232.6	221.4	221.6	195.7	236.5
22 Västernorrland	163.6	165.4	149.7	155.2	181.0	221.6	170.9
23 Jämtland	206.2	179.4	107.9	153.6	156.1	175.4	216.6
24 Västerbotten	150.9	151.4	132.5	137.4	138.9	159.0	158.8
25 Norrbotten	190.6	170.8	150.2	142.1	162.6	179.5	218.9
The whole country	162.1	158.3	154.8	150.3	158.9	166.5	171.1

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 2018 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	2012	2013	2014	2015	2016	2017	2018
01 Stockholm	76.9	86.5	85.4	79.9	95.7	102.7	102.1
03 Uppsala	131.0	156.5	115.0	136.9	112.0	106.4	128.8
04 Södermanland	126.3	133.7	139.3	136.9	120.9	170.1	146.9
05 Östergötland	132.6	136.1	110.3	109.3	120.2	138.4	122.2
06 Jönköping	134.6	120.8	143.0	131.6	136.0	118.9	158.1
07 Kronoberg	134.8	82.8	134.5	141.1	164.5	143.6	149.4
08 Kalmar	127.8	150.5	141.0	145.4	143.0	186.8	172.8
09 Gotland	169.1	148.0	140.7	98.2	132.3	185.7	183.6
10 Blekinge	169.1	168.1	141.4	162.4	178.5	174.0	184.4
12 Skåne	111.3	119.9	118.7	118.9	138.6	146.9	143.0
13 Halland	156.6	142.7	150.1	137.7	163.7	171.5	180.0
14 Västra Götaland	117.0	113.1	110.4	109.1	111.3	110.6	113.6
17 Värmland	156.9	170.5	157.4	164.7	168.7	170.7	167.8
18 Örebro	134.7	110.9	97.9	82.3	128.2	115.6	99.6
19 Västmanland	139.8	110.4	112.1	90.3	89.1	124.0	149.3
20 Dalarna	191.9	202.3	176.8	154.6	182.8	156.7	173.8
21 Gävleborg	175.1	170.8	194.7	190.9	183.2	153.2	186.1
22 Västernorrland	127.2	117.2	115.1	127.5	129.9	177.5	126.6
23 Jämtland	143.9	97.9	83.4	87.6	134.7	168.3	159.4
24 Västerbotten	95.6	101.4	103.8	98.8	102.5	134.7	120.2
25 Norrbotten	141.7	130.3	112.4	100.4	126.8	136.3	168.9
The whole country	119.4	119.7	116.2	113.2	124.2	131.0	132.4

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	1976-1987	1988-1992	1993-1997	1998-2002	2003-2007	2008-2012	2013-2017	2018
<45	1.0	1.0	1.1	1.6	1.7	2.4	2.1	2.2
45-54	12.9	13.0	19.0	34.6	58.7	87.6	85.0	92.7
55-64	44.1	76.9	112.8	153.7	236.1	318.5	348.3	393.3
65-74	100.1	225.3	331.0	396.1	520.4	563.8	535.9	579.9
75-84	76.0	217.0	337.5	406.7	528.8	609.8	590.0	606.1
>84	7.1	35.0	65.0	87.4	105.1	121.0	113.2	119.5
Total	23.0	50.9	74.4	93.2	128.6	156.2	157.8	171.1

Men

Age group	1976-1987	1988-1992	1993-1997	1998-2002	2003-2007	2008-2012	2013-2017	2018
<45	0.4	0.5	0.5	0.8	1.2	1.5	1.4	1.7
45-54	5.3	6.2	10.1	19.0	37.6	50.1	52.5	60.8
55-64	19.4	45.3	69.5	101.9	175.4	253.3	277.7	296.2
65-74	45.5	124.9	197.8	267.9	395.8	453.3	464.9	516.8
75-84	39.5	142.8	211.6	272.7	390.1	484.0	482.8	511.0
>84	8.7	34.4	64.9	68.9	111.7	119.3	119.4	118.2
Total	9.3	25.1	38.0	53.2	85.6	112.5	121.0	132.4

Number of primary arthroplasties per unit and year

Hospital	1975-2013	2014	2015	2016	2017	2018	Total	Percent
Akademiska sjukhuset	3,002	86	108	88	85	91	3,460	1.2
Alingsås	2,220	204	193	160	200	179	3,156	1.1
Art Clinic Göteborg	.	.	16	55	108	140	319	0.1
Art Clinic Jönköping	10	13	29	24	90	146	312	0.1
Arvika	1,687	193	171	189	193	213	2,646	0.9
Avesta	67	.	.	.	.	.	67	0.0
Boden	1,622	.	.	.	.	.	1,622	0.6
Bollnäs	3,433	402	353	344	325	367	5,224	1.8
Borås	2,932	78	72	74	69	114	3,339	1.2
Capio Artro Clinic	.	.	.	.	242	392	635	0.2
Carlanderska	645	137	136	156	224	323	1,621	0.6
Dalslands Sjukhus	81	.	.	.	.	.	81	0.0
Danderyd	3,439	185	185	187	185	189	4,370	1.5
Eksjö (Höglandssjukh.)	3,108	211	202	221	217	299	4,258	1.5
Elisabethsjukhuset	827	7	1	7	6	13	861	0.3
Enköping	2,911	373	392	346	365	381	4,768	1.7
Eskilstuna	1,893	41	42	55	69	81	2,181	0.8
Fagersta	71	.	.	.	.	.	71	0.0
Falköping	1,688	.	.	.	.	.	1,688	0.6
Falun	5,211	356	205	270	215	170	6,427	2.3
Frölunda Spec.	1,308	120	124	.	.	.	1,552	0.5
Gällivare	1,523	68	46	53	54	88	1,832	0.6
Gävle	3,410	129	132	147	85	76	3,979	1.4
Halmstad	3,370	190	186	208	185	198	4,337	1.5
Halmstad Capio Movement	1,700	250	430	417	434	467	3,698	1.3
Helsingborg	1,797	45	67	41	19	16	1,985	0.7
Huddinge	2,960	166	159	168	111	107	3,671	1.3
Hudiksvall	1,651	60	87	74	56	62	1,990	0.7
Hässleholm	8,148	683	669	707	883	891	11,981	4.2
Jönköping	2,942	168	141	135	11	.	3,397	1.2
Kalix	215	.	.	.	.	.	215	0.1
Kalmar	2,656	91	89	90	100	86	3,112	1.1
Karlshamn	3,093	242	249	305	295	278	4,462	1.6
Karlskoga	2,031	124	124	104	39	7	2,429	0.9
Karlskrona	1,117	.	.	.	.	.	1,117	0.4
Karlstad	4,299	193	182	162	132	117	5,085	1.8
Karolinska	2,680	101	91	98	59	55	3,084	1.1
Kristianstad	1,297	.	1	.	.	.	1,298	0.5
Kristinehamn	252	.	.	.	.	.	252	0.1

(cont.)

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

Hospital	1975-2013	2014	2015	2016	2017	2018	Total	Percent
Kullbergska sjukhuset	2,572	201	153	157	244	220	3,547	1.2
Kungsbacka	38	.	.	.	.	.	38	0.0
Kungälv	2,154	197	215	197	207	199	3,169	1.1
Köping	1,605	.	.	.	.	.	1,605	0.6
Landskrona	1,918	.	.	.	.	.	1,918	0.7
Lidköping	2,157	199	234	224	250	171	3,235	1.1
Lindesberg	2,181	172	162	319	424	493	3,751	1.3
Linköping	1,735	.	.	.	.	.	1,735	0.6
Linköping medical cent	15	.	.	.	.	.	15	0.0
Ljungby	1,873	151	141	150	135	169	2,619	0.9
Ludvika	339	.	.	.	.	.	339	0.1
Luleå	9	4	7	11	19	19	69	0.0
Lund	2,769	98	82	122	43	52	3,166	1.1
Lycksele	821	93	42	130	150	143	1,379	0.5
Löwenströmska*	3,562	403	431	444	463	681	5,984	2.1
Malmö	2,240	.	.	.	1	.	2,241	0.8
Mora	2,251	150	186	203	195	203	3,188	1.1
Motala	4,980	470	512	552	605	653	7,772	2.7
Mölndal	2,525	387	405	505	378	401	4,601	1.6
Nacka	203	.	.	.	.	.	203	0.1
Nacka-Proxima	785	111	143	154	173	223	1,589	0.6
Norrköping	2,760	140	129	160	175	153	3,517	1.2
Norrtälje	1,378	85	94	123	152	164	1,996	0.7
Nyköping	1,787	100	101	74	102	89	2,253	0.8
OrthoCenter IFK klin.**	1,016	108	113	129	162	171	1,699	0.6
Ortopediska huset	4,039	418	460	625	719	656	6,917	2.4
Oskarshamn	2,992	268	276	316	370	374	4,596	1.6
Piteå	2,775	259	245	279	305	373	4,236	1.5
S:t Göran	7,744	387	424	470	521	466	10,012	3.5
Sabbatsberg (Aleris)	2,012	141	23	.	.	.	2,176	0.8
Sahlgrenska	1,546	4	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	0.4
Skellefteå	1,557	107	119	80	77	86	2,026	0.7
Skene	1,689	104	97	131	127	129	2,277	0.8
Skövde	3,137	115	120	114	73	20	3,579	1.3
Sollefteå	1,505	89	93	102	206	151	2,146	0.8
Sophiahemmet	1,698	98	138	127	229	185	2,475	0.9
Spenshult	1,450	155	.	.	.	.	1,605	0.6
Sunderby	398	.	.	.	.	.	398	0.1
Sundsvall	3,057	95	44	12	5	15	3,228	1.1
Säffle	484	.	.	.	.	.	484	0.2
Söderhamn	279	.	.	.	.	.	279	0.1
Södersjukhuset	5,219	316	281	320	284	227	6,647	2.3
Södertälje	1,563	110	113	163	149	145	2,243	0.8
Torsby	1,772	114	130	108	134	130	2,388	0.8
Trelleborg	7,129	759	791	823	850	814	11,166	3.9
Uddevalla	3,946	207	187	244	247	242	5,073	1.8
Umeå	3,084	104	147	111	120	138	3,704	1.3
Varberg	3,120	149	127	185	214	177	3,972	1.4
Visby	1,579	70	60	76	97	115	1,997	0.7
Vänersborg-NÄL	939	.	.	.	.	.	939	0.3
Värnamo	2,221	163	148	142	193	208	3,075	1.1
Västervik	2,071	94	90	99	81	94	2,529	0.9
Västerås	3,315	246	177	217	273	194	4,422	1.5
Växjö	2,368	109	115	101	77	94	2,864	1.0
Ystad	1,169	.	.	.	.	.	1,169	0.4
Ängelholm - Aleris	.	.	.	.	.	82	82	0.0
Ängelholm	2,464	233	221	338	345	242	3,843	1.3
Örebro	3,413	54	30	47	8	3	3,555	1.2
Örnsköldsvik	2,208	88	115	143	172	142	2,868	1.0
Östersund	2,480	106	120	141	164	178	3,189	1.1
Östra sjukhuset	2,100	.	.	.	.	.	2,100	0.7
Total	**215,088**	**13,147**	**12,924**	**14,053**	**14,974**	**15,430**	**285,616**	**100**

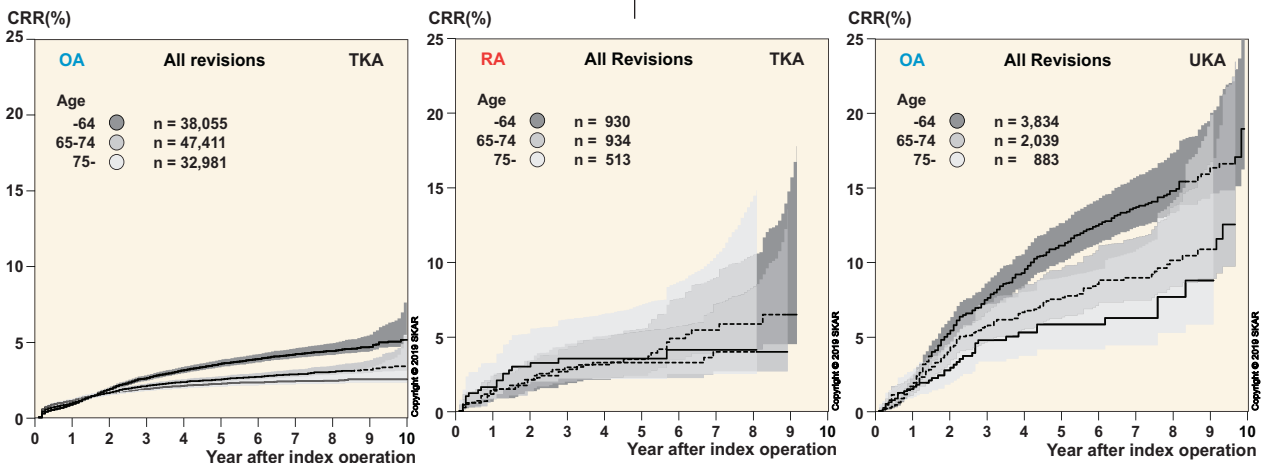
* Lövenströmska was taken over by Stockholms Specialistvård in 2001 and OrthoCenter Stockholm in 2008.

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

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.

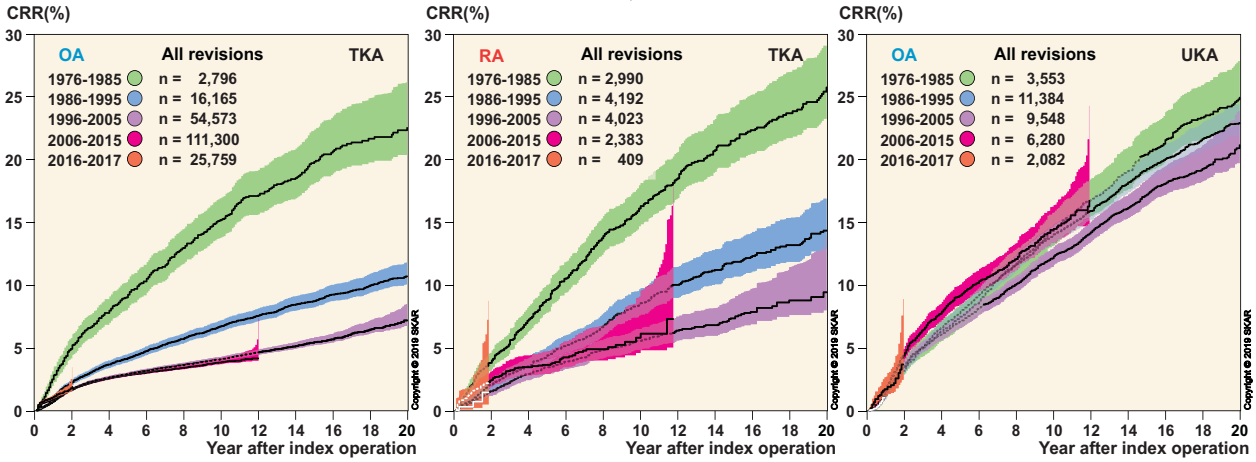
Age – The effect of age at primary surgery can be illustrated by dividing patients into separate age groups. This shows for both TKA and UKA that that the risk is higher for the younger groups (see figures below). Possible explanations are that the younger have higher physical activity, higher expectancy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



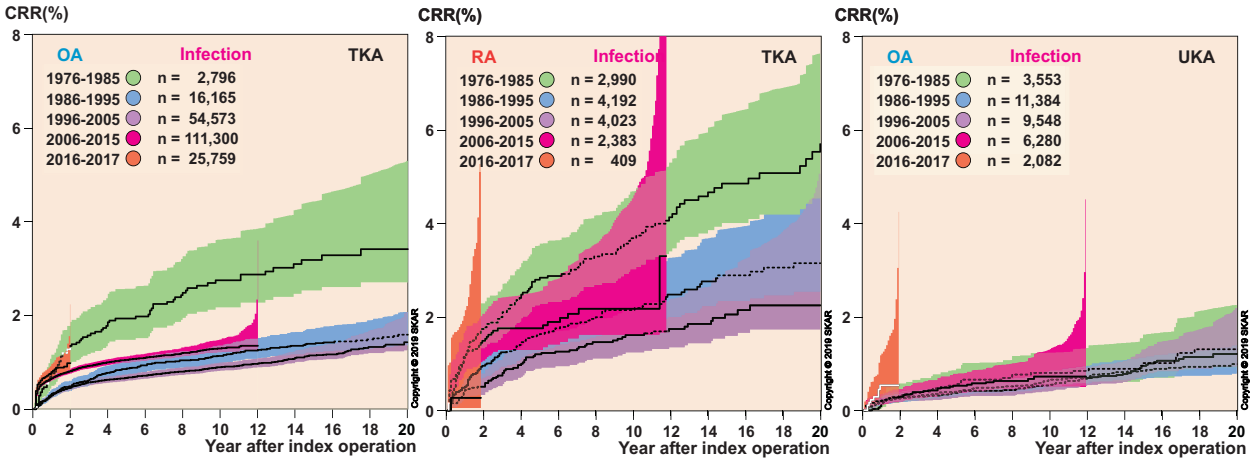
The CRR (2008–2017) for the 3 age groups (<65, 65–75, >75) shows an increase in revision rate with younger age. In TKA/OA those younger than 65 have 1.5 times the risk of those over 75 and 1.9 times higher risk in UKA/OA. The difference in TKA/RA is not significant.

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 2016-2017. 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 rvisions increased during 2006-2015 and 2016-2017. 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 higher risk of revision.



CRR for surgeries performed during four 10-year periods and during 2016-2017. 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 2016-17.

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 2016-17, 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 1.8). If changes of inserts are excluded the differences diminish somewhat (RR 1.5 and RR 1.7).

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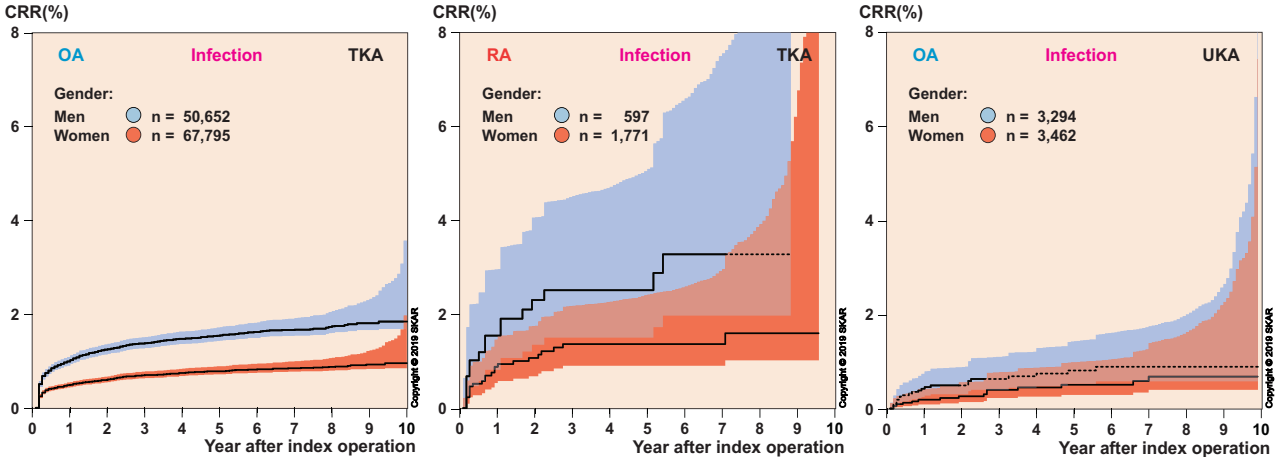
Gender – It is somewhat complicated to evaluate the effect of gender on the risk of revision as males and females have somewhat different revision pattern. Early revision for infection is more common in males (figures below) but early revision for loosening and patellar pain in women. Due to their higher 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 still larger when the endpoint only includes revisions for infection (see figures with text below).

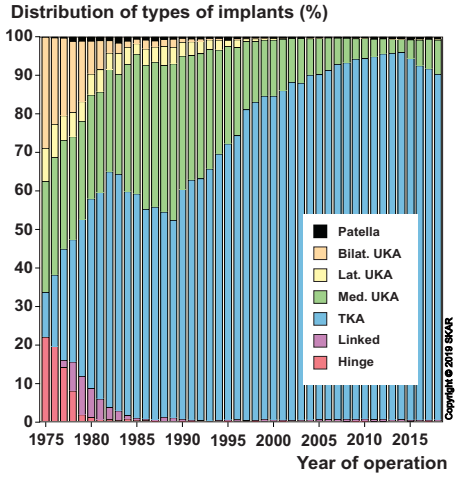
While it is well known that RA patients have a higher risk of infection, being ascribed to the effect of corticosteroid and immunosuppressive medications, it is not obvious why men, more often have their knee arthroplasties revised for infection.



CRR (2008–2017) using the end-point; revision for infection shows men having a higher risk than women (TKA/OA: RR 2.0 and TKA/RA: RR 2.1). In UKA, which has a lower risk of infection than TKA, men also have a higher risk (RR 1.6).
In TKA, patients with RA are more affected than those with OA (RR 1.8).

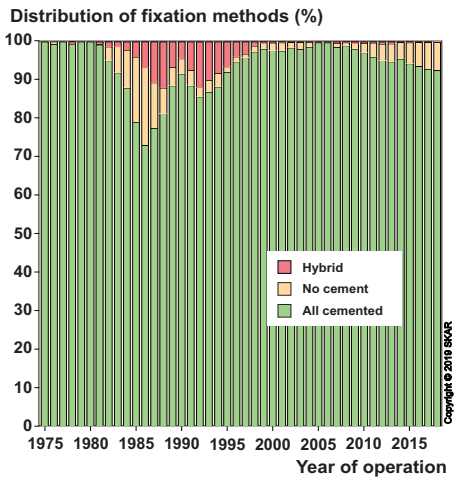
Type of implant – The modern condylar tricompartmental knee implant (TKA) was developed in the seventies when hinged and unicondylar implants were already available. When the register started in 1975, TKA had just been introduced in Sweden, why hinges and UKA's were used for the majority of the primary 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 has diminished over the years, both proportionally as well as in number of surgeries and since the millennium UKA being used on the lateral side is uncommon.

The reason for the lessened 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, besides that the unresurfaced compartments of the knee may be affected by disease this implies that it can be tempting to offer a revision of an UKA to a TKA in patients with knee pain of unclear reason. 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).

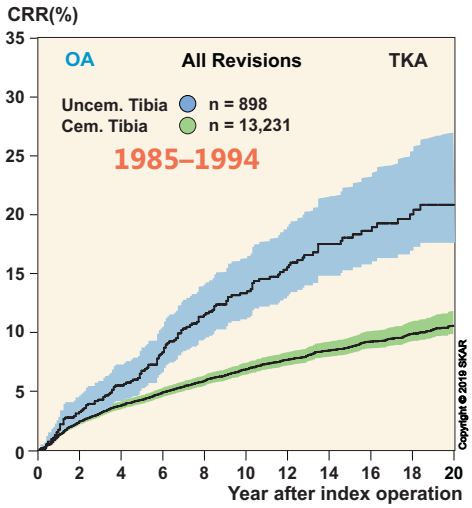


The relative yearly distribution of implant types used for primary surgery.

Use of bone-cement – As the figure below shows, bone cement has been used for the majority of arthroplasties since the nineties. In recent years we have seen a slight increase in the use of uncemented implants, of which two thirds were inserted at one hospital. During the latest 10-year period, we found no significant difference in CRR based on if the tibia component was cemented or not. However, for the period 1985–1994 with follow-up until 2017, the risk is higher for cases in which the tibia was uncemented (see figure right).



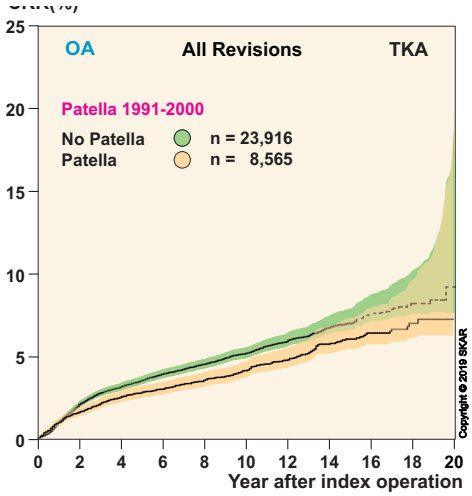
The relative yearly distribution regarding the use of cement for fixation.



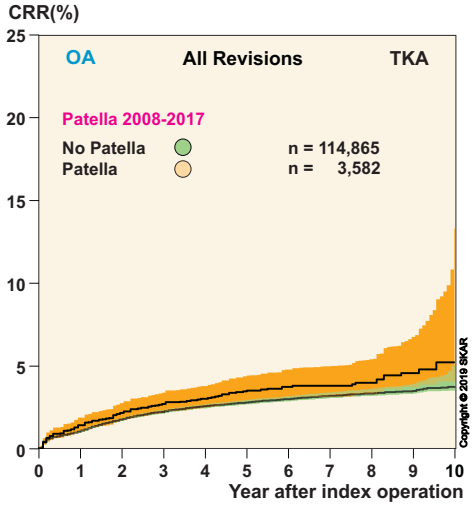
The CRR for TKA inserted 1985-1994 in which the tibial component was fixed with or without cement.

Cox regression, adjusting for age, gender, year of operation and the use of a patellar button shows that the risk for TKA with an uncemented tibial component was 1.6 (1.3-1.9) times higher than for those cemented. This may be because the implants at the time were not suited for uncemented use but is still in agreement with registers in Finland, England, New-Zealand and California which also have found increased risk of revision for uncemented implants.

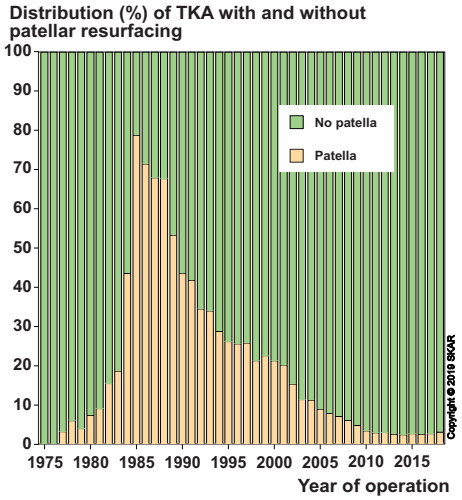
Patellar resurfacing in TKA – Estimating how the use of a patellar button affects the revision rate is complex. The use of a patellar button varies with the brand of prosthesis used and its use also has lessened in recent years. During the eighties, when patellar button was used in just over half of the cases, its use had a negative effect. Since then its use has diminished so that it was only used in 2.6% of the TKA cases in 2017 (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. One can see that the TKA without a patellar button had a significantly higher revision rate 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 current 10-year period, 2008-2017 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.

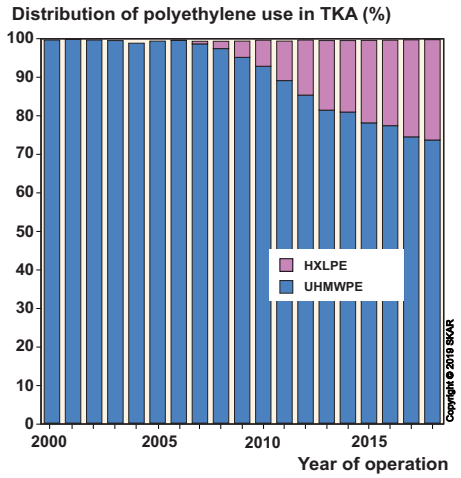
In 2007 the advantage of using a patellar button started to decrease and in 2010 (for surgeries performed 1999-2008) we could not find an advantage of using a button. However, for the current period 2008-2017 (figure left, below) we find the opposite of that observed during 1991-2000; TKA with a patellar button now have a higher risk of revision than TKA without a button (RR x 1.3 (CI 1.1-1.5)).

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 have a secondary one due to patellar pain. So if the femoral components have become more "patellar friendly" or if the surgeons have discovered that patellar additions not always are successful, the number of such secondary patellar resurfacing would decrease improving the results of those without a primary button as compared to those that received one.

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).

94 percent of the implants that used highly crosslinked polyethylene through 2018 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.



Bilden visar den årliga fördelningen mellan den gamla UHMWPE plasten och de nya korslänkade plasttyperna (XLP)

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 that after modifications and increased training of surgeons showed improved results leading to continued use.

Type of operations and implants in 2018

Types of primary arthroplasties

	Number	Percent
Linked	58	0.4
TKA	13,885	90.0
UKA Medial	1,373	8.9
UKA Lateral	52	0.3
Fem-Pat	54	0.3
Partial (PRKA)	8	0.1
Total	15,430	100

In primary knee arthroplasty the TKA is the standard treatment which accounted for 90% of the surgeries in 2017 (table above). The use of UKA increased a little and accounted for good 9% of the cases. The use of femoro-patellar and especially partial implants is still very limited.

72 hospitals performing elective knee arthroplasties reported to the registry during 2018 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 summer, 15,430 primaries had been reported for 2018 which is 3.2% more than at the same time in 2017 (14,957).

Primary TKA implants

	Number	Percent
NexGen MBT	7,002	50.4
PFC-MBT	2,800	20.2
Triathlon	1,705	12.3
PFC-APT	919	6.6
Genesis II	384	2.8
Legion/GenII Prim	355	2.6
NexGen TM	232	1.7
Persona	138	1.0
Attune	46	0.3
Journey	31	0.2
PFC-RP	11	0.1
Other*	262	1.9
Total :	13,885	100

*Mainly revision models (see separate table) except 17 knees for which part numbers are missing

As compared to last year, the number of TKA increased by 1.4%. As last year, 3 TKA brands dominate. NexGen from Zimmer was used in good half of the primaries, PFC from DePuy in 20% and Triathlon from Stryker in 12%. The use of other brands was less and the Vanguard from Biomet was not reported as used at all during 2018. The group "Others" mainly stands for revision models (see table right).

After having diminished for many years the use of UKA has increased again since 2014 and accounted in 2018 for 8% of the primary knee arthroplasties. The Oxford model was used in 70% of the cases, an increase from 66% in 2017.

Primary UKA implants

	Number	Percent
Oxford	997	70.0
Link	146	10.2
ZUK	119	8.4
Triathlon PKR	93	6.5
Sigma PKR	35	2.5
Persona PK	22	1.5
Ibalance	11	0.8
Missing	2	0.1
Total	1,425	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, 51 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	97	39.6
PFC Revision	87	35.5
NexGen Revision	53	21.6
Legion/Genesis II Rev.	8	3.3
Total	245	100

58 linked prostheses not included (27 RotaLink, 22 NexGen RHK and 9 other)

974 revisions were reported in 2018 of which 239 were secondary (not the first revision). In 771 cases the primary was a TKA, in 187 it was an UKA, in 8 cases a Femoro-Patellar implant and in 8 a linked implant.

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 becoming 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 2017.

The most common implants in the counties in 2018

TKA in the counties

	Model 1	n	Model 2	n	Model 3	n	Other
01 Stockholm	NexGen	1,830	PFC Sigma	895	Triathlon	221	99
03 Uppsala	PFC Sigma	457	Other	4	Missing	1	
04 Södermanland	PFC Sigma	234	NexGen	70	Other	8	5
05 Östergötland	NexGen	332	Legion/Genesis II	143	Persona	71	4
06 Jönköping	NexGen	616	Other	1			
07 Kronoberg	PFC Sigma	158	Other	12	NexGen	1	
08 Kalmar	NexGen	550	Other	1			
09 Gotland	PFC Sigma	100	Triathlon	13	Other	2	
10 Blekinge	NexGen	257	Other	1			
12 Skåne	Triathlon	1,470	PFC Sigma	235	NexGen	134	158
13 Halland	NexGen	745	Other	9			
14 Västra Götaland	NexGen	1,242	PFC Sigma	668	Other	26	27
17 Värmland	NexGen	417	Other	1			
18 Örebro	Genesis II	384	NexGen	72	Journey	22	2
19 Västmanland	NexGen	176	Other	3			
20 Dalarna	NexGen	214	PFC Sigma	133	Other	4	
21 Gävleborg	PFC Sigma	450	NexGen	14			
22 Västernorrland	NexGen	286	Other	2			
23 Jämtland	NexGen	163	Other	5			
24 Västerbotten	Legion/Genesis II	211	NexGen	114	Persona	6	5
25 Norrbotten	PFC Sigma	389	Other	10	NexGen	1	1

The table above shows that 11 of 21 reported having used only one ordinary TKA model (revision models not included) while only few counties used 3 models. When "Other" is used instead of an implant name, it generally stands for revision models.

UKA in the counties

	Model 1	n	Model 2	n	Model 3	n	Other
01 Stockholm	Oxford	212	Link	70	Triathlon PKR	63	61
03 Uppsala	Oxford	15	ZUK	3			
04 Södermanland	Oxford	72					
05 Östergötland	Oxford	239	Sigma PKR	7			
06 Jönköping	Oxford	33					
07 Kronoberg	Oxford	90					
08 Kalmar	Link	3					
09 Gotland							
10 Blekinge	Oxford	19					
12 Skåne	Link	40	Oxford	32	Triathlon PKR	16	
13 Halland	ZUK	62	Oxford	24			
14 Västra Götaland	Oxford	93	ZUK	13			
17 Värmland	Oxford	41	Övriga	1			
18 Örebro	ZUK	20					
19 Västmanland	Triathlon PKR	14					
20 Dalarna	Oxford	21					
21 Gävleborg	Link	32					
22 Västernorrland	Oxford	20					
23 Jämtland	Oxford	8					
24 Västerbotten	Persona PK	22	Link	1			
25 Norrbotten	Oxford	78					

In 2018, eight counties reported 50 or more UKA's (Stockholm, Södermans län, Östergötland, Kronoberg, Skåne, Halland,Västra Götaland and Norrboten). Three counties reported between 25 and 50 UKA's, and nine reported from 1 to 24 procedures. Gotland did not report any UKA procedures.

Bone cement and minimally invasive surgery in 2018

Use of cement in primary surgery

	Primary TKA	Primary UKA
No component without cement	12,814	470
Only the femoral component without cement	7	52
Only the tibial component without cement	11	13
The femur- and tibial components without cement	1,014	886
Unknown	39	4
Total	13,885	1,425

	Primary TKA		Primary UKA	
	Number	Percent	Number	Percent
Palacos R+G (gentamicin)	6,312	49.1	301	55.9
Optipac Refobacin	6,037	46.9	191	35.4
Refobacin Bone Cement (genta)	348	2.7	27	5
Smartset GHV gentamycin	122	0.9	12	2.2
Copal (genta+vanco)	14	0.1		
Refobacin Revision Cement (genta+clinda)	5	0	5	0.9
Copal (genta+clinda	2	0		
Unknown	31	0.2	3	0.6
Subtotal	12,871	100	539	100
All components without cement	1,014		886	
Total	13,885		1,425	

Type of bone cement

In Sweden, the use of bone cement is the most common method for fixing components to the bone. Cementless fixation has again become slightly more common. It was used in 7% of the TKA's in 2018 while 0.1% were hybrids. However, in UKA cementless fixation was used in 62% of the cases and as hybrids in 4.6%. The reason is the popularity of the Oxford cementless variant which was used in 95% of the Oxford cases.

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

Since 2007, almost all the hospitals have sent stickers for the cement used, allowing for reliable identification of the cement brands (see table above).

The mixing system may have an effect on the cement quality. Thus, in cases where a separate mixing system (not a part of the cement package) is used we are interested in receiving the part numbers.

Minimally invasive surgery (MIS) in UKA

For UKA, we have registered the use of mini-arthrotomy 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, the popularity of minimally invasive surgery for UKA quickly increased and reached 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 2018, 43% of the UKA were inserted using MIS.

The type of incision for 1,425 primary UKA's

	Standard incision	Mini-incision	Unknown
Oxford	444	552	1
Link	142		4
ZUK	103	16	
Triathlon PKR	58	35	
Sigma PKR	35		
Persona PK	18	4	
Ibalance UKA	5	6	
Missing	2		
Total	807	613	5

When MIS initally started to become popular there were signs that MIS was associated with a higher revision rate, which may have been caused by an initial learning curve. This tendency disappeared and with the present 17-year follow-up, we cannot see that miniarthrotomy negatively affects the overall revision rate.

The use of patella button for TKA in 2018

The use of patellar resurfacing has been decreasing since the mid-eighties so that it is now only used in 2.9% of the TKA cases. During 2018 a button was most commonly used in the counties of Gävlsborg and Västerbotten but not at all in Värmland Västmannland and Jämtland (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 2018, a button was most often used in primary arthroplasty together with the Legion/Genesis II and PFC-MBT.

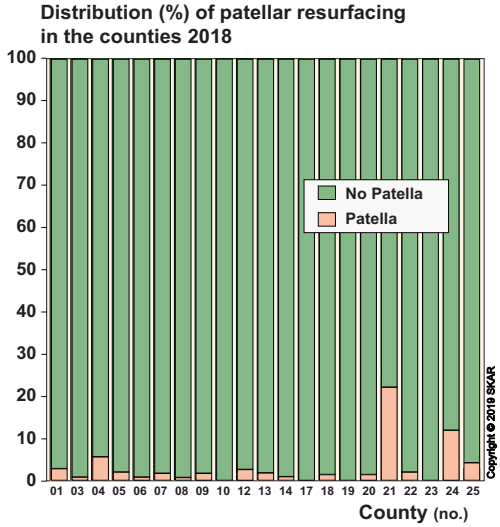
In Sweden, females have their patella resurfaced slightly more often in TKA than males. Thus, in the whole material, from 1975 to the end of 2018, 11.9% of the women had their patella resurfaced compared to 8.6% of the men, which is a significant difference. It has been attempted to explain this difference by femoro-patellar pain being more common in women.

In 2018, 2.1% of the men had a patella button compared to 3.5% of the women which also is a significant difference.

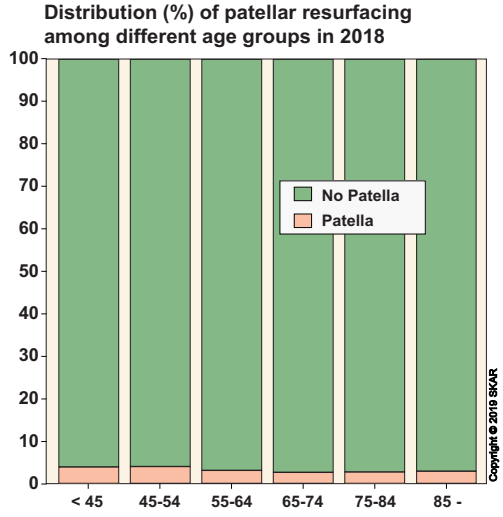
Use of patella button with different TKA implants

	No patella button	%	Patella button	%
NexGen MBT	6,884	98.3	118	1.7
PFC MBT	2,646	94.5	154	5.5
Triathlon	1,662	97.5	43	2.5
PFC-APT	900	97.9	19	2.1
GenesisII	377	98.2	7	1.8
Legion/Genesis II	324	91.3	31	8.7
NexGen TM	223	96.1	9	3.9
Persona	136	98.6	2	1.4
Attune	46	100	0	0.0
Journey	31	100	0	0.0
PFC-RP	11	100	0	0.0
Missing	16	94.1	1	5.9
Other	239	94.5	14	5.5
Total	13,487	97.1	398	2.9

Looking at the relative use of patella button among the different age groups in 2018 (see figure below), it can be seen patellar resurfacing is slightly more common in the youngest age groups. This is less obvious than it was in 2017, but 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 curves can be found showing the CRR during the current period of 2008-2017, for TKA with and without a button respectively.



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).



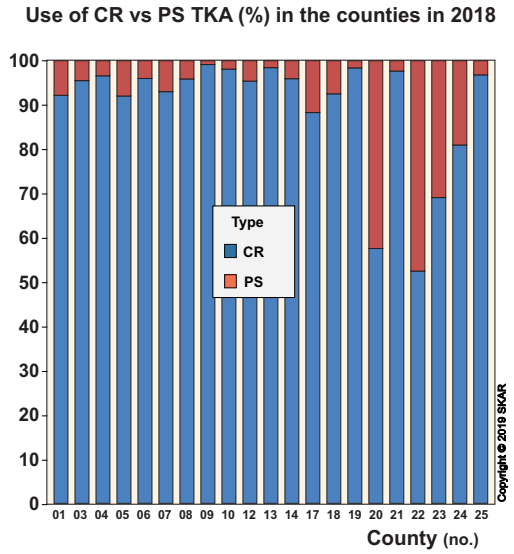
The figure shows the relative proportion of TKA with and without patella button in the different age-groups.

Posterior stabilized prostheses during 2018

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 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. 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.

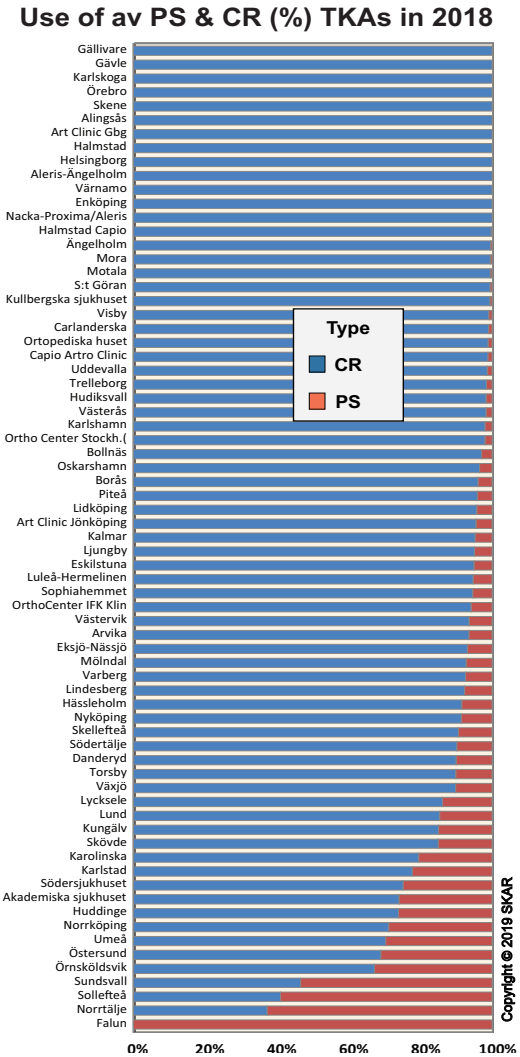


The figure shows the relative use of CR and PS implants in the different counties.

As can be seen from the figure above, the counties are different with respect to their use of PS implants. During 2018, PS implants were most commonly used in 4 counties; Västernorrland, Dalarna, Jämtland and Västerbotten (a list and a chart for the counties can be found on page 20 and a list on page 36).

During 2018, just less than 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 one unit exclusively using PS implants, 3 units using PS for more than 50% of cases and 13 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 4 units that mostly used PS knees was that they almost only used the NexGen MBT implant (see table on next page). However, looking at the whole country, 91% of the NexGen MBT 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 2018

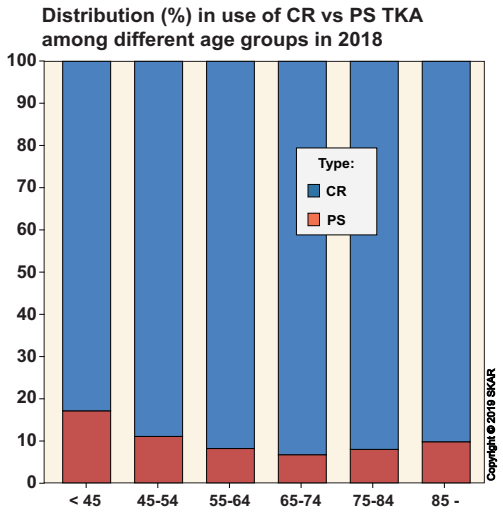
	CR	%	PS	%
NexGen MBT	6,406	91.5	596	8.5
PFC-MBT	2,692	96.4	101	3.6
Triathlon	1,698	99.6	7	0.4
PFC-HPT	919	100.0	0	0.0
Genesis II	372	96.9	12	3.1
Legion/GenII Prim	302	85.1	53	14.9
NexGen TM	138	59.5	94	40.5
Persona	138	100.0	0	0.0
Attune	45	97.8	1	2.2
Journey	9	29.0	22	71.0
PFC-RP	3	27.3	8	72.7
Others	83	30.9	186	69.1
Totalt	12,805	92.2	1,080	7.8

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).

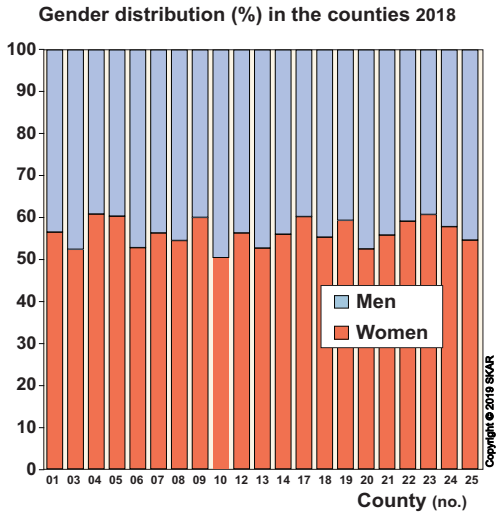
It is probably necessary to perform a randomized trial in order to estimate the differences in survival between the types.



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

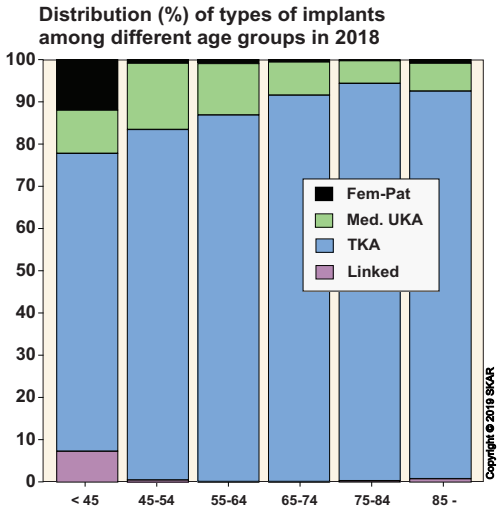
Please note that tibial components that in order to increase stability use an anterior lip or an extra concave polyethylene (deep dish) are not considered being PS implants. Some can be used both with an intact cruciate ligament as well as when the cruciate is insufficient or absent. However, there are 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



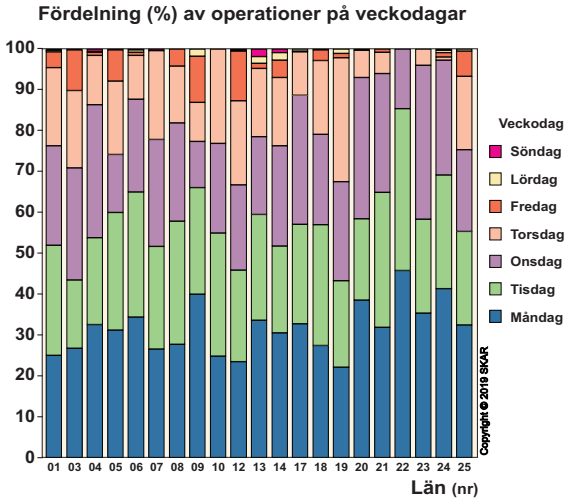
The proportion of females having surgery in the different counties was similar, varying between 50.5% and 59.4% .

Type of implants in different age groups



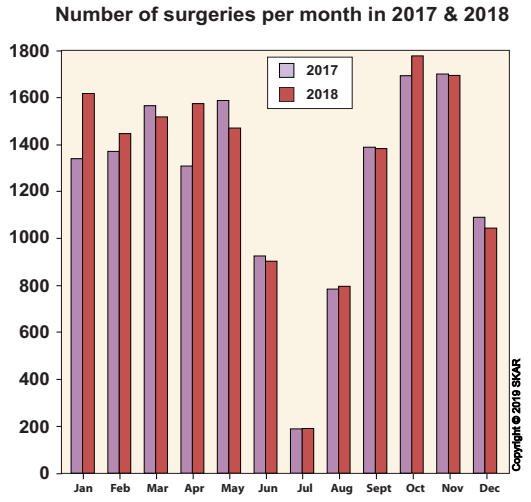
Uncommon models are most often used in younger patients. The use of linked implant in primaries is limited, but these are mainly used for serious conditions (tumors. trauma etc.)

Distribution of primary surgery on weekdays and months



Distribution of surgery on weekdays during 2018. Surgery on Fridays and weekends is uncommon.

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.



The mean number of primary knee arthroplasties inserted each month.

All the counties perform at least 87% of their surgeries Monday to Thursday. Skåne, Gotland and Uppsala are the counties performing the highest proportion of their surgeries on Fridays.

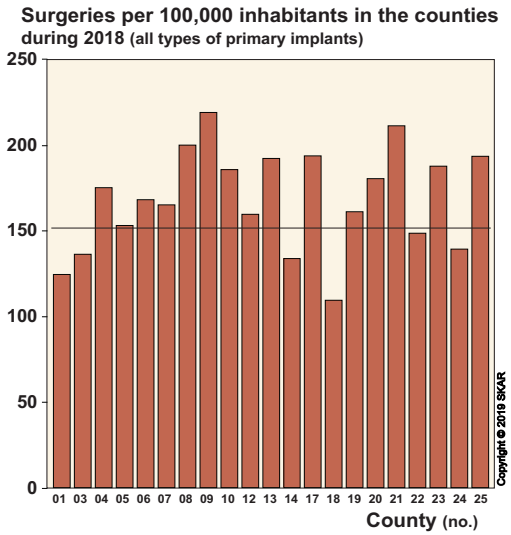
The figure above shows the number of surgeries during the different months of 2017 and 2018. It is evident how the production drops during the summer as around Christmas.

Age distribution and incidence in the counties 2018

County, number of inhabitants and incidence in 2018

Nr	County	No. of inhabitants	no. of primaries	Incidence/ 100.000
01	Stockholm	2,326,134	2,898	124.6
03	Uppsala	372,663	508	136.3
04	Södermanland	293,018	513	175.1
05	Östergötland	459,540	703	153.0
06	Jönköping	359,031	603	168.0
07	Kronoberg	198,703	328	165.1
08	Kalmar	244,103	488	199.9
09	Gotland	58,922	129	218.9
10	Blekinge	159,528	296	185.5
12	Skåne	1,353,427	2,159	159.5
13	Halland	327,089	628	192.0
14	Västra Götaland	1,700,298	2,275	133.8
17	Värmland	280,941	544	193.6
18	Örebro	300,580	329	109.5
19	Västmanland	272,512	439	161.1
20	Dalarna	286,678	517	180.3
21	Gävleborg	286,092	604	211.1
22	Västernorrland	245,711	365	148.5
23	Jämtland	130,043	244	187.6
24	Västerbotten	269,310	375	139.2
25	Norrbotten	250,896	485	193.3
Country		**10,175,214**	**15,430**	**151.6**

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

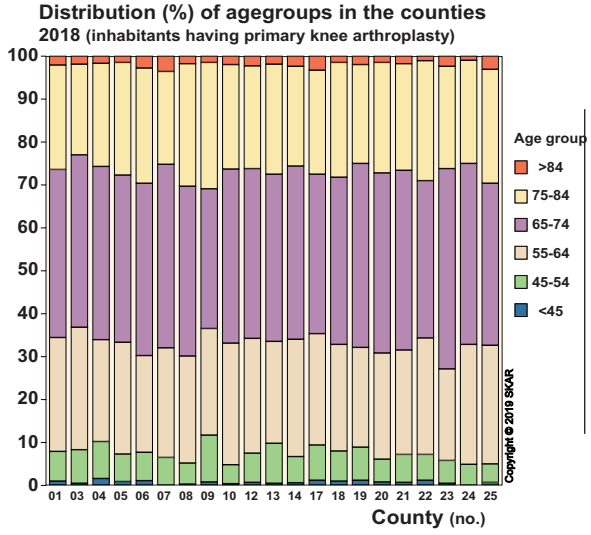


Incidence (no. of arthroplasties per 100.000 inhabitants)

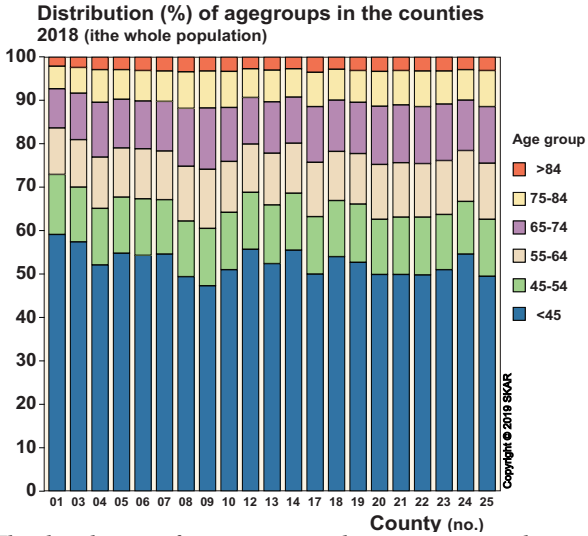
The table and figure above show the number of primary knee arthroplasties per 100,000 inhabitants in each county in 2018. They are based on the domicile of patients at surgery. The incidence (not age-standardized) is highest in Gotland and Gävleborg county and lowest in the county of Örebro.

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 Gotland but lowest in Jämtland. Gotland and Kalmar 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 2018

Distribution (%) of age groups in the counties in 2018 (whole population)

Age group:	0-44	45-54	55-64	65-74	75-84	85-
01 Stockholm	59.1	13.8	10.7	9.0	5.2	2.1
03 Uppsala	57.4	12.6	10.9	10.7	6.0	2.4
04 Södermanland	52.1	13.1	11.8	12.6	7.5	3.0
05 Östergötland	54.8	12.9	11.3	11.2	6.8	2.9
06 Jönköping	54.3	13.0	11.5	11.1	6.9	3.2
07 Kronoberg	54.6	12.6	11.2	11.4	7.0	3.3
08 Kalmar	49.4	12.9	12.6	13.3	8.4	3.5
09 Gotland	47.3	13.2	13.6	14.2	8.5	3.3
10 Blekinge	51.0	13.2	11.8	12.4	8.2	3.4
12 Skåne	55.8	13.1	11.1	10.7	6.6	2.8
13 Halland	52.4	13.5	11.8	11.9	7.3	3.0
14 Västra Götaland	55.5	13.1	11.5	10.7	6.4	2.8
17 Värmland	50.0	13.2	12.5	12.8	7.9	3.5
18 Örebro	54.0	12.9	11.3	11.8	7.1	2.9
19 Västmanland	52.7	13.3	11.7	11.8	7.4	3.1
20 Dalarna	49.9	12.7	12.6	13.5	8.0	3.3
21 Gävleborg	49.9	13.3	12.5	13.3	7.9	3.1
22 Västernorrland	49.8	13.3	12.4	13.1	8.2	3.2
23 Jämtland	51.0	12.7	12.4	13.0	7.6	3.2
24 Västerbotten	54.6	12.1	11.7	11.6	7.1	2.9
25 Norrbotten	49.5	13.1	13.0	13.1	8.3	3.1
Country	54.9	13.2	11.5	11.0	6.6	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 105.6 in Örebro county and highest 183.3 in Gävleborg. In 2017 Örebro also had the lowest incidence while Halland, which this year has the third 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 2018)

Nr	County	Incidence
1	Stockholms län	146.1
3	Uppsala län	144.8
4	Södermanlands län	161.0
5	Östergötlands län	152.1
6	Jönköpings län	164.6
7	Kronobergs län	179.5
8	Kalmar län	169.9
9	Gotlands län	182.1
10	Blekinge län	167.1
12	Skåne län	163.5
13	Hallands län	180.5
14	Västra Götalands län	136.5
17	Värmlands län	171.4
18	Örebro län	105.6
19	Västmanlands län	151.9
20	Dalarnas län	155.2
21	Gävleborgs län	183.3
22	Västernorrlands län	129.7
23	Jämtlands län	164.4
24	Västerbottens län	147.3
25	Norrbottens län	165.6
	Country	151.9

Implants for primary arthroplasty 2008–2017

In the tables below, the implants used during the investigated period 2008-2017 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.

Implants for primary TKA

	Number	Percent
NexGen Metal Backed Tib.	51,900	42.1
NexGen All Poly Tib.	3,323	2.7
NexGen Trabicular Metal	1,740	1.4
NexGen unspecified	1	0.0
Natural	1	0.0
Persona	94	0.1
Vanguard I-Beam modular	8,384	6.8
Vanguard Finned modular	2,053	1.7
Vanguard unspecified	68	0.1
AGC	2,536	2.1
PFC Sigma_MBT	21,497	17.4
PFC Sigma_HPT	11,571	9.4
PFC Rotating Platform	830	0.7
PFC Unspecified	23	0.0
Triathlon MBT	11,872	9.6
Triathlon unspecified	97	0.1
Duracon	1,211	1.0
Profix	1,518	1.2
Genesis II	1,382	1.1
Legion/Genesis II	894	0.7
Journey	158	0.1
Attune	69	0.1
F/S MIII	105	0.1
Link Gemini	68	0.1
Other*	1,843	1.5
Model missing	113	0.1
Total	123,351	100

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

Among the UKA's, 3 models accounted for the majority of surgeries during the period.

Implants for primary UKA

	Number	Percent
Oxford	3,653	52.4
Link	1,457	20.9
ZUK	908	13.0
Triathlon PKR	297	4.3
Genesis	238	3.4
MillerGalante	231	3.3
Sigma PKR	126	1.8
Preservation	25	0.4
Persona PK	20	0.3
Ibalance	15	0.2
Model missing	4	0.1
Total	6,974	100

Implants that are specifically made for use in revision surgery or standard models with extra-long stems (5cm 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
NexGen revision	557	30.2
Triathlon revision	518	28.1
PFC revision	455	24.7
Vanguard revision	123	6.7
Legion/Genesis II rev	62	3.4
Profix revision	51	2.8
Duracon revision	40	2.2
AGC revision	37	2.0
Total	1,843	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	208	34.8
Link Endo RHK	206	34.4
MUTARS Tumor impant	53	8.9
S-ROM Noiles RHK	40	6.7
Stryker/Howmedica RHK	34	5.7
METS	30	5.0
Stanmore	7	1.2
Biomet RHK	6	1.0
Smith&Nephew HK	4	0.7
Other	7	1.2
Model missing	3	0.5
Total	601	100

Femoro-patellar implants are uncommon. Only 460 cases using 7 different brands were reported during the 10 year period.

Femoro-Patellar implants

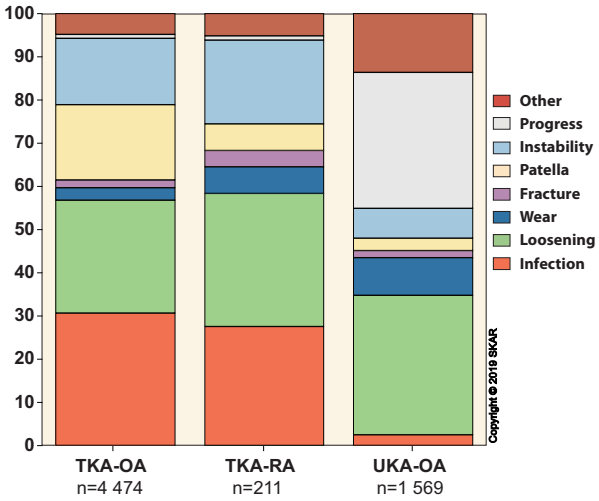
	Number	Percent
Zimmer P-F	302	65,7
PFC P-F	79	17,2
Avon	48	10,4
Link P-F	15	3,3
Journey P-F	6	1,3
Vanguard P-F	6	1,3
LCS P-F	1	0,2
Model misisng	3	0,7
Total	460	100

Revisions during 2008–2017

During the 10-year period, 6,701 first time revisions were performed. In 90 cases the primary was a linked implant, in 4,918 cases a TKA, in 1,616 an UKA, in 75 a P-F implant and in 2 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. Infection and loosening are now equally often the reason for revision of TKAs while loosening 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 2008-2017. 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.

Distribution (%) of indications for revision 2008-2017



For TKA the proportion of revisions in which the poly is exchanged has increased as compared to previously (28% in OA and 24% 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 revisions using a new UKA are few, 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)	428	9.6
TKA	1,222	27.3
Exchange of femur comp.	45	1.0
Exchange of tibia comp.	272	6.1
Exchange of disc/insert	1,250	27.9
Patella addition	773	17.3
Patella removal	9	0.2
Patella exchange	28	0.6
Total implant removal	396	8.9
Arthrodesis	8	0.2
Amputation	36	0.8
Other	4	0.1
Missing	3	0.1
Total	4,474	100

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

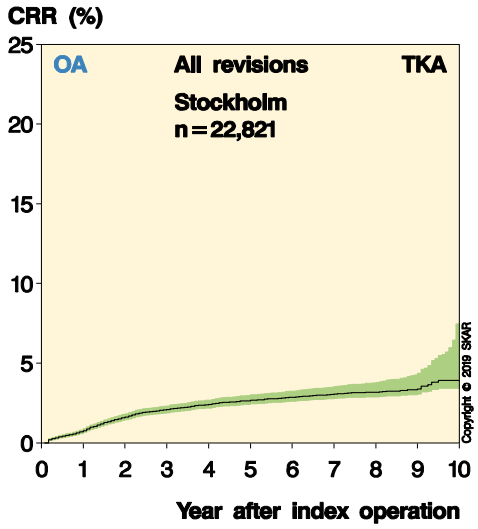
	Number	Percent
Linked (rot. hinge)	31	2.0
TKA	1,419	90.4
UKA	2	0.1
Exchange of femur comp.	5	0.3
Exchange of tibia comp.	9	0.6
Exchange/reposition of poly	78	5.0
Patella addition	4	0.3
Total implant removal	18	1.1
Amputation	2	0.1
Missing	1	0.1
Total	1,569	100

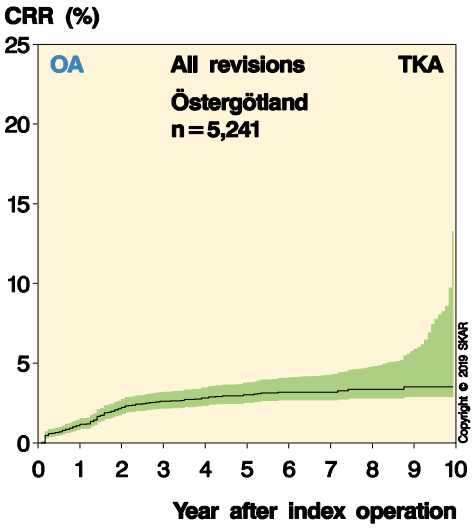
Type of revision in which the primary was a TKA/RA

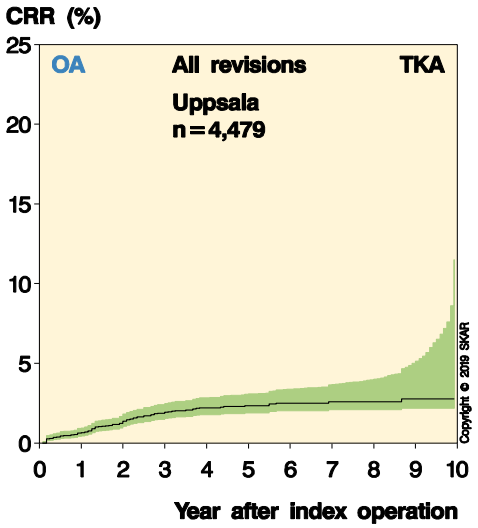
	Number	Percent
Linked (rot. hinge)	44	20.9
TKA	61	28.9
Exchange of femur comp.	5	2.4
Exchange of tibia comp.	7	3.3
Exchange of disc/insert	51	24.2
Patella addition	16	7.6
Total implant removal	19	9.0
Arthrodesis	1	0.5
Amputation	6	2.8
Missing	1	0.5
Total	211	100

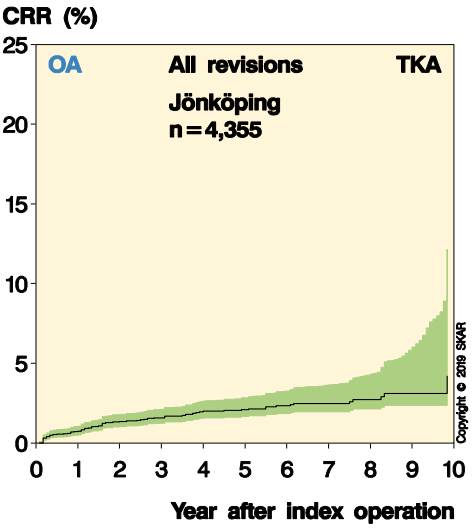
When evaluating the survival curves it should be noted that as the part of the curve to the right contains implants with long follow-up it also to a larger extent reflects older models.

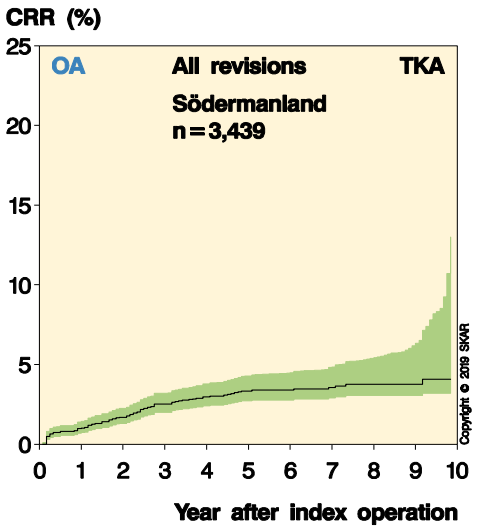
CRR in the counties after primary TKA for OA 2008–2017

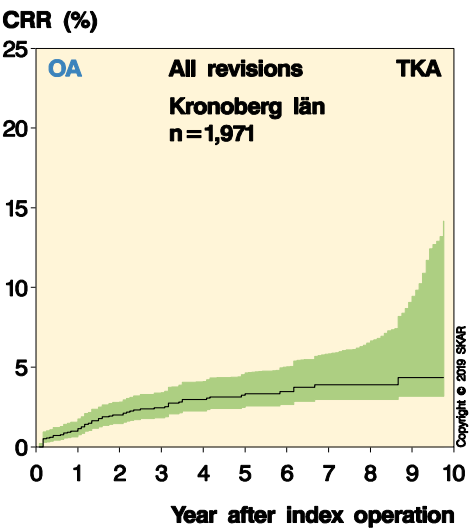




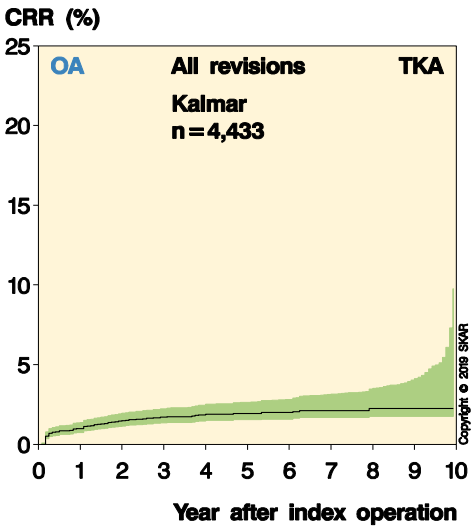


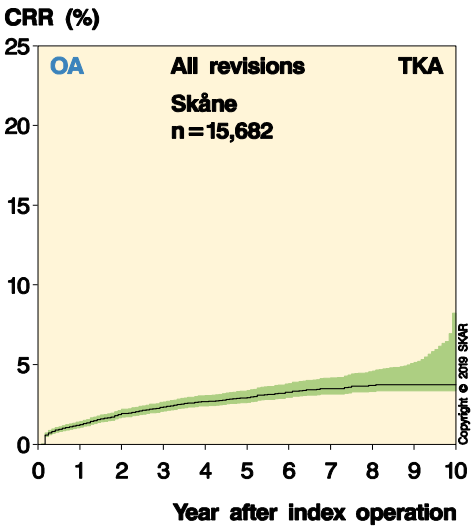


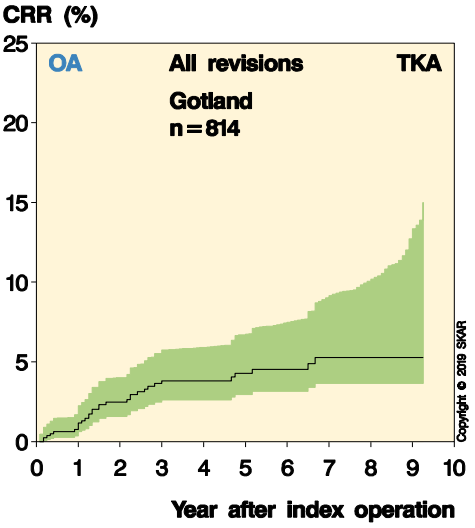


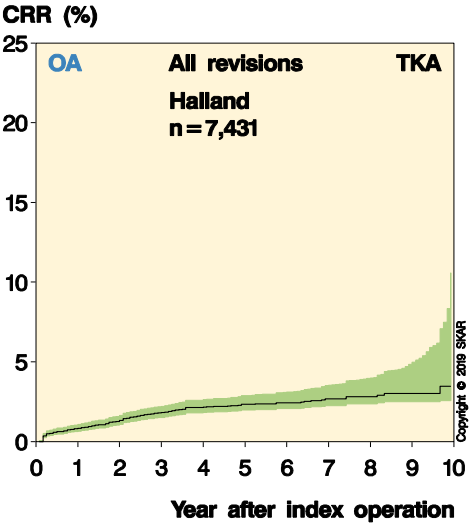


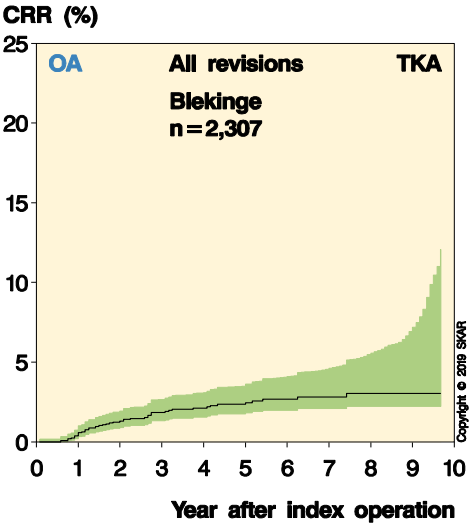
The curves are cut when less than 40 patients are left "at risk"

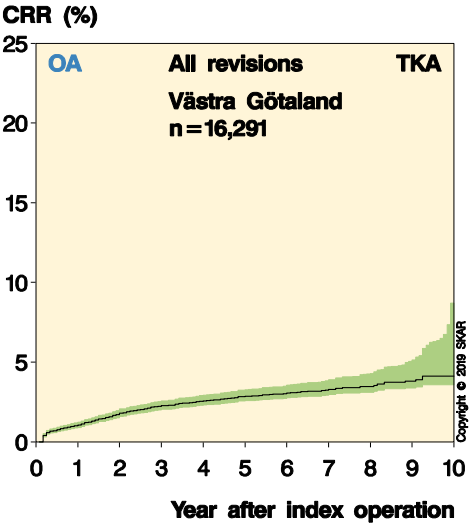






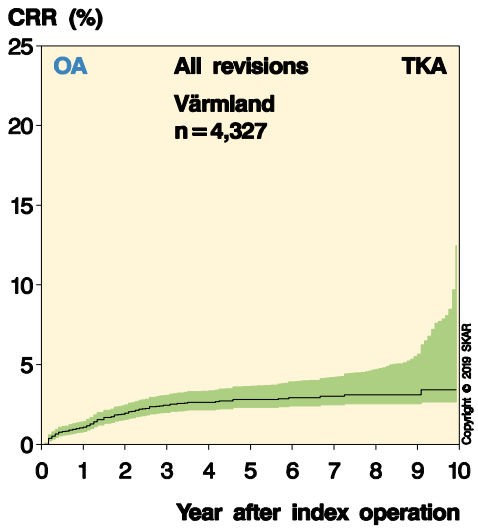


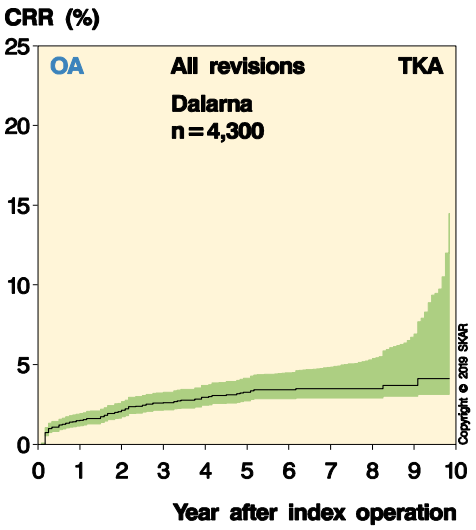


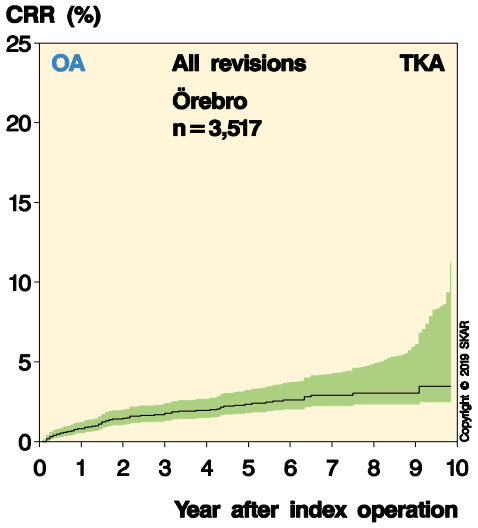


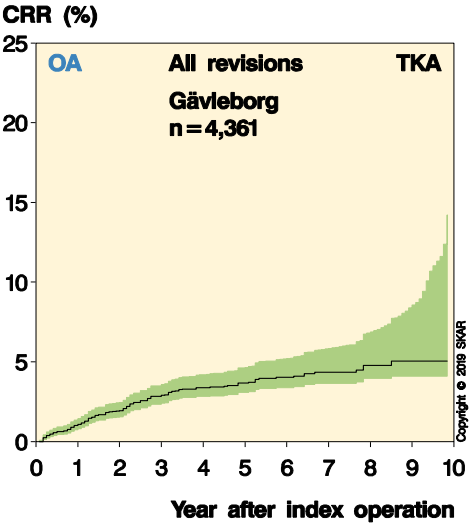
The curves are cut when less than 40 patients are left "at risk"

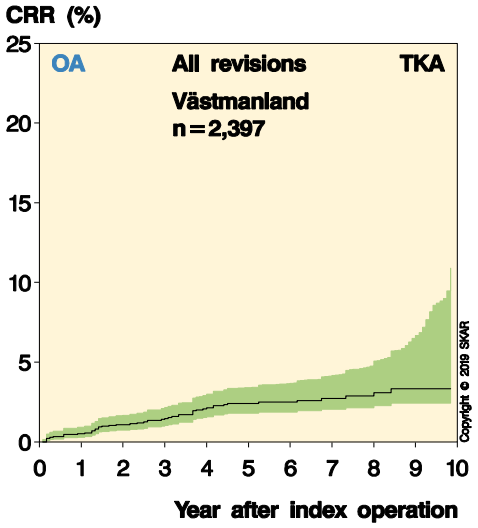
CRR in the counties after primary TKA for OA 2008–2017

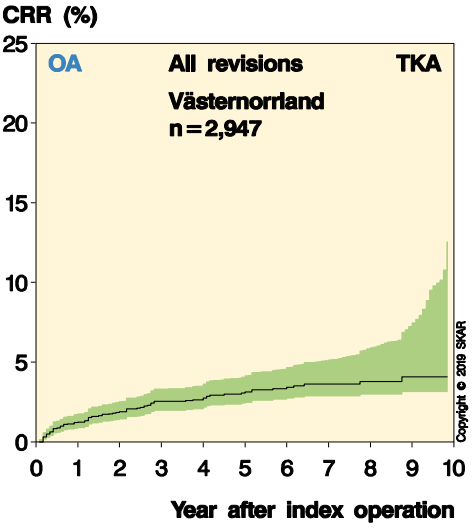




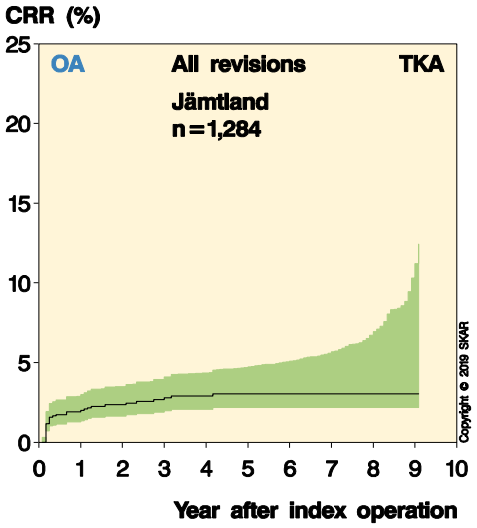


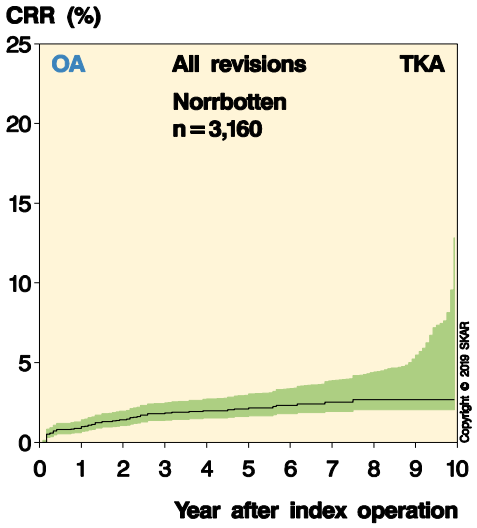


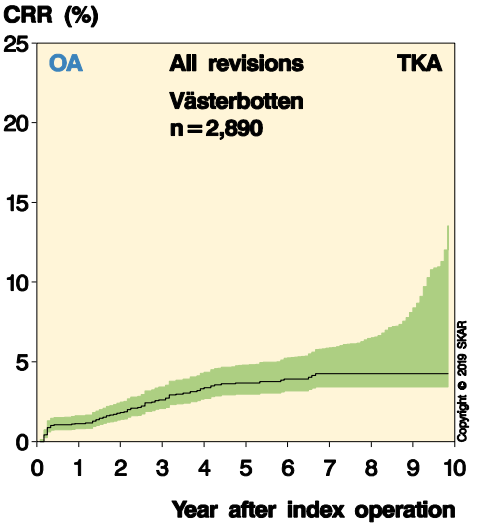




The curves are cut when less than 40 patients are left "at risk"

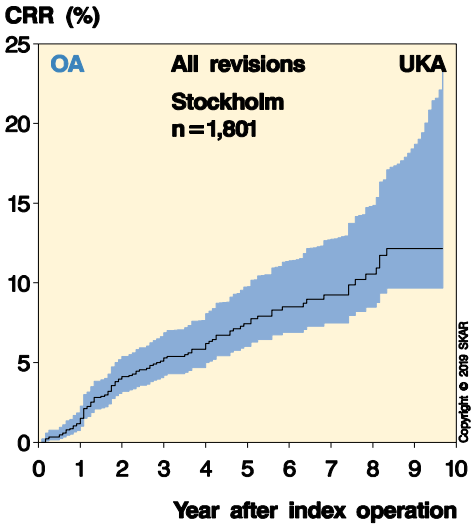


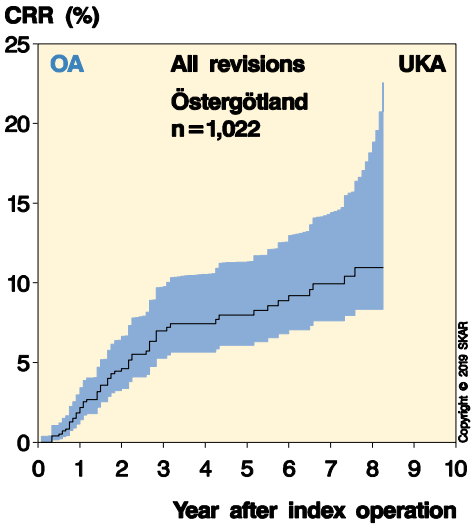


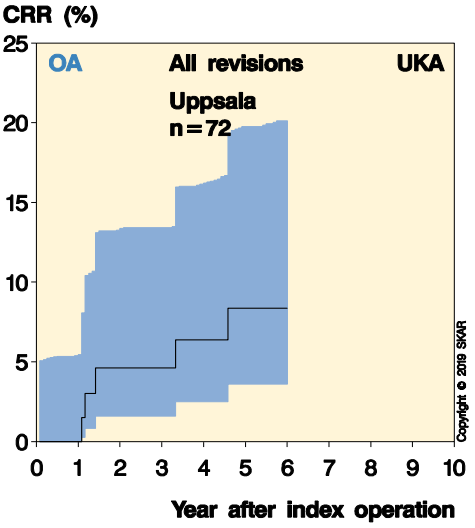


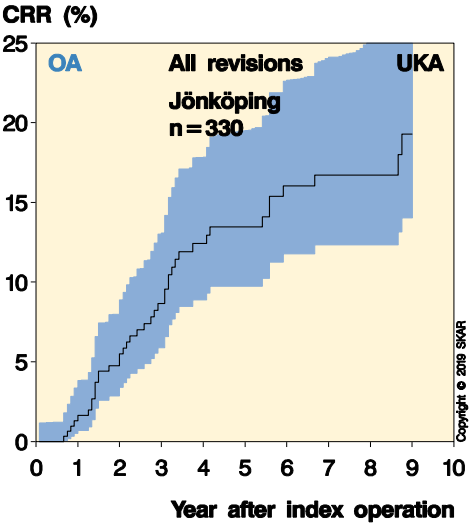
The curves are cut when less than 40 patients are left "at risk"

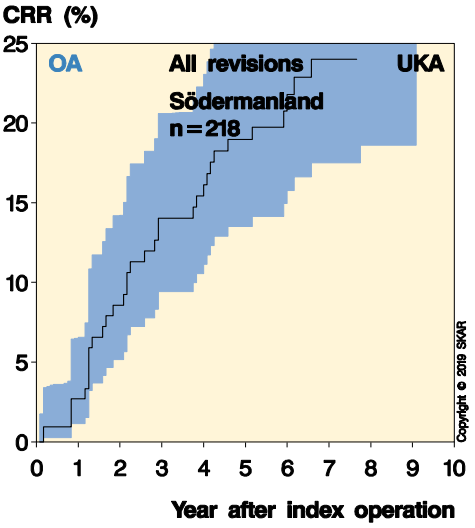
CRR in the counties after primary UKA for OA 2008–2017

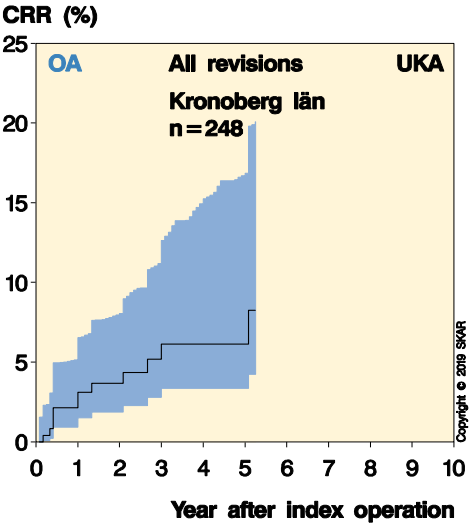




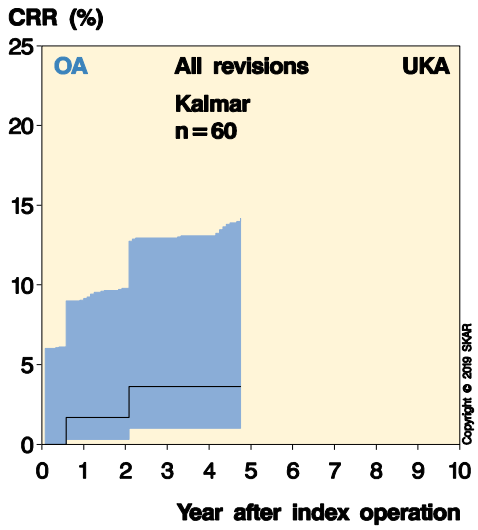


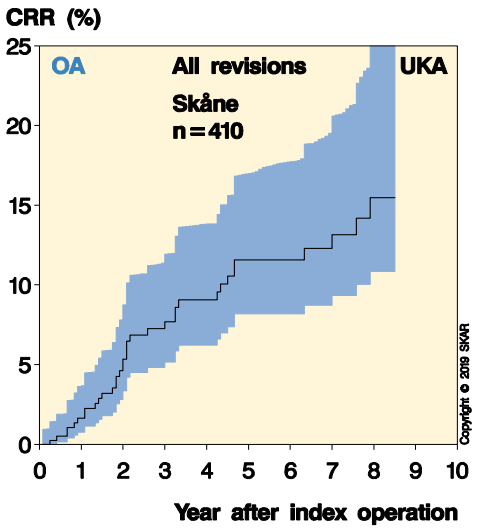


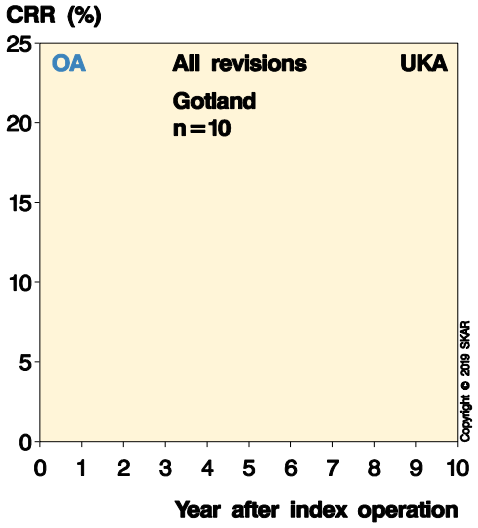


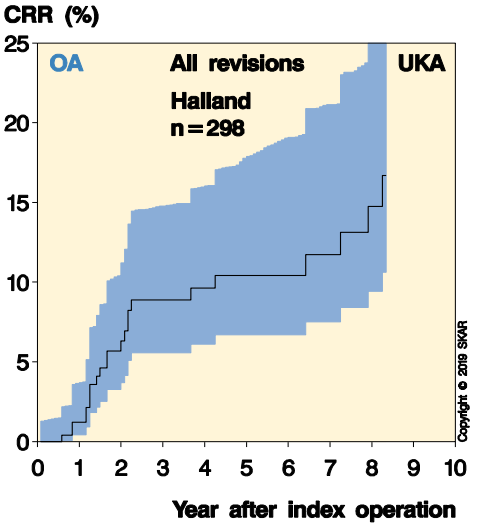


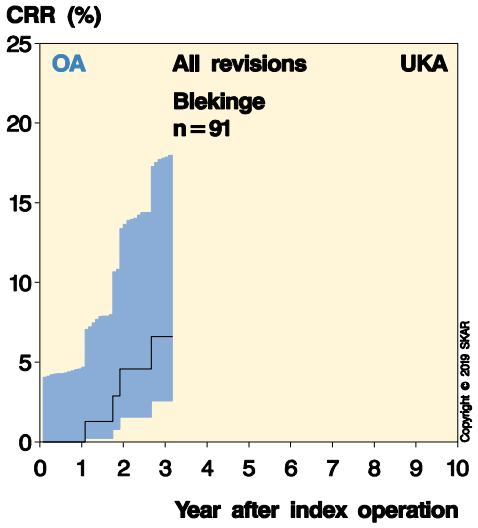
The curves are cut when less than 40 patients are left "at risk"

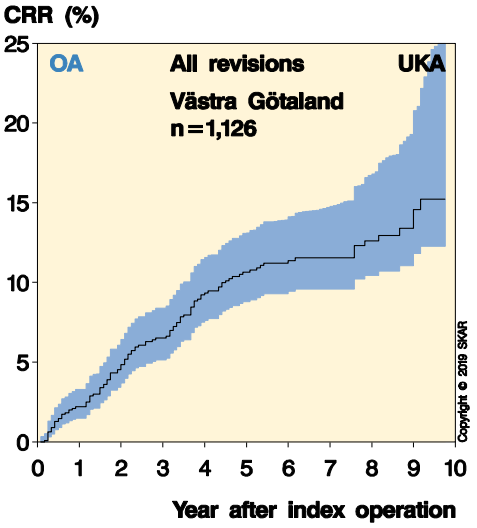






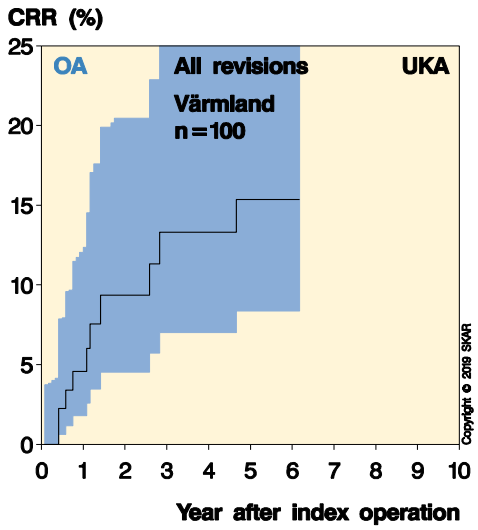


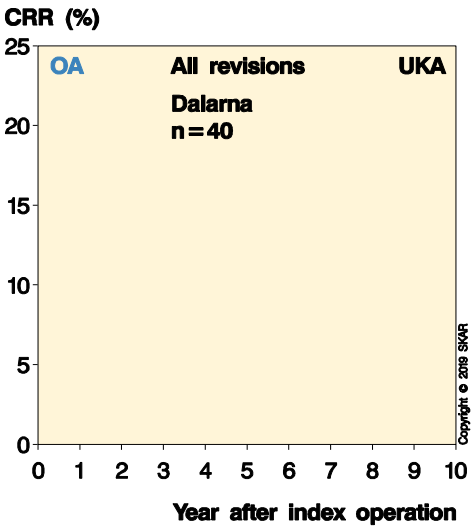


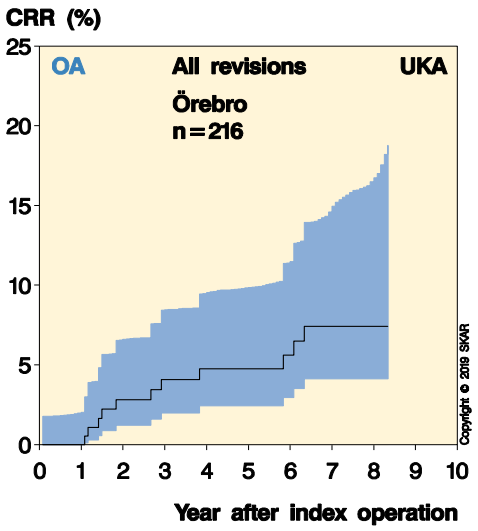


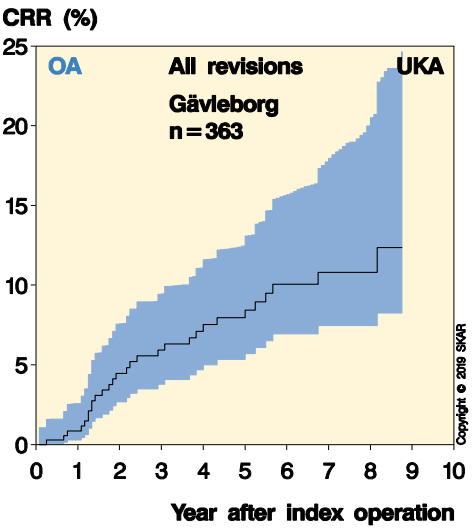
The curves are cut when less than 40 patients are left "at risk"

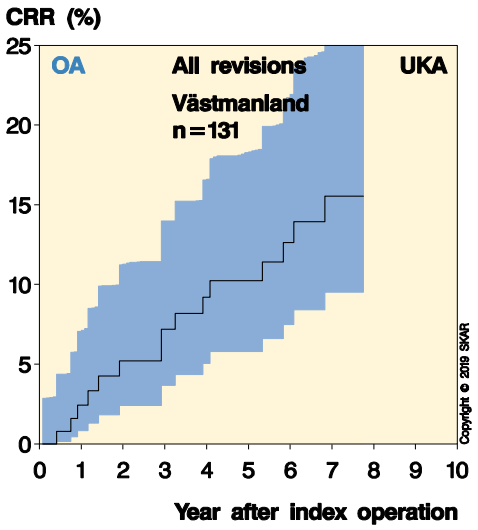
CRR in the counties after primary UKA for OA 2008–2017

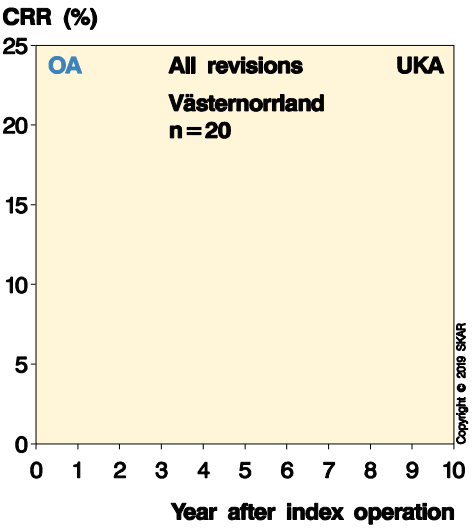




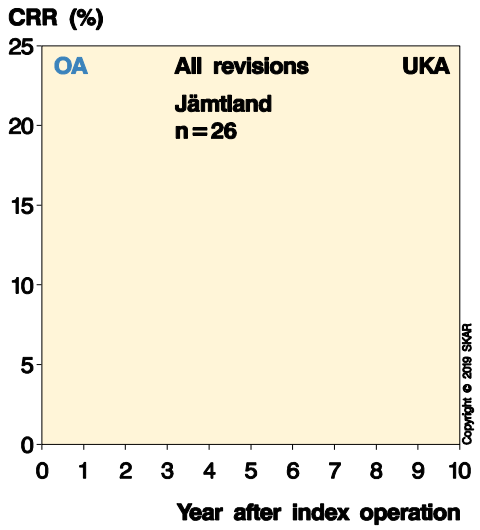


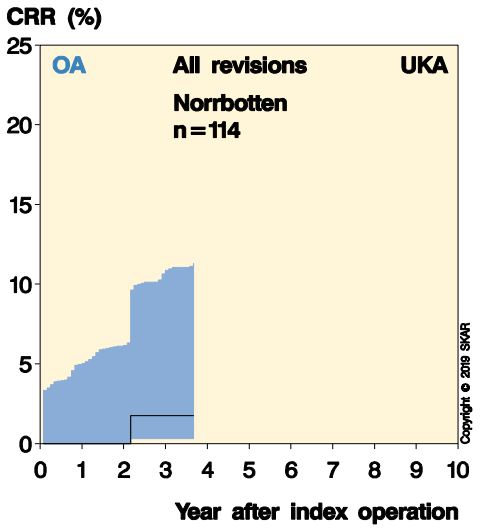


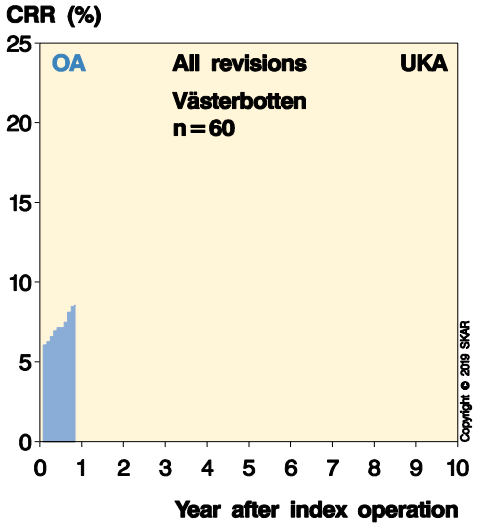




The curves are cut when less than 40 patients are left "at risk"







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

The relative risk for implants used in primary arthroplasty during 2008–2017

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), this year it are the F/S MIII, Genesis II/Legion, Journey, PFC RP and the combination of "Other" models that have significantly higher risk than the reference PFC-MBT. The F/S MIII was used in Sweden from 1989 until 2008. 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 11 inserted in 2018. 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 MBT and NexGen TM as well as the PFC-Sigma MBT 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. Last year we found the Finned version to have significantly higher risk than the PFC-MBT reference while this year, the difference was not

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	20,661		ref.	
AGC Anat	2,456	0.55	1.07	0.85-1.35
Duracon	1,162	0.25	1.20	0.88-1.62
F/S MIII	102	0.04	2.12	1.05-4.28
GenesisII	1,343	0.20	0.74	0.47-1.17
Genesis II/Legion	856	0.04	1.61	1.02-2.56
Journey	153	0.01	2.37	1.23-4.58
NexGen MBT	50,102	0.01	0.87	0.78-0.96
NexGen APT	3,254	0.21	0.86	0.69-1.08
NexGen TM	1,605	0.03	0.70	0.51-0.97
PFC RP	773	<0.01	1.81	1.37-2.40
PFC-Sigma HPT	11,246	<0.01	0.70	0.60-0.82
Profix	1,445	0.75	1.05	0.78-1.42
Triathlon MBT	11,460	0.88	1.01	0.88-1.17
Vanguard I-Beam	8,071	0.46	1.06	0.91-1.23
Vanguard Finned	1,966	0.07	1.29	0.98-1.70
Other	1,792	<0.01	1.77	1.38-2.25
Gender (male is ref.)		<0.01	0.88	0.82-0.95
Age (per year)		<0.01	0.98	0.97-0.98
Year of op. (per year)		0.16	1.01	1.00-1.03

OA / UKA	n	p–value	RR	95% CI
Link	1,428		ref.	
Oxford	3,559	0.93	1.01	0.81-1.25
MillerGalante	220	0.77	1.06	0.72-1.55
Genesis	234	0.06	1.40	0.98-2.00
Sigma PKR	120	0.40	0.65	0.24-1.76
ZUK	851	0.96	1.01	0.75-1.35
Triathlon PKR	283	0.11	1.43	0.92-2.22
Other	61	0.47	1.36	0.60-3.08
Gender (male is ref.)		0.83	1.02	0.86-1.21
Age (per year)		<0.01	0.97	0.96-0.98
Year of op. (per year)		0,07	0,96	0,93-1,00

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	20,097		ref.	
AGC Anat	2,026	0.13	1.21	0.94-1.54
Duracon	979	0.56	1.11	0.78-1.57
F/S MIII	98	0.07	2.01	0.95-4.26
GenesisII	1,325	0.13	0.69	0.42-1.12
Genesis II/Legion	810	0.04	1.65	1.03-2.65
Journey	148	<0.01	2.52	1.30-4.88
NexGen MBT	49,384	0.03	0.89	0.80-0.99
NexGen APT	3,189	0.38	0.90	0.72-1.14
NexGen TM	1,551	0.06	0.73	0.53-1.02
PFC RP	608	<0.01	1.80	1.31-2.47
PFC-Sigma HPT	10,786	<0.01	0.72	0.61-0.84
Profix	1,312	0.59	1.09	0.80-1.49
Triathlon MBT	11,261	0.52	1.05	0.91-1.21
Vanguard I-Beam	7,637	0.07	1.15	0.99-1.34
Vanguard Finned	1,925	0.06	1.31	0.99-1.73
Other	1,729	<0.01	1.84	1.43-2.35
Gender (male is ref.)		<0.01	0.9	0.83-0.97
Age (per year)		<0.01	0.98	0.97-0.98
Year of op. (per year)		0.13	1.01	1.00-1.03

With patella button OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	564		ref.	
AGC Anat	430	<0.01	0.21	0.10-0.46
Duracon	183	0.23	0.62	0.29-1.34
F/S MIII	4	0.35	2.63	0.34-20.10
GenesisII	18	0.16	2.80	0.66-11.87
Genesis II/Legion	46	0.99	1.01	0.13-7.62
Journey	*5*	*0.98*	.	.
NexGen MBT	718	0.08	0.61	0.36-1.05
NexGen APT	65	0.08	0.16	0.02-1.22
NexGen TM	54	0.18	0.25	0.03-1.90
PFC RP	165	0.18	0.61	0.30-1.25
PFC-Sigma HPT	460	0.02	0.42	0.20-0.86
Profix	133	0.08	0.39	0.13-1.12
Triathlon MBT	199	0.02	0.27	0.09-0.78
Vanguard I-Beam	434	<0.01	0.06	0.01-0.25
Vanguard Finned	41	0.90	0.91	0.22-3.85
Other	63	0.41	0.55	0.13-2.30
Gender (male is ref.)		<0.01	0.56	0.39-0.81
Age (per year)		<0.01	0.97	0.95-0.99
Year of op. (per year)		0.17	0.94	0.86-1.03

Implants lacking sufficient numbers for analysis are shown in italics

significant. As it seems that the use of the Vanguard implant has halted in Sweden (no primary reported in 2018) this is probably mainly of historical interest.

Women had a reduced 10-year risk of revision (all types) as compared to men. This may be explained by the higher risk that men have being revised for infection, which often is an early postoperative complication. As last year, the risk of revision decreases with increasing age while we no longer can see significant effect with increase in the year of surgery. The reason for the latter may be that the number of insert exchanges in manifest or suspected infections, which increased in the start of the millennium, has reached a steady state, On the next page we have performed the same analysis but without considering such insert exchanges being revisions.

With respect to UKA inserted for OA (table on the previous page) 2 models, Oxford and Link, account for74% of the surgeries. None of the UKA models had a significantly different risk as compared to the reference model Endo-Link. The risk diminishes with increasing age of patients at surgery while there is no significant effeect with inreasing 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 PFC-Sigma APT and the NexGen MBT that have significantly lower risk of revision than the reference as when all TKA's are analyzed (table on the previous page). Those implants having significantly higher risk are also the same with the exemption of F/S MIII which only includes few cases as it has not been used since 2008.

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, Vanguard I-Beam and the Triathlon have a lower risk than the reference when used together with a button.

The relative risk for implants used in primary arthroplasty during 2008–2017 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 synovectomy is not considered possible without removal of the insert. This could result in a reversed bias if the exchanges 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. It has to be observed that such exclusion reduces the number of revisions, which in turn reduces the sensitivity of the statistical calculations. During the 10-year period this lead to exclusion of 865 TKA and 13 UKA revisions. However, any later revisions of these knees will count instead.

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 and the Vanguard I-Beam. 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 PFC APT and NexGen TM are no longer 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	20,661		ref.	
AGC Anat	2,456	<0.01	1.44	1.14-1.84
Duracon	1,162	0.06	1.38	0.99-1.92
F/S MIII	102	<0.01	2.81	1.39-5.70
GenesisII	1,343	0.24	0.70	0.38-1.28
Genesis II/Legion	856	<0.01	2.24	1.31-3.85
Journey	153	<0.01	3.39	1.75-6.56
NexGen MBT	50,102	0.11	0.90	0.80-1.02
NexGen APT	3,254	0.17	1.18	0.93-1.50
NexGen TM	1,605	0.17	0.79	0.56-1.11
PFC RP	773	<0.01	2.03	1.51-2.74
PFC-Sigma HPT	11,246	0.91	0.99	0.83-1.17
Profix	1,445	0.16	1.26	0.91-1.75
Triathlon MBT	11,460	0.91	1.01	0.85-1.20
Vanguard I-Beam	8,071	0.04	1.19	1.01-1.42
Vanguard Finned	1,966	0.07	1.36	0.98-1.89
Other	1,792	<0.01	1.59	1.18-2.16
Gender (male is ref.)		0.04	1.09	1.01-1.19
Age (per year)		<0.01	0.96	0.96-0.97
Year of op. (per year)		0.67	1.00	0.98-1.02

OA / UKA	n	p–value	RR	95% CI
Link	1,428		ref.	
Oxford	3,559	0.92	0.99	0.80-1.23
MillerGalante	220	0.81	1.05	0.72-1.53
Genesis	234	0.07	1.39	0.98-1.99
Sigma PKR	120	0.42	0.66	0.24-1.80
ZUK	851	0.94	1.01	0.76-1.36
Triathlon PKR	283	0.10	1.44	0.93-2.24
Other	61	0.46	1.36	0.60-3.08
Gender (male is ref.)		0.70	1.03	0.87-1.23
Age (per year)		<0.01	0.97	0.96-0.98
Year of op. (per year)		0.05	0.96	0.92-1.00

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	20,097		ref.	
AGC Anat	2,026	<0.01	1.63	1.26-2.10
Duracon	979	0.24	1.25	0.86-1.83
F/S MIII	98	0.01	2.69	1.27-5.70
GenesisII	1,325	0.20	0.66	0.35-1.24
Genesis II/Legion	810	<0.01	2.43	1.41-4.16
Journey	148	<0.01	3.58	1.85-6.95
NexGen MBT	49,384	0.19	0.92	0.81-1.04
NexGen APT	3,189	0.08	1.23	0.97-1.57
NexGen TM	1,551	0.24	0.81	0.58-1.15
PFC RP	608	<0.01	1.98	1.41-2.79
PFC-Sigma HPT	10,786	0.92	1.01	0.85-1.20
Profix	1,312	0.10	1.33	0.95-1.86
Triathlon MBT	11,261	0.58	1.05	0.88-1.25
Vanguard I-Beam	7,637	<0.01	1.29	1.09-1.54
Vanguard Finned	1,925	0.08	1.36	0.97-1.90
Other	1,729	<0.01	1.62	1.19-2.22
Gender (male is ref.)		0.02	1.11	1.02-1.21
Age (per year)		<0.01	0.96	0.96-0.97
Year of op. (per year)		0.61	1.01	0.98-1.03

With patella button OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	564		ref.	
AGC Anat	430	<0.01	0.30	0.13-0.70
Duracon	183	0.63	0.81	0.35-1.89
F/S MIII	4	0.25	3.36	0.43-26.27
GenesisII	18	0.43	2.24	0.30-16.93
Legion/Genesis Prim	*46*	*0.98*	.	.
Journey	*5*	*0.99*	.	.
NexGen MBT	718	0.56	0.83	0.45-1.53
NexGen APT	65	0.15	0.23	0.03-1.74
NexGen TM	54	0.30	0.34	0.05-2.62
PFC RP	165	0.60	0.81	0.37-1.77
PFC-Sigma HPT	460	0.21	0.62	0.29-1.32
Profix	133	0.17	0.42	0.12-1.44
Triathlon MBT	199	0.03	0.20	0.05-0.86
Vanguard I-Beam	434	<0.01	0.09	0.02-0.37
Vanguard Finned	41	0.65	1.40	0.32-6.09
Other	63	0.80	0.83	0.19-3.59
Gender (male is ref.)		0.07	0.69	0.46-1.03
Age (per year)		<0.01	0.96	0.94-0.98
Year of op. (per year)		0.27	0.94	0.85-1.05

Implants lacking sufficient numbers for analysis are shown in italics

In case of UKA (table previous page right), there were only 13 exchanges of inserts during the 10-year period for manifest or suspected infection (of which 8 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 that were inserted without, respective with, a patellar button.

When the table above left (without a patella button) is compared to the the table when all the TKA's were included (table on the previous page to the left), we find no difference in what implants have a significantly higher revision rate than the reference PFC MBT and there are still no implants with a significantly lower risk.

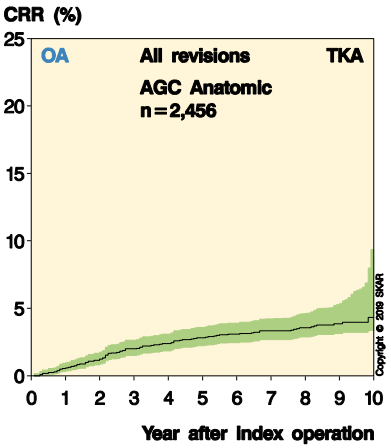
As compared to the table on page 49 in which change of inserts for infection were considered revisions the difference is that the NexGen MBT and the PFC-Sigma APT are no longer better than the reference while the AGC, F/S MII and Vanguard I-beam have become significantly inferior.

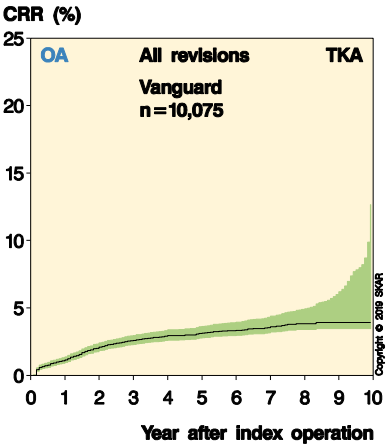
The table above concerns TKA's in which a patellar button was used. When this table is compared to the same table on page 49 the difference is that the PFC APT a no longer has significantly lower risk than the reference PFC MBT.

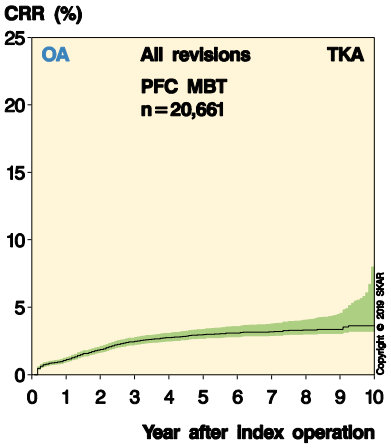
However, as has been mentioned, the number of TKA implants with patellar button is small making it difficult to show and even interpret significant differences.

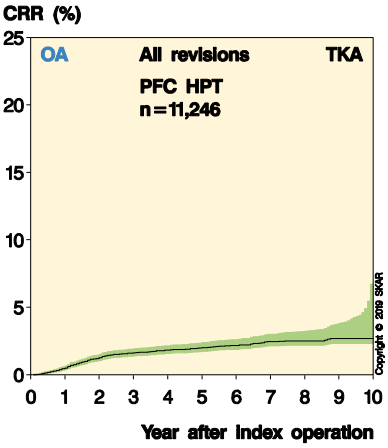
In summary one can establish that excluding an exchange of insert in infected cases does affect the results and that the effect negatively affects non-modular implants as compared to modular ones. One explanation may be that a number of debridement's without exchange of inserts in non-modular TKA's have 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.

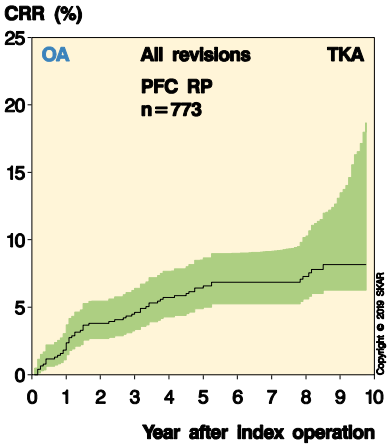
CRR for commonly used TKA implants for OA 2008–2017

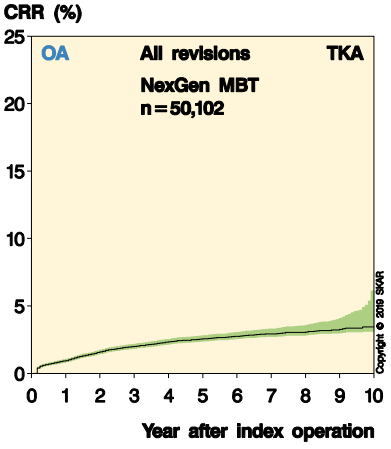


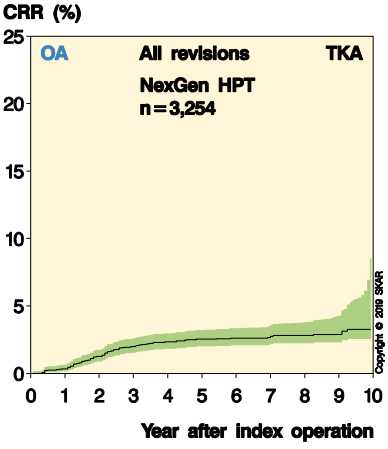


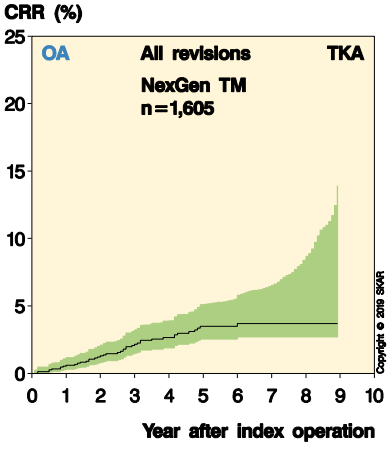


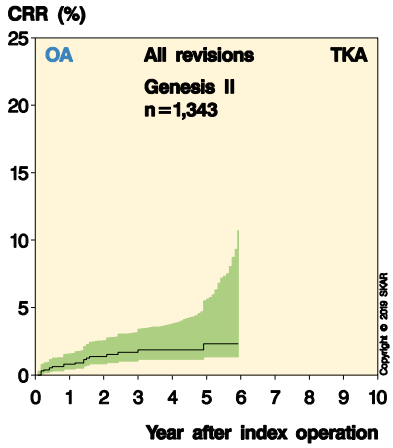











CRR (%)
OA
All revisions
TKA
Genesis II
n=1,343
Year after index operation
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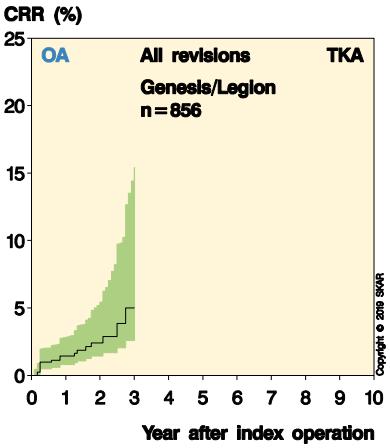
CRR (%)
OA
All revisions
TKA
Genesis/Legion
n=856
Year after index operation
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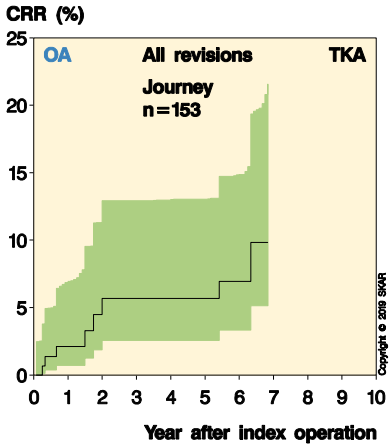
CRR (%)
OA
All revisions
TKA
Journey
n=153
Year after index operation
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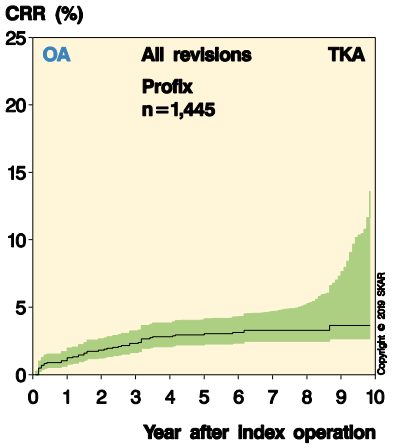
CRR (%)
OA
All revisions
TKA
Profix
n=1,445
Year after index operation
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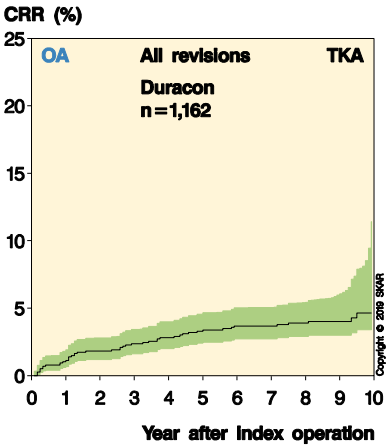
CRR (%)
OA
All revisions
TKA
Duracon
n=1,162
Year after index operation
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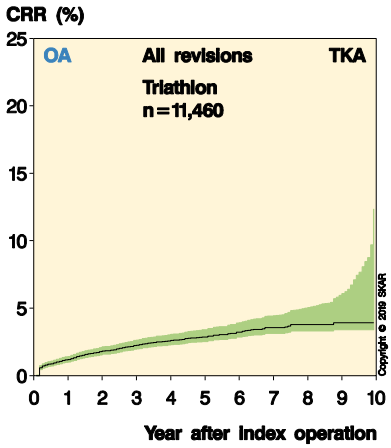
CRR (%)
OA
All revisions
TKA
Triathlon
n=11,460
Year after index operation
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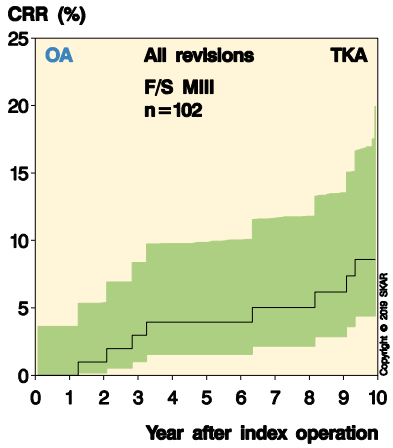
CRR (%)
OA
All revisions
TKA
F/S MIII
n=102
Year after index operation
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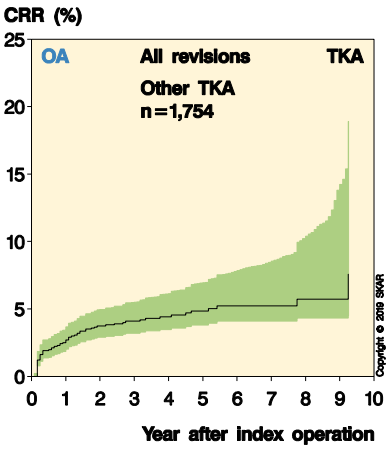
CRR (%)
OA
All revisions
TKA
Other TKA
n=1,754
Year after index operation
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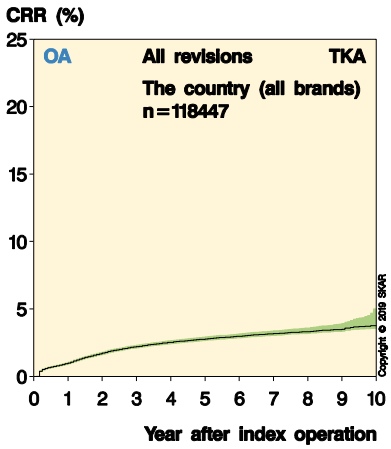
CRR (%)
OA
All revisions
TKA
The country (all brands)
n=118447
Year after index operation
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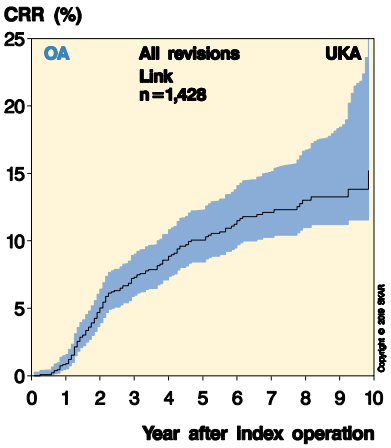
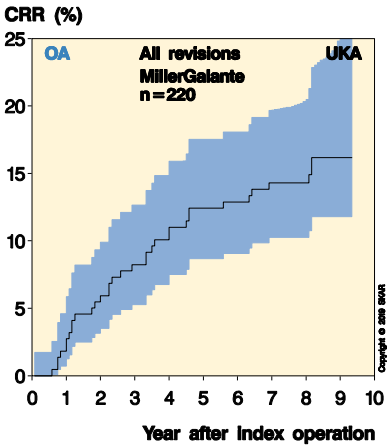
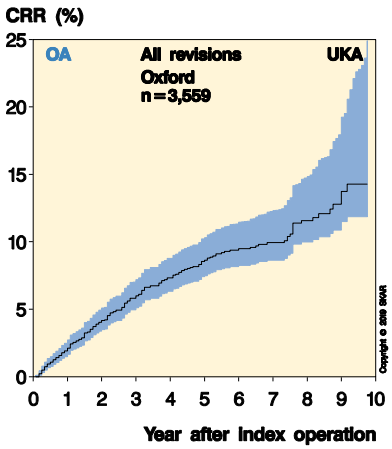
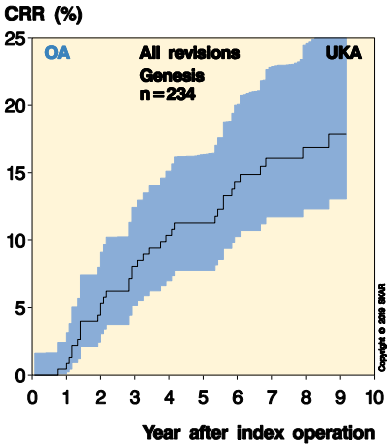
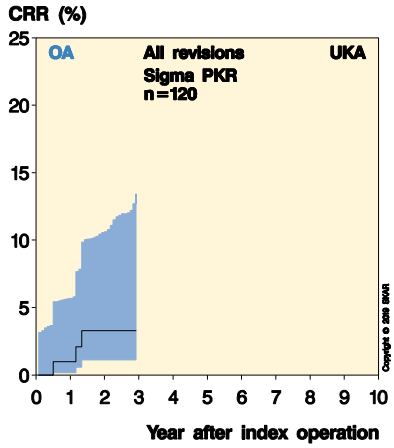
CRR for commonly used UKA implants for OA 2008–2017

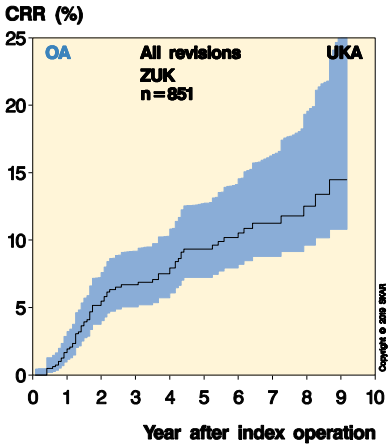


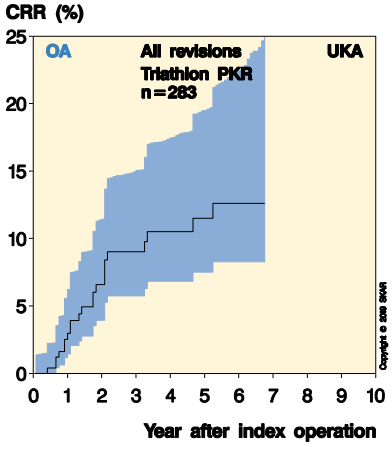


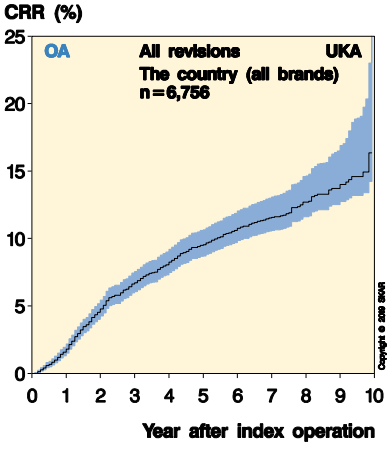












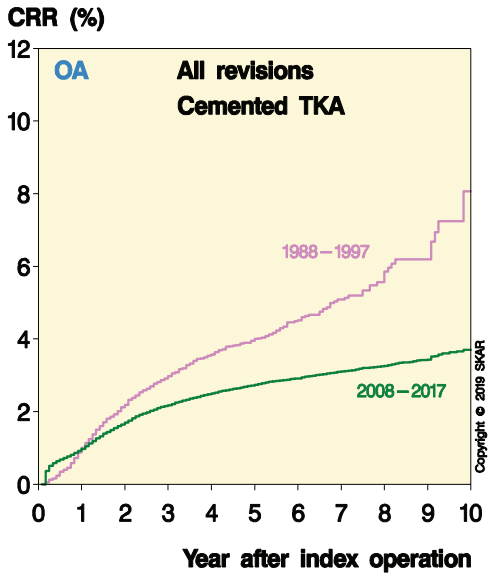
Changes in risk of revision over time (TKA for OA)

The figure below shows the overall risk of revision for the current 10-year period, 2008-2017, as compared to the period 1988-1997. It can be observed that the risk for the current period is considerably lower than for the earlier period.

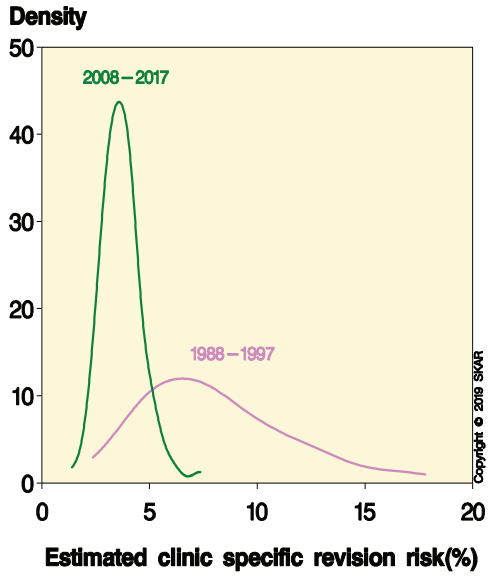
When the absolute specific risk of revision for the units is plotted for both periods (figure below left), it can be seen that the risk has become lower and the distribution has diminished. This implies that the results have improved overall and at the same time the results for the different units have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

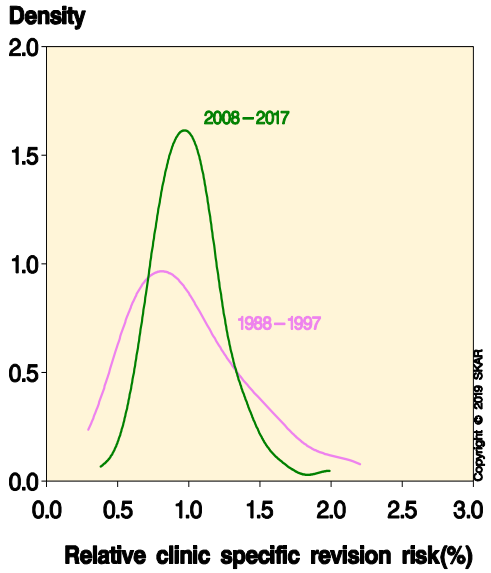
The register is requested to account for hospital specific results which can be found on the next pages. This year, there were 8 hospitals having significantly better results than the average hospital and 9 with inferior results. One can only speculate on the causes for these differences. An unfortunate 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 1988–1997 and 2008–2017 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 1988-1997 and 2008–2017 (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 1988–1997 and 2008–2017 (x-axis = relative risk).

Relative risk of revision for hospitals 2008–2017 (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	1,888	13	0.40	0.27-0.60	1	1-5
11015	Nacka-Proxima	1,239	12	0.56	0.37-0.84	2	1-24
10010	Sabbatsberg (Aleris)	711	8	0.59	0.37-0.93	3	1-34
11002	Huddinge	1,184	16	0.64	0.43-0.93	4	2-34
25011	Oskarshamn	2,614	39	0.67	0.50-0.88	5	2-29
50480	Carlanderska	1,165	16	0.67	0.46-0.98	6	2-39
12481	Elisabethsjukhuset	381	6	0.70	0.43-1.13	7	2-55
52013	Skene	952	15	0.71	0.48-1.05	8	2-46
12010	Enköping	3,192	52	0.73	0.57-0.94	9	4-35
11001	Karolinska	950	18	0.75	0.52-1.08	10	3-50
22010	Jönköping	1,318	24	0.75	0.54-1.05	11	3-47
42015	Halmstad Capio Movement	2,804	49	0.76	0.59-0.98	12	5-39
22012	Värnamo	1,305	25	0.76	0.54-1.07	13	3-48
50020	OrthoCenter IFK klin.*	1,088	21	0.78	0.55-1.11	14	3-53
25010	Kalmar	909	15	0.79	0.53-1.16	15	3-57
42011	Varberg	1,484	28	0.81	0.59-1.11	16	5-53
65012	Gällivare	628	11	0.81	0.53-1.24	17	3-63
11013	Löwenströmska**	3,870	80	0.82	0.66-1.01	18	8-42
61012	Hudiksvall	674	12	0.83	0.55-1.25	19	3-64
22405	Art Clinic Jönköping	142	0	0.83	0.46-1.53	20	2-74
55011	Karlskoga	987	20	0.84	0.59-1.19	21	5-59
42420	Spenshult	1,313	33	0.85	0.63-1.15	22	6-56
56010	Västerås	2,241	47	0.85	0.66-1.11	23	8-52

(cont.)

Relative risk of revision for units (continued)

Code	Hospital	no. of TKA	Revised	RR	95% CI	Rank	95% CI
27011	Karlshamn	2,306	47	0.87	0.67-1.13	24	9-54
13011	Nyköping	870	18	0.87	0.60-1.26	25	5-64
65013	Piteå	2,475	52	0.87	0.68-1.12	26	9-53
62011	Örnsköldsvik	1,157	23	0.87	0.62-1.22	27	6-62
52011	Borås	808	18	0.87	0.60-1.27	28	5-64
10011	S:t Göran	3,487	75	0.89	0.72-1.11	29	12-53
62010	Sundsvall	752	18	0.90	0.63-1.30	30	6-67
41011	Trelleborg	6,637	144	0.91	0.77-1.07	31	16-49
23010	Växjö	951	23	0.93	0.66-1.30	32	8-67
55012	Lindesberg	1,901	37	0.94	0.70-1.25	33	11-63
28011	Ängelholm	1,885	39	0.94	0.71-1.24	34	11-64
50498	Art Clinic Göteborg	171	1	0.94	0.53-1.67	35	3-75
54010	Karlstad	1,677	39	0.94	0.71-1.25	36	12-63
55010	Örebro	629	17	0.94	0.65-1.37	37	7-70
10911	Capio Artro Clinic Sthlm.	215	1	0.95	0.53-1.70	38	3-76
57011	Mora	1,638	38	0.97	0.73-1.29	39	13-66
56012	Köping	156	5	0.98	0.59-1.61	40	5-75
53010	Falköping	432	14	0.99	0.66-1.47	41	9-73
42010	Halmstad	1,830	46	0.99	0.76-1.29	42	15-66
22011	Eksjö (Höglandssjukh.)	1,590	36	1.00	0.75-1.34	43	15-69
64010	Skellefteå	877	23	1.03	0.73-1.44	44	13-72
10016	Ortopediska huset	4,423	113	1.03	0.86-1.23	45	25-62
53011	Lidköping	1,685	40	1.05	0.79-1.38	46	19-70
54014	Torsby	1,042	27	1.05	0.76-1.45	47	16-72
10013	Södersjukhuset	2,690	75	1.06	0.86-1.32	48	26-68
21014	Motala	3,877	104	1.06	0.88-1.28	49	28-66
24010	Västervik	910	24	1.07	0.77-1.50	50	17-73
54012	Arvika	1,608	42	1.08	0.83-1.42	51	22-72
10015	Sophiahemmet	746	23	1.09	0.78-1.54	52	17-74
50071	Frölunda Spec.	889	29	1.10	0.80-1.50	53	19-73
13012	Kullbergska sjukhuset	2,151	64	1.11	0.88-1.39	54	28-71
64011	Lycksele	735	19	1.11	0.77-1.59	55	17-75
11010	Danderyd	1,252	35	1.11	0.83-1.49	56	23-73
21013	Norrköping	1,364	37	1.11	0.84-1.48	57	23-73
30001	Malmö	54	3	1.11	0.65-1.90	58	8-77
63010	Östersund	1,284	35	1.13	0.84-1.51	59	24-74
51010	Uddevalla	1,897	52	1.14	0.88-1.46	60	28-73
50010	Östra sjukhuset	143	7	1.16	0.72-1.85	61	14-77
51011	Mölndal	2,600	70	1.17	0.94-1.46	62	35-73
41012	Helsingborg	276	9	1.18	0.76-1.84	63	16-77
12001	Akademiska sjukhuset	906	33	1.19	0.88-1.60	64	27-75
41001	Lund	352	11	1.23	0.80-1.87	65	20-77
57010	Falun	2,662	86	1.24	1.01-1.51	66	42-74
28012	Hässleholm	6,477	198	1.24	1.08-1.42	67	48-72
61011	Bollnäs	2,792	89	1.25	1.02-1.52	68	44-74
53013	Skövde	1,061	35	1.26	0.94-1.69	69	35-76
11011	Södertälje	1,191	40	1.28	0.97-1.69	70	38-76
64001	Umeå	1,278	49	1.29	1.00-1.66	71	41-76
26010	Visby	814	31	1.32	0.97-1.79	72	39-77
23011	Ljungby	1,020	37	1.35	1.02-1.80	73	43-77
13010	Eskilstuna	418	18	1.38	0.96-2.00	74	36-78
11012	Norrtälje	863	33	1.45	1.08-1.96	75	49-78
62013	Sollefteå	1,037	42	1.54	1.18-2.02	76	58-78
61010	Gävle	895	41	1.59	1.21-2.10	77	60-78
51012	Kungälv	1,511	82	1.98	1.61-2.44	78	75-78

* 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 2008–2017 (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, Huddinge, Carlanderska och Enköping no longer are significant better than the average. However, of these only Enköping used monobloc tibia components in any number (42%). Jönköping, Piteå och Trelleborg are now added to those better than the average, but the 2 first used few monobloc components (Piteå 10%).

In the other end, Falun Hässleholm and Norrtälje are no longer worse than the average while Ortopediska huset and Visby have become that. Of these, Falun, Ortopediska huset and Visby used relatively many monobloc tibia components (17%, 17% och 39%).

Thus, it seems that modularity of the tibia, allowing for change of insert, may have an effect on the risk of revision. However, the use of monobloc tibias has diminished from 37% of cases in 2008 to 9% in 2017 and, if the trend continues, the problem with hospital results being biased by modularity will also diminish.

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	1,888	11	0.45	0.30-0.69	1	1-12
11015	Nacka-Proxima	1,239	9	0.58	0.37-0.91	2	1-32
25011	Oskarshamn	2,614	26	0.61	0.44-0.85	3	1-27
10010	Sabbatsberg (Aleris)	711	7	0.64	0.40-1.02	4	1-44
42015	Halmstad Capio Movement	2,804	30	0.65	0.48-0.89	5	2-30
22010	Jönköping	1,318	15	0.67	0.45-0.99	6	1-40
65013	Piteå	2,475	30	0.71	0.52-0.96	7	2-38
41011	Trelleborg	6,637	85	0.72	0.58-0.88	8	4-30
11002	Huddinge	1,184	15	0.72	0.49-1.06	9	2-48
50480	Carlanderska	1,165	13	0.72	0.48-1.08	10	2-50
12481	Elisabethsjukhuset	381	5	0.72	0.44-1.19	11	1-58
25010	Kalmar	909	9	0.73	0.47-1.14	12	2-53
24010	Västervik	910	10	0.76	0.49-1.18	13	2-57
62011	Örnsköldsvik	1,157	14	0.77	0.52-1.15	14	3-54
42011	Varberg	1,484	20	0.78	0.54-1.11	15	3-52
50020	OrthoCenter IFK klin.	1,088	16	0.79	0.54-1.16	16	3-55
62010	Sundsvall	752	11	0.79	0.52-1.21	17	3-59
54010	Karlstad	1,677	24	0.8	0.57-1.11	18	4-53
11001	Karolinska	950	16	0.8	0.55-1.17	19	3-57
52011	Borås	808	12	0.81	0.53-1.23	20	3-61
52013	Skene	952	14	0.81	0.55-1.21	21	3-60
42420	Spenshult	1,313	25	0.82	0.59-1.14	22	5-53
22012	Värnamo	1,305	22	0.83	0.58-1.19	23	5-58

(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
55011	Karlskoga	987	15	0.83	0.56-1.23	24	4-61
65012	Gällivare	628	9	0.86	0.55-1.35	25	4-68
57010	Falun	2,662	45	0.88	0.67-1.14	26	10-55
12010	Enköping	3,192	48	0.88	0.68-1.14	27	10-55
22405	Art Clinic Jönköping	142	0	0.89	0.48-1.63	28	2-75
53011	Lidköping	1,685	24	0.89	0.64-1.25	29	8-61
55012	Lindesberg	1,901	26	0.92	0.67-1.28	30	10-63
64010	Skellefteå	877	15	0.92	0.63-1.36	31	7-68
61012	Hudiksvall	674	11	0.93	0.61-1.43	32	6-70
22011	Eksjö-Nässjö (Höglandssjukh.)	1,590	24	0.93	0.67-1.31	33	10-66
54014	Torsby	1,042	17	0.94	0.64-1.36	34	8-68
56010	Västerås	2,241	41	0.95	0.72-1.25	35	14-62
63010	Östersund	1,284	21	0.95	0.67-1.35	36	9-67
55010	Örebro	629	14	0.96	0.64-1.42	37	8-70
42010	Halmstad	1,830	35	0.98	0.73-1.31	38	15-66
57011	Mora	1,638	29	0.99	0.72-1.35	39	14-68
12001	Akademiska sjukhuset	906	22	1	0.71-1.41	40	13-70
13011	Nyköping	870	17	1	0.69-1.46	41	11-72
50498	Art Clinic Göteborg	171	1	1.01	0.56-1.81	42	4-77
51011	Mölndal	2,600	45	1.01	0.78-1.32	43	18-66
10015	Sophiahemmet	746	16	1.01	0.69-1.49	44	11-72
53010	Falköping	432	12	1.02	0.67-1.54	45	10-73
11013	Löwenströmska	3,870	80	1.02	0.83-1.26	46	23-63
56012	Köping	156	5	1.04	0.63-1.71	47	7-76
10911	Capio Artro Clinic	215	1	1.04	0.58-1.86	48	5-78
30001	Malmö	54	2	1.06	0.61-1.85	49	6-77
27011	Karlshamn	2,306	45	1.06	0.82-1.39	50	22-69
23010	Växjö	951	22	1.06	0.75-1.51	51	16-73
28011	Ängelholm	1,885	35	1.08	0.81-1.45	52	21-71
28012	Hässleholm	6,477	131	1.08	0.91-1.28	53	31-65
50010	Östra sjukhuset	143	5	1.09	0.66-1.80	54	10-77
21014	Motala	3,877	83	1.1	0.90-1.36	55	30-68
10011	S:t Göran	3,487	73	1.1	0.89-1.37	56	29-68
11010	Danderyd	1,252	27	1.11	0.80-1.53	57	21-73
13010	Eskilstuna	418	10	1.12	0.73-1.73	58	14-77
21013	Norrköping	1,364	30	1.17	0.86-1.59	59	27-75
41012	Helsingborg	276	7	1.18	0.74-1.89	60	15-78
10013	Södersjukhuset	2,690	66	1.18	0.94-1.48	61	35-72
13012	Kullbergska sjukhuset	2,151	54	1.19	0.93-1.52	62	33-73
54012	Arvika	1,608	36	1.2	0.90-1.60	63	30-75
53013	Skövde	1,061	26	1.22	0.88-1.70	64	29-76
51010	Uddevalla	1,897	44	1.24	0.95-1.62	65	35-75
10016	Ortopediska huset	4,423	108	1.24	1.03-1.49	66	44-73
64011	Lycksele	735	17	1.25	0.86-1.82	67	26-77
50071	Frölunda Spec.	889	29	1.29	0.94-1.76	68	34-77
11011	Södertälje	1,191	33	1.32	0.98-1.78	69	38-77
41001	Lund	352	10	1.33	0.86-2.05	70	26-78
11012	Norrtälje	863	23	1.35	0.96-1.90	71	36-78
23011	Ljungby	1,020	29	1.36	1.00-1.87	72	40-78
64001	Umeå	1,278	44	1.39	1.06-1.82	73	47-77
61011	Bollnäs	2,792	80	1.43	1.16-1.77	74	55-77
26010	Visby	814	28	1.45	1.05-1.99	75	46-78
51012	Kungälv	1,511	48	1.53	1.18-1.99	76	57-78
61010	Gävle	895	32	1.57	1.16-2.12	77	56-78
62013	Sollefteå	1,037	38	1.72	1.30-2.28	78	64-78

* 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 2018. 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, of women and that 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, Bollnäs-Aleris, Motala-Aleris and S:t Görans being the exemption.

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 Västerås. The proportion of patients with ASA ≥3 is twice the national average in Danderyd, Södersjukhuset and Södertälje while it is less than half in Hässleholm and Kullbergska.

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 2018	Number of reports	Complete reports %	% OA	% Women	% <55 years	% BMI 35+	% ASA ≥3
Country	**15,431**	**99.9**	**96.7**	**56.1**	**7.4**	**9,0**	**17.1**
University hospitals							
Akademiska	91	100	91.2	59.3	9.9	14.3	27.5
Huddinge	107	100	89.7	67.3	5.6	18.7	52.3
Karolinska Solna	55	99.6	74.6	56.4	21.8	13.0	67.3
Lund	52	100	50.0	61.5	19.2	28.9	69.2
Umeå	138	100	92.0	55.1	3.6	12.3	25.4
Örebro	3	100	100	66.7	0.0	0.0	0.0
Private units							
Art Clinic Göteborg	140	99.9	100	51.4	13.6	1.4	6.4
Art Clinic Jönköping	146	100	97.3	51.4	4.1	2.1	0.7
Bollnäs Aleris	367	100	97.6	54.5	6.3	2.5	22.3
Capio Artro Clinic Sthlm.	392	100	97.7	57.9	12.5	4.3	3.1
Carlanderska	323	100	99.1	45.8	11.2	8.7	2.5
Elisabethkliniken	13	100	100	23.1	15.4	0,0	16.7
Hermelinen-Luleå	19	100	94.7	26.3	0.0	26.3	5.3
Motala Aleris	653	99.9	96.3	59.6	8.3	8.6	23
Movement Halmstad	467	99.9	99.8	51.8	8.1	7.1	15.2
Nacka Aleris	223	100	100	68.2	5.4	7.6	4.9
OrthoCenter IFK-kliniken	176	100	96.6	39.2	9.7	1.7	6.3
OrthoCenter Sthlm	676	100	97.8	52.4	5.6	2.5	1.8
Ortopediska huset	656	99.9	98.9	56.6	8.1	4.0	4
Sophiahemmet	185	100	99.5	35.1	18.4	6.5	8.1
St Göran	467	100	98.1	57.2	6.6	9.6	40.9
Ängelholm Aleris	82	100	96.3	56.1	9.8	9.8	7.3

A previous surgery of the index knee (not shown in the table) was reported for 17.6% of the patients. Meniscal surgery was most common (7.2%) followed by arthroscopy (5.2%), cruciate ligament surgery (2.6%), osteotomy (1.3%), osteosynthesis (0.8%) and "other" (0.5%). 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 2018	Number of reports	Complete reports %	% OA	% Women	% <55 years	% BMI 35+	% ASA ≥3
< 100 operations/year							
Eskilstuna	81	100	91.4	70.4	7.4	25.9	30.9
Gällivare	88	100	92.1	62.5	6.8	14.8	26.1
Gävle	76	100	96.1	56.6	4.0	21.1	32.9
Helsingborg	16	100	93.8	50.0	0.0	31.3	75.0
Hudiksvall	62	100	98.4	62.9	6.5	11.3	22.6
Kalmar	86	100	95.4	55.8	0.0	4.7	17.4
Karlskoga	7	100	100	42.9	0.0	0.0	14.3
Nyköping	89	100	95.5	47.2	6.7	10.1	15.7
Skellefteå	86	99.7	97.7	60.5	5.8	10.5	23.3
Skövde	20	100	95.0	60.0	0.0	15	15.0
Sundsvall	15	98.7	78.6	60.0	0.0	6.7	26.7
Västervik	94	100	98.9	59.6	4.3	7.5	10.6
Växjö	94	100	96.8	58.5	5.3	8.5	26.6
100-300 operations/year							
Alingsås	179	100	99.4	59.2	3.9	8.4	14.0
Arvika	213	100	99.0	60.6	4.7	12.2	17.4
Borås	114	100	97.3	61.4	3.5	15.8	36.8
Danderyd	189	100	91.0	58.2	6.9	14.9	36.5
Eksjö-Nässjö	299	100	97.3	52.5	7.4	4.7	12.0
Falun	170	100	94.7	51.8	8.2	7.7	21.8
Halmstad	198	99.8	97.5	53.5	9.1	16.8	16.2
Karlshamn	278	100	97.5	50.4	4.3	9.4	14.8
Karlstad	117	99.8	95.7	62.4	10.3	9.5	13.7
Kullbergska sjukhuset	220	100	97.3	62.7	8.6	12.3	3.6
Kungälv	199	99.9	99.0	59.8	8.5	13.6	11.6
Lidköping	171	100	95.9	62.0	5.9	11.7	11.7
Ljungby	169	100	97.0	55.0	8.3	11.2	13.6
Lycksele	143	100	96.5	58.7	6.3	13.3	10.5
Mora	203	99.9	98.0	53.2	3.5	9.9	17.2
Norrköping	153	100	94.8	63.4	5.2	7.2	16.3
Norrtälje	164	100	98.8	57.9	6.1	9.2	13.1
Skene	129	100	98.5	63.6	8.5	3.1	9.3
Sollefteå	151	100	96.7	61.6	6.6	11.3	15.9
Södersjukhuset	227	100	93.0	60.4	12.8	9.3	42.7
Södertälje	145	100	99.3	62.1	6.9	11.0	40.0
Torsby	130	100	100	57.7	14.6	11.5	26.2
Uddevalla	242	100	93.8	57.0	0.8	8.3	29.8
Varberg	177	100	97.2	54.2	10.2	9.0	18.1
Visby	115	100	93.0	60.0	12.2	17.4	25.2
Värnamo	208	100	96.2	54.3	7.7	10.1	20.2
Västerås	194	100	93.8	59.3	9.8	18.0	30.9
Ängelholm	242	99.8	95.5	62.0	8.3	11.6	10.3
Örnsköldsvik	142	100	95.1	56.3	3.5	13.4	25.4
Östersund	178	99.9	95.5	60.7	5.1	6.8	23.6
> 300 operations/year							
Enköping	381	100	98.7	51.3	6.0	9.2	18.1
Hässleholm	891	99.9	96.0	50.8	6.6	6.4	7.1
Lindesberg	493	100	98.4	55.4	7.5	9.5	17.0
Mölndal	401	99.9	92.8	62.3	6.7	6.0	12.7
Oskarshamn	374	100	98.4	52.9	6.7	13.1	14.7
Piteå	373	100	95.4	54.2	4.3	13.1	18.2
Trelleborg	814	100	98.9	60.0	7.4	10.8	21.3

Prophylactic antibiotics for knee arthroplasties

The table shows what was reported for primary knee arthroplasties in 2018.

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 2018 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 2018 in the use of Clindamicin for prophylaxis has been marginal (7.5% vs 7.1%). Cefotaxim was reported being used in 0.5% 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 registry started to register the time for delivery of the first dose in 2009 after which some improvement in the routines was noted with 87% of patients in 2011 being reported to having received the dose

Prophylactic antibiotics

Hospital 2018	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	**15,431**	**99.6**	**99.7**	**92.9**	**80.9**	**38.9**
University hospitals						
Akademiska	91	96.7	98.9	88.6	20.2	0.0
Huddinge	107	98.8	100	88.5	69.5	31.4
Karolinska Solna	55	98.8	100	89.1	71.7	47.2
Lund	52	95.5	100	87.5	56.3	31.2
Umeå	138	98.8	99.3	95.6	87.4	29.6
Örebro	3	100	100	100	66.7	0.0
Private units						
Art Clinic Göteborg	140	99.0	100	100	78.7	9.6
Art Clinic Jönköping	146	99.5	100	97.2	97.9	35.4
Bollnäs Aleris	367	99.9	100	98.9	89.9	29.0
Capio Artro Clinic	392	99.7	99.5	75.1	94.1	38.7
Carlanderska	323	99.5	100	98.1	87.9	31.1
Elisabethkliniken	13	97.4	100	23.1	16.7	16.7
Hermelinen-Luleå	19	100	100	89.5	100	10.5
Motala Aleris	653	99.8	100	97.9	91.8	45.6
Movement Halmstad	467	99.5	100	95.9	82.6	11.3
Nacka Aleris	223	99.3	100	95.1	87.6	47.3
OrthoCenter IFK-kliniken	176	99.8	98.3	93.1	93.7	81.1
OrthoCenter Sthlm	676	100	100	97.2	97.6	48.1
Ortopediska huset	656	99.6	100	97.6	87.2	32.4
Sophiahemmet	185	99.3	100	79.4	80.1	48.6
St Göran	467	98.8	100	96.6	88.6	34.6
Ängelholm Aleris	82		100	92.7	93.7	8.9

within the recommended 45-15 minutes. However during 2013-2018 the proportion has lessened to 80%. Only Orthocenter-IFK has implemented the latest PRISS recommendation and in 2018, only 39% 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 2018	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	81	99.2	98.8	88.8	72.2	38.0
Gällivare	88	100	100	95.5	77.3	21.6
Gävle	76	100	98.7	96.0	85.5	32.9
Helsingborg	16	97.9	100	87.5	73.3	40.0
Hudiksvall	62	98.9	100	91.9	86.7	50.0
Kalmar	86	100	100	96.5	89.5	22.1
Karlskoga	7	100	100	85.7	71.4	42.9
Nyköping	89	99.6	100	87.5	72.7	35.2
Skellefteå	86	100	100	95.4	68.6	31.4
Skövde	20	100	100	100	45.0	10.0
Sundsvall	15	100	100	86.7	66.7	40.0
Västervik	94	99.6	100	96.8	52.7	40.9
Växjö	94	96.8	100	100	80.2	18.6
100-300 operations/year						
Alingsås	179	99.8	99.4	97.8	65.2	55.6
Arvika	213	98.9	100	98.6	68.9	48.5
Borås	114	99.7	100	96.5	60.2	31.9
Danderyd	189	99.1	99.5	83.4	75.0	37.5
Eksjö-Nässjö	299	99.8	100	97.7	84.9	60.3
Falun	170	99.5	100	94.7	82.4	49.4
Halmstad	198	99.3	100	91.4	81.0	31.8
Karlshamn	278	99.5	98.9	98.6	81.4	27.4
Karlstad	117	99.1	100	96.6	72.8	47.4
Kullbergska sjukhuset	220	99.7	100	93.6	83.0	40.8
Kungälv	199	99.8	100	96.5	78.8	53.5
Lidköping	171	99.8	100	93.6	95.9	57.1
Ljungby	169	99.8	100	95.9	91.1	67.3
Lycksele	143	99.3	100	95.1	70.7	44.3
Mora	203	99.8	99.5	20.3	88.6	55.0
Norrköping	153	99.6	100	96.1	62.3	41.1
Norrtälje	164	99.2	100	95.7	77.5	30.0
Skene	129	99.2	100	94.6	73.8	42.1
Sollefteå	151	99.6	99.3	96.7	83.9	42.3
Södersjukhuset	227	98.8	99.6	94.3	62.1	37.9
Södertälje	145	98.2	100	96.5	87.7	44.2
Torsby	130	99.0	100	97.7	81.1	61.4
Uddevalla	242	99.6	100	96.3	63.2	41.8
Varberg	177	99.8	100	80.8	63.1	33.5
Visby	115	99.1	99.1	94.7	82.1	38.4
Värnamo	208	99.2	99.5	97.1	87.2	46.3
Västerås	194	99.0	99.5	95.3	75.0	41.5
Ängelholm	242	99.3	100	92.5	79.3	40.1
Örnsköldsvik	142	99.8	100	97.2	78.7	50.5
Östersund	178	99.8	98.9	93.7	85.3	29.4
> 300 operations/year						
Enköping	381	99.9	100	94.7	84.5	41.0
Hässleholm	891	100	100	85.9	66.2	24.0
Lindesberg	493	100	100	92.1	72.0	42.7
Mölndal	401	99.8	100	93.5	74.5	41.1
Oskarshamn	374	100	100	90.4	72.1	53.3
Piteå	373	100	100	96.0	93.6	39.5
Trelleborg	814	100	100	98.0	85.5	31.6

Antithrombotic prophylaxis for knee arthroplasties

The table ”Antithrombotic prophylaxis” shows what the hospitals reported having administrated for primary knee arthroplasties in 2018.

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 63% 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 76% and 83%. In some cases (3.1%) 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%).

Antithrombotic prophylaxis

Hospital 2018	Number of reports	Complete reports %	Percent starting postoperatively	Percent having injection	Percent treated for 8-14 days
Country	**15,431**	**99.2**	**90.8**	**63.2**	**75.3**
University hospitals					
Akademiska	91	100	87.9	4.4	92.7
Huddinge	107	98.8	99.1	96.3	90.3
Karolinska Solna	55	95.2	70.6	100	0.0
Lund	52	96.2	86.0	100	70.8
Umeå	138	100	97.8	2.2	98.6
Örebro	3	100	100	66.7	66.7
Private units					
Art Clinic Göteborg	140	99.5	92.8	0.7	98.6
Art Clinic Jönköping	146	100	97.3	2.1	93.2
Bollnäs Aleris	367	99.7	98.4	71.1	95.0
Capio Artro Clinic	392	99.3	92.1	84.0	95.3
Carlanderska	323	99.4	92.6	2.5	87.1
Elisabethkliniken	13	100	100	100	92.3
Hermelinen-Luleå	19	100	100	0.0	0.0
Motala Aleris	653	99.5	98.5	98.5	97.2
Movement Halmstad	467	99.6	97.4	97.9	0.2
Nacka Aleris	223	99.3	98.7	96.4	97.3
OrthoCenter IFK-kliniken	176	99.6	93.2	1.7	92.0
OrthoCenter Sthlm	676	99.9	96.0	82.3	98.5
Ortopediska huset	656	99.7	97.3	16.6	98.2
Sophiahemmet	185	98.7	94.5	97.3	62.6
St Göran	467	97.8	85.4	81.3	91.2
Ängelholm Aleris	82	99.6	95.1	6.1	78.8

Antithrombotic prophylaxis

Hospital 2018	Number of reports	Complete reports %	Percent starting postoperatively	Percent having injection	Percent treated for 8-14 days
< 100 operations/year					
Eskilstuna	81	98.8	96.3	7.5	92.2
Gällivare	88	99.6	93.2	23.9	82.8
Gävle	76	99.3	90.8	82.9	94.6
Helsingborg	16	100	87.5	93.8	93.8
Hudiksvall	62	99.5	87.1	100	92.7
Kalmar	86	98.1	94.2	96.5	88.9
Karlskoga	7	100	100	14.3	100
Nyköping	89	99.7	95.5	2.3	96.4
Skellefteå	86	100	96.5	100	100
Skövde	20	100	100	15.0	90.0
Sundsvall	15	100	93.3	0.0	100
Västervik	94	98.6	88.0	97.8	93.3
Växjö	94	98.6	28.0	85.0	96.7
100-300 operations/year					
Alingsås	179	100	93.3	100	97.8
Arvika	213	99.7	90.1	5.6	91.9
Borås	114	98.8	85.0	31.3	91.9
Danderyd	189	98.4	92.0	95.7	91.0
Eksjö-Nässjö	299	95.5	99.3	99.3	98.6
Falun	170	99.4	95.8	100	1.8
Halmstad	198	98.3	95.4	99.5	1.0
Karlshamn	278	99.6	96.0	97.8	96.0
Karlstad	117	99.7	91.5	7.7	96.5
Kullbergska sjukhuset	220	100	92.7	5.0	95.8
Kungälv	199	99.3	91.5	2.5	89.7
Lidköping	171	99.6	94.7	2.4	90.0
Ljungby	169	99.2	23.7	76.9	92.7
Lycksele	143	99.3	9.1	100	100
Mora	203	99.0	95.1	4.4	96.9
Norrköping	153	100	93.5	100	64.1
Norrtälje	164	99.0	86.5	84.1	62.9
Skene	129	99.0	99.2	22.8	95.3
Sollefteå	151	98.9	88.7	99.3	92.1
Södersjukhuset	227	97.5	90.6	62.1	95.8
Södertälje	145	99.8	80.0	98.6	72.9
Torsby	130	99.5	94.6	10.0	81.1
Uddevalla	242	100	95.9	99.2	96.3
Varberg	177	99.2	85.9	97.7	7.6
Visby	115	99.1	92.2	37.4	12.5
Värnamo	208	99.8	90.9	99.5	98.6
Västerås	194	97.9	90.7	7.3	92.3
Ängelholm	242	99.7	93.8	88.4	88.8
Örnsköldsvik	142	99.8	91.6	7.8	95.7
Östersund	178	100	95.5	100	97.8
> 300 operations/year					
Enköping	381	98.8	93.4	8.4	93.4
Hässleholm	891	99.9	97.9	3.0	2.7
Lindesberg	493	98.7	76.3	25.4	70.3
Mölndal	401	97.4	91.9	3.3	95.6
Oskarshamn	374	98.8	85.6	99.2	97.8
Piteå	373	99.4	68.6	33.8	95.1
Trelleborg	814	99.8	97.7	100	3.0

Surgical technique for knee arthroplasties

The table ”Surgical technique” shows what the hospitals reported for having used in their primary knee arthroplasties in 2018.

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 (67.2%) while the increase that we have seen in the proportion having general anesthesia in recent years seems to have stagnated (31.6% in 2017, 32.1% in 2018). Twelve 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 2018. The proportion of surgeries performed using tourniquet continued to decrease from 90% in 2011 to little over 37% in 2018.

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 35 minutes to almost two hours. For TKA's it was overall 70 min., for UKA's 61 min., for femoropatellar arthroplasties 60 min., for linked implants 139 min. and for partial implants 55 min. Since 2009, the median operating time for TKA's has varied between 70 and 82 min. and for UKA's between 61 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 femur (57%) than in the tibia (46%).

Computer aided surgery (CAS) was only reported for 6 cases by 4 units (15 in 2017).
No UKA's were reported using CAS.
The number of cases using custom made instru-

Surgical technique

Hospital 2018	Number of reports	Complete reports %	Percent having General anesthesia	Percent Drainage	Percent Tourniquet	Percent LIA	Median Op-time
Country	**15,431**	**99.2**	**32.1**	**0.9**	**37.7**	**96.7**	**70**
University Hospitals							
Akademiska	**91**	**99.3**	**18.7**	**0.0**	**85.7**	**95.5**	**91**
Huddinge	**107**	**100**	**18.7**	**0.9**	**16.8**	**88.8**	**125**
Karolinska Solna	**55**	**100**	**21.8**	**21.8**	**100**	**81.8**	**93**
Lund	**52**	**100**	**38.5**	**0.0**	**25.0**	**86.5**	**96**
Umeå	**138**	**98.1**	**18.1**	**1.5**	**53.0**	**61.9**	**90**
Örebro	**3**	**100**	**100**	**0.0**	**66.7**	**100**	**102**
Private units							
Art Clinic Göteborg	**140**	**99.7**	**100**	**0.0**	**10.7**	**98.6**	**62**
Art Clinic Jönköping	**146**	**100**	**98.6**	**0.0**	**9.6**	**98.6**	**79**
Bollnäs Aleris	**367**	**100**	**88.3**	**0.0**	**68.1**	**97.8**	**51**
Capio Artro Clinic	**392**	**100**	**95.9**	**0.0**	**0.5**	**97.2**	**60**
Carlanderska	**323**	**100**	**15.5**	**0.0**	**40.6**	**95.1**	**63**
Elisabethkliniken	**13**	**100**	**0.0**	**0.0**	**100**	**100**	**90**
Hermelinen-Luleå	**19**	**100**	**5.3**	**5.3**	**0.0**	**100**	**65**
Motala Aleris	**653**	**99.9**	**5.4**	**2.2**	**37.1**	**99.2**	**41**
Movement Halmstad	**467**	**100**	**2.6**	**0.0**	**5.1**	**99.1**	**61**
Nacka Aleris	**223**	**99.7**	**100**	**0.0**	**2.3**	**95.7**	**60**
OrthoCenter IFK-kliniken	**176**	**99.9**	**7.4**	**0.0**	**0.6**	**100**	**82**
OrthoCenter Sthlm	**676**	**99.8**	**3.0**	**0.2**	**7.3**	**98.7**	**59**
Ortopediska huset	**656**	**99.7**	**3.8**	**0.3**	**69.9**	**99.1**	**48**
Sophiahemmet	**185**	**99.4**	**93.0**	**22.8**	**42.2**	**96.2**	**70**
St Göran	**467**	**99.2**	**19.9**	**0.2**	**95.5**	**95.3**	**66**
Ängelholm Aleris	**82**	**100**	**80.5**	**0.0**	**1.2**	**100**	**59**

ments/cutting blocks was 68 (<0,5%) or only good one third of the 181 (1.2%) that were reported in 2017. Use of such instruments was reported by16 units (15 in 2017). Most of those only performed a few surgeries, each.

Surgical technique

Hospital 2018	Number of reports	Complete reports %	Percent having General anaesthesia	Percent Drainage	Percent Tourniquet	Percent LIA**	Median Op-time
< 100 operations/year							
Eskilstuna	81	100	12.4	0.0	0.0	98.8	92
Gällivare	88	100	6.8	0.0	13.6	98.9	95
Gävle	76	100	31.6	0.0	96.1	98.7	69
Helsingborg	16	100	18.8	0.0	0.0	100	102
Hudiksvall	62	100	19.4	0.0	45.2	91.9	82
Kalmar	86	100	15.1	0.0	0.0	89.5	81
Karlskoga	7	100	42.9	0.0	42.9	100	127
Nyköping	89	99.6	4.5	0.0	25.3	97.8	84
Skellefteå	86	100	1.2	1.2	98.8	100	89
Skövde	20	100	30.0	0.0	32.9	75.0	89
Sundsvall	15	100	6.7	6.7	0.0	93.3	126
Västervik	94	100	39.4	1.0	7.5	97.9	94
Växjö	94	100	37.2	0.0	25.5	90.4	80
100-300 operations/year							
Alingsås	179	100	9.5	1.1	0.0	96.7	84
Arvika	213	100	4.2	0.0	5.6	98.1	55
Borås	114	100	16.7	0.0	82.5	99.1	96
Danderyd	189	100	14.8	0.0	73.5	90.0	89
Eksjö-Nässjö	299	100	20.1	0.0	23.8	99.0	68
Falun	170	100	21.8	2.9	97.7	99.4	85
Halmstad	198	99.3	12.2	4.6	86.7	100	87
Karlshamn	278	99.9	93.2	0.0	91.7	99.3	69
Karlstad	117	99.1	19.7	0.0	0.9	98.3	72
Kullbergska sjukhuset	220	100	5.5	0.5	29.6	98.6	71
Kungälv	199	100	22.6	0.0	24.1	97.0	84
Lidköping	171	100	14.6	1.2	37.3	97.1	79
Ljungby	169	99.9	35.5	0.6	7.2	96.5	62
Lycksele	143	99.9	6.3	0.7	96.5	93.0	95
Mora	203	100	5.9	0.0	99.0	96.1	56
Norrköping	153	100	13.1	0.0	7.2	97.4	88
Norrtälje	164	99.9	36.0	1.2	54.9	85.9	78
Skene	129	99.7	17.8	0.8	65.6	100	96
Sollefteå	151	98.9	5.3	0.0	88.3	98.7	76
Södersjukhuset	227	99.7	16.3	1.3	1.8	94.3	75
Södertälje	145	99.7	95.2	1.4	1.4	93.8	65
Torsby	130	100	6.9	0.0	25.4	100	60
Uddevalla	242	99.9	9.1	0.0	12.8	99.2	84
Varberg	177	100	24.3	0.0	7.9	97.7	85
Visby	115	100	14.8	0.9	0.0	98.3	110
Värnamo	208	100	9.6	0.0	0.0	96.2	91
Västerås	194	99.9	12.9	0.0	0.5	88.7	74
Ängelholm	242	99.8	63.2	7.4	26.6	87.6	69
Örnsköldsvik	142	100	6.3	0.7	95.1	98.6	87
Östersund	178	100	9.0	0.0	51.7	100	95
> 300 operations/year							
Enköping	381	99.9	14.2	0.0	92.1	99.5	75
Hässleholm	891	99.9	92.3	0.0	0.9	99.8	39
Lindesberg	493	99.8	98.0	0.0	0.4	98.0	79
Mölndal	401	99.1	20.3	0.5	1.5	92.2	79
Oskarshamn	374	100	14.4	0.5	82.1	88.0	72
Piteå	373	100	5.1	0.3	93.6	99.5	64
Trelleborg	814	100	28.5	0.0	51.0	99.8	70

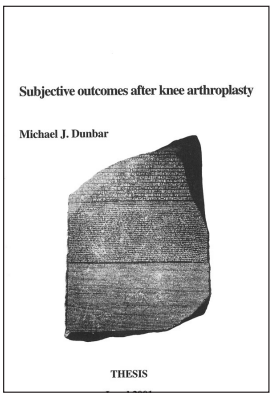
Patient reported outcome before and after knee arthroplasty

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 answering 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 12 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 i Solna and Ortho-Center Stockholm joined and 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 and in 2018 Hudiksvall, Nacka and Västervik. Mölndal and Ortopediska huset have chosen not to register the disease specific KOOS but only the EQ-5D, VAS pain and satisfaction with the surgery one year postoperatively. Additional units have expressed their interest and initiated the task of engaging their hospitals in the project and finding resources for the data gathering. During 2018 PROM data were registered for approximately 50% of the primary surgeries.

Instruments used for the evaluation

EQ-5D is a general health instrument measuring quality of life 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 recently was reported in the Läkartidningen (36, 2011). If one wants to perform statistical analyses using a single value as a measure of the health related quality of life 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 best (100 to the worst imaginable health status (0) (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 a 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 pf 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

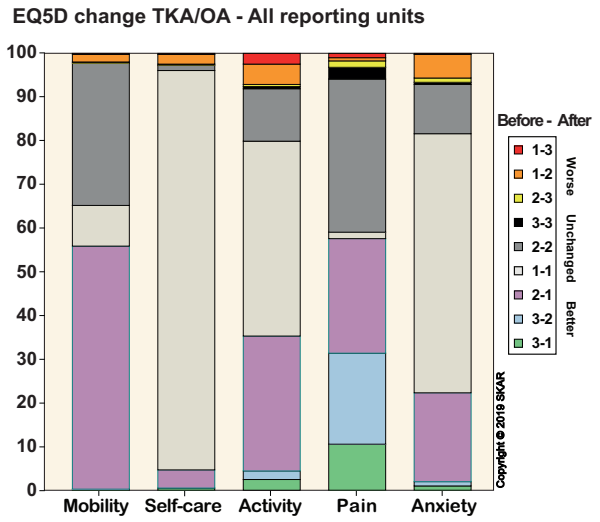
EQ5D

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 2016 estimated their general health, both pre- and postoperatively, the difference between the units was relatively small (0-17 points). This was true for units with a relatively high (≥75%) response rate (Bollnäs, Eksjö, Hässleholm, Kalmar, Kungälv, Mölndal, Ortho-Center Stockholm, Oskarshamn och Trelleborg) as well as 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 2017 estimated their knee pain, both pre- and postoperatively, the diffence between the units that had a relatively high response rate (see EQ-VAS above) was also relatively small both preoperatively (0-9 points) as well as 1 year postoperatively (0-6 points). For the other units the differences between the units were also similar; 1-13 points preoperatively and 3-9 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 2017. For patients operated in 2018 only the preoperative values are availiable.

VAS – Satisfaction with the surgery

One year postoperatively, 70 % of the patients operated in 2017 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, 87% of the patients operated in 2017 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 (97%) Oskarshamn (93%), Eksjö (92%) följt av OrthoCenter Stockholm (87%), Mölndal (87%),Kungälv (86%), Bollnäs (86%), Trelleborg (85%) and Hässleholm (84%). For the other hospitals the proportion of satisfied patients varied from 77-100%

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)
All hospitals 2017	4,721	70	64 (18)	17 (20)	65 (22)	77 (20)
All hospitals 2018	6,496	82	64 (20)		63 (23)	
Hospital :						
Alingsås						
2017	186	65	65 (18)	16 (20)	67 (22)	78 (19)
2018	171	86	61 (20)		65 (22)	
Bollnäs						
2017	258	82	61 (20)	17 (20)	61 (20)	76 (18)
2018	314	97	66 (18)		62 (23)	
Eksjö						
2017	177	79	61 (18)	16 (17)	61 (18)	79 (17)
2018	250	90	62 (19)		65 (20)	
Helsingborg						
2017	18	39	67 (19)	20 (24)	42 (23)	61 (20)
2018	15	67	71 (9)		60 (25)	
Huddinge						
2017	79	58	72 (17)	21 (21)	59 (26)	68 (23)
2018	79	66	69 (20)		55 (24)	
Hudiksvall						
2018	58	76	67 (16)	18(21)	63 (24)	
Hässleholm						
2017	614	79	62 (19)	20 (21)	71 (21)	77 (20)
2018	701	98	65 (18)		66 (22)	
Kalmar						
2017	87	77	65 (19	11 (14)	72 (20)	80 (18)
2018	79	78	67 (18)		62 (24)	
Karlskoga						
2017	22	59	74 (15)	21 (27)	63 (20)	79 (17)
2018						
Karolinska						
2017	34	47	70 (19)	17 (22)	60 (25)	73 (14)
2018	34	74	67 (20)		56 (18)	
Kungälv						
2017	158	77	67 (20)	18 (22)	62 (22)	76 (19)
2018	150	88	68 (18)		63 (24)	
Lindesberg						
2017	355	55	65 (16)	17 (20)	66 (22)	78 (19)
2018	443	49	65 (18)		61 (22)	
Lund						
2017	25	36	64 (18)	16 (21)	65 (19)	69 (27)
2018	24	13	69 (15)		61 (26)	
Motala						
2017	359	72	66 (17)	17 (19)	61 (22)	76 (19)
2018	372	87	69 (16)		61 (22)	
Mölndal						
2017	320	77	63 (20)	18 (21)	61 (22)	75 (19)
2018	340	77	63 (21)		63 (23)	
Nacka						
2018 (feb-dec)	178	49	68 (18)		65 (23)	
Norrköping						
2017	144	67	70 (15)	26 (26)	62 (21)	74 (18)
2018	137	87	71 (15)		61 (24)	
Norrtälje						
2017	115	45	64 (19)	16 (20)	64 (21)	75 (17)
2018	135	45	60 (20)		66 (21)	
OrthoCenter Sthlm						
2017	389	81	67 (18)	15 (18)	65 (22)	80 (16)
2018	566	92	65 (17)		64 (21)	
Ortopediska huset						
2017 (okt-dec)	227	49	61 (18)	14 (17)	69 (20)	82 (16)
2018	605	87	60 (22)		65 (22)	
Oskarshamn						
2017	315	85	63 (19)	13 (16)	63 (22)	77 (19)
2018	347	91	64 (18)		65 (22)	
Piteå						
2017	232	58	68 (17)	17 (19)	62 (22)	74 (19)
2018	272	65	68 (18)		61 (22)	
Södertälje						
2017	137	51	69 (17)	16 (22)	62 (23)	76 (21)
2018	138	75	44 (35)		55 (24)	
Trelleborg						
2017	679	76	64 (19)	17 (19)	68 (22)	78 (19)
2018	693	87	66 (18)		66 (23)	
Västervik						
2018	93	59	72 (18)		51 (20)	
Ängelholm Aleris						
2017	167	27	64 (14)	13 (15)	55 (27)	76 (24)
2018	109	77	28 (29)		42 (32)	
Ängelholm						
2017	86	34	69 (19)	18 (24)	62 (22)	83 (15)
2018	161	55	62 (26)		60 (25)	

TKA/OA - Satisfaction one year after surgery (2017)
VAS (0-100) (worst - best)

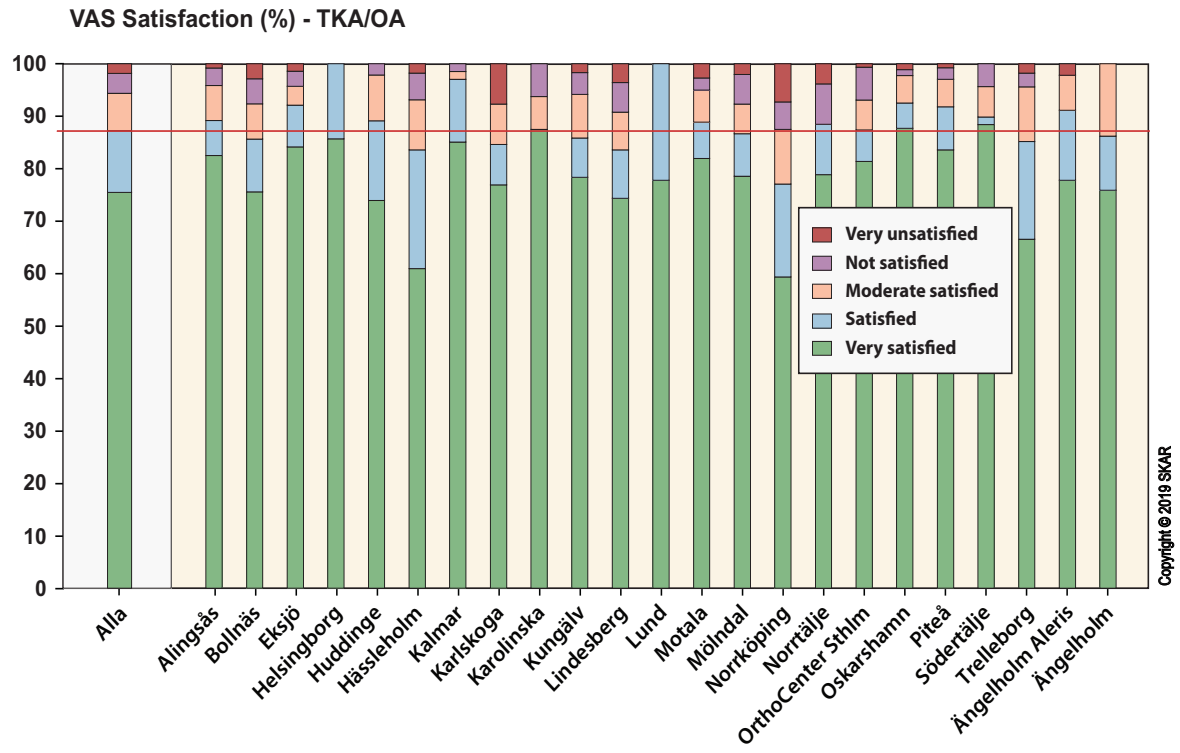
Hospital 2017	Number of reports	Complete reports (%)	Postop Mean (SD)
All units	4,721	70	16 (22)
Alingsås	186	65	13 (20)
Bollnäs	258	81	18 (24)
Eksjö	177	76	14 (19)
Helsingborg	18	39	11 (11)
Huddinge	79	58	18 (18)
Hässleholm	614	79	20 (22)
Kalmar	87	77	11 (15)
Karlskoga	22	59	18 (29)
Karolinska	34	44	12 (22)
Kungälv	158	76	16 (22)
Lindesberg	355	55	18 (25)
Lund	25	36	14 (22)
Motala	359	72	14 (22)
Mölndal	320	77	16 (23)
Norrköping	144	67	25 (29)
Norrtälje	115	45	17 (27)
OrthoCenter Sthlm	389	81	15 (23)
Ortopediska huset*	227	49	11 (17)
Oskarshamn	315	85	11 (17)
Piteå	232	58	12 (18)
Södertälje	137	51	11 (20)
Trelleborg	679	73	19 (22)
Ängelholm	86	34	16 (18)
Ängelholm Aleris	167	27	13 (19)

* enbart oct-dec

KOOS

The differences were small between those units having a relatively high response rate in 2016 (Bollnäs, Eksjö, Hässleholm, Kalmar, Kungälv, OrthoCenter Stockholm, Oskarshamn and Trelleborg). However, the patients in Eksjö reported somewhat less problems with postoperative sport and recreation function than those in Hässleholm, Kungälv, OrthoCenter Stockholm and Trelleborg. Further, the Eksjö patients reported higher knee related postoperative QOL than the patients in Kungälv. For units with few patients and/or low response rate the results vary and are difficult to interpret. The preoperative KOOS values in 2018 are similar to those reported in 2017.

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 2017 both the pre- and postoperative results are shown but for patients operated in 2018 only preoperative results are available (see table on page 74-75).



Proportion (%) of satisfied patients one year after surgery (in 2017) for all reporting units together (to the left) as well as for each unit seperately.

OMERACT-OARSI responders

In 89% of the reported surgeries in 2017, the patients became classified as responders acting to the OMERACT-OARSI criteria with 79% being high responders (see figure below). For the units with relatively high response rate the proportion of responders was 87-93%. In Kalmar and Orthocenter Stockholm, 93% were responders of which respectively 87% and 85% were high responders. In Eksjö and Oskarshamn, the corresponding result was 91% with 80% and 81% being high responders respectively. For units with few surgeries and/or low response rate the proportion of responders ranged between 78-100% of which high responders were 71-94%.

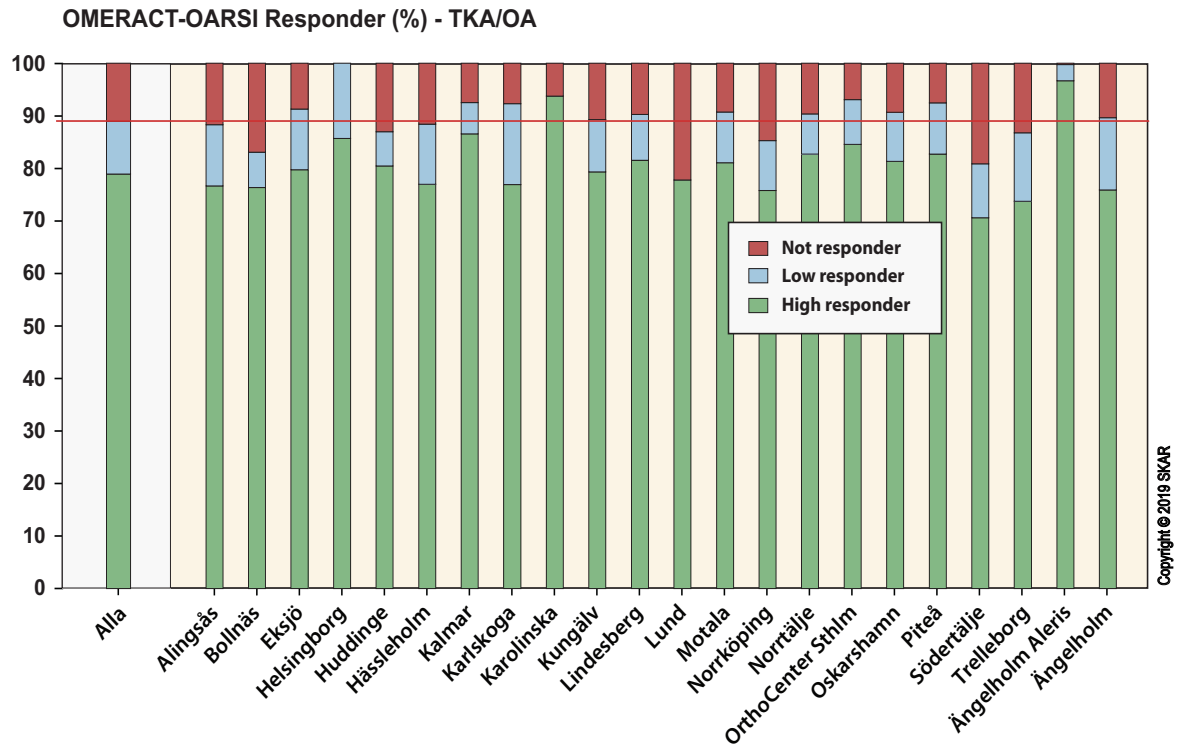
Summary

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 97% of the patients in Kalmar and 92% of those in Eksjö reported that they were very satisfied or satisfied one year after their knee arthroplasty surgery. Additionally, 93% of the patients in Kalmar and 91% of those in Oskarshamn 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 we 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 registries and hospitals and how the results can be used for clinical improvement.



Proportion (%) of OMERACT-OARSI responders one year after surgery (in 2017) for all reporting units together (to the left) as well as for each unit seperately.

TKA/OA - Results for KOOS preoperatively (surgeries 2017 & 2018) 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 *													
2017	4 721	70	42.2	41 (16)	81 (18)	46 (17)	78 (17)	47 (17)	80 (19)	12 (14)	39 (26)	22 (14)	65 (24)
2018	5 551	81	45.7	40 (15)		46 (18)		46 (17)		11 (15)		21 (14)	
Sjukhus													
Alingsås													
2017	186	65	35	42 (15)	82 (19)	48 (17)	79 (18)	48 (16)	81 (20)	14 (16)	37 (27)	24 (13)	65 (26)
2018	171	86	46.2	44 (15)		48 (18)		49 (16)		13 (14)		24 (15)	
Bollnäs													
2017	257	82	35.6	41 (16)	81 (19)	45 (16)	76 (17)	47 (16)	79 (18)	11 (15)	41 (26)	20 (12)	65 (23)
2018	314	97	41.1	41 (15)		46 (18)		47 (17)		13 (15)		21 (13)	
Eksjö													
2017	177	79	36	44 (15)	85 (16)	51 (17)	81 (16)	51 (15)	86 (17)	14 (14)	48 (28)	25 (12)	72 (22)
2018	250	90	44.3	42 (14)		48 (16)		47 (15)		14 (18)		24 (14)	
Helsingborg													
2017	18	39	71.4	44 (6)	82 (15)	50 (15)	81 (12)	40 (5)	76 (16)	4 (4)	25 (18)	18 (6)	62 (32)
2018	15	67	70	39 (16)		46 (18)		34 (17)		7 (13)		16 (11)	
Huddinge													
2017	79	58	47.8	34 (19)	77 (20)	41 (17)	70 (18)	38 (21)	69 (25)	10 (18)	32 (27)	19 (15)	54 (27)
2018	79	66	57.7	38 (15)		45 (19)		40 (15)		10 (15)		20 (14)	
Hudiksvall													
2018	58	76	53.3	38 (13		48 (17)		43 (16)		9 (11)		19 (11)	
Hässleholm													
2017	698	82	39	41 (15)	81 (18)	48 (17)	78 (15)	46 (16)	79 (18)	12 (14)	37 (28)	25 (14)	65 (23)
2018	701	98	45.6	39 (15)		46 (18)		44 (16)		10 (13)		21 (14)	
Kalmar													
2017	87	77	32.8	43 (16)	85 (15)	51 (18)	81 (16)	49 (15)	83 (15)	13 (16)	42 (25)	23 (13)	71 (23)
2018	79	78	54.8	44 (15)		53 (19)		46 (14)		11 (12)		23 (14)	
Karlskoga													
2017	22	59	38.5	34 (19)	80 (23)	37 (20)	72 (26)	41 (17)	77 (23)	5 (7)	42 (32)	20 (13)	63 (30)
2018													
Karolinska													
2017	34	47	80	34 (15)	74 (24)	43 (21)	72 (20)	36 (14)	68 (26)	9 (22)	16 (20)	13 (13)	58 (31)
2018	34	74	45.8	42 (20)		48 (22)		46 (20)		11 (18)		19 (11)	
Kungälv													
2017	158	77	47.1	39 (18)	82 (18)	45 (20)	77 (17)	46 (19)	80 (19)	11 (15)	36 (29)	22 (15)	63 (23)
2018	150	88	55	40 (17)		47 (20)		45 (17)		10 (14)		21 (14)	
Lindesberg													
2017	355	55	34	40 (13)	82 (18)	46 (17)	77 (17)	46 (14)	81 (18)	10 (12)	40 (29)	21 (12)	67 (24)
2018	443	49	46.9	39 (15)		43 (18)		46 (16)		9 (13)		19 (13)	
Lund													
2017	25	36	33.3	42 (14)	82 (21)	43 (18)	72 (11)	47 (11)	79 (21)	11 (11)	39 (35)	24 (11)	67 (30)
2018	24	13	33.3	36 (12)		55 (15)		39 (16)		2 (3)		10 (7)	

TKA/OA - Results for KOOS preoperatively (surgeries 2017 & 2018) as well as 1 year postoperatively (surgeries 2017)

				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.) :													
Motala													
2017	359	72	40,2	39 (16)	81 (19)	43 (18)	79 (18)	44 (16)	79 (19)	9 (11)	36 (26)	20 (12)	64 (23)
2018	372	87	45,9	38 (14)		42 (16)		43 (16)		10 (15)		20 (14)	
Mölndal													
2017	320	77	44,5										
2018	340	77	46,1										
Nacka													
2018 (feb-dec)	178	49	40	38 (14)		40 (16)		45 (13)		10 (12)		20 (12)	
Norrköping													
2017	144	67	46,3	38 (13)	74 (21)	42 (15)	72 (19)	43 (13)	73 (22)	9 (12)	27 (25)	19 (13)	54 (25)
2018	137	87	46,2	36 (14)		41 (18)		41 (16)		9 (12)		18 (11)	
Norrtälje													
2017	115	45	45,1	40 (14)	83 (20)	47 (18)	77 (18)	47 (15)	82 (15)	13 (18)	36 (27)	23 (13)	64 (23)
2018	135	45	47,7	43 (15)		52 (19)		50 (16)		12 (13)		25 (13)	
OrthoCenter Sthlm													
2017	389	81	40	41 (15)	83 (17)	46 (18)	79 (16)	49 (16)	83 (16)	13 (13)	40 (27)	22 (13)	65 (22)
2018	566	92	40,7	43 (16)		47 (18)		48 (17)		12 (15)		21 (15)	
Ortopediska huset													
2017 (okt-dec)	227	49	40,7										
2018	605	87	37,1										
Oskarshamn													
2017	315	85	42,4	42 (16)	85 (16)	47 (18)	80 (15)	46 (16)	84 (17)	12 (16)	46 (28)	21 (14)	69 (23)
2018	347	91	48	43 (15)		48 (17)		47 (16)		13 (16)		23 (13)	
Piteå													
2017	232	58	47,4	38 (14)	83 (17)	44 (17)	80 (15)	43 (14)	81 (17)	11 (16)	43 (28)	19 (12)	67 (24)
2018	272	65	44,9	38 (14)		44 (17)		43 (15)		10 (15)		19 (12)	
Södertälje													
2017	137	51	50	38 (16)	74 (24)	43 (19)	71 (22)	43 (18)	72 (25)	8 (11)	32 (27)	19 (14)	57 (26)
2018	138	75	58,4	37 (16)		44 (17)		41 (18)		10 (16)		20 (14)	
Trelleborg													
2017	679	76	46,3	42 (17)	81 (19)	48 (18)	77 (18)	49 (18)	80 (19)	13 (16)	38 (28)	24 (14)	66 (24)
2018	693	87	43	41 (16)		47 (18)		46 (18)		12 (17)		22 (13)	
Västervik													
2018	93	59	48,2	35 (14)		45 (20)		42 (17)		11 (17)		19 (13)	
Ängelholm Aleris													
2017	167	27	59	39 (16)	84 (14)	45 (20)	77 (16)	44 (17)	82 (17)	9 (9)	39 (26)	20 (13)	67 (21)
2018	109	77	52,2	40 (15)		46 (16)		45 (16)		12 (15)		21 (13)	
Ängelholm													
2017	86	34	62,1	43 (19)	81 (17)	47 (17)	80 (13)	46 (18)	80 (19)	10 (10)	39 (28)	21 (11)	63 (22)
2018	161	55	50,6	38 (17)		43 (18)		42 (18)		9 (15)		19 (15)	

* All except Mölndal and Ortopediska huset which do not report KOOS but Charnley dass

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 40% of the reported UKA results. The outcome is similar as that for TKAs with small differences between units pre- and postoperatively. 89% of the UKA patients reported that they were satisfied or very satisfied with the surgery and 92% were classified as OMERACT-OARSI responders of which 84% were high responders.

UKA/OA - Satisfaction one year after surgery (2017)
Proportion of very satisfied or satisfied (VAS 0-40)

Hospital	Number of reports	Complete reports (%)	Postop: very satisfied or satisfied (%)
All reporting units	**400**	**61**	**89**
Eksjö	17	71	92
Huddinge	19	68	92
Kungälv	33	70	78
Lindesberg	18	0	
Motala	163	64	90
OrthoCenter Sthlm	21	67	100
Piteå	39	59	91
Trelleborg	31	74	78
Ängelholm Aleris	34	32	100

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						
2017	400	61	65 (17)	15 (19)	63 (23)	79 (18)
2018	578	82	65 (20)		61 (23)	
Hospital :						
Bollnäs						
2017	25	76	58 (20)	14 (24)	63 (22)	78 (26)
2018	27	96	58 (16)		61 (20)	
Eksjö						
2017	17	71	58 (19)	21 (15)	73 (20)	77 (19)
2018	22	95	63 (17)		57 (25)	
Huddinge						
2017	19	68	60 (25)	12 (14)	66 (22)	76 (18)
2018	12	67	77 (11)		49 (27)	
Hässleholm						
2018	12	92	61 (24)		67 (22)	
Kungälv						
2017	33	70	62 (16)	18 (22)	57 (22)	73 (18)
2018	42	83	64 (20)		61 (22)	
Lindesberg						
2017	18	0				
2018	20	40	73 (8)		62 (16)	
Motala						
2017	163	64	68 (13)	16 (21)	63 (22)	78 (19)
2018	219	83	68 (17)		64 (21)	
Mölndal						
2018	13	92	72 (11)		55 (19)	
OrthoCenter Sthlm						
2017	21	67	64 (20)	7 (9)	72 (22)	89 (11)
2018	68	94	67 (15)		61 (23)	
Ortopediska huset						
2018	13	92	45 (29)		75 (18)	
Piteå						
2017	39	59	73 (16)	8 (12)	57 (24)	78 (15)
2018	69	58	74 (16)		56 (22)	
Trelleborg						
2017	31	81	65 (16)	25 (21)	69 (22)	79 (15)
2018	33	94	62 (23)		67 (17)	
Ängelholm Aleris						
2017	34	32	55 (15)	1 (1)	54 (27)	92 (6)
2018	28	79	30 (33)		34 (32)	

UKA/OA - Results for KOOS preoperatively (surgeries 2017 & 2018) as well as 1 year postoperatively (surgeries 2017)

				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 *													
2017	400	61	42	41 (15)	84 (17)	48 (16)	81 (16)	49 (16)	84 (17)	14 (16)	43 (27)	23 (14)	67 (23)
2018	578	82	39	40 (15)		48 (18)		46 (16)		12 (14)		20 (13)	
Hospital													
Bollnäs													
2017	25	76	42,1	45 (14)	82 (25)	48 (16)	82 (20)	52 (17)	85 (22)	19 (17)	51 (33)	27 (14)	78 (26)
2018	27	96	24	47 (12)		52 (13)		51 (11)		17 (13)		22 (10)	
Eksjö													
2017	17	71	57,1	44 (22)	82 (17)	53 (20)	79 (19)	59 (23)	80 (18)	22 (29)	44 (25)	30 (21)	77 (19)
2018	22	95		43 (16)		46 (16)		47 (16)		13 (12)		21 (15)	
Huddinge													
2017	19	68	45,5	45 (15)	88 (15)	49 (18)	80 (18)	52 (17)	86 (18)	12 (18)	54 (24)	21 (18)	76 (18)
2018	12	67	75	35 (25)		41 (25)		40 (27)		14 (20)		17 (13)	
Hässleholm													
2018	12	92	27,3	39 (14)		55 (17)		52 (20)		12 (15)		22 (15)	
Kungälv													
2017	33	70	50	43 (16)	82 (19)	50 (18)	80 (14)	50 (15)	82 (16)	10 (12)	34 (28)	23 (12)	73 (18)
2018	42	83	44,1	41 (16)		50 (18)		45 (16)		11 (16)		19 (16)	
Lindesberg													
2017	18	0											
2018	20	40	25	33 (18)		36 (17)		44 (18)		5 (6)		13 (7)	
Motala													
2017	163	64	43,3	39 (13)	85 (17)	46 (16)	82 (16)	46 (14)	84 (17)	12 (13)	40 (27)	22 (13)	78 (19)
2018	219	83	36,8	40 (15)		46 (17)		46 (16)		11 (14)		21 (12)	
Mölndal													
2018	13	92	25										
OrthoCenter Sthlm													
2017	21	67	42,9	43 (18)	87 (11)	49 (22)	84 (10)	52 (21)	86 (16)	23 (17)	55 (23)	23 (12)	89 (11)
2018	68	94	35,9	40 (14		49 (18)		46 (14)		11 (12)		19 (12)	
Ortopediska huset													
2018	13	92	30										
Piteå													
2017	39	59	47,8	36 (16)	88 (14)	39 (14)	82 (13)	43 (17)	84 (16)	4 (7)	43 (24)	15 (11)	78 (15)
2018	69	58	56,4	35 (13)		43 (21)		43 (16)		10 (15)		16 (11)	
Trelleborg													
2017	31	81	44	42 (13)	80 (18)	55 (14)	78 (18)	49 (14)	78 (20)	16 (18)	42 (26)	23 (13)	79 (15)
2018	33	94	32,3	45 (16)		54 (18)		49 (19)		20 (19)		24 (17)	
Ängelholm Aleris													
2017	34	32	37,5	45 (15)	90 (11)	54 (11)	85 (12)	51 (18)	91 (10)	15 (13)	57 (28)	30 (14)	92 (6)
2018	28	79	33,3	41 (19)		50 (21)		49 (17)		11 (12)		22 (12)	

* All except Mölndal and Ortopediska Huset which do not report KOOS but Chamley 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.

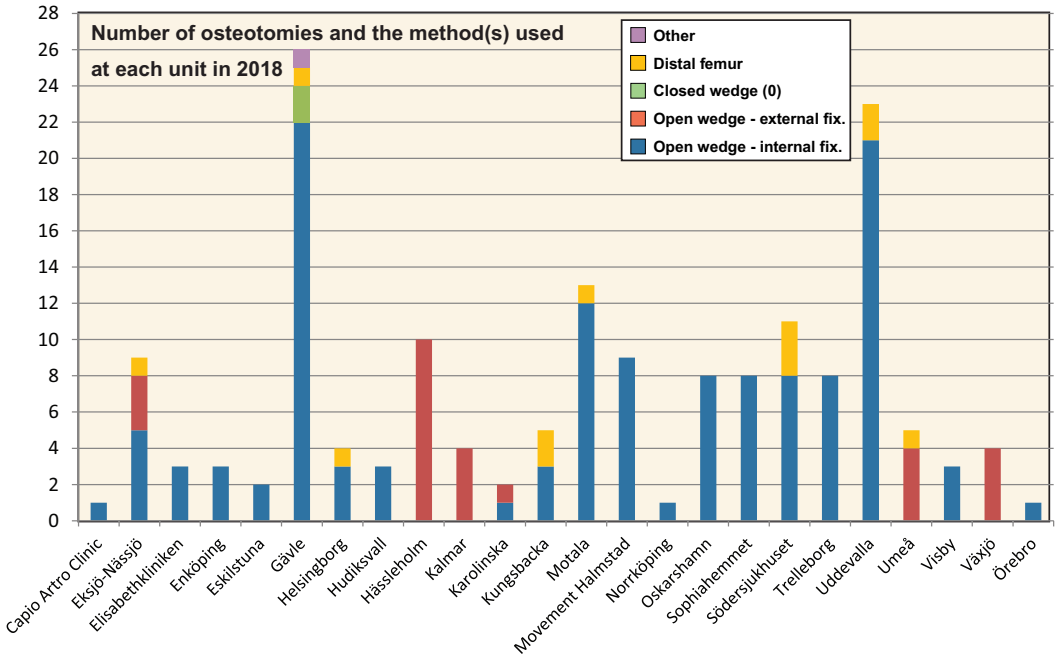
The choice of method and technique may have an effect on the short- and long-term risk for complications as well as influence a later knee replacement with respect to techniques used and outcome. The health economical perspective is also important for the health providers, the society and not least the 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 2018, 163 osteotomies were reported from 24 hospitals. As the figure below shows, only 5 hospitals reported having performed 10 or more osteotomies during the year. The hospital performing most was Gävle that did 26. As compared to 2017 the number of reported osteotomies was one less 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 2014-2017 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 2014-2017.



Patient characteristics and case-mix in knee osteotomy surgery

Results

The following pages show the results for the knee osteotomies that were reported in 2018.

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

67% of the patients were males and the median age was 51 years that can be compared to the median age in 2018 for TKA patients (70) and UKA (65.6). A good half of the patients were reported as beging healthy (ASA class I) and having a mean BMI of 28. 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=163	Prox. Tibia n=151 (93%)	Dist. Femur n=12 (7%)
Age (years)			
median (range)	51 (21-72)	52 (22-72)	33 (21-49)
Gender			
Men - n (%)	109 (67)	107 (71)	2
Women - n (%)	54 (33)	44 (29)	10
Preop HKA angle, n=161			
median (range)	7 (0-25)	7 (0-18)	9 (0-25)
ASA classification, n=159			
ASA I - n (%)	87 (53)	81 (54)	6
ASA II - n (%)	71 (44)	67 (44)	4
ASA III-IV - n (%)	5 (3)	3 (2)	2
Compartment affected, n=161			
Medial n (%)	151 (93)	148 (98)	3
Lateral n (%)	12 (7)	3 (2)	9
Diagnosis OA:	149 (91)	141 (93)	8
OA grade, n=147			
Ahlbäck 1 - n (%)	72 (49)	68 (45)	4
Ahlbäck 2 - n (%)	59 (40)	55 (36)	4
Ahlbäck 3 - n (%)	16 (11)	16 (11)	0

Body Mass Index

BMI group	Number	Percent
<25	34	20.9
25-29.9	78	47.9
30-34.9	36	22.1
35-39.9	14	8.5
40+	1	0.6
Missing	0	0
Total	163	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 63% of the patients and more than one surgery for 15%. 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	59	36.2
Fracture surgery	2	1.2
Meniscal surgery	43	26.4
Cruciate surgery	18	11.1
Arthroscopy	37	22.7
Other	2	1.2
Missing	2	1.2
Total	163	100

Reason for and type of osteotomy

The majority of the surgeries (91%) were performed for osteoarthritis. The most common method was open wedge with internal fixation followed by open wedge with external fixation. Two closed wedge osteotomies were reported in 2018 (none in 2016 and 2017) but for a long time this was the standard treatment for osteoarthritis in Sweden.

Reason for the osteotomy

Diagnosis	Number	Percent
Osteoarthritis	149	91.4
Acquired deformity	1	0.6
Congenital deformity	4	2.5
Instability	3	1.8
Osteonecrosis	1	0.6
Other	5	3.1
Missing	0	0.0
Total	163	100

Type of osteotomy

Type	Number	Percent
Open wedge intern fixation	125	76.7
Open wedge extern fixation	23	14.1
Closed wedge	2	1.2
Curved/Dome	1	0.6
Distal femur	12	7.4
Missing	0	0.0
Total	163	100

Technique and prophylaxis for knee osteotomies

Open wedge osteotomy with internal fixation

Many 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	77	61.6
CountourLock	1	0.8
Puddu	20	16.0
iBalance	7	5.6
PEEKPower	18	14.4
Other	1	0.8
Missing	1	0.8
Total	125	100

Transplantation of bone

No bone transplantation was reported in good half of the open wedge osteotomies that used internal fixation,. In case of bone transplantation, synthetic bone was most commonly used followed by bank bone and auto transplantation (see table). OSferion was the most commonly used synthetic bone.

Transplantation of bone in open wedge osteotomy with internal fixation

Bone transplantate	Number	Percent
None	70	56.0
Auto transplantation	5	4.0
Bank bone	13	10.4
Synthetic bone	37	29.6
Missing	0	0.0
Total	125	100
Synthetic bone:		
DePuy/Synthes Chronos	9	
Osferion	23	
Quickset	2	
Other	2	
Missing	1	

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	18
Monotube	4
Taylor Spatial frame	1
Missing	0
Total	23

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
ContourLock	0
Tomofix	8
Puddu	3
Monotub	1
Missing	0
Total	12

Simultaneous surgery

An additional simultaneous surgery was reported to have been performed together with the osteotomy in 23 (14%) cases. Arthroscopy was the most common simultaneous procedure (see below).

Simultaneous surgery with the osteotomy

Surgery	Number	Percent
None	133	81.5
Arthroscopy	12	7.4
Cruciate surgery	5	3.1
Meniscal surgery	0	0.0
Other	6	3.7
Missing	7	4.3
Total	163	100

Type of anesthesia

General anesthesia which was used in 65% of cases was the most common method (see table).

.

Type of anesthesia

Type	Number	Percent
General	106	65.0
Epidural	1	0.6
Spinal	55	33.8
Missing	1	0.6
Total	163	100

Operating time

After excluding osteotomies performed with another simultaneous surgery, the median operating time was shorter for open wedge osteotomies with external fixation (48 min, 17-93) than for those with internal fixation (63 min, 26-189). The median time for distal femur osteotomies was 90 min, 50-177). The table below shows the median operating times including those osteotomies done with simultaneous surgeries.

Operating time

Type of osteotomy(n)	Median (min)	Range (Min)
Open wedge internal	66	(2-189)
Open wedge external	48	(17-124)
Distal femur	90	(50-177)
Closed wedge	69	(67-71)
Curved/Dome	156	

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 substances. When Fragmin, Innohep or Klexane was used, the prophylaxis more often started postoperatively. Five percent of the osteotomy patients did not receive any antithrombotic prophylaxis at all (see table), unlike the knee arthroplasty patients which almost always receive prophylaxis.

Thromboprophylaxis

Substance - time	Number	Percent
No prophylaxis	8	4.9
Fragmin preop	7	4.3
Fragmin postop	59	36.2
Inohep preop	2	1.2
Inohep postop	66	40.5
Klexane preop	5	3.1
Klexane postop	10	6.1
Eliqvis	6	3.7
Total	163	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	8	4.9
1-7	12	7.4
8-14	124	76.1
15-21	3	1.8
22-28	15	9.2
29-35	0	0.0
>35	0	0.0
Missing	1	0.6
Total	163	100

Antibiotic drugs

Cloxacilline or Clindamicin were used in all the surgeries for which a substance name was reported. Clindamycin was used in 6% of the surgeries which is somewhat lower proportion than seen for knee arthroplasties (7%). As use of Clindamicin 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 Aptil 2018 (www.patientforsakringen.se).

Antibiotic drug

Substance	Number	Percent
Cloxacilline	152	93.3
Clindamicin	10	6.1
Other	1	0.6
Missing	0	0.0
Total	163	100

Cloxacillin dosage

For 56% of the osteotomies it was reported that the intention was to use 2g x 3 within 24 hours while 26% were planned having a single 2g dose (see below).

Cloxacillin dose

Dose	Number	Percent
Cloxacilline 2gx1	39	25.7
Cloxacilline 2gx2	22	14.5
Cloxacilline 2gx3	85	55.9
Cloxacilline 2gx4	3	2.0
Cloxacilline 1gx3	2	1.3
Other	1	0.0
Missing	0	0.6
Total	152	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 Cloxacilline 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 36% of the osteotomies it was reported that the preoperative dose had been given within the currently PRISS recommended time interval (table below) while 62% lied within the previously recommended time interval.

Antibiotic - time of administration (PRISS recommendation)

Min. before surgery	Number	Percent
0-29	52	31.9
30-45	58	35.6
>45	39	23.9
Start after surgery	9	5.5
No antibiotic administered	1	0.6
Missing	4	2.5
Total	163	100

Tourniquet and drainage

Use of tourniquet is popular among Swedish orthopedic surgeons and it was used in 61% of the osteotomies (table below) as compared to 38% of the knee arthroplasties. Drainage was used in 11% of the osteotomies as compared to less than 1% of the knee arthroplasties.

Tourniquet and drainage

Tourniquet	Number	Percent
Yes	18	11.0
No	145	89.0
Missing	0	0.0
Total	163	100

Drainage	Number	Percent
Yes	100	61.4
No	61	37.4
Missing	2	1.2
Total	163	100

Re-operations

Since the start of the osteotomy register in 2013, more than 50 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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