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

Annual Report 2018

Swedish Knee Arthroplasty Register

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

Primary knee arthroplasties 1975-2017
Revision knee arthroplasties 1975-2016
Knee osteotomies 2013-2017

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 pages seem to have many visitors. Our webpage for the patients (www.gangbar.se) is most popular having 55,000 unique visits during 2017. The average user spent 3 minutes on the page. The register website (www.knee.se) has almost 10,000 unique visitors of which most looked at the English version. The statistics webpage which was completed in 2017 and includes both perioperative- as well as PROM-data had 2,500 unique visits (4 minutes on average). However, during the first half of 2018, the number increased to 3,100 which indicate a great interest in the register results. 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.

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 neccessary to perform additional clinical controls. That the SKAR has done this for 18 years shows its engagement concerning patient safety.

For the third 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 2017 as well as analyses covering the 10-year period 2007-2016.

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 and the head of department. It provides compilations of what the hospital has reported as well as information on all surgeries reported by the unit for 2017 (sorted by ID and date of surgery). It is our hope that this hospital specific information will be compared to other available information in order to identify and correct potential registration errors.

We also provide a USB stick containing an Excel file with all the reported surgeries by the hospital, a PDF file with the annual report and graphics comparing the revision rate of the unit to that of the national average.
It is important to inform your colleagues about the report to stimulate discussions and analyses that can be used to initiate 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.

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 25th, 2018.

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, 73 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% and by 6.5% in 2017 to 14,957 primaries, the largest number ever reported in one year. We consider it likely that the volumes will continue to increase as the incidence in Sweden (see page 19) still is lower than in countries such as USA and Germany. 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, 16 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 2017). Analyses concerning the revision rate end one year earlier (2016). 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. How-

ever, 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 ICOR (International Collaboration of Orthopedic Registries) 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). 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. Thus, we now provide information in this respect on pages 8-9.

The Office has concurrently also reduced the funding of the register by more than 30% which will affect the register activity and probably the future annual reports.

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 (5 cm. or more).

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 2016

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 98.1% of all admissions and the NPR 89.5%.

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	Number	SKAR-percent	NPR percent
Akademiska	88	100.0	100.0
Alingsås	159	99.4	98.7
Art Clinic Göteborg	55	100.0	0
Art Clinic Jönköping	24	100.0	0
Arvika	174	98.9	95.4
Blekingesjukhuset*	306	99.7	81.7
Bollnäs (Aleris)	347	98.6	94.2
Carlanderska	156	100.0	0
Danderyd	190	97.4	96.8
Eksjö	221	99.5	99.5
Elisabethsjukhuset	7	100.0	100.0
Enköping	346	99.7	99.4
Eskilstuna Mälarsjh.	55	100.0	100.0
Falun	272	98.9	33.1
Gällivare	53	100.0	100.0
Gävle	163	90.2	91.4
Hallands sjukhus**	9	0	100.0
Halmstad	208	100.0	95.7
Halmstad Capio Movement	412	100.0	0
Helsingborg	42	97.6	97.6
Huddinge	172	97.7	98.3
Hudiksvall	76	97.4	94.7
Hässleholm	622	99.4	99.0
Kalmar	91	98.9	100.0
Karlskoga	104	100.0	100.0
Karlstad	151	95.4	95.4
Karolinska Solna	102	96.1	98.0
Kullbergska	162	96.3	96.3
Kungälv	204	95.6	97.1
Lindesberg	318	99.7	99.7
Ljungby	152	97.4	99.3
Luleå-Sensia	11	100.0	0
Lund	114	100.0	94.7
Lycksele	131	99.2	100.0
Löwenströmska (Ortho Center)	444	100.0	90.8
Mora	208	97.1	97.6
Motala	557	98.2	99.1
Nacka	156	98.7	96.8
Norrköping Vrinnevisjh.	165	97.0	99.4
Norrtälje	124	99.2	100.0
NU-sjukvården***	243	99.6	98.8
Nyköping	74	98.6	97.3
Ortho Center IFK-Kliniken	125	100.0	0
Ortopediska Huset	645	96.9	82.0
Oskarshamn	318	99.4	100.0
Piteå	281	98.9	98.2
Ryhov	138	97.8	99.3
S:t Göran	488	96.1	98.6
Sahlgrenska****	512	97.9	98.2
Skaraborgs sjukhus*****	355	95.2	98.3
Skellefteå	82	97.6	98.8
Sollefteå	103	99.0	95.1
Sophiahemmet	125	98.4	40.0
Sundsvall	12	100.0	100.0
Södersjukhuset	331	96.7	99.1
Södertälje	166	97.6	97.6
Södra Älvsborgs sjukhus**	213	95.8	97.7
Torsby	110	96.4	100.0
Trelleborg	760	98.9	98.4
Umeå	112	98.2	92.9
Varberg	185	100.0	100.0
Visby	80	95.0	98.8
Värnamo	149	95.3	96.6
Västervik	100.0	99.0	100.0
Västerås	221	97.7	98.2
Växjö	105	96.2	100.0
Ängelholm	337	98.8	93.5
Örebro	48	97.9	95.8
Örnsköldsvik	144	99.3	99.3
Östersund	147	95.9	99.3
Other units	2	0	100.0

* Blekingesjukhuset is the combined name for the hospitals in Karlshamn and Karlskrona.
** Hallands sjukhus includes Halmstad (which is in the list) and Varberg.
*** 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.

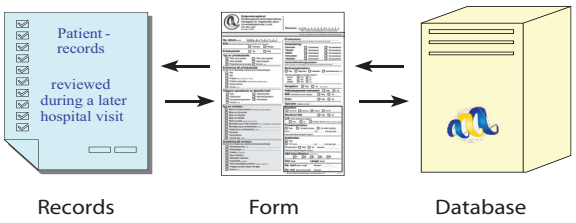
Method of validation at the hospital level

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 year 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 2017, almost 15,000 primary knee arthroplasties were performed to the cost of more than 1 billion SEK. Additionally 900 revisions were performed (approx. 200 million SEK). Using a fraction of this cost for quality control and improvement work within the field of knee arthroplasty surgery seems reasonable.

The basic value

The main function of the register has been to describe the knee arthroplasty surgery performed in the Swedish health care system. What patients are treated, what methods and implants are used, how the results are affected and how the patients experience their treatment. Without such information it is not possible for the profession or decision makers to realize that their own routines may not be the most optimal or cost-effective. The patients gain knowledge on what 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 18 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 18 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 2017, 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 achieved permission to gather 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 2014-2016

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 by the National Board of Health and Welfare in their publication "Öppna Jämförelser - Säker vård - En indikatorbaserad uppföljning" that can be found at: http://www.socialstyrelsen.se/publikationer2017/2017-1-16.

Description

Patients having primary total knee arthroplasty for osteoarthritis during 2014-2016 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	386	6	15.5
Dalarna	735	22	29.9
Gotland	105	3	28.6
Gävleborg	825	12	14.5
Halland	1,169	30	25.7
Jämtland	208	12	57.7
Jönköping	814	24	29.5
Kalmar	778	31	39.8
Kronoberg	317	21	66.2
Norrbotten	481	13	27.0
Skåne	2,871	70	24.4
Stockholm	3,870	104	26.9
Sörmland	480	11	22.9
Uppsala	756	50	66.1
Värmland	714	23	32.2
Västerbotten	486	27	55.6
Västernorrland	413	18	43.6
Västmanland	367	11	30.0
Västra Götaland	2,893	61	21.1
Örebro	619	14	22.6
Östergötland	830	36	43.4
The Country	20,117	599	29.8

MEN in the counties

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

County	Surgeries	Events	Risk/1000
Blekinge	337	14	41.5
Dalarna	589	23	39.0
Gotland	93	6	64.5
Gävleborg	692	13	18.8
Halland	940	34	36.2
Jämtland	128	6	46.9
Jönköping	641	24	37.4
Kalmar	572	32	55.9
Kronoberg	273	10	36.6
Norrbotten	387	10	25.8
Skåne	2,062	58	28.1
Stockholm	3,016	98	32.5
Sörmland	371	16	43.1
Uppsala	553	31	56.1
Värmland	524	22	42.0
Västerbotten	366	33	90.2
Västernorrland	319	13	40.8
Västmanland	219	9	41.1
Västra Götaland	2,321	74	31.9
Örebro	436	18	41.3
Östergötland	572	25	43.7
The Country	15,411	569	36.9

Adverse cardiovascular events within 90 days (DC)

County	Surgeries	Events	Risk/1000
Blekinge	386	1	2.6
Dalarna	735	4	5.4
Gotland	105	0	0.0
Gävleborg	825	7	8.5
Halland	1,169	5	4.3
Jämtland	208	3	14.4
Jönköping	814	3	3.7
Kalmar	778	4	5.1
Kronoberg	317	2	6.3
Norrbotten	481	2	4.2
Skåne	2,871	16	5.6
Stockholm	3,870	19	4.9
Sörmland	480	1	2.1
Uppsala	756	6	7.9
Värmland	714	2	2.8
Västerbotten	486	3	6.2
Västernorrland	413	3	7.3
Västmanland	367	7	19.1
Västra Götaland	2,893	19	6.6
Örebro	619	2	3.2
Östergötland	830	4	4.8
The Country	20,117	113	5.6

Adverse cardiovascular events within 90 days (DC)

County	Surgeries	Events	Risk/1000
Blekinge	337	4	11.9
Dalarna	589	3	5.1
Gotland	93	0	0.0
Gävleborg	692	15	21.7
Halland	940	7	7.4
Jämtland	128	1	7.8
Jönköping	641	3	4.7
Kalmar	572	5	8.7
Kronoberg	273	3	11.0
Norrbotten	387	2	5.2
Skåne	2,062	22	10.7
Stockholm	3,016	20	6.6
Sörmland	371	4	10.8
Uppsala	553	7	12.7
Värmland	524	10	19.1
Västerbotten	366	4	10.9
Västernorrland	319	7	21.9
Västmanland	219	0	0.0
Västra Götaland	2,321	22	9.5
Örebro	436	5	11.5
Östergötland	572	6	10.5
The Country	15,411	150	9.7

Other adverse medical events within 90 days. (DM)

County	Surgeries	Events	Risk/1000
Blekinge	386	3	7.8
Dalarna	735	5	6.8
Gotland	105	1	9.5
Gävleborg	825	6	7.3
Halland	1,169	10	8.6
Jämtland	208	6	28.8
Jönköping	814	10	12.3
Kalmar	778	13	16.7
Kronoberg	317	5	15.8
Norrbotten	481	3	6.2
Skåne	2,871	29	10.1
Stockholm	3,870	59	15.2
Sörmland	480	4	8.3
Uppsala	756	7	9.3
Värmland	714	4	5.6
Västerbotten	486	9	18.5
Västernorrland	413	7	16.9
Västmanland	367	2	5.4
Västra Götaland	2,893	29	10.0
Örebro	619	4	6.5
Östergötland	830	11	13.3
The Country	20,117	227	11.3

Other adverse medical events within 90 days. (DM)

County	Surgeries	Events	Risk/1000
Blekinge	337	2	5.9
Dalarna	589	3	5.1
Gotland	93	1	10.8
Gävleborg	692	8	11.6
Halland	940	7	7.4
Jämtland	128	2	15.6
Jönköping	641	5	7.8
Kalmar	572	22	38.5
Kronoberg	273	4	14.7
Norrbotten	387	1	2.6
Skåne	2,062	32	15.5
Stockholm	3,016	55	18.2
Sörmland	371	6	16.2
Uppsala	553	8	14.5
Värmland	524	7	13.4
Västerbotten	366	23	62.8
Västernorrland	319	9	28.2
Västmanland	219	3	13.7
Västra Götaland	2,321	25	10.8
Örebro	436	3	6.9
Östergötland	572	11	19.2
The Country	15,411	237	15.4

WOMEN in the counties
Death within 90 days

County	Surgeries	Events	Risk/1000
Blekinge	386	1	2.6
Dalarna	735	1	1.4
Gotland	105	0	0.0
Gävleborg	825	0	0.0
Halland	1,169	1	0.9
Jämtland	208	0	0.0
Jönköping	814	0	0.0
Kalmar	778	2	2.6
Kronoberg	317	0	0.0
Norrbotten	481	1	2.1
Skåne	2,871	2	0.7
Stockholm	3,870	3	0.8
Sörmland	480	1	2.1
Uppsala	756	0	0.0
Värmland	714	0	0.0
Västerbotten	486	0	0.0
Västernorrland	413	1	2.4
Västmanland	367	0	0.0
Västra Götaland	2,893	3	1.0
Örebro	619	0	0.0
Östergötland	830	3	3.6
The Country	20,117	19	0.9

MEN in the counties
Death within 90 days

County	Surgeries	Events	Risk/1000
Blekinge	337	0	0.0
Dalarna	589	2	3.4
Gotland	93	0	0.0
Gävleborg	692	2	2.9
Halland	940	1	1.1
Jämtland	128	2	15.6
Jönköping	641	2	3.1
Kalmar	572	3	5.2
Kronoberg	273	0	0.0
Norrbotten	387	1	2.6
Skåne	2,062	9	4.4
Stockholm	3,016	2	0.7
Sörmland	371	2	5.4
Uppsala	553	1	1.8
Värmland	524	0	0.0
Västerbotten	366	0	0.0
Västernorrland	319	1	3.1
Västmanland	219	1	4.6
Västra Götaland	2,321	3	1.3
Örebro	436	0	0.0
Östergötland	572	0	0.0
The Country	15,411	32	2.1

All adverse events within 90 days (incl. death)

County	Surgeries	Events	Risk/1000
Blekinge	386	11	28.5
Dalarna	735	29	39.5
Gotland	105	3	28.6
Gävleborg	825	24	29.1
Halland	1,169	44	37.6
Jämtland	208	20	96.2
Jönköping	814	34	41.8
Kalmar	778	46	59.1
Kronoberg	317	27	85.2
Norrbotten	481	17	35.3
Skåne	2,871	110	38.3
Stockholm	3,870	172	44.4
Sörmland	480	16	33.3
Uppsala	756	62	82.0
Värmland	714	28	39.2
Västerbotten	486	36	74.1
Västernorrland	413	27	65.4
Västmanland	367	18	49.0
Västra Götaland	2,893	108	37.3
Örebro	619	19	30.7
Östergötland	830	50	60.2
The Country	20,117	901	44.8

All adverse events within 90 days (incl. death)

County	Surgeries	Events	Risk/1000
Blekinge	337	18	53.4
Dalarna	589	31	52.6
Gotland	93	7	75.3
Gävleborg	692	35	50.6
Halland	940	47	50.0
Jämtland	128	11	85.9
Jönköping	641	33	51.5
Kalmar	572	53	92.7
Kronoberg	273	15	54.9
Norrbotten	387	14	36.2
Skåne	2,062	111	53.8
Stockholm	3,016	168	55.7
Sörmland	371	25	67.4
Uppsala	553	45	81.4
Värmland	524	37	70.6
Västerbotten	366	51	139.3
Västernorrland	319	28	87.8
Västmanland	219	13	59.4
Västra Götaland	2,321	119	51.3
Örebro	436	25	57.3
Östergötland	572	39	68.2
The Country	15,411	925	60.0

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 3.3% 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 0.14% die within the first 90 days. The overall risk for a patient for experiencing a least one adverse event during this time is 5.1%.

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	723	1	1.2
Dalarna	1,324	3	2.0
Gotland	198	0	0.0
Gävleborg	1,517	2	1.3
Halland	2,109	2	1.1
Jämtland	336	2	6.2
Jönköping	1,455	2	1.1
Kalmar	1,350	5	3.6
Kronoberg	590	0	0.0
Norrbotten	868	2	2.4
Skåne	4,933	11	2.2
Stockholm	6,886	5	0.8
Sörmland	851	3	3.6
Uppsala	1,309	1	0.8
Värmland	1,238	0	0.0
Västerbotten	852	0	0.0
Västernorrland	732	2	2.5
Västmanland	586	1	1.5
Västra Götaland	5,214	6	1.1
Örebro	1,055	0	0.0
Östergötland	1,402	3	1.8
The Country	35,528	51	1.4

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

County	Surgeries	Events	Risk/1000
Blekinge	723	28	38.4
Dalarna	1,324	60	45.3
Gotland	198	9	47.6
Gävleborg	1,517	58	38.6
Halland	2,109	92	43.5
Jämtland	336	32	94.2
Jönköping	1,455	65	44.8
Kalmar	1,350	100	73.9
Kronoberg	590	43	73.1
Norrbotten	868	31	36.3
Skåne	4,933	219	44.5
Stockholm	6,886	350	50.8
Sörmland	851	40	47.5
Uppsala	1,309	107	81.7
Värmland	1,238	65	52.4
Västerbotten	852	87	102.6
Västernorrland	732	55	74.8
Västmanland	586	31	52.7
Västra Götaland	5,214	229	43.8
Örebro	1,055	43	41.1
Östergötland	1,402	88	62.8
The Country	35,528	1 826	51.4

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	244	17	69.7
Alingsås	543	13	23.9
Art Clinic Gbg	68	2	29.4
Art Clinic Jönköping	60	0	0.0
Arvika	480	15	31.3
Bollnäs	977	12	12.3
Borås	209	10	47.8
Carlanderska	408	3	7.4
Danderyd	343	9	26.2
Eksjö	573	23	40.1
Enköping	1,062	64	60.3
Eskilstuna	121	11	90.9
Falun	797	27	33.9
Frölunda Spec.	242	4	16.5
Gällivare	161	3	18.6
Gävle	324	9	27.8
Halmstad	548	30	54.7
Helsingborg	149	3	20.1
Huddinge	377	14	37.1
Hudiksvall	216	4	18.5
Hässleholm	1,769	58	32.8
Jönköping	422	11	26.1
Kalmar	248	7	28.2
Karlshamn	723	20	27.7
Karlskoga	333	6	18.0
Karlstad	435	19	43.7
Karolinska	211	15	71.1
Kullbergska sjukhuset	491	15	30.5
Kungälv	479	17	35.5
Lidköping	646	24	37.2
Lindesberg	621	24	38.6
Ljungby	334	18	53.9
Luleå-Sensia	20	1	50.0
Lund	200	7	35.0
Lycksele	257	16	62.3
Mora	527	18	34.2
Motala	1,007	44	43.7
Movement Halmstad	1,024	14	13.7
Mölndal	1,135	29	25.6
Nacka-Proxima/Aleris	407	8	19.7
Norrköping	395	17	43.0
Norrtälje	276	19	68.8
Nyköping	239	1	4.2
Ortho Center Stockh.(Löw)	1,209	15	12.4
OrthoCenter IFK Klin	326	2	6.1
Ortopediska huset	1,443	23	15.9
Oskarshamn	824	41	49.8
Piteå	687	19	27.7
S:t Göran	1,079	44	40.8
Sabbatsberg	163	1	6.1
Skellefteå	291	14	48.1
Skene	293	6	20.5
Skövde	323	8	24.8
Sollefteå	271	11	40.6
Sophiahemmet	216	3	13.9
Spenshult	142	5	35.2
Sundsvall	134	7	52.2
Södersjukhuset	789	34	43.1
Södertälje	373	17	45.6
Torsby	323	11	34.1
Trelleborg	2,114	34	16.1
Uddevalla	540	17	31.5
Umeå	304	30	98.7
Varberg	395	15	38.0
Visby	198	9	45.5
Värnamo	400	14	35.0
Västervik	278	15	54.0
Västerås	586	20	34.1
Växjö	256	13	50.8
Ängelholm	700	26	37.1
Örebro	101	2	19.8
Örnsköldsvik	327	13	39.8
Östersund	336	18	53.6
The Country	35,528	1,168	32.9

Adverse cardiovascular events within 90 days (DC)

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	244	4	16.4
Alingsås	543	5	9.2
Art Clinic Gbg	68	1	14.7
Art Clinic Jönköping	60	0	0.0
Arvika	480	2	4.2
Bollnäs	977	11	11.3
Borås	209	5	23.9
Carlanderska	408	3	7.4
Danderyd	343	3	8.7
Eksjö	573	3	5.2
Enköping	1,062	9	8.5
Eskilstuna	121	1	8.3
Falun	797	4	5.0
Frölunda Spec.	242	2	8.3
Gällivare	161	1	6.2
Gävle	324	8	24.7
Halmstad	548	3	5.5
Helsingborg	149	1	6.7
Huddinge	377	4	10.6
Hudiksvall	216	3	13.9
Hässleholm	1,769	11	6.2
Jönköping	422	2	4.7
Kalmar	248	4	16.1
Karlshamn	723	5	6.9
Karlskoga	333	2	6.0
Karlstad	435	6	13.8
Karolinska	211	3	14.2
Kullbergska sjukhuset	491	2	4.1
Kungälv	479	5	10.4
Lidköping	646	7	10.8
Lindesberg	621	5	8.1
Ljungby	334	5	15.0
Luleå-Sensia	20	1	50.0
Lund	200	3	15.0
Lycksele	257	3	11.7
Mora	527	3	5.7
Motala	1,007	7	7.0
Movement Halmstad	1,024	5	4.9
Mölndal	1,135	11	9.7
Nacka-Proxima/Aleris	407	1	2.5
Norrköping	395	3	7.6
Norrtälje	276	1	3.6
Nyköping	239	2	8.4
Ortho Center Stockh.(Löw)	1,209	1	0.8
OrthoCenter IFK Klin	326	1	3.1
Ortopediska huset	1,443	5	3.5
Oskarshamn	824	4	4.9
Piteå	687	2	2.9
S:t Göran	1,079	12	11.1
Sabbatsberg	163	1	6.1
Skellefteå	291	2	6.9
Skene	293	0	0.0
Skövde	323	0	0.0
Sollefteå	271	3	11.1
Sophiahemmet	216	1	4.6
Spenshult	142	0	0.0
Sundsvall	134	3	22.4
Södersjukhuset	789	4	5.1
Södertälje	373	3	8.0
Torsby	323	4	12.4
Trelleborg	2,114	17	8.0
Uddevalla	540	1	1.9
Umeå	304	2	6.6
Varberg	395	4	10.1
Visby	198	0	0.0
Värnamo	400	1	2.5
Västervik	278	1	3.6
Västerås	586	7	11.9
Växjö	256	0	0.0
Ängelholm	700	5	7.1
Örebro	101	0	0.0
Örnsköldsvik	327	4	12.2
Östersund	336	4	11.9
The Country	**35,528**	**263**	**7.4**

Other adverse medical events within 90 days. (DM)

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	244	2	8.2
Alingsås	543	6	11.0
Art Clinic Gbg	68	0	0.0
Art Clinic Jönköping	60	0	0.0
Arvika	480	2	4.2
Bollnäs	977	9	9.2
Borås	209	4	19.1
Carlanderska	408	2	4.9
Danderyd	343	20	58.3
Eksjö	573	7	12.2
Enköping	1,062	13	12.2
Eskilstuna	121	1	8.3
Falun	797	7	8.8
Frölunda Spec.	242	0	0.0
Gällivare	161	0	0.0
Gävle	324	2	6.2
Halmstad	548	9	16.4
Helsingborg	149	1	6.7
Huddinge	377	12	31.8
Hudiksvall	216	3	13.9
Hässleholm	1,769	23	13.0
Jönköping	422	5	11.8
Kalmar	248	9	36.3
Karlshamn	723	5	6.9
Karlskoga	333	3	9.0
Karlstad	435	7	16.1
Karolinska	211	4	19.0
Kullbergska sjukhuset	491	5	10.2
Kungälv	479	7	14.6
Lidköping	646	6	9.3
Lindesberg	621	4	6.4
Ljungby	334	5	15.0
Luleå-Sensia	20	0	0.0
Lund	200	8	40.0
Lycksele	257	4	15.6
Mora	527	1	1.9
Motala	1,007	9	8.9
Movement Halmstad	1,024	4	3.9
Mölndal	1,135	8	7.0
Nacka-Proxima/Aleris	407	0	0.0
Norrköping	395	13	32.9
Norrtälje	276	4	14.5
Nyköping	239	4	16.7
Ortho Center Stockh.(Löw)	1,209	5	4.1
OrthoCenter IFK Klin	326	3	9.2
Ortopediska huset	1,443	7	4.9
Oskarshamn	824	24	29.1
Piteå	687	4	5.8
S:t Göran	1,079	22	20.4
Sabbatsberg	163	1	6.1
Skellefteå	291	8	27.5
Skene	293	4	13.7
Skövde	323	4	12.4
Sollefteå	271	5	18.5
Sophiahemmet	216	2	9.3
Spenshult	142	1	7.0
Sundsvall	134	2	14.9
Södersjukhuset	789	26	33.0
Södertälje	373	11	29.5
Torsby	323	2	6.2
Trelleborg	2,114	25	11.8
Uddevalla	540	10	18.5
Umeå	304	20	65.8
Varberg	395	3	7.6
Visby	198	2	10.1
Värnamo	400	3	7.5
Västervik	278	2	7.2
Västerås	586	5	8.5
Växjö	256	4	15.6
Ängelholm	700	4	5.7
Örebro	101	0	0.0
Örnsköldsvik	327	9	27.5
Östersund	336	8	23.8
The Country	**35,528**	**464**	**13.1**

Death within 90 days

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	244	1	4.1
Alingsås	543	2	3.7
Art Clinic Gbg	68	0	0.0
Art Clinic Jönköping	60	0	0.0
Arvika	480	0	0.0
Bollnäs	977	0	0.0
Borås	209	1	4.8
Carlanderska	408	0	0.0
Danderyd	343	0	0.0
Eksjö	573	1	1.7
Enköping	1,062	0	0.0
Eskilstuna	121	1	8.3
Falun	797	2	2.5
Frölunda Spec.	242	1	4.1
Gällivare	161	0	0.0
Gävle	324	2	6.2
Halmstad	548	1	1.8
Helsingborg	149	3	20.1
Huddinge	377	1	2.7
Hudiksvall	216	0	0.0
Hässleholm	1,769	4	2.3
Jönköping	422	1	2.4
Kalmar	248	2	8.1
Karlshamn	723	1	1.4
Karlskoga	333	0	0.0
Karlstad	435	0	0.0
Karolinska	211	0	0.0
Kullbergska sjukhuset	491	1	2.0
Kungälv	479	0	0.0
Lidköping	646	1	1.5
Lindesberg	621	0	0.0
Ljungby	334	0	0.0
Luleå-Sensia	20	0	0.0
Lund	200	2	10.0
Lycksele	257	0	0.0
Mora	527	1	1.9
Motala	1,007	2	2.0
Movement Halmstad	1,024	1	1.0
Mölndal	1,135	0	0.0
Nacka-Proxima/Aleris	407	0	0.0
Norrköping	395	1	2.5
Norrtälje	276	0	0.0
Nyköping	239	1	4.2
Ortho Center Stockh.(Löw)	1,209	1	0.8
OrthoCenter IFK Klin	326	0	0.0
Ortopediska huset	1,443	0	0.0
Oskarshamn	824	3	3.6
Piteå	687	2	2.9
S:t Göran	1,079	2	1.9
Sabbatsberg	163	0	0.0
Skellefteå	291	0	0.0
Skene	293	0	0.0
Skövde	323	0	0.0
Sollefteå	271	1	3.7
Sophiahemmet	216	0	0.0
Spenshult	142	0	0.0
Sundsvall	134	0	0.0
Södersjukhuset	789	1	1.3
Södertälje	373	0	0.0
Torsby	323	0	0.0
Trelleborg	2,114	1	0.5
Uddevalla	540	1	1.9
Umeå	304	0	0.0
Varberg	395	0	0.0
Visby	198	0	0.0
Värnamo	400	0	0.0
Västervik	278	0	0.0
Västerås	586	1	1.7
Växjö	256	0	0.0
Ängelholm	700	0	0.0
Örebro	101	0	0.0
Örnsköldsvik	327	1	3.1
Östersund	336	2	6.0
The Country	**35,528**	**51**	**1.4**

All adverse events within 90 days (incl. death)

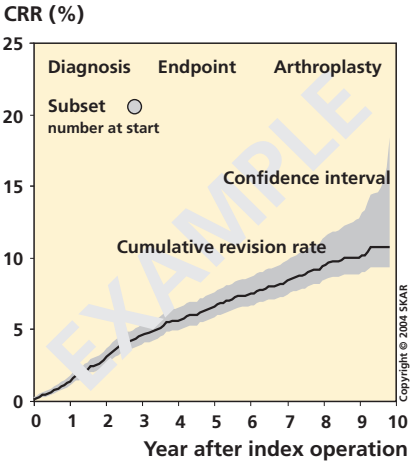
Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	244	23	94.3
Alingsås	543	24	44.2
Art Clinic Gbg	68	3	44.1
Art Clinic Jönköping	60	0	0.0
Arvika	480	19	39.6
Bollnäs	977	31	31.7
Borås	209	20	95.7
Carlanderska	408	7	17.2
Danderyd	343	32	93.3
Eksjö	573	31	54.1
Enköping	1,062	84	79.1
Eskilstuna	121	13	107.4
Falun	797	37	46.4
Frölunda Spec.	242	7	28.9
Gällivare	161	4	24.8
Gävle	324	19	58.6
Halmstad	548	41	74.8
Helsingborg	149	8	53.7
Huddinge	377	29	76.9
Hudiksvall	216	9	41.7
Hässleholm	1,769	87	49.2
Jönköping	422	18	42.7
Kalmar	248	18	72.6
Karlshamn	723	29	40.1
Karlskoga	333	11	33.0
Karlstad	435	32	73.6
Karolinska	211	21	99.5
Kullbergska sjukhuset	491	21	42.8
Kungälv	479	28	58.5
Lidköping	646	36	55.7
Lindesberg	621	31	49.9
Ljungby	334	26	77.8
Luleå-Sensia	20	2	100.0
Lund	200	17	85.0
Lycksele	257	18	70.0
Mora	527	23	43.6
Motala	1,007	58	57.6
Movement Halmstad	1,024	23	22.5
Mölndal	1,135	47	41.4
Nacka-Proxima/Aleris	407	9	22.1
Norrköping	395	31	78.5
Norrtälje	276	22	79.7
Nyköping	239	7	29.3
Ortho Center Stockh.(Löw)	1,209	21	17.4
OrthoCenter IFK Klin	326	5	15.3
Ortopediska huset	1,443	34	23.6
Oskarshamn	824	64	77.7
Piteå	687	25	36.4
S:t Göran	1,079	76	70.4
Sabbatsberg	163	3	18.4
Skellefteå	291	21	72.2
Skene	293	10	34.1
Skövde	323	11	34.1
Sollefteå	271	20	73.8
Sophiahemmet	216	6	27.8
Spenshult	142	6	42.3
Sundsvall	134	12	89.6
Södersjukhuset	789	56	71.0
Södertälje	373	31	83.1
Torsby	323	14	43.3
Trelleborg	2,114	73	34.5
Uddevalla	540	29	53.7
Umeå	304	48	157.9
Varberg	395	21	53.2
Visby	198	10	50.5
Värnamo	400	18	45.0
Västervik	278	17	61.2
Västerås	586	31	52.9
Växjö	256	16	62.5
Ängelholm	700	35	50.0
Örebro	101	2	19.8
Örnsköldsvik	327	23	70.3
Östersund	336	31	92.3
The Country	**35,528**	**1,826**	**51.4**

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.

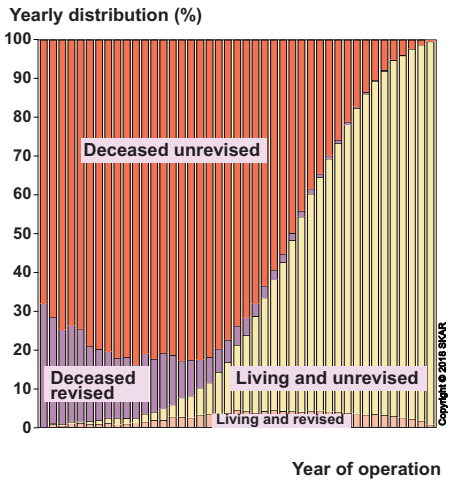
Cox regression allows for taking into account different factors that may vary within groups. The results are expressed as risk ratios (RR) between factors. If a factor is a category (e.g. implant model), one category is defined as a reference with a risk of 1 to which the other categories are compared. 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 half of the few still alive have suffered revision.

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.

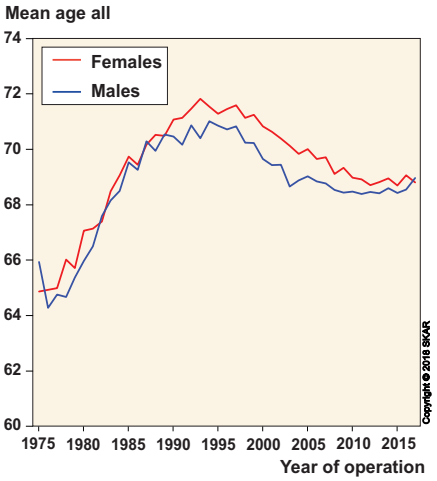


The present status for each yearly batch of patients operated since 1975.

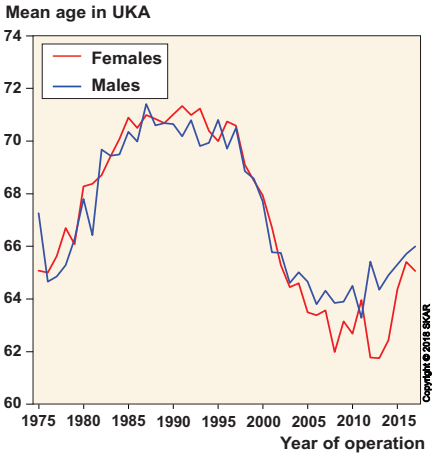
Gender and age distribution

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 2017 was 68.9 years (figure on the right).

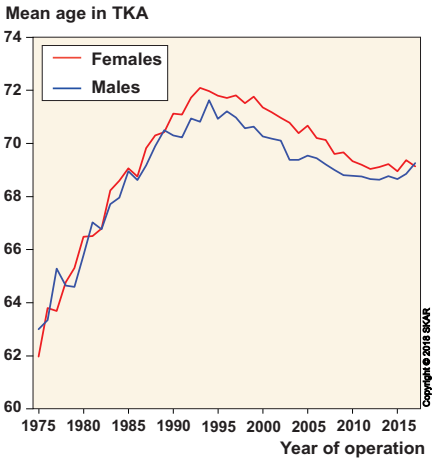
When TKA and UKA are analyzed separately, it is apparent that when TKA was introduced in the seventies it was used for younger patients than the UKA, which at the time was the standard treatment (figures below and on the next page). However, in the late nineties the mean age at UKA surgery fell considerably 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.



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

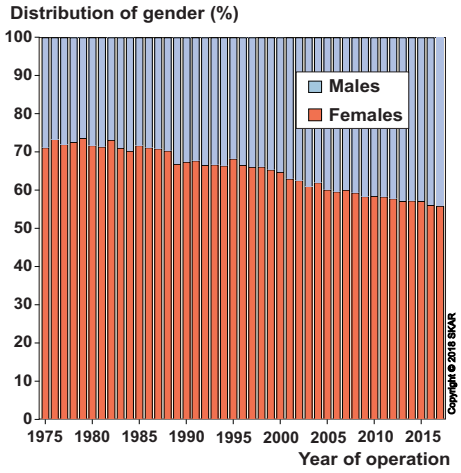


For UKA, the mean age of patients at surgery has decreased sharply in recent years coinciding with the introduction of mini-invasive surgery.



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

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



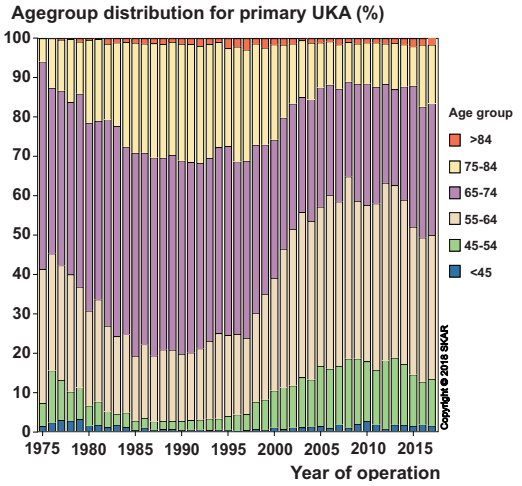
The proportion of males has increased slightly over the years.

Knee arthroplasty is more common in females than in males. At the start of the registration, females accounted for about 70% of the operations. As the figure above shows, the proportion of men has been slowly increasing and in 2017 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.

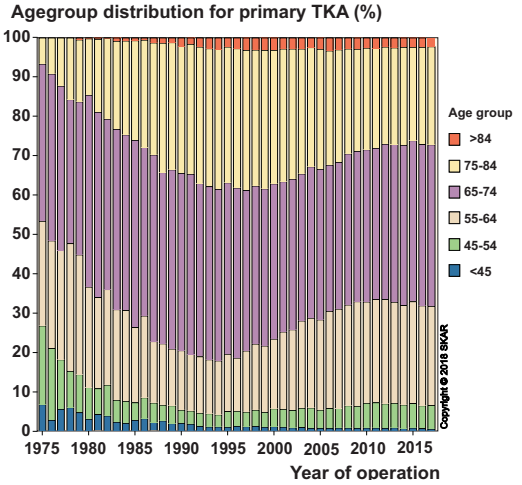
The figure to the right shows the relative number of operations performed in the different age groups over a period of thirty five years. In a somewhat different manner than the mean age (previous page) it shows how the relative proportion of the older groups increased until the mid-nineties after which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

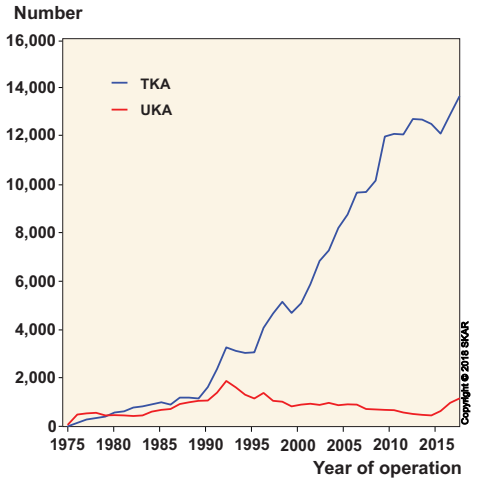
In UKA the relative proportion of patients less than 65 years of age doubled during 1998-2002, i.e. during the time when mini-invasive surgery caught on in Sweden. However, it has to be kept in mind that the actual number of UKA´s has diminished since 1993 in contrast to the TKA´s where it has increased fourfold (figure above). This implies that although the relative number of TKA among younger age groups not has increased as much as for UKA, the actual number of TKA patients, younger than 65 years of age, has increased 7.6 times since 1993 while the number of UKA patients under 65 has only increased 1.6 times during the same period.



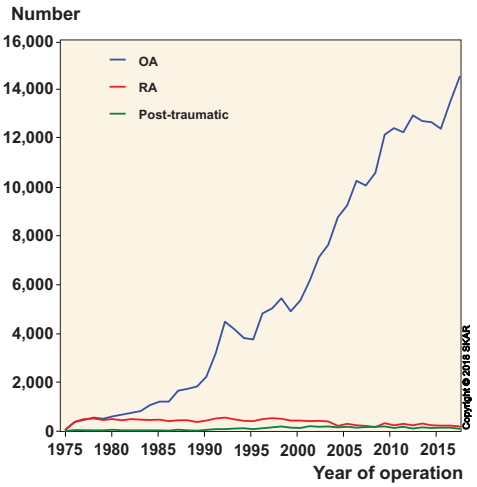
The relative distribution of primary UKA arthroplasties among different age groups.



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



The yearly number of TKA and UKA (all diagnoses)



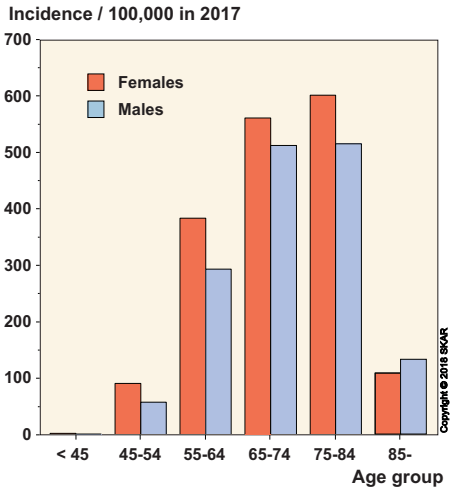
The yearly number of arthroplasties for different diagnoses

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.

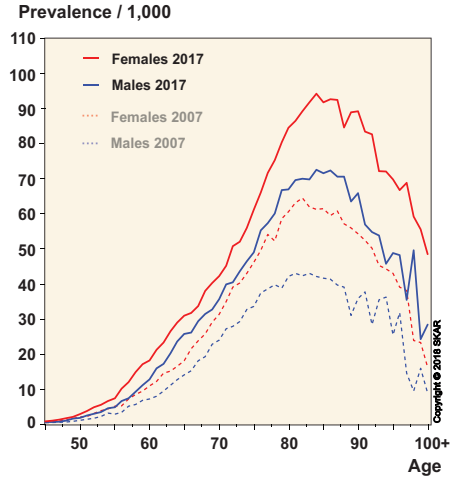
Incidence and prevalence

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.

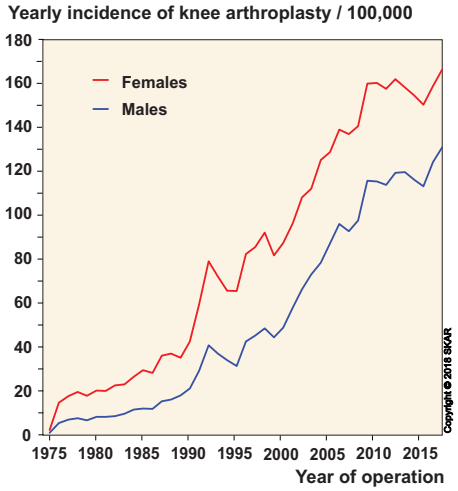
The figure below shows the incidence among different age groups during 2017. It is highest in the group of with those 65-84 years of age. At this age, knee arthroplasty is 8 times more common than among those 45-54 years old and 5 times more common than among those 85 years or older. In 2017, as well as 2016, 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 in 2016 per 100,000 inhabitants (males and females) in the different age groups.



The prevalence of knee arthroplasty in 2007 and 2017. One of fourteen elderly women has a knee arthroplasty.



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

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.

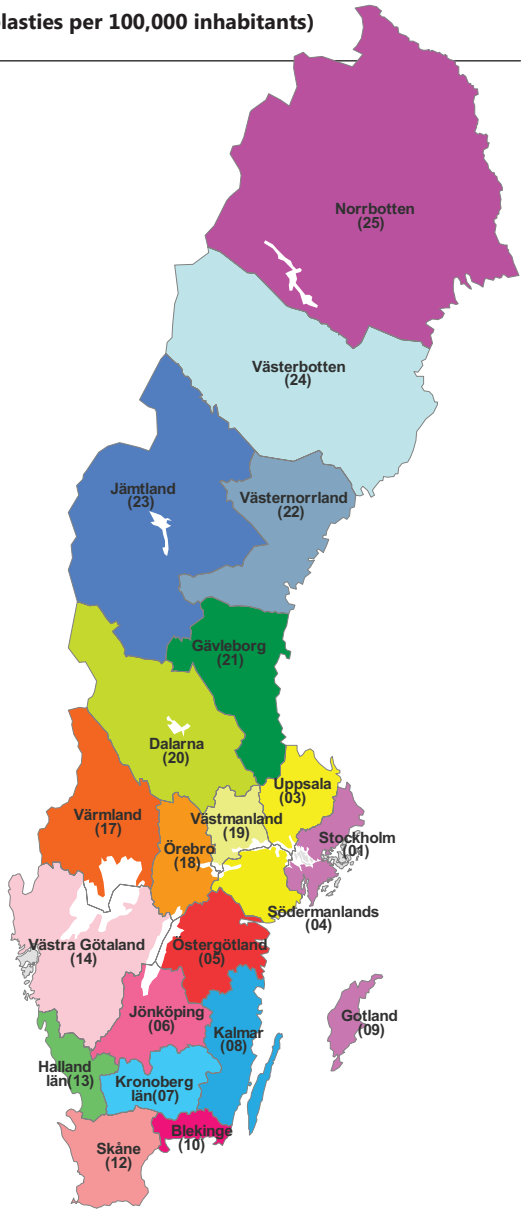
For both men and women in 2017, the prevalence peaks around 80-85 years of age at which good 9% of the women and good 7% of the men had at least one knee arthroplasty. Comparing the prevalence in 2017 with that in 2007, it can be seen that it has increased in all age groups. The fact that a large proportion 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 2011-2017 (knee arthroplasties per 100,000 inhabitants)

County and number of inhabitants 2017

No	County	Inhabitants
01	Stockholm	2,288,602
03	Uppsala	365,172
04	Södermanland	289,719
05	Östergötland	454,801
06	Jönköping	354,986
07	Kronoberg	196,074
08	Kalmar	242,919
09	Gotland	58,299
10	Blekinge	158,912
12	Skåne	1,334,627
13	Halland	322,579
14	Västra Götaland	1,681,283
17	Värmland	279,867
18	Örebro	296,924
19	Västmanland	269,362
20	Dalarna	285,348
21	Gävleborg	285,112
22	Västernorrland	245,770
23	Jämtland	129,240
24	Västerbotten	267,173
25	Norrbotten	250,933

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



Knee arthroplasties per 100,000 inhabitants

County	2011	2012	2013	2014	2015	2016	2017
01 Stockholm	106.4	103.9	104.9	99.5	93.3	111.4	124.0
03 Uppsala	136.7	154.9	174.8	142.9	161.6	123.3	132.0
04 Södermanland	150.9	151.7	157.2	161.9	145.3	139.9	189.8
05 Östergötland	146.9	157.5	154.2	135.0	132.9	137.0	151.9
06 Jönköping	142.6	168.4	147.6	172.4	153.7	149.9	131.6
07 Kronoberg	123.7	158.7	115.3	150.4	154.5	175.1	155.6
08 Kalmar	154.3	168.4	175.9	167.0	172.4	174.6	196.4
09 Gotland	249.6	165.9	178.3	134.6	106.4	150.8	178.4
10 Blekinge	169.2	178.8	177.7	161.6	165.6	206.5	196.3
12 Skåne	122.3	125.8	137.3	142.6	144.4	158.4	167.7
13 Halland	150.0	177.3	165.6	168.4	155.4	177.0	199.6
14 Västra Götaland	139.1	132.0	130.7	125.6	127.8	125.9	124.3
17 Värmland	170.0	179.9	180.3	195.4	184.5	181.5	184.0
18 Örebro	125.7	146.3	120.3	116.8	104.6	152.6	126.6
19 Västmanland	128.2	156.7	125.4	134.8	109.1	118.4	141.4
20 Dalarna	219.6	217.0	231.4	199.5	174.7	199.4	171.7
21 Gävleborg	174.8	191.4	188.6	213.6	206.1	202.3	174.3
22 Västernorrland	143.2	145.4	141.3	132.3	141.3	155.3	199.4
23 Jämtland	162.1	175.0	138.5	95.6	120.4	145.3	171.8
24 Västerbotten	119.9	123.1	126.2	117.3	117.9	120.5	146.7
25 Norrbotten	150.1	165.7	150.2	131.0	120.9	144.3	157.4
The whole country	135.8	140.8	139.1	135.5	131.8	141.5	148.7

Information on domicile is by the Swedish Tax Agency

For age-standardized incidence see page 37

The incidence in the counties 2011-2017 (knee arthroplasties per 100,000 inhabitants)

Incidence for women

County	2011	2012	2013	2014	2015	2016	2017
01 Stockholm	129.3	130.4	123.0	113.3	106.4	126.9	145.4
03 Uppsala	155.3	178.6	193.1	170.6	186.2	134.5	156.5
04 Södermanland	173.6	176.8	180.4	184.5	154.4	159.0	209.7
05 Östergötland	165.2	182.6	172.5	159.9	156.9	154.1	165.7
06 Jönköping	174.3	202.3	174.4	202.1	176.1	163.9	144.5
07 Kronoberg	147.8	183.1	148.4	166.7	168.3	186.1	167.9
08 Kalmar	148.9	209.0	201.2	193.1	199.7	206.7	206.1
09 Gotland	273.4	162.7	208.1	128.5	114.5	169.2	171.1
10 Blekinge	188.5	188.9	187.5	182.3	168.9	235.6	219.5
12 Skåne	140.8	140.1	154.4	166.0	169.6	177.9	188.5
13 Halland	173.5	197.8	188.4	186.6	173.0	190.2	227.9
14 Västra Götaland	160.1	146.9	148.2	140.7	146.4	140.8	137.7
17 Värmland	182.2	202.9	190.1	233.5	204.5	194.4	197.5
18 Örebro	152.0	157.7	129.6	135.7	127.0	176.9	137.7
19 Västmanland	147.9	173.6	140.3	157.5	128.1	148.0	160.6
20 Dalarna	248.3	242.1	260.7	222.4	195.0	216.4	187.1
21 Gävleborg	198.9	207.7	206.4	232.6	221.4	221.6	195.7
22 Västernorrland	172.3	163.6	165.4	149.7	155.2	181.0	221.6
23 Jämtland	212.0	206.2	179.4	107.9	153.6	156.1	175.4
24 Västerbotten	141.0	150.9	151.4	131.0	137.4	138.9	159.0
25 Norrbotten	184.7	190.6	170.8	150.2	142.1	162.6	179.5
The whole country	157.6	162.1	158.3	154.7	150,3	158,8	166,5

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 2017 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	2011	2012	2013	2014	2015	2016	2017
01 Stockholm	83.0	76.9	86.5	85.5	80.1	95.7	102.5
03 Uppsala	117.9	131.0	156.5	115.0	136.9	112.0	107.5
04 Södermanland	128.1	126.3	133.7	139.3	136.2	120.9	170.1
05 Östergötland	128.7	132.6	136.1	110.3	109.3	120.2	138.4
06 Jönköping	110.9	134.6	120.8	143.0	131.6	136.0	118.9
07 Kronoberg	100.0	134.8	82.8	134.5	141.1	164.5	143.6
08 Kalmar	159.7	127.8	150.5	141.0	145.4	143.0	186.8
09 Gotland	225.4	169.1	148.0	140.7	98.2	132.3	185.7
10 Blekinge	150.5	169.1	168.1	141.4	162.4	178.5	174.0
12 Skåne	103.3	111.3	119.9	118.7	118.9	138.6	146.8
13 Halland	126.4	156.6	142.7	150.1	137.7	163.7	171.5
14 Västra Götaland	117.9	117.0	113.1	110.4	109.1	111.1	111.0
17 Värmland	157.7	156.9	170.5	157.4	164.7	168.7	170.7
18 Örebro	99.0	134.7	110.9	97.9	82.3	128.2	115.6
19 Västmanland	108.4	139.8	110.4	112.1	90.3	89.1	122.5
20 Dalarna	191.1	191.9	202.3	176.8	154.6	182.8	156.7
21 Gävleborg	150.6	175.1	170.8	194.7	190.9	183.2	153.2
22 Västernorrland	114.0	127.2	117.2	115.1	127.5	129.9	177.5
23 Jämtland	112.2	143.9	97.9	83.4	87.6	134.7	168.3
24 Västerbotten	98.9	95.6	101.4	103.8	98.8	102.5	134.7
25 Norrbotten	116.5	141.7	130.3	112.4	100.4	126.8	136.3
The whole country	113.8	119.4	119.7	116.2	113.3	124.2	131.0

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	1976-1986	1987-1991	1992-1996	1997-2001	2002-2006	2007-2011	2012-2016	2017
<45	1.0	1.0	1.1	1.5	1.8	2.2	2.2	1.9
45-54	12.8	11.8	18.1	30.3	55.6	81.0	85.4	90.6
55-64	43.1	64.2	110.1	143.1	219.5	301.7	341.9	384.1
65-74	94.4	188.4	327.6	378.6	505.9	560.3	532.9	562.1
75-84	69.1	173.6	329.0	394.2	507.0	598.7	593.9	602.3
>84	6.0	25.7	59.7	85.0	101.6	121.6	113.9	108.9
Total	21.7	42.2	73.1	88.7	122.9	151.2	156.8	166.5

Men

Age group	1976-1986	1987-1991	1992-1996	1997-2001	2002-2006	2007-2011	2012-2016	2017
<45	0.4	0.4	0.5	0.8	1.0	1.6	1.5	1.0
45-54	5.4	5.2	9.4	16.7	33.9	48.4	51.4	56.9
55-64	19.1	35.0	69.1	90.0	165.1	235.2	274.0	293.7
65-74	42.2	99.4	191.5	251.8	376.7	444.3	455.0	513.4
75-84	35.5	112.3	208.5	255.8	373.1	467.8	477.5	516.4
>84	7.1	24.1	61.2	71.8	101.5	120.9	115.8	133.2
Total	8.7	20.0	37.2	49.0	80.4	107.1	118.6	131.0

Number of primary arthroplasties per unit and year

Hospital	1975-2012	2013	2014	2015	2016	2017	Total	Percent
Akademiska sjukhuset	2,912	90	86	108	88	86	3,370	1.2
Alingsås	2,006	214	204	193	160	199	2,976	1.1
Art Clinic Göteborg	.	.	.	16	55	108	179	0.1
Art Clinic Jönköping	8	2	13	29	24	90	166	0.1
Arvika	1,558	129	193	171	189	193	2,433	0.9
Avesta	67	.	.	.	.	.	67	0.0
Boden	1,622	.	.	.	.	.	1,622	0.6
Bollnäs	3,127	305	402	353	344	325	4,856	1.8
Borås	2,841	91	78	72	74	69	3,225	1.2
Capio Artro Clinic	.	.	.	.	.	241	241	0.1
Carlanderska	537	108	137	136	156	224	1,298	0.5
Dalslands,Sjukhus	81	.	.	.	.	.	81	0.0
Danderyd	3,243	196	185	185	187	176	4,172	1.5
Eksjö (Höglandssjukh.)	2,935	173	211	202	220	217	3,958	1.5
Elisabethsjukhuset	769	58	7	1	7	6	848	0.3
Enköping	2,497	415	373	392	346	366	4,389	1.6
Eskilstuna	1,850	43	41	42	55	69	2,100	0.8
Fagersta	71	.	.	.	.	.	71	0.0
Falköping	1,688	.	.	.	.	.	1,688	0.6
Falun	4,847	364	356	205	270	215	6,257	2.3
Frölunda Spec.	1,188	120	120	124	.	.	1,552	0.6
Gällivare	1,429	94	68	46	53	54	1,744	0.6
Gävle	3,246	164	129	132	147	85	3,903	1.4
Halmstad	3,139	232	190	186	208	185	4,140	1.5
Helsingborg	1,776	21	45	67	41	19	1,969	0.7
Huddinge	2,813	147	166	159	168	111	3,564	1.3
Hudiksvall	1,579	73	60	87	74	56	1,929	0.7
Hässleholm	7,448	698	683	669	707	883	11,088	4.1
Jönköping	2,775	167	168	141	135	11	3,397	1.3
Kalix	215	.	.	.	.	.	215	0.1
Kalmar	2,550	106	91	89	90	100	3,026	1.1
Karlshamn	2,833	260	242	249	305	295	4,184	1.5
Karlskoga	1,902	129	124	124	104	39	2,422	0.9
Karlskrona	1,118	.	.	.	.	.	1,118	0.4
Karlstad	4,106	192	193	182	162	132	4,967	1.8
Karolinska	2,540	140	101	93	98	59	3,031	1.1
Kristianstad	1,297	.	.	1	.	.	1,298	0.5
Kristinehamn	252	.	.	.	.	.	252	0.1
Kullbergska sjukhuset	2,345	227	201	153	156	244	3,326	1.2

(cont.)

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

Hospital	1975-2012	2013	2014	2015	2016	2017	Total	Percent
Kungsbacka	38	.	.	.	.	.	38	0.0
Kungälv	1,999	155	197	215	197	207	2,970	1.1
Köping	1,605	.	.	.	.	.	1,605	0.6
Landskrona	1,918	.	.	.	.	.	1,918	0.7
Lidköping	1,957	200	199	234	224	250	3,064	1.1
Lindesberg	1,989	192	172	162	319	424	3,258	1.2
Linköping	1,735	.	.	.	.	.	1,735	0.6
Linköping medical center	15	.	.	.	.	.	15	0.0
Ljungby	1,792	81	151	141	150	135	2,450	0.9
Ludvika	339	.	.	.	.	.	339	0.1
Luleå	2	7	4	7	11	19	50	0.0
Lund	2,682	87	98	82	122	43	3,114	1.2
Lycksele	752	69	93	42	130	150	1,236	0.5
Löwenströmska*	3,119	443	403	431	444	463	5,303	2.0
Malmö	2,237	3	.	.	.	1	2,241	0.8
Mora	2,065	186	150	186	202	195	2,984	1.1
Motala	4,457	519	470	511	552	605	7,114	2.6
Movement Halmstad	1,482	218	250	430	417	434	3,231	1.2
Mölndal	2,288	237	387	404	504	379	4,199	1.6
Nacka	203	.	.	.	.	.	203	0.1
Nacka-Proxima	640	145	111	143	154	174	1,367	0.5
Norrköping	2,616	144	140	129	160	175	3,364	1.2
Norrtälje	1,304	74	85	94	123	152	1,832	0.7
Nyköping	1,708	79	100	101	74	102	2,164	0.8
OrthoCenter IFK,klin.**	920	96	108	113	129	162	1,528	0.6
Ortopediska huset	3,649	390	418	460	625	719	6,261	2.3
Oskarshamn	2,732	260	268	276	316	370	4,222	1.6
Piteå	2,502	273	259	245	279	305	3,863	1.4
S:t,Göran	7,344	400	387	424	470	521	9,546	3.5
Sabbatsberg (Aleris)	1,887	125	141	23	.	.	2,176	0.8
Sahlgrenska	1,545	1	4	2	1	.	1,553	0.6
Sala	115	.	.	.	.	.	115	0.0
Sandviken	301	.	.	.	.	.	301	0.1
Sergelkliniken	160	.	.	.	.	.	160	0.1
Simrishamn	1,021	.	.	.	.	.	1,021	0.4
Skellefteå	1,460	97	107	119	80	77	1,940	0.7
Skene	1,553	135	104	97	131	127	2,147	0.8
Skövde	2,992	145	115	120	114	73	3,559	1.3
Sollefteå	1,408	97	89	93	102	206	1,995	0.7
Sophiahemmet	1,577	121	98	138	127	229	2,290	0.8
Spenshult	1,120	330	155	.	.	.	1,605	0.6
Sunderby	398	.	.	.	.	.	398	0.1
Sundsvall	2,943	114	95	44	12	5	3,213	1.2
Säffle	484	.	.	.	.	.	484	0.2
Söderhamn	279	.	.	.	.	.	279	0.1
Södersjukhuset	4,949	270	317	281	320	284	6,421	2.4
Södertälje	1,475	88	110	113	163	149	2,098	0.8
Torsby	1,641	131	114	130	108	134	2,258	0.8
Trelleborg	6,419	709	759	791	823	850	10,351	3.8
Uddevalla	3,717	229	207	187	243	247	4,830	1.8
Umeå	2,929	155	102	147	111	119	3,563	1.3
Varberg	2,947	173	149	127	185	214	3,795	1.4
Visby	1,491	88	70	60	76	97	1,882	0.7
Vänersborg-NÄL	939	.	.	.	.	.	939	0.3
Värnamo	2,079	142	163	148	142	194	2,868	1.1
Västervik	1,958	113	94	90	99	81	2,435	0.9
Västerås	3,059	256	246	177	217	264	4,219	1.6
Växjö	2,270	98	109	115	101	78	2,771	1.0
Ystad	1,169	.	.	.	.	.	1,169	0.4
Ängelholm	2,263	201	233	221	338	343	3,599	1.3
Örebro	3,362	51	54	30	47	8	3,552	1.3
Örnsköldsvik	2,096	112	88	115	143	172	2,726	1.0
Östersund	2,316	164	106	120	141	164	3,011	1.1
Östra sjukhuset	2,100	.	.	.	.	.	2,100	0.8
Total	**201,721**	**13,361**	**13,146**	**12,925**	**14,049**	**14,957**	**270,159**	**100**

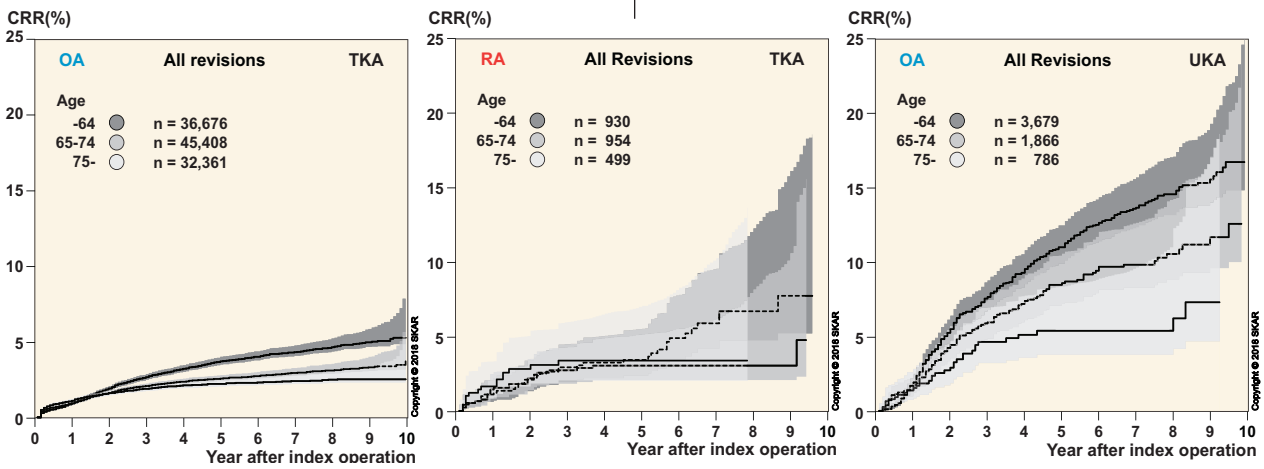
* Lövenströmska was taken over by Stockholms Specialistvård in 2001 and OrthoCenter Stockholm in 2008.

** 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.

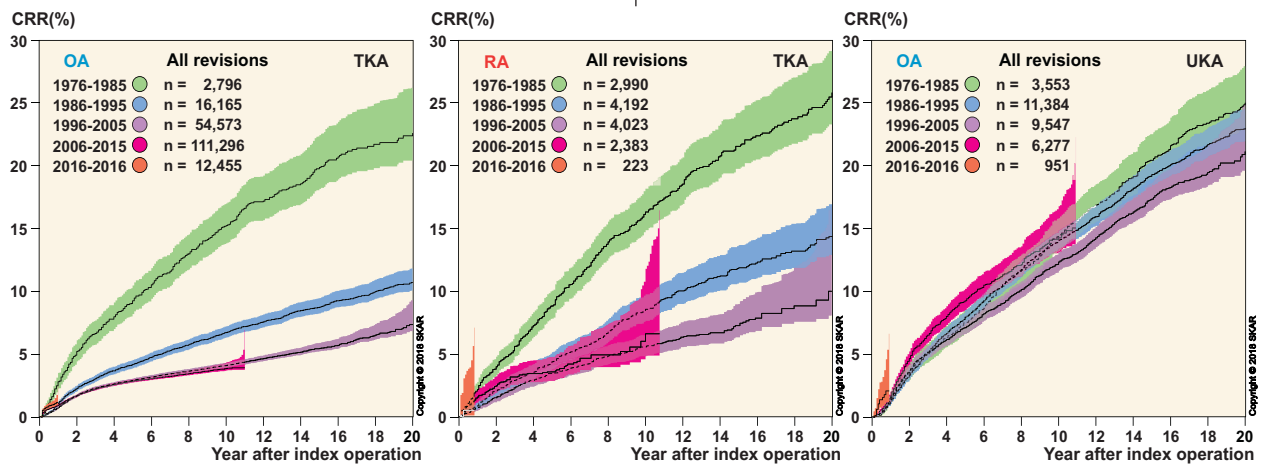
Age – The effect of age at primary surgery can be illustrated by dividing patients into separate age groups. This shows for both TKA and UKA that that the risk is higher for the younger groups (see figures below). Possible explanations are that the younger have higher physical activity, higher expectancy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



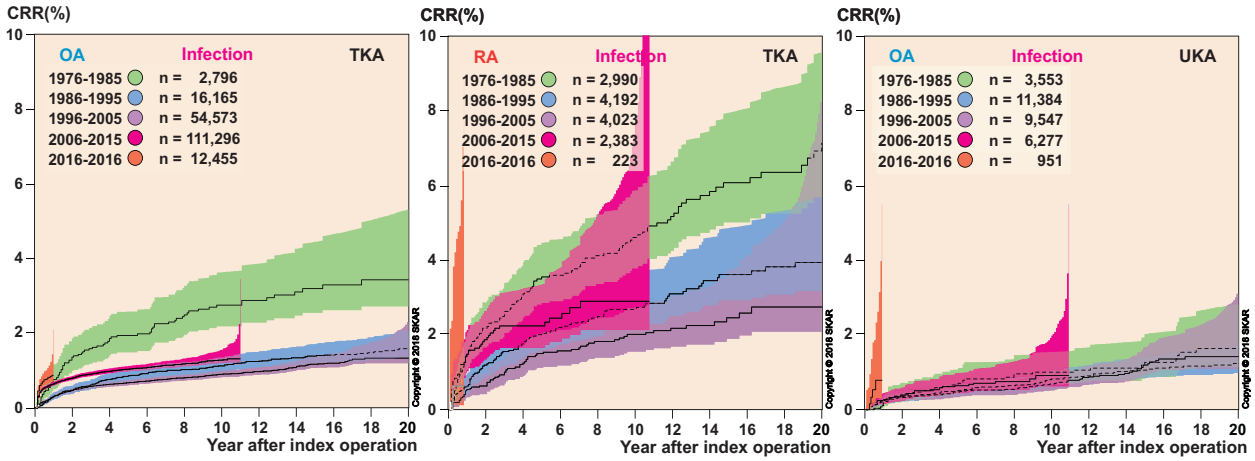
The CRR (2007–2016) for the 3 age groups (<65, 65–75, >75) shows an increase in revision rate with younger age. In TKA/OA those younger than 65 have 1.6 times the risk of those over 75 and 2.2 times higher risk in UKA/OA. The difference in TKA/RA is not significant.

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, For during the period 2006-2015 the number of early revisions inreased, a tendeincy that continued 2016. 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 in 2016. 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 4 different 10-year periods and for surgeries performed in 2016. One finds for TKA, that the risk for the 2 first periods is considerably higher than for the later ones. In TKA the risk for early revision increased 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 risk increased in the latest 2 periods which is mainly explained by a higher proportion of younger patients.



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.

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 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 1.8) and patients with RA have a higher risk than those with OA (RR 2.0). This is independent of if changes of inserts due to infection are considered being revisions or not.

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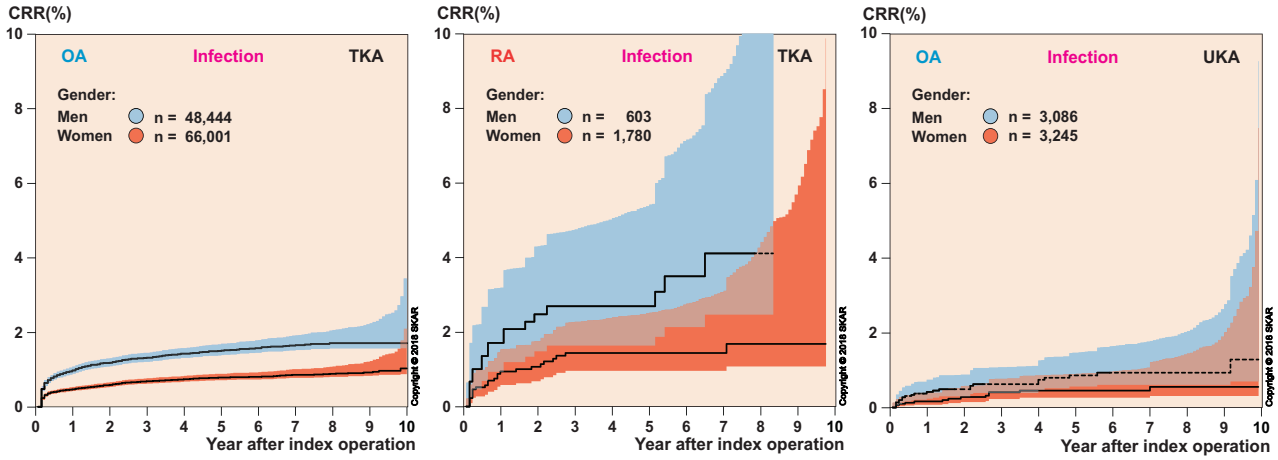
Gender – It is somewhat complicated to evaluate the effect of gender on the risk of revision as males and females have somewhat different revision pattern. Early revision for infection is more common in males (figures below) but early revision for loosening and patellar pain in women. Due to their higher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

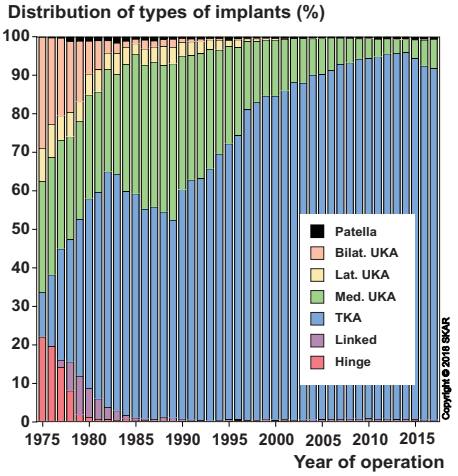
While it is well known that RA patients have a higher risk of infection, being ascribed to the effect of corticosteroid and immunosuppressive medications, it is not obvious why men, more often have their knee arthroplasties revised for infection.



CRR (2007–2016) using the end-point; revision for infection shows men having a higher risk than women (TKA/OA: RR 1.9 and TKA/RA: RR 2.3). In UKA, which has a lower risk of infection than TKA, men also have a higher risk (RR 2.0).
In TKA, patients with RA are more affected than those with OA (RR 2.0).

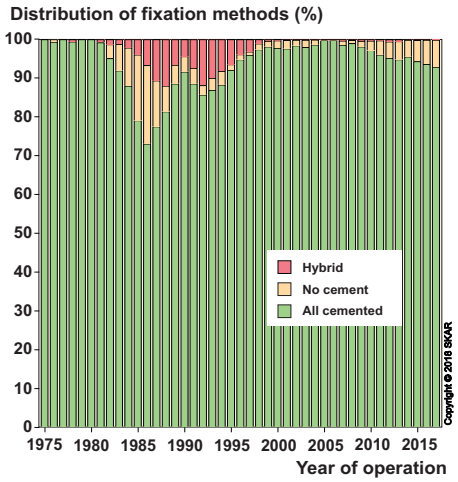
Type of implant – The modern condylar tricompartmental knee implant (TKA) was developed in the seventies when hinged and unicondylar implants were already available. When the register started in 1975, TKA had just been introduced in Sweden, why hinges and UKA's were used for the majority of the primary 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 0.6) as well as the need for revision with stabilized implants, arthrodesis or amputation (see page 39).

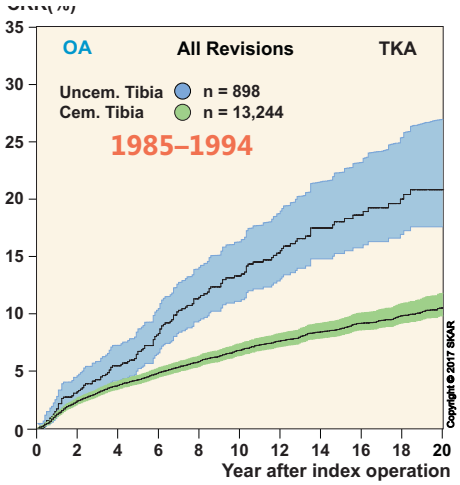


The relative yearly distribution of implant types used for primary surgery.

Use of bone-cement – As the figure below shows, bone cement has been used for the majority of arthroplasties since the nineties. In the most recent years we have again seen an increase in the use of uncemented implants, of which two thirds were inserted at one hospital. During the latest 10-year period, we find no significant difference in CRR based on if cement was used or not. However, for the period 1985–1994 with follow-up until 2016, the risk is higher for cases in which the tibial component was left uncemented (see figure right). 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.

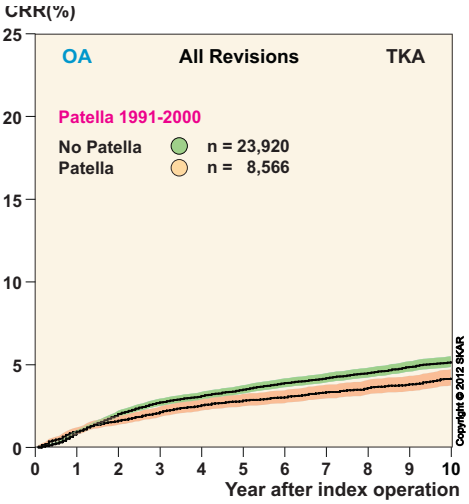


The relative yearly distribution regarding the use of cement for fixation.

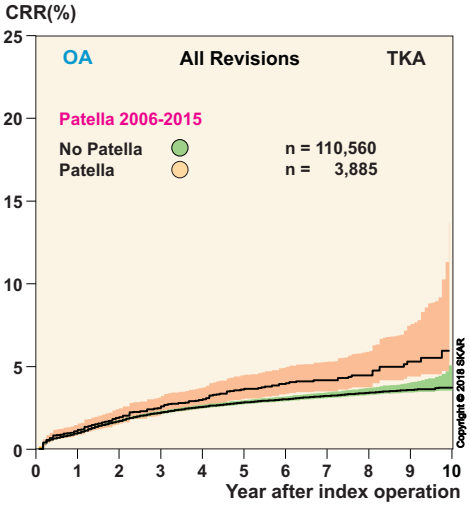


The CRR for TKA inserted 1985-1994 in which the tibial component was fixed with or without cement.

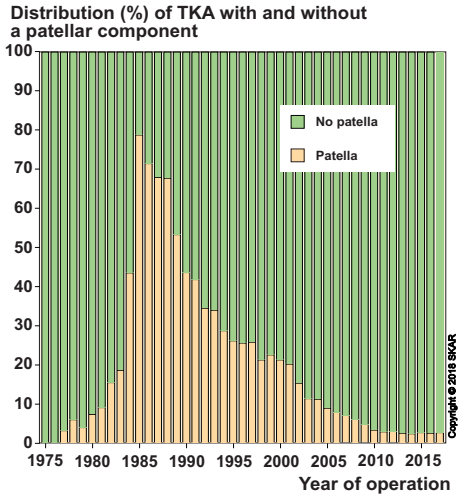
Patellar button in TKA – Estimating how the use of a patellar button affects the revision rate is complex. The use of a patellar button varies with the brand of prosthesis used and its use also has lessened in recent years. During the eighties, when patellar button was used in just over half of the cases, 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, 2007-2016 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 2007-2016 (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 1.4 (CI 1.1-1.6)).

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.

(*cont.*)

Use of patellar button (cont.) – The use of a patellar button varies between countries. In its annual report, the Danish knee arthroplasty register (https://www.sundhed.dk/content/cms/99/4699_dkr-rapport-2017_final_til_offentliggørelse.pdf) reports that a patellar button was used in 82% of TKA cases (2016) while it was only used in 4% of cases in Norway during 2016 according to the Norwegian arthroplasty register report (http://nrlweb.ihelse.net/Rapporter/Rapport2017.pdf). According to the 2017 annual report of the Australian Joint Replacement Registry (https://aoanjrr.sahmri.com/home), the use of a patellar button has increased in recent years from 41% of the TKA cases in 2005 to 64% in 2016. They also reported for TKA's inserted during the last 16 years that TKAs without a button had 1.3 (1.3-1.4) times higher risk of becoming revised than those with a button. As can be seen on the previous page this is similar as what we found in Sweden for the period 1991-2000 when the use of patellar button was relatively more common but that the results had become the opposite in the period 2003-2012 when TKA with patellar button had higher risk of revision than those without. It is unclear why the policies with respect to use of patellar buttons differ so much between the surgeons in the mentioned countries and regions. However, it is possible that previous bad experience of using metal backed patellar buttons has played a role.

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 2017

Types of primary arthroplasties

	Number	Percent
Linked	51	0.3
TKA	13,689	91.5
UKA Medial	1,143	7.7
UKA Lateral	23	0.2
Fem-Pat	47	0.3
Partial (PRKA)	4	0.0
Total	14,957	100

In primary knee arthroplasty the TKA is the standard treatment which accounted for 92% of the surgeries in 2017 (table above). The use of UKA increased a little and accounted for almost 8% of the cases. The use of femoro-patellar and especially partial implants is still very limited.
73 hospitals performing elective knee arthroplasties reported to the registry during 2017 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, 14,957 primaries had been reported for 2017 which is 6.5% more than at the same time in 2016 (14,044).

Primary TKA implants

	Number	Percent
NexGen,MBT	7,007	51.2
PFC-MBT	2,682	19.6
Triathlon	1,568	11.5
PFC-APT	1,036	7.6
Genesis.II	366	2.7
Legion/Genesis.II	339	2.5
NexGen.TM	221	1.6
Persona	84	0.6
Journey	50	0.4
Vanguard	45	0.3
Attune	42	0.3
PFC-RP	16	0.1
Other*	233	1.7
Total	13,689	100

*Mainly revision models (see separate table) except 15 knees for which part numbers are missing

As compared to last year, the number of TKA increased by 6%. 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 GenesisII from Smith & Nephew increased while the Vanguard from Biomet continues to decrease. 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 now accounts for 8% of the primary knee arthroplasties. Oxford accounts for two thirds of the UKA while the LINK and ZUK account for 11% each.

Primary UKA implants

	Number	Percent
Oxford	765	65.6
ZUK	134	11.5
Link	133	11.4
Triathlon PKR	77	6.6
Sigma PKR	28	2.4
Persona PK	20	1.7
Ibalance	5	0.4
Genesis	4	0.3
Total	1,166	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	83	38.1
PFC revision	69	31.7
NexGen revision	51	23.4
Legion/Genesis II revision	15	6.9
Total	218	100

51 linked prostheses not included (25 NexGen RHK, 17 RotaLink and 9 other)

938 revisions were reported in 2017 of which 238 were secondary (not the first revision). In 731 cases the primary was a TKA, in 182 it was an UKA, in 15 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 2016.

The most common implants in the counties in 2017

TKA in the counties

	Model 1	n	Model 2	n	Model 3	n	Other
01 Stockholm	NexGen	1,711	PFC Sigma	1,005	Triathlon	139	61
03 Uppsala	PFC Sigma	396	NexGen	51	Other	4	
04 Södermanland	PFC Sigma	257	NexGen	82	PFC RP	5	6
05 Östergötland	NexGen	407	Legion/GenesisII	160	Persona	2	9
06 Jönköping	NexGen	473	Other	1			
07 Kronoberg	PFC Sigma	106	Vanguard	40	Other	13	
08 Kalmar	NexGen	541	Other	5			
09 Gotland	PFC Sigma	96	Other	1			
10 Blekinge	NexGen	279					
12 Skåne	Triathlon	1,425	PFC Sigma	218	NexGen	214	191
13 Halland	NexGen	742	Other	3			
14 Västra Götaland	NexGen	1,149	PFC Sigma	713	Attune	34	40
17 Värmland	NexGen	429	Other	1			
18 Örebro	GenesisII	366	NexGen	48	Journey	23	1
19 Västmanland	NexGen	235	Other	7			
20 Dalarna	NexGen	200	PFC Sigma	195	Other	4	
21 Gävleborg	PFC Sigma	409	NexGen	7	Other	2	
22 Västernorrland	NexGen	371	Other	3			
23 Jämtland	NexGen	158	Other	2			
24 Västerbotten	Legion/GenesisII	179	NexGen	131	Other	7	
25 Norrbotten	PFC Sigma	327	Triathlon	4	Other	1	

The table above shows that 9 of 21 reported having used only one ordinary TKA model (revision models not included) while only 4 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	175	Link	50	Triathlon PKR	50	57
03 Uppsala	Oxford	6	ZUK	1			
04 Södermanland	Oxford	65					
05 Östergötland	Oxford	187	Sigma PKR	7			
06 Jönköping	Oxford	35					
07 Kronoberg	Oxford	50					
08 Kalmar	Link	3					
09 Gotland							
10 Blekinge	Oxford	15					
12 Skåne	Link	38	Oxford	37	Triathlon PKR	10	
13 Halland	ZUK	65	Oxford	14	Link	3	
14 Västra Götaland	Oxford	85	ZUK	12			
17 Värmland	Oxford	29					
18 Örebro	ZUK	20	Oxford	8	Link	1	
19 Västmanland	Triathlon PKR	17	Genesis	4			
20 Dalarna	Oxford	9					
21 Gävleborg	Link	38					
22 Västernorrland	Oxford	8					
23 Jämtland	Oxford	2	ZUK	1			
24 Västerbotten	Persona PK	20					
25 Norrbotten	Oxford	40	Sigma PKR	4			

In 2017, seven counties reported 50 or more UKA's (Stockholm, Södermans län, Östergötland, Kronoberg, Skåne, Halland and Västra Götaland). Five counties reported between 25 and 50 UKA's, and eight reported from 1 to 24 procedures. Gotland did not report any UKA procedures.

Bone cement and minimally invasive surgery in 2017

Use of cement in primary surgery

	Primary TKA	Primary UKA
No component without cement	12,678	469
Only the femoral component without cement	6	26
Only the tibial component without cement	8	6
The femur- and tibial components without cement	955	665
Unknown	42	
Total	13,689	1,166

	Primary TKA		Primary UKA	
	Number	Percent	Number	Percent
Palacos R+G (gentamicin)	6,165	48.4	274	54.7
Refobacin Bone Cement (genta)	3,476	27.3	116	23.2
Optipac Refobacin	2,901	22.8	97	19.4
Smartset GHV gentamycin	139	1.1	9	1.8
Copal (genta+vanco)	9	0.1		
Refobacin Revision Cement (genta+clinda)	4	0	1	0.2
Optipac Refobacin Revision	4	0	4	0.8
Copal (genta+clinda	2	0		
Unknown	34	0.3		
Subtotals	12,734	100	501	100
All components without cement	955		665	
Total	13,689		1166	

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 2017 while 0.1% were hybrids. However, in UKA cementless fixation was used in 57% of the cases and as hybrids in 2.7%. The reason is the popularity of the Oxford cementless variant which was used in 90% 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).

The type of incision for 1,166 primary UKA's

	Standard incision	Mini-incision	Missing
Oxford	293	470	2
Link	133		
ZUK	113	21	
Triathlon PKR	59	18	
Sigma PKR	28		
Persona PK	18	1	1
Genesis	4		
Ibalance		5	
Total	648	515	3

In 2017, 44% of the UKA were inserted using MIS. 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 16-year follow-up, we cannot see that miniarthrotomy negatively affects the overall revision rate.

The use of patella button for TKA in 2017

The use of patellar resurfacing has been decreasing since the mid-eighties so that it is now only used in 2.4% of the TKA cases. During 2017 a button was most commonly used in the counties of Gävlsborg and Västerbotten but not at all in Uppsala, Kalmar, Blekinge, 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 2017, a button was most often used in primary arthroplasty together with the PFC-RP, PFC-APT, NexGen-TM, Legion/Genesis II and PFC-MBT.

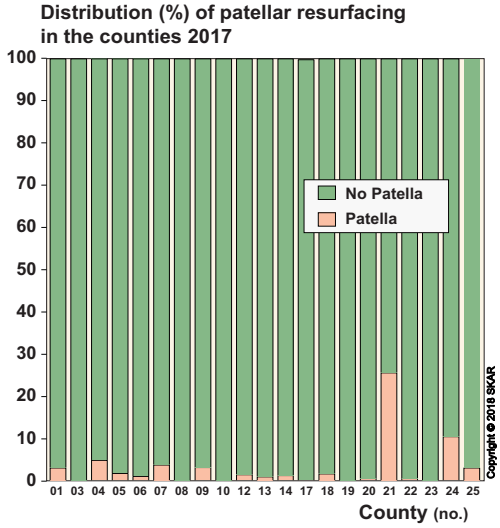
In Sweden, females have their patella resurfaced slightly more often in TKA than males. Thus, in the whole material, from 1975 to the end of 2017, 12.4% of the women had their patella resurfaced compared to 9.0% of the men, which is a significant difference. It has been attempted to explain this difference by femoro-patellar pain being more common in women.

In 2017, 1.8% of the men had a patella button compared to 3.2% of the women which also is a significant difference.

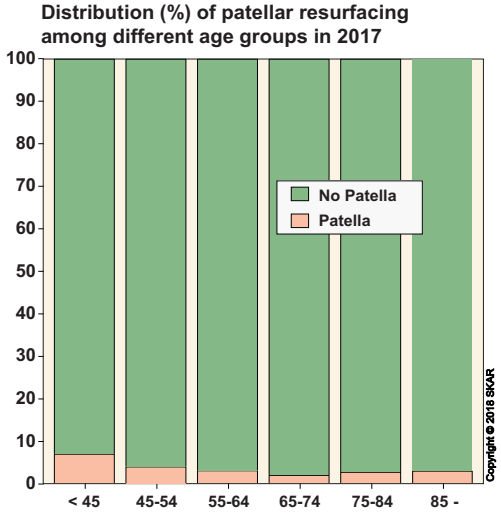
Use of patella button with different TKA implants

	No patella button	%	Patella button	%
NexGen MBT	6,921	98.8	86	1.2
PFC-MBT	2,558	95.4	124	4.6
Triathlon	1,545	98.5	23	1.5
PFC-HPT	972	93.8	64	6.2
Genesis II	362	98.9	4	1.1
Legion/Genesis II	319	94.1	20	5.9
NexGen TM	210	95.0	11	5.0
Persona	84	100.0	0	0.0
Journey	48	96.0	2	4.0
Vanguard	45	100.0	0	0.0
Attune	42	100.0	0	0.0
PFC-RP	12	75.0	4	25.0
Other	221	94.8	12	5.2
Total	13,339	97.4	350	2.6

Looking at the relative use of patella button among the different age groups in 2017 (see figure below), it can be seen patellar resurfacing is more common in the younger age groups. This has varied somewhat 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 2007-2016, 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).



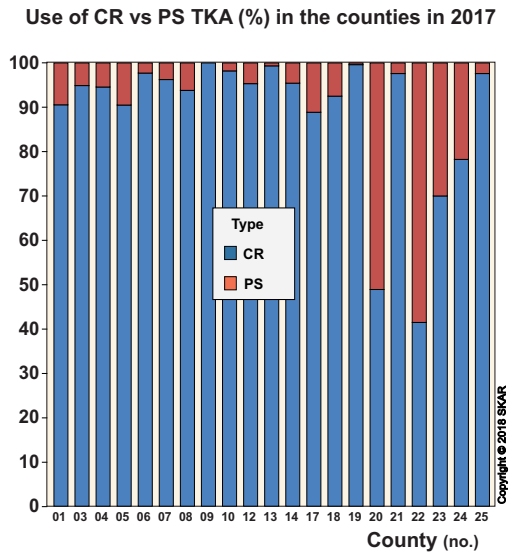
The figure shows the relative proportion of TKA with and without patella button in the different age-groups.

Posterior stabilized prostheses during 2017

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.

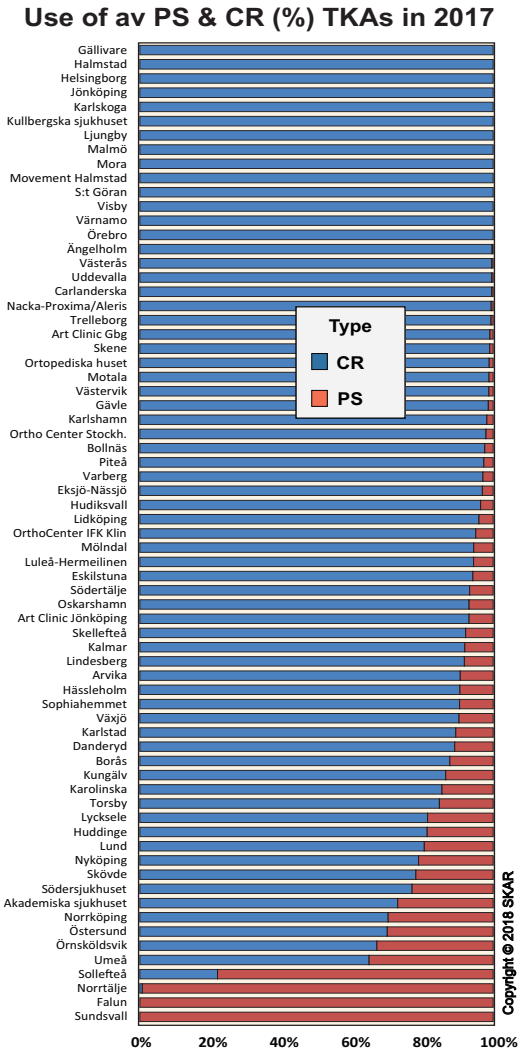


The figure shows the relative use of CR and PS implants in the different counties.

As can be seen from the figure above, the counties are different with respect to their use of PS implants. During 2017, 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 2017, just over 9% 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 3 units almost exclusively using PS implants and 16 exclusively using CR implants.



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

We do not have any good explanation why the use of PS implants differs so much among the hospitals. Common for those 3 that exclusively used PS knees was that they almost only used the NexGen MBT implant (see table on next page). However, looking at the whole country, 89% 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 2017

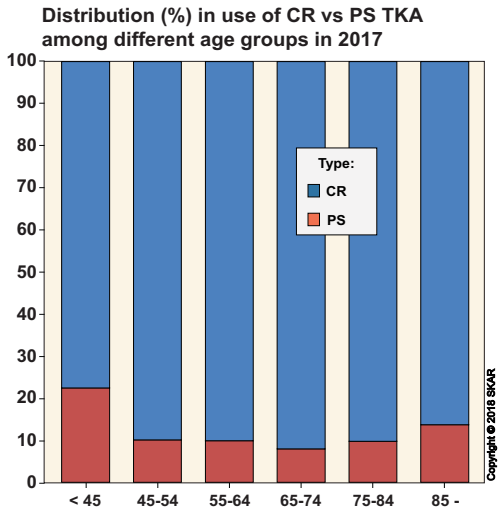
	CR	%	PS	%
NexGen MBT	6 217	88.7	790	11.3
PFC-MBT	2 601	97.0	81	3.0
Triathlon	1 566	99.9	2	0.1
PFC-HPT	1 036	100.0	0	0.0
Genesis II	357	97.5	9	2.5
Legion/Genesis II	293	86.4	46	13.6
NexGen TM	101	45.7	120	54.3
Persona	84	100.0	0	0.0
Journey	7	14.0	43	86.0
Vanguard	45	100.0	0	0.0
Attune	42	100.0	0	0.0
PFC-RP	5	31.3	11	68.8
Others	76	32.6	157	67.4
Total	12,430	90.8	1,259	9.2

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).

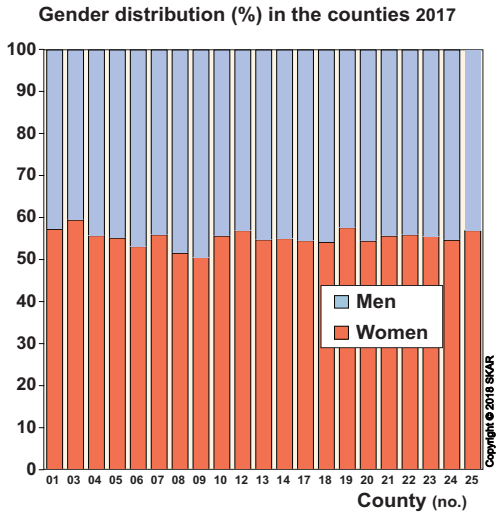
It is probably necessary to perform a randomized trial in order to estimate the differences in survival between the types.



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

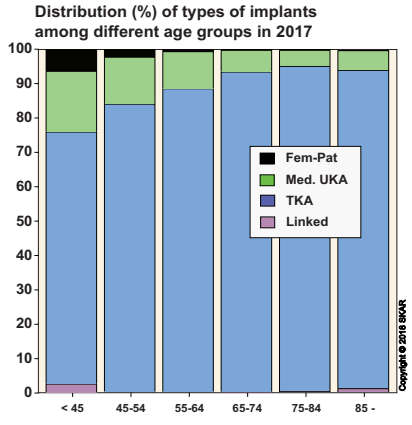
Please note that tibial components that in order to increase stability use an anterior lip or an extra concave polyethylene (deep dish) are not considered being PS implants. Some can be used both with an intact cruciate ligament as well as when the cruciate is insufficient or absent. However, there are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



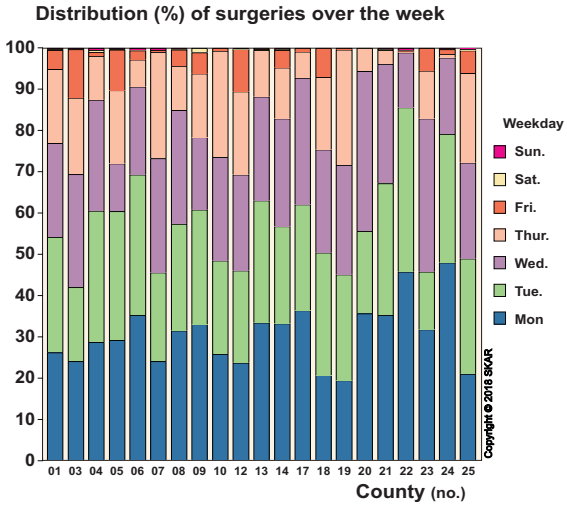
The proportion of females having surgery in the different counties was similar, varying between 50.5% and 59.4% .

Type of implants in different age groups



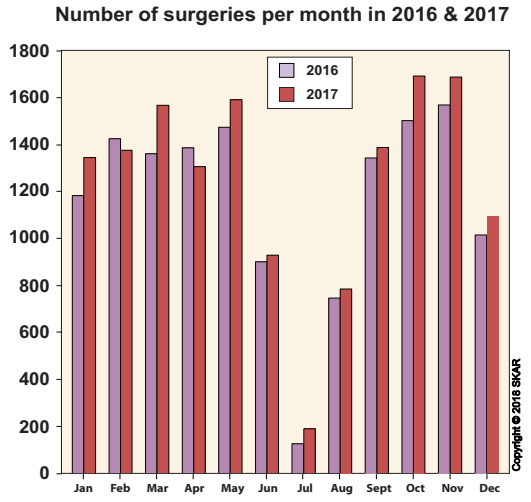
Uncommon models are most often used in younger patients. The use of linked implant in primaries is limited, but these are mainly used for serious conditions (tumors. trauma etc.)

Distribution of primary surgery on the weekdays and months



Distribution of surgery on the weekdays during 2017. 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 88% of their surgeries Monday to Thursday. Uppsala and Skåne are the counties performing the highest proportion of their surgeries on Fridays.

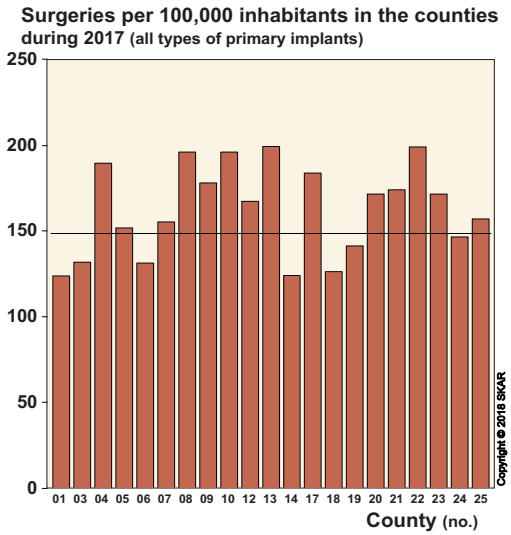
The figure above shows the number of surgeries during the different months of 2016 and 2017. It is evident how the production drops during the summer as around Christmas.

Age distribution and incidence in the counties 2017

County, number of inhabitants and incidence in 2017

Nr	County	No. of inhabitants	no. of primaries	Incidence/ 100.000
01	Stockholm	2,288,602	2,838	124.0
03	Uppsala	365,172	482	132.0
04	Södermanland	289,719	550	189.8
05	Östergötland	454,801	691	151.9
06	Jönköping	354,986	467	131.6
07	Kronoberg	196,074	305	155.6
08	Kalmar	242,919	477	196.4
09	Gotland	58,299	104	178.4
10	Blekinge	158,912	312	196.3
12	Skåne	1,334,627	2,238	167.7
13	Halland	322,579	644	199.6
14	Västra Götaland	1,681,283	2,091	124.4
17	Värmland	279,867	515	184.0
18	Örebro	296,924	376	126.6
19	Västmanland	269,362	381	141.4
20	Dalarna	285,348	490	171.7
21	Gävleborg	285,112	497	174.3
22	Västernorrland	245,770	490	199.4
23	Jämtland	129,240	222	171.8
24	Västerbotten	267,173	392	146.7
25	Norrbotten	250,933	395	157.4
Country		**10,057,698**	**14,957**	**148.7**

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

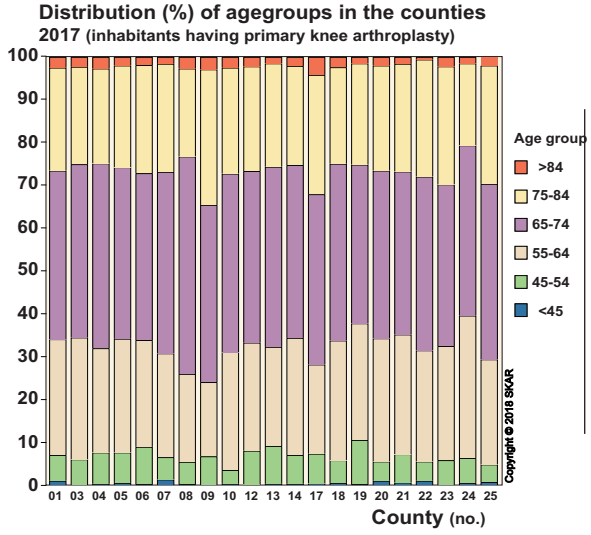


Incidence (no. of arthroplasties per 100.000 inhabitants)

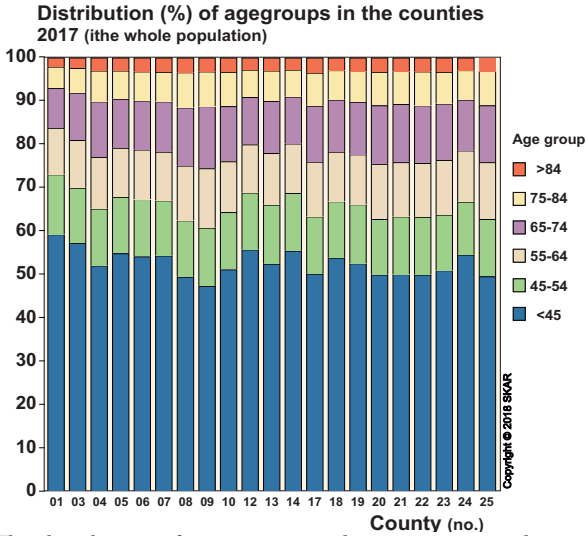
The table and figure above show the number of primary knee arthroplasties per 100,000 inhabitants in each county in 2017. The calculations are based on the domicile of patients at surgery. The incidence (not age-standardized) is highest in Halland county and lowest in the county of Stockholm.

The figure below shows for each county, the relative proportion of age groups having a primary arthroplasty. The proportion of patients less than 65 years of age was highest in Västerbotten but lowest in Gotland. Gotland and Värmland 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 2017

Distribution (%) of age groups in the counties in 2017 (whole population)

Age group:	0-44	45-54	55-64	65-74	75-84	85-
01 Stockholm	59.2	13.9	10.7	9.2	4.9	2.1
03 Uppsala	57.2	12.7	11.0	10.9	5.7	2.4
04 Södermanland	52.0	13.2	11.9	12.8	7.2	3.0
05 Östergötland	54.8	13.0	11.3	11.3	6.6	3.0
06 Jönköping	54.1	13.2	11.5	11.3	6.7	3.2
07 Kronoberg	54.3	12.7	11.3	11.6	6.8	3.3
08 Kalmar	49.4	13.0	12.6	13.5	8.1	3.5
09 Gotland	47.3	13.4	13.7	14.3	8.1	3.2
10 Blekinge	51.1	13.2	11.7	12.7	7.9	3.4
12 Skåne	55.7	13.2	11.1	10.9	6.3	2.8
13 Halland	52.4	13.7	11.9	12.0	7.0	3.1
14 Västra Götaland	55.4	13.3	11.5	10.8	6.2	2.8
17 Värmland	50.1	13.3	12.5	12.9	7.7	3.5
18 Örebro	53.8	13.0	11.5	12.0	6.7	3.0
19 Västmanland	52.5	13.5	11.6	12.0	7.1	3.1
20 Dalarna	49.9	12.9	12.7	13.5	7.7	3.4
21 Gävleborg	50.0	13.3	12.6	13.4	7.6	3.2
22 Västernorrland	49.9	13.3	12.5	13.2	7.9	3.2
23 Jämtland	50.9	12.8	12.6	13.1	7.3	3.3
24 Västerbotten	54.5	12.3	11.8	11.7	6.9	2.9
25 Norrbotten	49.5	13.2	13.1	13.1	8.0	3.1
Country	54.9	13.3	11.5	11.2	6.4	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 122.2 in Örebro county and highest 188.1 in Halland. In 2015 Uppsala had 50% higher incidence than Stockholm but has now as in 2016 roughly the same incidene. This because the number of surgeries of Uppsala inhabitants decreased between 2015 and 2016 by 22% while it increased 21% for the inhabitants of Stockholm. However, between 2016 and 2017 the increase was 9% and 13% respectively in the two counties.

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 2017)

Nr	County	Incidence
1	Stockholm	146.6
3	Uppsala	144.9
4	Södermanland	173.6
5	Östergötland	151.5
6	Jönköping	130.0
7	Kronoberg	151.9
8	Kalmar	165.8
9	Gotland	162.8
10	Blekinge	176.3
12	Skåne	172.0
13	Halland	188.1
14	Västra Götaland	127.4
17	Värmland	160.9
18	Örebro	122.2
19	Västmanland	134.8
20	Dalarna	149.5
21	Gävleborg	153.6
22	Västernorrland	173.6
23	Jämtland	169.2
24	Västerbotten	143.2
25	Norrbotten	134.7
	Country	149.4

Implants for primary arthroplasty 2007–2016

In the tables below, the implants used during the investigated period 2007-2016 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 Vanguard which use has diminished considerably the last 2 years.

Implants for primary TKA

	Antal	Procent
NexGen_Metal Backed Tib.	47,052	39.4
NexGen All Poly Tib.	3,915	3.3
NexGen Trabicular Metal	1,554	1.3
NexGen unspecified	2	0
Natural	82	0.1
Persona	9	0
Vanguard I-Beam tib.	8,646	7.2
Vanguard Finned tib.	2,008	1.7
Vanguard unspecified	78	0.1
AGC	4,075	3.4
PFC Metal Backed Tib.	20,184	16.9
PFC All Poly Tib.	11,689	9.8
PFC Rotating Platform	938	0.8
PFC unspecified	23	0
Triathlon MBT	10,764	9
Triathlon unspecified	97	0.1
Duracon	2,150	1.8
Profix	1,700	1.4
GenesisII	1,016	0.9
Legion/Genesis II	554	0.5
Journey	108	0.1
Attune	27	0
F/S MIII	788	0.7
Link Gemini	68	0.1
Other	1,754	1.5
Model missing	106	0.1
Total	119,387	100

* For revision models. see table right.

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	531	30.3
Triathlon revision	435	24.8
PFC revision	421	24.0
Vanguard revision	128	7.3
Duracon revision	67	3.8
Profix revision	65	3.7
AGC revision	59	3.4
Legion/Genesis II rev	48	2.7
Total	1,754	100

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

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
Övriga	7	1.2
Model missing	3	0.5
Total	598	100

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

Implants for primary UKA

	Number	Percent
Oxford	3,075	47.1
Link	1,563	23.9
ZUK	833	12.8
MillerGalante	370	5.7
Genesis	304	4.7
Triathlon PKR	219	3.4
Sigma PKR	98	1.5
Preservation	55	0.8
Ibalance	10	0.2
Model missing	4	0.1
Total	6,531	100

Femoro-patellar implants are uncommon. Only 424 cases using 8 different brands were reported during the 10 year period.

Femoro-Patellar implants

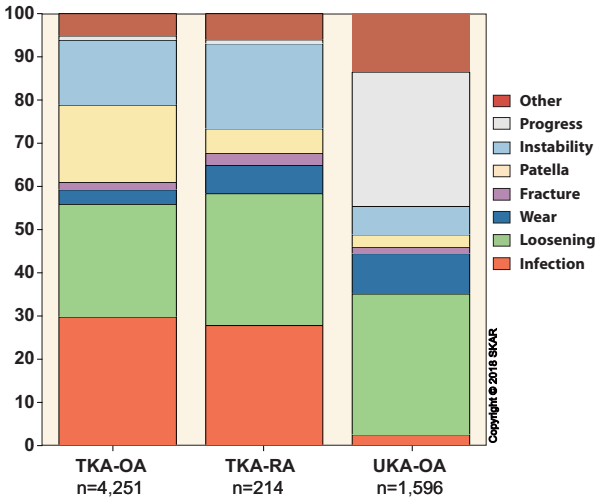
	Number	Percent
Zimmer P-F	269	63.44
PFC P-F	67	15.8
Avon	49	11.56
Link P-F	17	4.01
Journey P-F	7	1.65
Vanguard P-F	6	1.42
Richard/Blazina	3	0.71
LCS P-F	3	0.71
Model missing	3	0.71
Total	424	100

Revisions during 2007–2016

During the 10-year period, 6,513 first time revisions were performed. In 89 cases the primary was a linked implant, in 4,704 cases a TKA, in 1,653 an UKA, in 65 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 2007-2016. There

Distribution (%) of indications for revision 2007-2016



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

For TKA the proportion of revisions in which the poly is exchanged has increased as compared to previously (27% 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)	404	9.5
TKA	1,163	27.4
Exchange of femur comp.	43	1.0
Exchange of tibia comp.	278	6.5
Exchange of disc/insert	1,143	26.9
Patella addition	749	17.6
Patella removal	34	0.8
Patella exchange	9	0.2
Total implant removal	382	9.0
Arthrodesis	11	0.3
Amputation	28	0.7
Other	4	0.1
Missing	3	0.1
Total	4,251	100

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

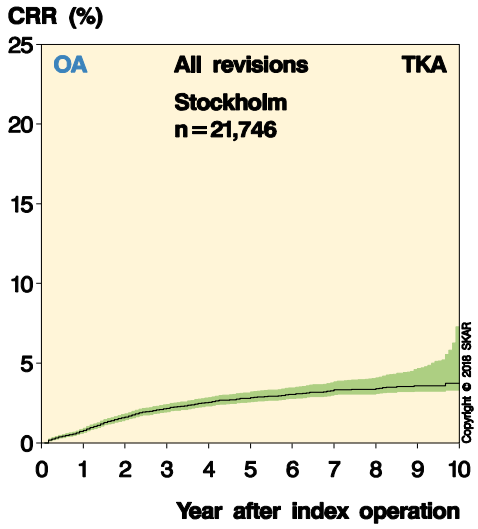
	Number	Percent
Linked (rot. hinge)	32	2.0
TKA	1,449	90.8
UKA	2	0.1
Exchange of femur comp.	6	0.4
Exchange of tibia comp.	9	0.6
Exchange/reposition of poly	73	4.6
Patella addition	4	0.3
Total implant removal	18	1.1
Amputation	2	0.1
Missing	1	0.1
Total	1,596	100

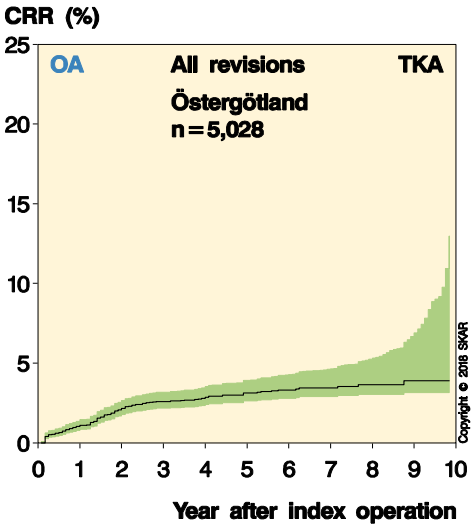
Type of revision in which the primary was a TKA/RA

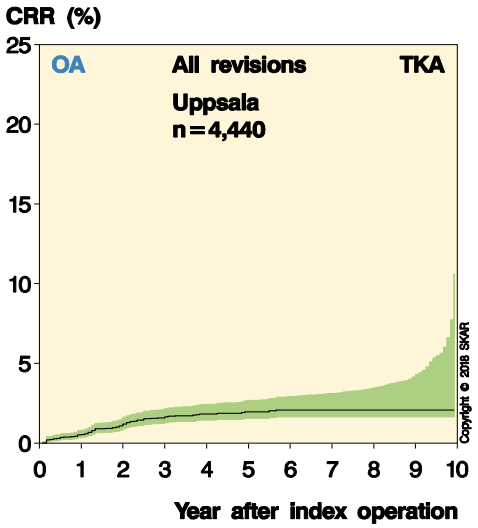
	Number	Percent
Linked (rot. hinge)	43	20.1
TKA	62	29.0
Exchange of femur comp.	5	2.3
Exchange of tibia comp.	6	2.8
Exchange of disc/insert	52	24.3
Patella addition	14	6.5
Total implant removal	25	11.7
Arthrodesis	1	0.5
Amputation	5	2.3
Missing	1	0.5
Total	214	100

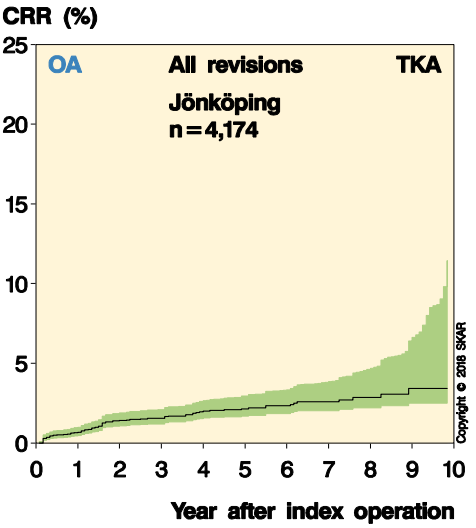
When evaluating the survival curves it should be noted that as the part of the curve to the right contains implants with long follow-up it also to a larger extent reflects older models.

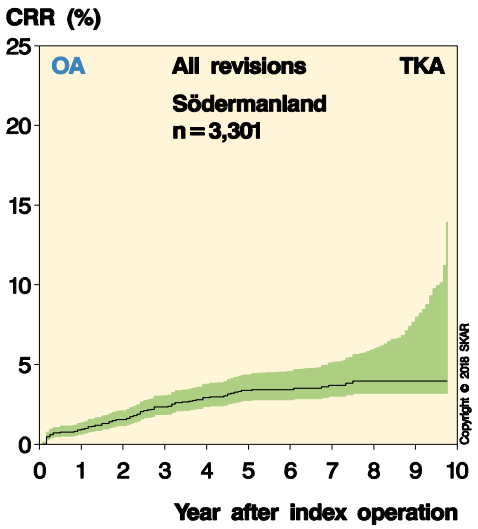
CRR in the counties after primary TKA for OA 2007–2016

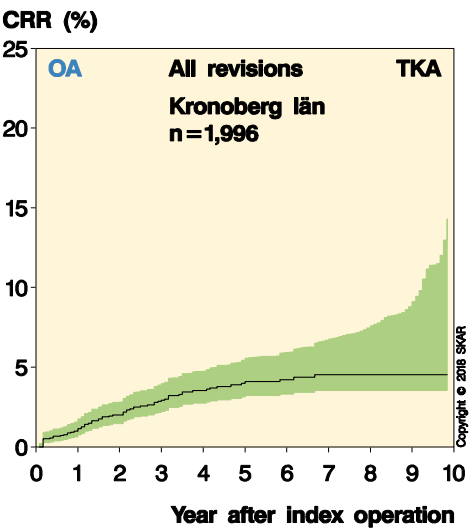




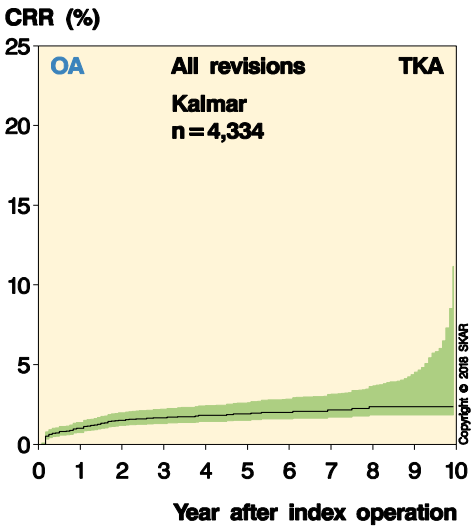


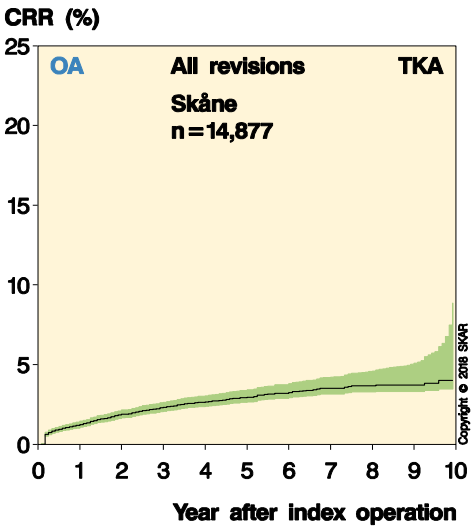


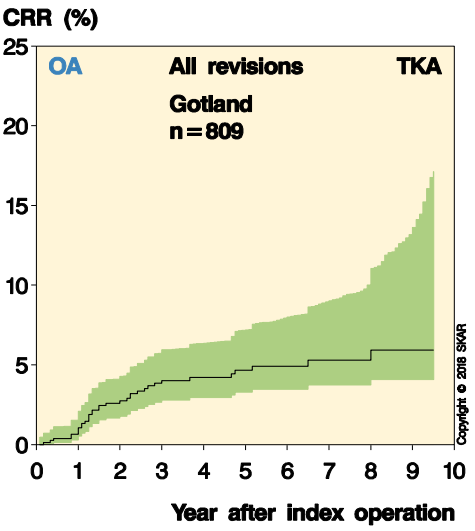


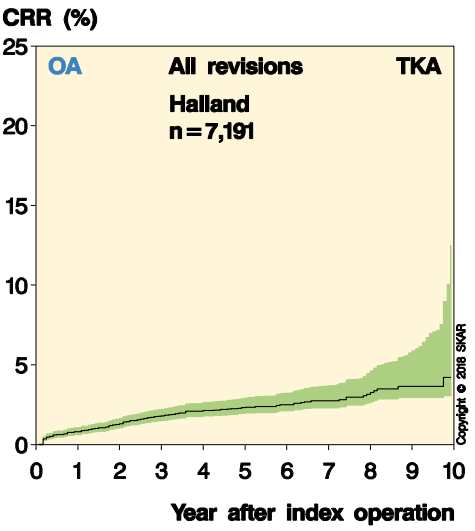


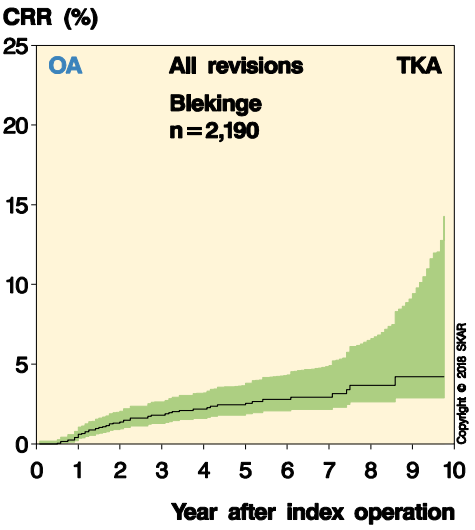
The curves are cut when less than 40 patients are left "at risk"

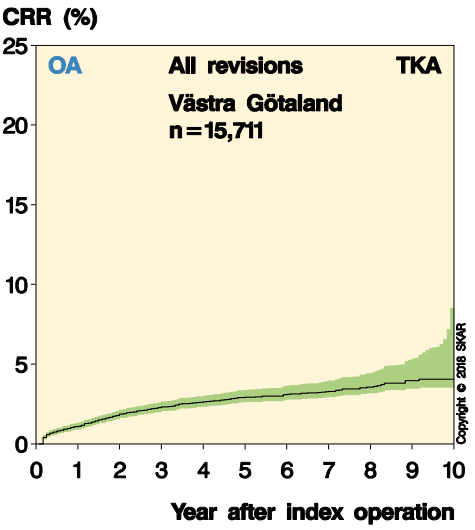






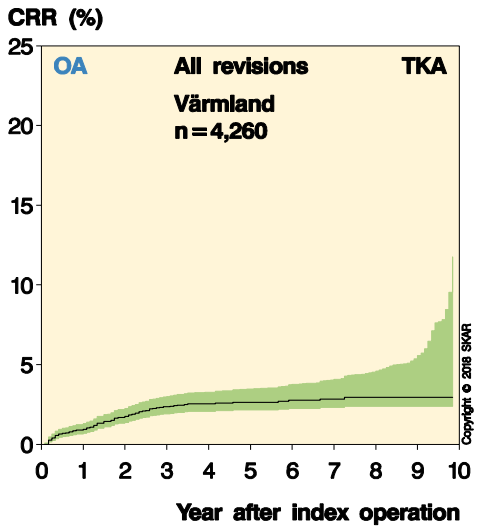


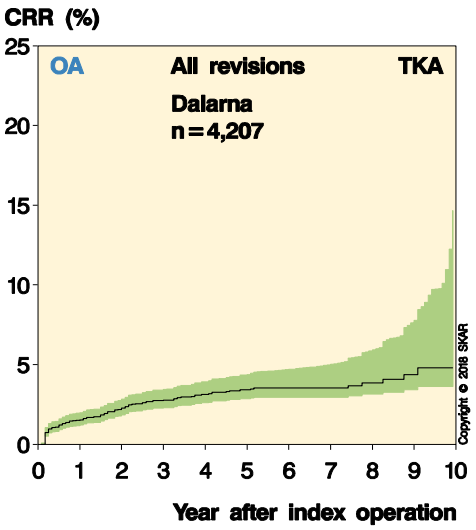


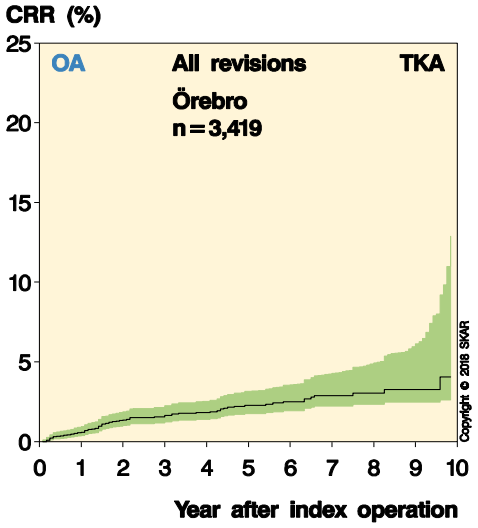


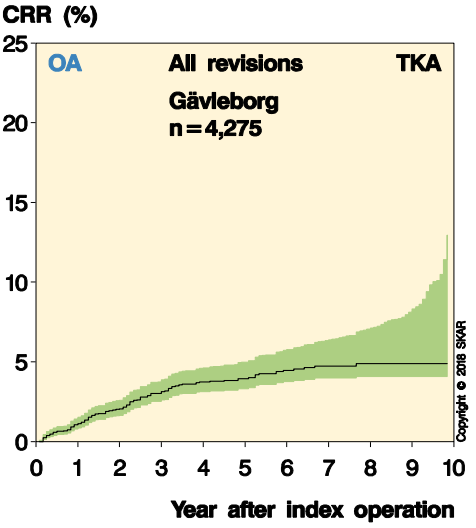
The curves are cut when less than 40 patients are left "at risk"

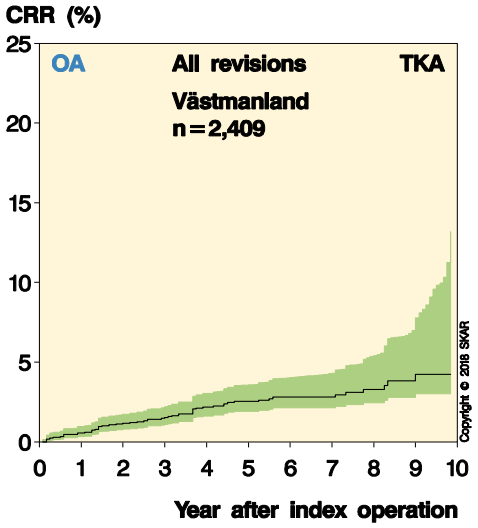
CRR in the counties after primary TKA for OA 2007–2016

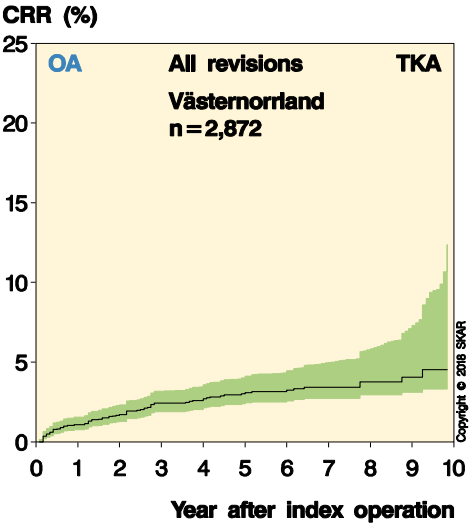




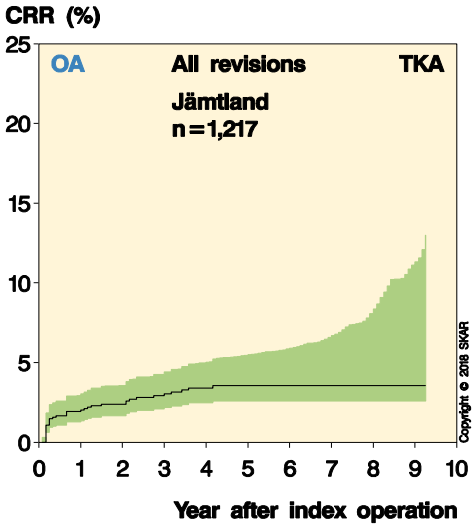


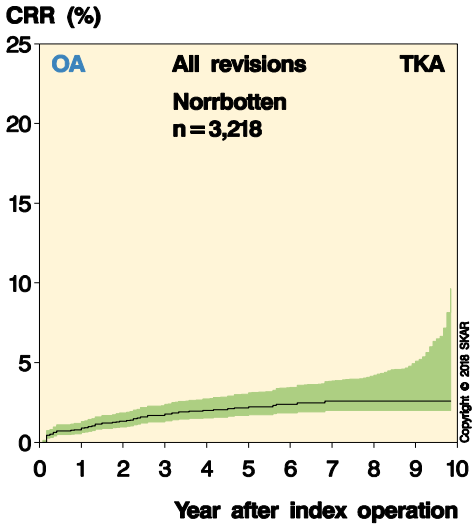


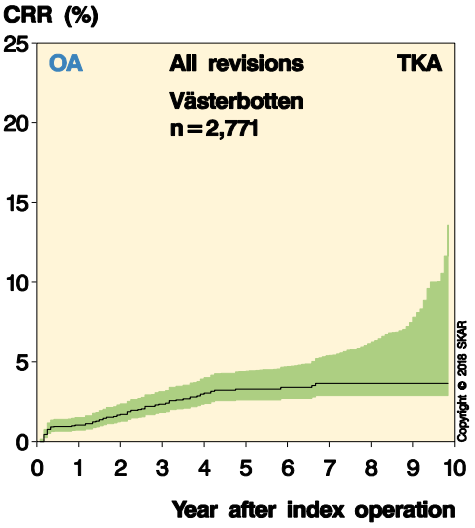




The curves are cut when less than 40 patients are left "at risk"

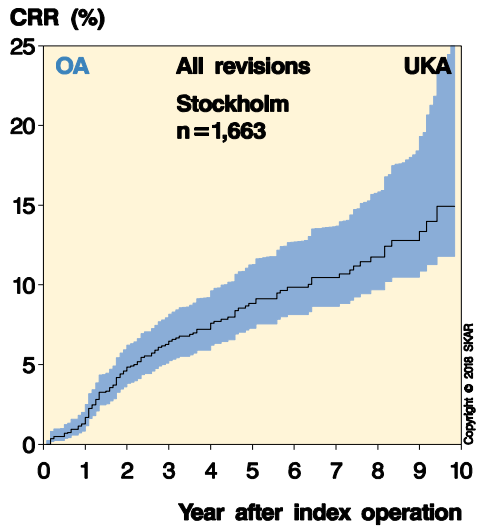


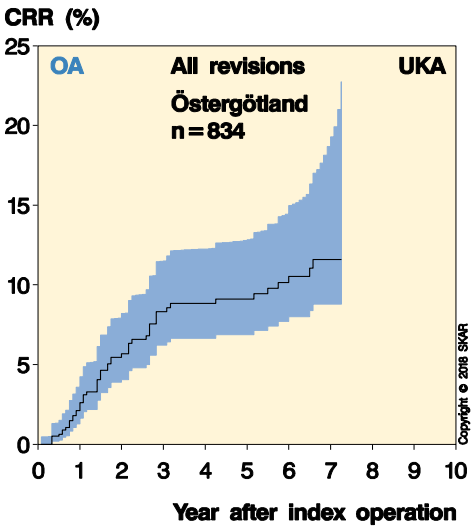


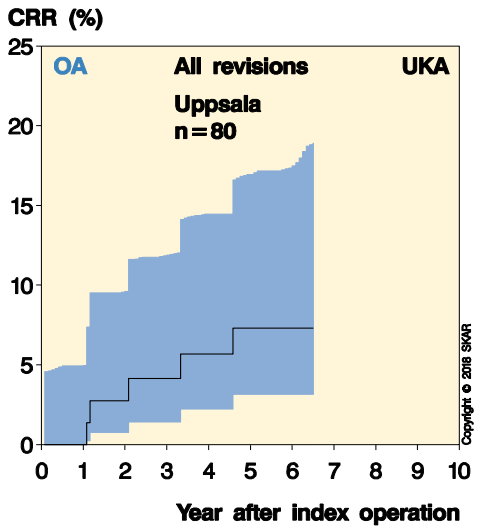


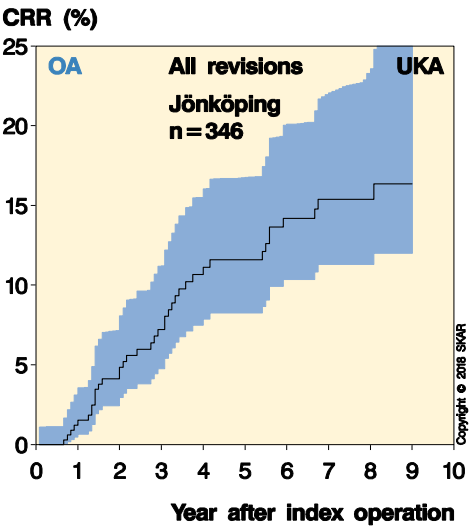
The curves are cut when less than 40 patients are left "at risk"

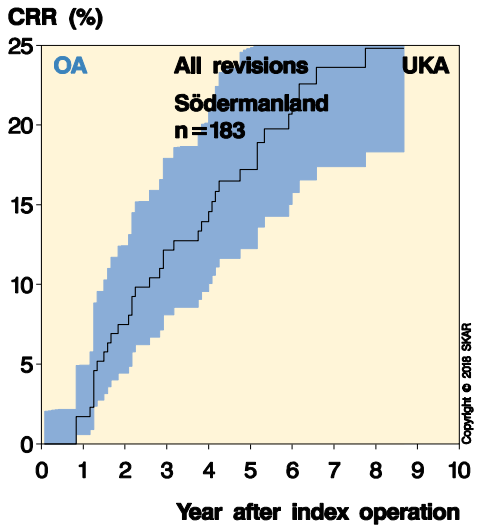
CRR in the counties after primary UKA for OA 2007–2016

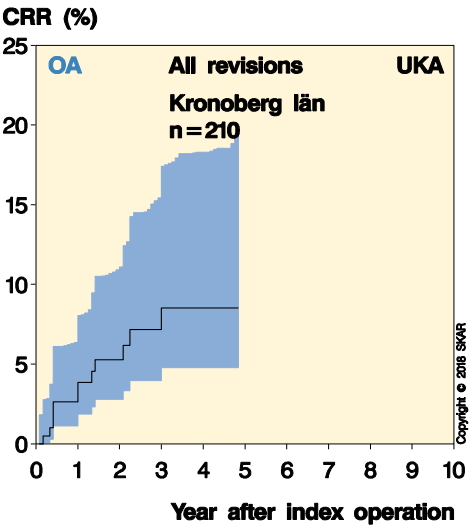




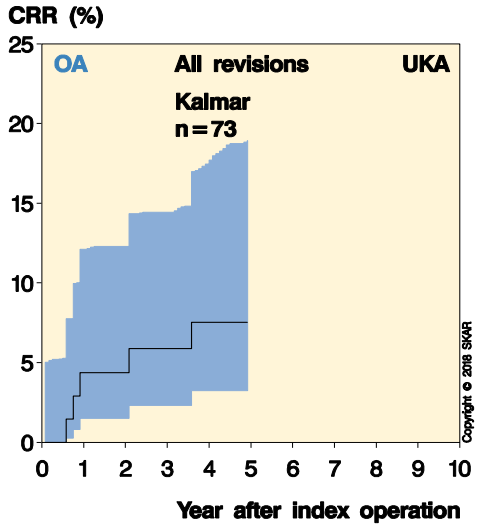


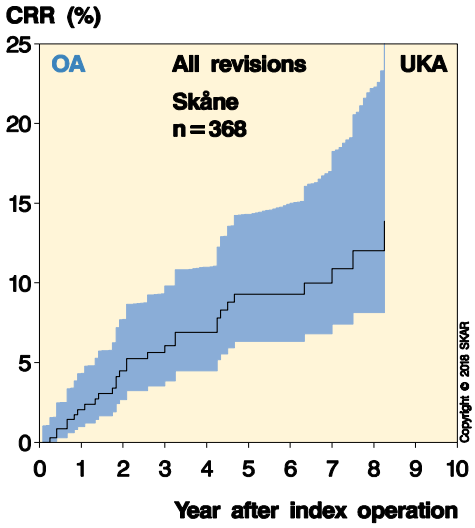


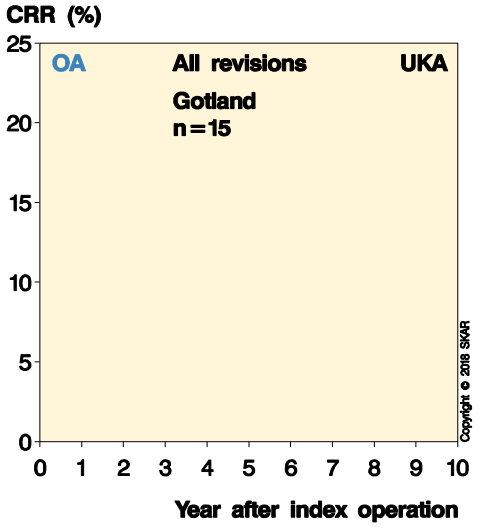


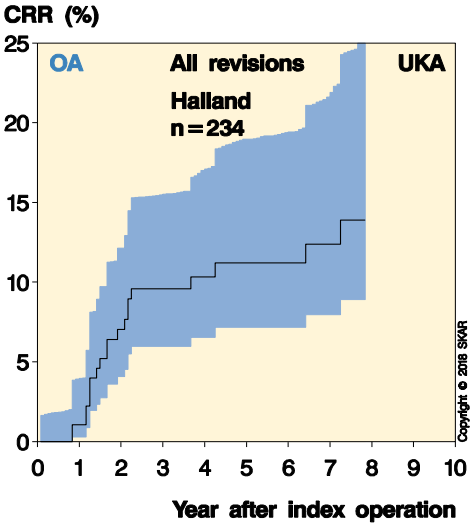


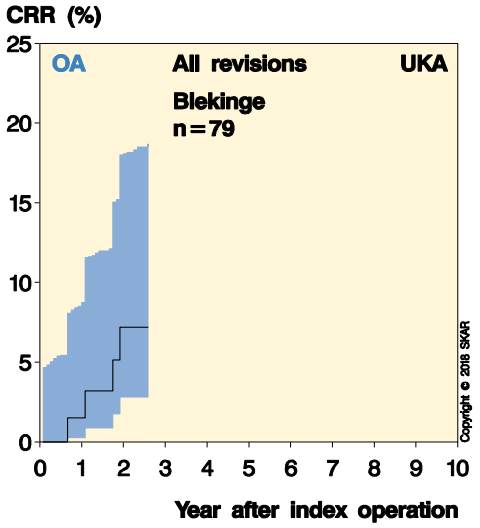
The curves are cut when less than 40 patients are left "at risk"

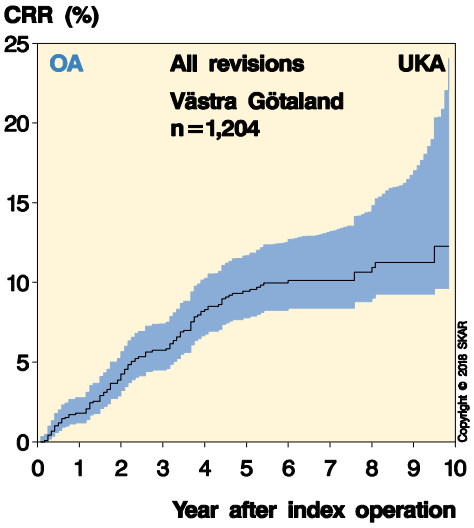






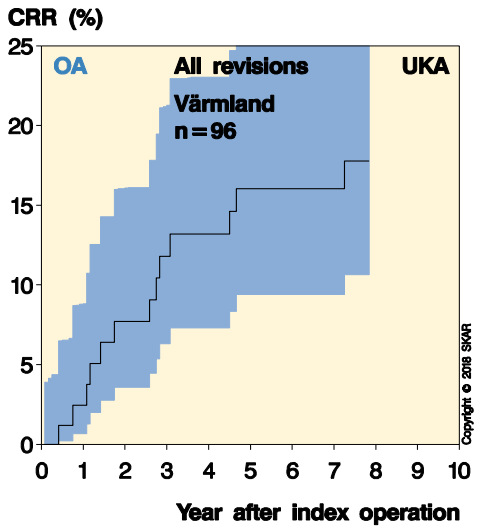


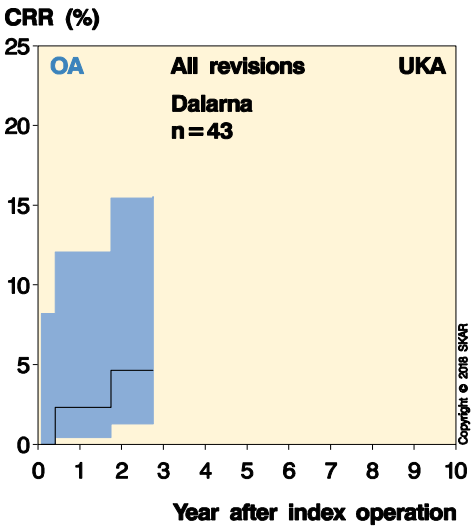


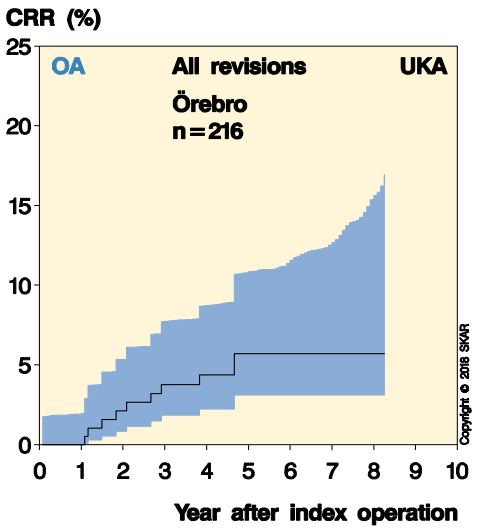


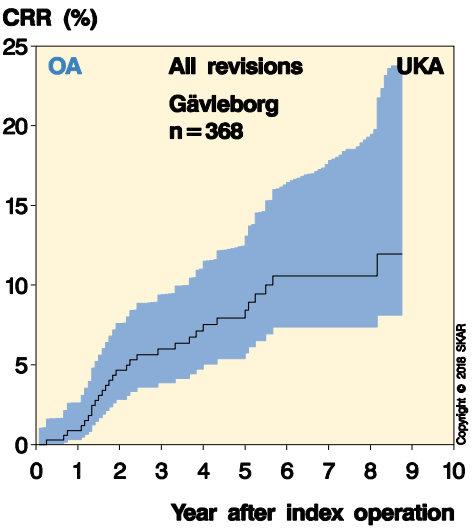
The curves are cut when less than 40 patients are left "at risk"

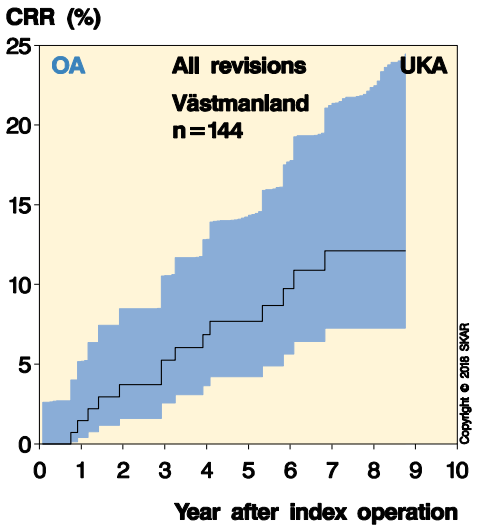
CRR in the counties after primary UKA for OA 2007–2016

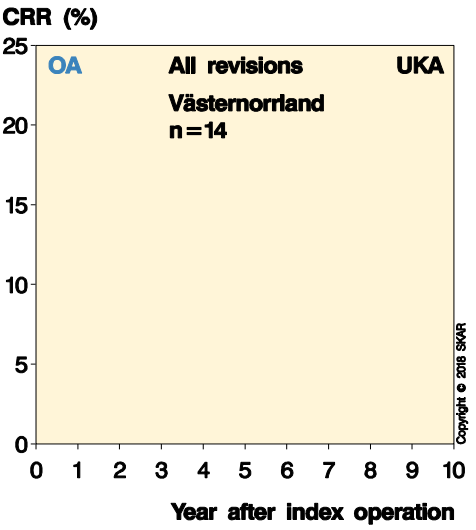




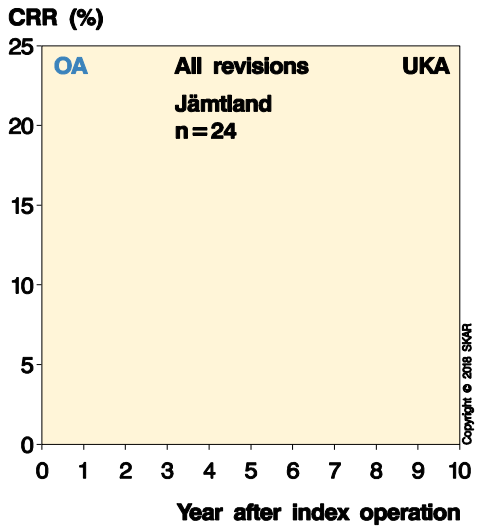


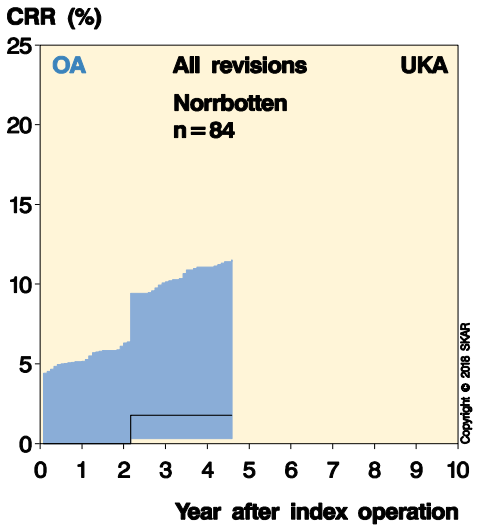


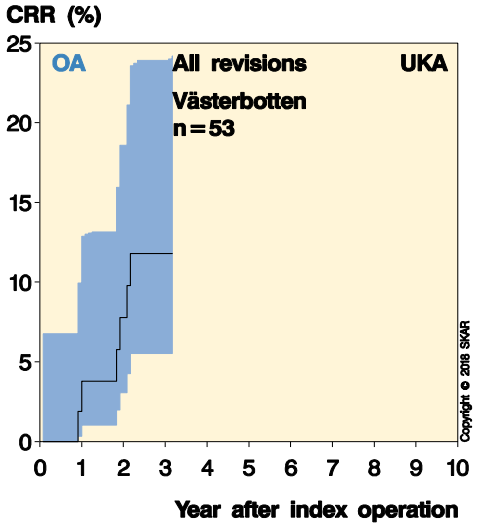




The curves are cut when less than 40 patients are left "at risk"







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

The relative risk for implants used in primary arthroplasty during 2007–2016

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), we have very similar results as last year where the AGC, Duracon, F/S MIII, PFC RP and the combination of "Other" models have significantly higher risk than the reference PFC-MBT. The Duracon and F/S MIII were used in Sweden in the nineties, the F/S until 2008 and the Duracon until 2011. The use of AGC, which was our reference for many years, began in the eighties and it was used until 2012. 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 16 inserted in 2017. As last year, the PFC-APT has a lower risk than the reference while the NexGen TM lies just around the significance limit for having a lower risk.

This year we show separate result for 2 different variants of the Vanguard implant as well as for the Journey prosthesis. The more common Vanguard version which has been in use during the whole analysis period uses the I-Beam tibial baseplate while the other which has a Finned baseplate has been used since 2010. However, the general use

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	19,364		ref.	
AGC Anatomic	3,943	0.02	1.24	1.03-1.51
Duracon	2,033	0.02	1.34	1.06-1.70
F/S MIII	773	<0.01	2.27	1.71-3.01
Genesis II	994	0.26	0.73	0.42-1.26
Genesis II/Legion	528	0.84	1.09	0.48-2.44
Journey	105	0.03	2.35	1.11-4.95
NexGen APT	3,832	0.41	0.91	0.73-1.13
NexGen MBT	45,333	0.07	0.90	0.81-1.01
NexGen TM	1,415	0.05	0.71	0.50-1.00
PFC RP	874	<0.01	2.19	1.70-2.82
PFC-Sigma APT	11,368	<0.01	0.73	0.62-0.85
Profix	1,616	0.36	1.14	0.86-1.52
Triathlon MBT	10,378	0.90	1.01	0.87-1.18
Vanguard Finned	1,923	0.04	1.37	1.01-1.84
Vanguard I-Beam	8,311	0.28	1.09	0.93-1.27
Other	1,655	<0.01	1.83	1.42-2.34
Gender (male is ref.)		0.03	0.92	0.86-0.99
Age (per year)		<0.01	0.97	0.97-0.98
Year of op. (per year)		0.01	1.02	1.00-1.04

OA / UKA	n	p–value	RR	95% CI
Link	1,531		ref.	
Genesis	298	0.53	1.12	0.79-1.58
MillerGalante	354	0.88	1.03	0.74-1.41
Oxford	2,994	0.21	0.87	0.71-1.08
Sigma PKR	93	0.59	0.76	0.28-2.07
Triathlon PKR	211	0.86	1.05	0.62-1.76
ZUK	783	0.63	0.93	0.70-1.24
Other	67	0.49	1.25	0.66-2.38
Gender (male is ref.)		0.51	1.06	0.89-1.25
Age (per year)		<0.01	0.97	0.96-0.98
Year of op. (per year)		0.78	1.01	0.97-1.05

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	18,851		ref.	
AGC Anatomic	3,288	<0.01	1.37	1.12-1.68
Duracon	1,719	0.05	1.30	1.00-1.70
F/S MIII	696	<0.01	2.39	1.78-3.22
GenesisII	980	0.14	0.64	0.35-1.16
Genesis II/Legion	502	0.94	0.97	0.40-2.34
Journey	102	0.02	2.49	1.18-5.26
NexGen APT	3,762	0.70	0.96	0.77-1.19
NexGen MBT	44,687	0.18	0.93	0.83-1.04
NexGen TM	1,370	0.11	0.76	0.54-1.07
PFC RP	663	<0.01	2.04	1.51-2.75
PFC-Sigma APT	10,945	<0.01	0.75	0.63-0.88
Profix	1,460	0.27	1.19	0.88-1.60
Triathlon MBT	10,181	0.60	1.04	0.89-1.22
Vanguard Finned	1,882	0.04	1.37	1.01-1.87
Vanguard I-Beam	7,872	0.04	1.18	1.01-1.38
Other	1,600	<0.01	1.89	1.47-2.44
Gender (male is ref.)		0.10	0.94	0.87-1.01
Age (per year)		<0.01	0.97	0.97-0.98
Year of op. (per year)		<0.01	1.03	1.01-1.04

With patella button OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	513		ref.	
AGC Anatomic	655	<0.01	0.29	0.16-0.54
Duracon	314	0.10	0.59	0.31-1.12
F/S MIII	77	0.31	0.62	0.24-1.58
Genesis II	14	0.03	4.89	1.12-21.23
Genesis II/Legion	26	0.30	2.99	0.38-23.31
Journey	*3*	*0.99*	.	.
NexGen APT	70	0.09	0.18	0.02-1.30
NexGen MBT	646	0.18	0.67	0.37-1.20
NexGen TM	*45*	*0.98*	.	.
PFC RP	211	0.66	0.87	0.48-1.59
PFC-Sigma APT	423	0.03	0.41	0.19-0.91
Profix	156	0.12	0.46	0.18-1.21
Triathlon MBT	197	0.04	0.37	0.14-0.96
Vanguard Finned	41	0.70	1.34	0.31-5.79
Vanguard I-Beam	439	<0.01	0.07	0.02-0.29
Other	55	0.60	0.68	
Gender (male is ref.)		<0.01	0.63	0.45-0.88
Age (per year)		<0.01	0.97	0.95-0.98
Year of op. (per year)		0.14	0.93	

Implants lacking sufficient numbers for analysis are shown in italics

of Vanguard has diminished considerably during the last years. The finned version was found to have significantly higher risk than the reference PFC-MBT. The same was found for the Journey prosthesis which has been used in relatively small numbers since 2008.

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 and increases with time (op. year). The latter may be caused by an increasing number of insert exchanges in manifest or suspected infections. On the next page we have performed the same analysis but without considering such insert exchanges being revisions and then the significant effect of the year of surgery disappears.

With respect to UKA inserted for OA (table on the previous page) 3 models account for 84% of the surgeries. None of the UKA models has a significantly different risk as compared to the reference model Endo-Link. The risk diminishes with increasing age of patients at surgery while for time (op. year) we no longer see a significant effect.

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, the PFC-Sigma APT still has significantly lower risk of revision than the reference. Those implants having significantly higher risk are the same as when all TKA's are analyzed (table on the previous page) with the addition of Vanguard I-Beam which without a patellar component has a significantly higher risk than the reference.

The number of TKA's using a patellar button, is small which makes it more difficult to show and even interpret significant differences. However, it is interesting to see that the AGC and Vanguard I-Beam, which had a higher risk than the reference when no button was used, have a lower risk when used together with a button.

The relative risk for implants used in primary arthroplasty during 2007–2016 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 721 TKA and 12 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 Vanguard I-Beam. In case of the 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.

After the exclusion, the risk of revision has become higher for women, indicating that they have higher risk of revision for other reasons than infection. The negative effect of time (year of op.) has disappeared probably because of an increased aggressiveness in recent years when treating early manifest or suspected infections. This has resulted in an increased number of debridement and exchange of inserts causing the negative effect of time in the previous table which disappeares when these revisions are not considered.

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	19,364		ref.	
AGC Anatomic	3 943	<0.01	1.61	1.32-1.97
Duracon	2 033	<0.01	1.45	1.11-1.88
F/S MIII	773	<0.01	2.84	2.12-3.79
Genesis II	994	0.25	0.64	0.30-1.36
Genesis II/Legion	528	0.36	1.59	0.59-4.29
Journey	105	<0.01	3.17	1.50-6.69
NexGen APT	3,832	0.09	1.22	0.97-1.52
NexGen MBT	45,333	0.34	0.94	0.82-1.07
NexGen TM	1,415	0.17	0.77	0.53-1.12
PFC RP	874	<0.01	2.47	1.89-3.23
PFC-Sigma APT	11,368	0.96	1.00	0.84-1.18
Profix	1,616	0.05	1.36	1.00-1.85
Triathlon MBT	10,378	0.70	0.96	0.80-1.16
Vanguard Finned	1,923	0.04	1.48	1.03-2.14
Vanguard I-Beam	8,311	0.04	1.20	1.01-1.44
Other	1,655	<0.01	1.57	1.15-2.14
Gender (male is ref.)		<0.01	1.12	1.03-1.22
Age (per year)		<0.01	0.96	0.96-0.97
Year of op. (per year)		0.59	1.01	0.99-1.03

OA / UKA	n	p–value	RR	95% CI
Link	1,531		ref.	
Genesis	298	0.54	1.12	0.79-1.58
MillerGalante	354	0.92	1.02	0.74-1.40
Oxford	2,994	0.15	0.85	0.69-1.06
Sigma PKR	93	0.62	0.78	0.29-2.11
Triathlon PKR	211	0.83	1.06	0.63-1.78
ZUK	783	0.65	0.94	0.70-1.25
Other	67	0.50	1.25	0.66-2.37
Gender (male is ref.)		0.43	1.07	0.90-1.27
Age (per year)		<0.01	0.97	0.96-0.98
Year of op. (per year)		0.90	1.00	0.96-1.04

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	18,851		ref.	
AGC Anatomic	3,288	<0.01	1.79	1.45-2.21
Duracon	1,719	0.03	1.38	1.03-1.85
F/S MIII	696	<0.01	3.01	2.22-4.08
Genesis II	980	0.17	0.57	0.25-1.28
Genesis II/Legion	502	0.30	1.70	0.63-4.56
Journey	102	<0.01	3.36	1.59-7.09
NexGen APT	3,762	0.03	1.28	1.02-1.60
NexGen MBT	44,687	0.50	0.95	0.83-1.09
NexGen TM	1,370	0.28	0.82	0.56-1.18
PFC RP	663	<0.01	2.32	1.69-3.18
PFC-Sigma APT	10,945	0.79	1.02	0.86-1.22
Profix	1,460	0.03	1.43	1.04-1.97
Triathlon MBT	10,181	0.97	1.00	0.83-1.21
Vanguard Finned	1,882	0.06	1.45	0.99-2.12
Vanguard I-Beam	7,872	<0.01	1.30	1.09-1.56
Other	1,600	<0.01	1.59	1.16-2.19
Gender (male is ref.)		<0.01	1.15	1.05-1.25
Age (per year)		<0.01	0.96	0.96-0.97
Year of op. (per year)		0.40	1.01	0.99-1.03

With patella button OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	513		ref.	
AGC Anatomic	655	<0.01	0.38	0.20-0.74
Duracon	314	0.30	0.69	0.34-1.39
F/S MIII	77	0.58	0.76	0.29-2.00
Genesis II	14	0.13	4.81	0.62-37.35
Genesis II/Legion	*26*	*0.99*	.	.
Journey	*3*	*1.00*	.	.
NexGen APT	70	0.16	0.23	0.03-1.74
NexGen MBT	646	0.85	0.94	0.49-1.81
NexGen TM	*45*	*0.98*	.	.
PFC RP	211	0.93	1.03	0.53-2.00
PFC-Sigma APT	423	0.26	0.62	0.27-1.43
Profix	156	0.23	0.51	0.17-1.52
Triathlon MBT	197	0.03	0.20	0.05-0.88
Vanguard Finned	41	0.25	2.43	0.54-11.01
Vanguard I-Beam	439	<0.01	0.11	0.02-0.46
Other	55	0.98	1.02	0.24-4.40
Gender (male is ref.)		0.09	0.73	0.51-1.05
Age (per year)		<0.01	0.96	0.94-0.98
Year of op. (per year)		0.04	0.89	0.80-1.00

Implants lacking sufficient numbers for analysis are shown in italics

In case of UKA (table previous page right), there were only 12 exchanges of inserts during the 10-year period for manifest or suspected infection (of which 6 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.

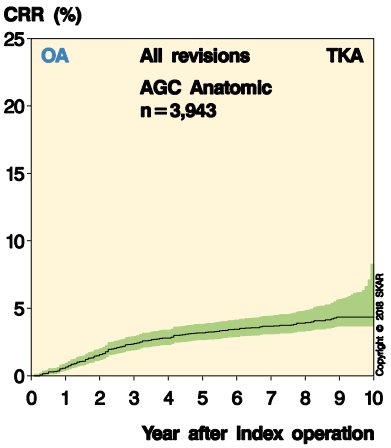
When the table above left (without a patella button) is compared to the the table when all the TKA's were included (table on the previous page to the left), we see that the NexGen-APT now has a significantly higher risk than the reference while the Vanguard Finned no longer is significantly inferior.

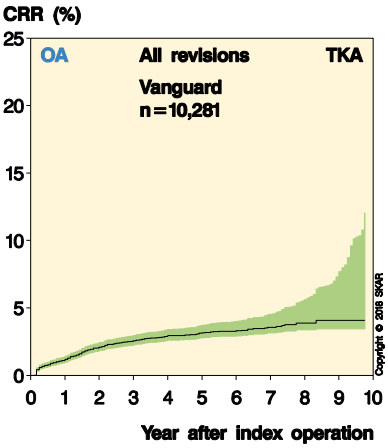
As compared to the table on page 49 in which change of inserts for infection were considered revisions the difference is that PFC-Sigma APT is no longer better than the reference while the Profix has become significantly inferior.

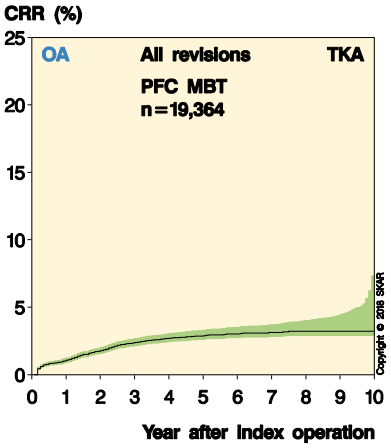
The table above concerns TKA's in which a patellar button was used. When this table is compared to the same table on page 49 the difference is that the PFC-Sigma APT and Triathlon MBT no longer have significantly lower risk while the 14 inserted Genesis II no longer are significantly inferior. However, as has been mentioned, the number of implants is small making it difficult to show and even interpret significant differences.

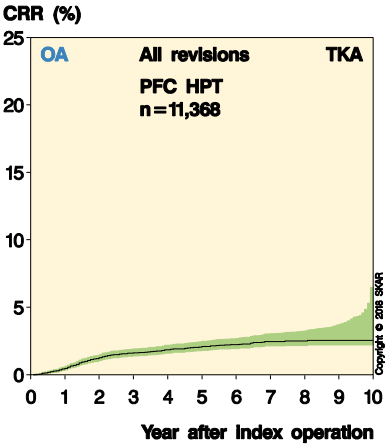
In summary one can establish that excluding an exchange of insert in infected cases does affect the results and that the effect negatively affects non-modular implants as compared to modular ones. One explanation may be that a number of debridement's without exchange of inserts in non-modular TKA's have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

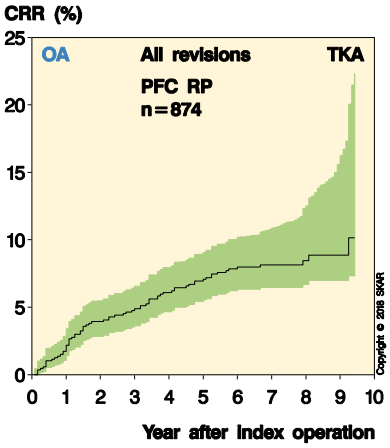
CRR for commonly used TKA implants for OA 2007–2016

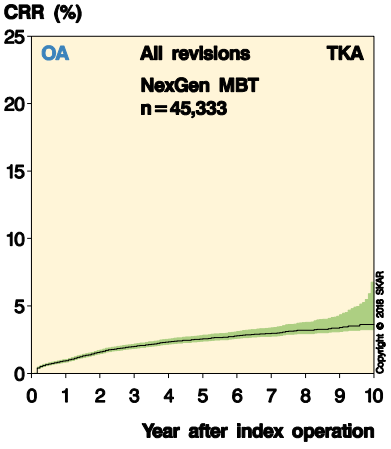


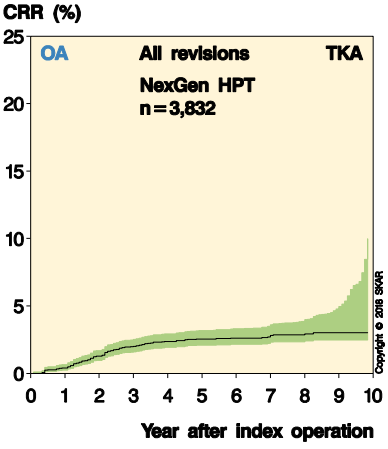


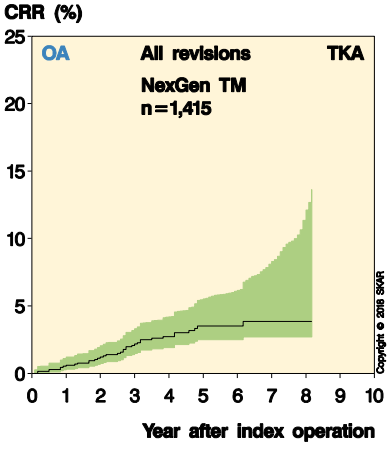


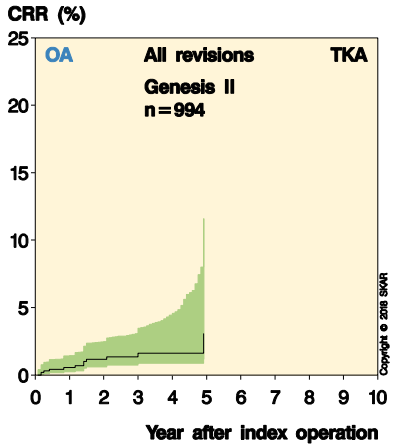











CRR (%)
OA
All revisions
TKA
Genesis II
n=994
Year after index operation
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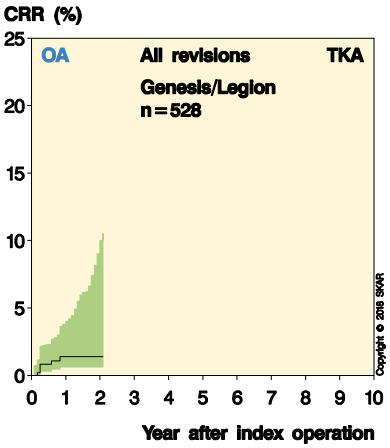
CRR (%)
OA
All revisions
TKA
Genesis/Legion
n=528
Year after index operation
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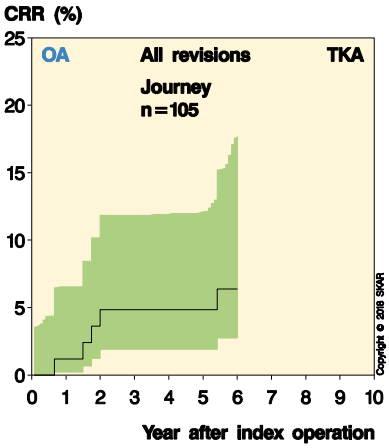
CRR (%)
OA
All revisions
TKA
Journey
n=105
Year after index operation
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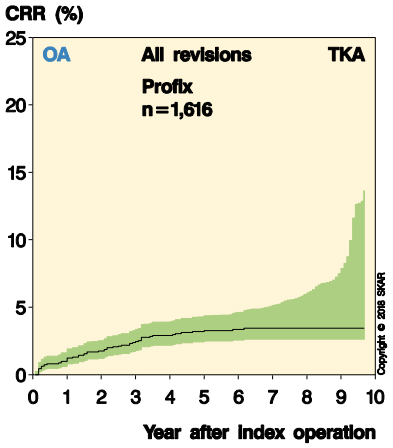
CRR (%)
OA
All revisions
TKA
Profix
n=1,616
Year after index operation
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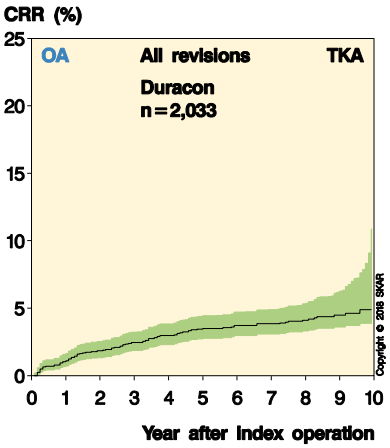
CRR (%)
OA
All revisions
TKA
Duracon
n=2,033
Year after index operation
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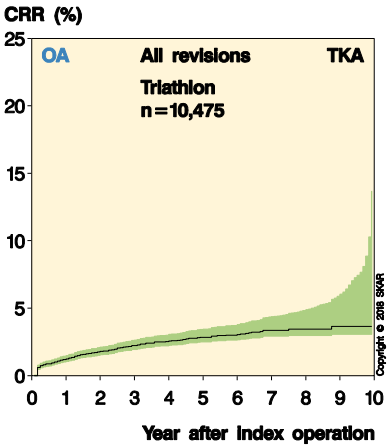
CRR (%)
OA
All revisions
TKA
Triathlon
n=10,475
Year after index operation
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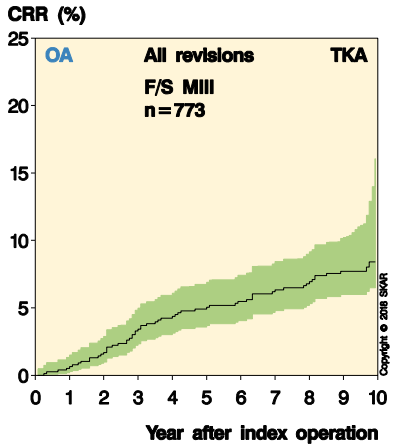
CRR (%)
OA
All revisions
TKA
F/S MIII
n=773
Year after index operation
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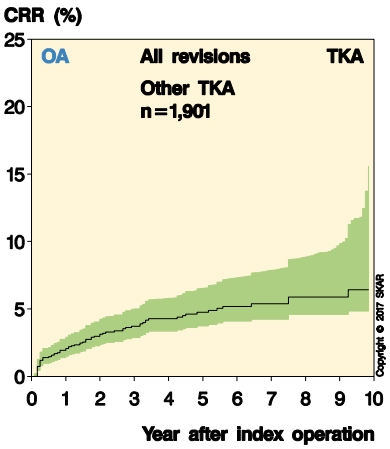
CRR (%)
OA
All revisions
TKA
Other TKA
n=1,901
Year after index operation
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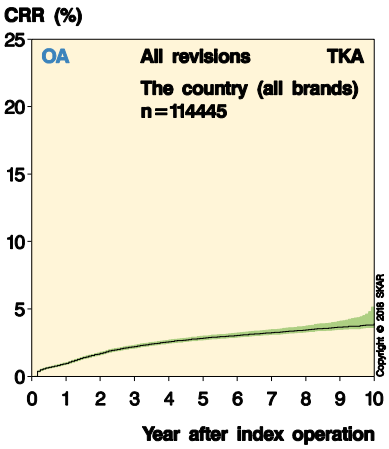
CRR (%)
OA
All revisions
TKA
The country (all brands)
n=114445
Year after index operation
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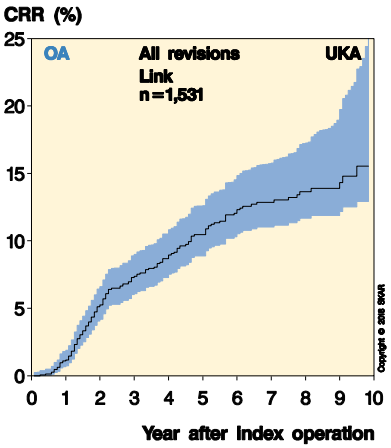
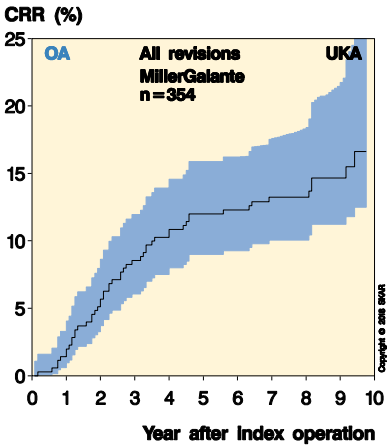
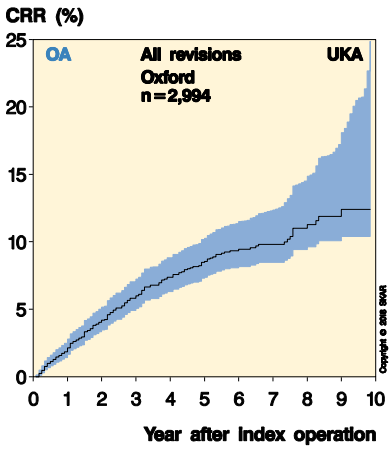
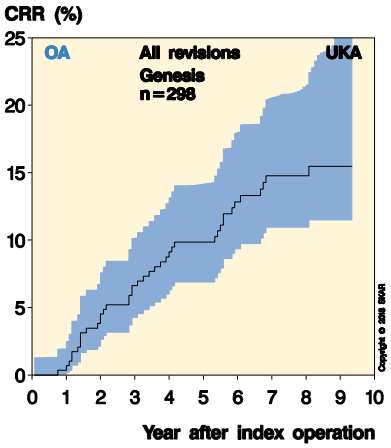
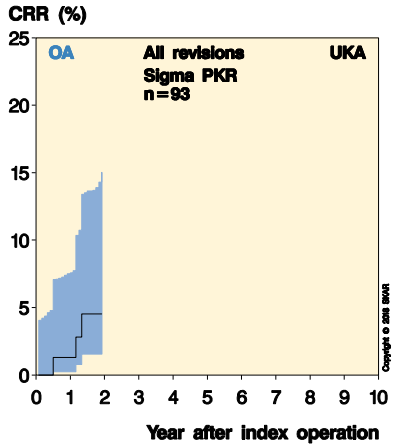
CRR for commonly used UKA implants for OA 2007–2016

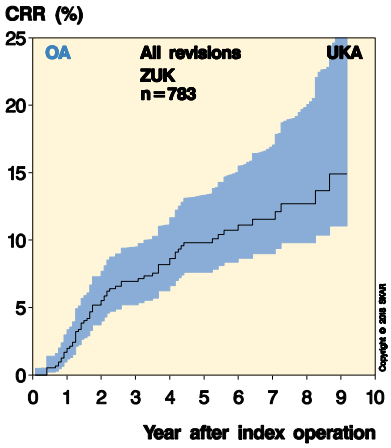


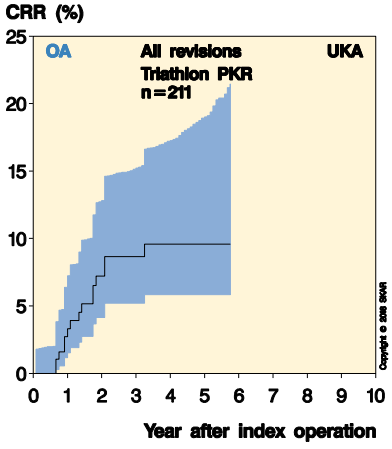


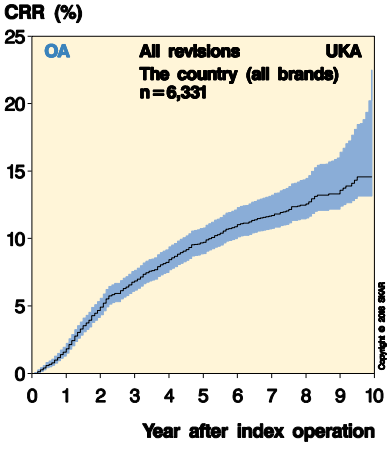












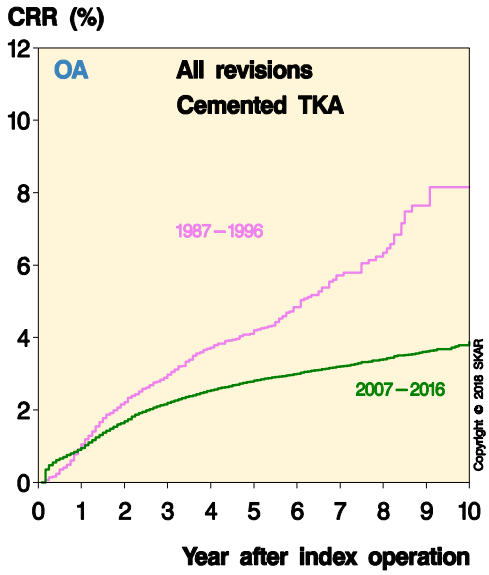
Changes in risk of revision over time (TKA for OA)

The figure below shows the overall risk of revision for the current 10-year period, 2007-2016, as compared to the period 1987-1996. It can be observed that the risk for the current period is considerably lower than for the earlier period.

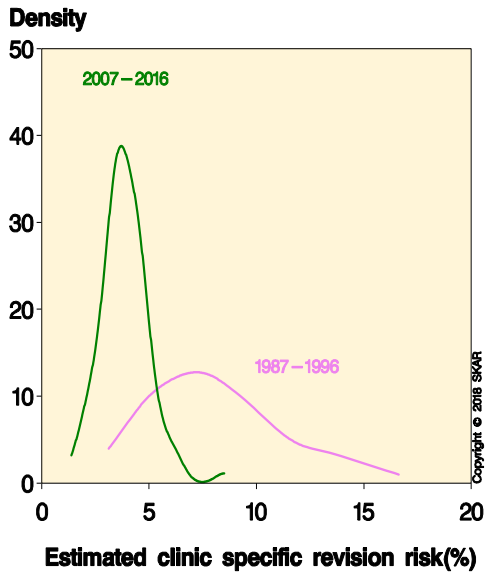
When the absolute specific risk of revision for the units is plotted for both periods (figure below left), it can be seen that the risk has become lower and the distribution has diminished. This implies that the results have improved overall and at the same time the results for the different units have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

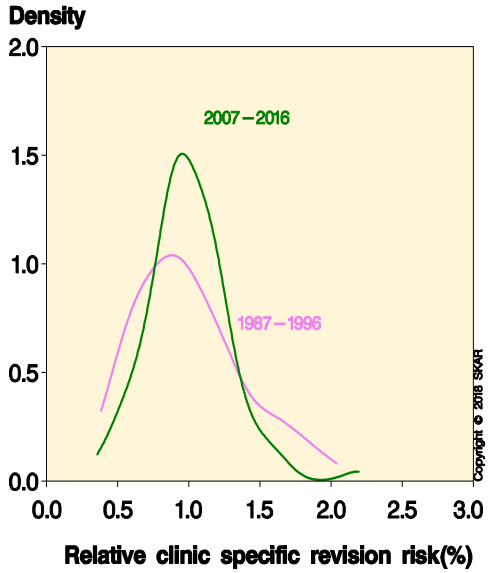
The register is requested to account for hospital specific results which can be found on the next pages. This year, there were 9 hospitals having significantly better results than the average hospital and 7 with inferior results. One can only speculate on the causes for these differences. An unfortunate 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 1987–1996 and 2007–2016 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 1987-1996 and 2007–2016 (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 1987–1996 and 2007–2016 (x-axis = relative risk).

Relative risk of revision for hospitals 2007–2016 (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	1,865	12	0.36	0.23-0.56	1	1-6
11015	Nacka-Proxima	1,089	8	0.47	0.28-0.76	2	1-19
10010	Sabbatsberg (Aleris)	711	5	0.47	0.27-0.82	3	1-22
12010	Enköping	3,029	34	0.54	0.40-0.73	4	2-16
11002	Huddinge	1,234	15	0.57	0.38-0.86	5	2-27
12481	Elisabethsjukhuset	474	6	0.58	0.34-0.98	6	1-39
52013	Skene	919	12	0.59	0.38-0.92	7	2-32
25011	Oskarshamn	2,512	38	0.65	0.48-0.87	8	3-28
50480	Carlanderska	969	14	0.67	0.44-1.03	9	3-44
65012	Gällivare	659	10	0.72	0.45-1.15	10	3-54
11001	Karolinska	1,059	20	0.72	0.50-1.05	11	4-46
25010	Kalmar	913	14	0.73	0.48-1.11	12	4-52
42015	Movement Halmstad	2,518	42	0.73	0.55-0.96	13	6-37
22010	Jönköping	1,389	24	0.76	0.53-1.07	14	5-48
22012	Värnamo	1,235	28	0.77	0.54-1.08	15	5-48
50020	OrthoCenter IFK klin.*	948	18	0.77	0.52-1.13	16	5-52
42420	Spenshult	1,362	30	0.80	0.58-1.10	17	7-49
55010	Örebro	754	17	0.84	0.56-1.24	18	6-61
56010	Västerås	2,065	42	0.84	0.63-1.11	19	9-50
11013	Löwenströmska**	3,612	77	0.84	0.68-1.05	20	12-46
55011	Karlskoga	1,056	21	0.84	0.59-1.22	21	7-60
62010	Sundsvall	830	18	0.85	0.58-1.26	22	7-62
28011	Ängelholm	1,738	33	0.87	0.64-1.18	23	9-56

(cont.)

Relative risk of revision for units (continued)

Code	Hospital	no. of TKA	Revised	RR	95% CI	Rank	95% CI
42011	Varberg	1,484	32	0.87	0.64-1.19	24	9-56
65013	Piteå	2,502	54	0.87	0.68-1.12	25	11-52
22405	Art Clinic Jönköping	69	0	0.87	0.43-1.77	26	3-75
52011	Borås	863	21	0.87	0.60-1.27	27	8-63
62011	Örnsköldsvik	1,099	23	0.88	0.61-1.25	28	8-61
61012	Hudiksvall	684	14	0.90	0.59-1.37	29	7-67
22011	Eksjö (Höglandssjukh.)	1,481	29	0.91	0.66-1.26	30	10-62
10011	S:t Göran	3,260	73	0.92	0.73-1.14	31	15-54
54010	Karlstad	1,750	39	0.92	0.69-1.22	32	12-59
54014	Torsby	1,023	22	0.92	0.64-1.33	33	10-66
13011	Nyköping	877	20	0.93	0.64-1.35	34	10-67
55012	Lindesberg	1,609	32	0.93	0.68-1.27	35	11-62
53010	Falköping	547	16	0.93	0.62-1.39	36	9-68
50498	Art Clinic Göteborg	67	0	0.93	0.46-1.89	37	3-76
27011	Karlshamn	2,189	49	0.94	0.72-1.22	38	15-59
53011	Lidköping	1,537	33	0.97	0.71-1.33	39	14-65
64010	Skellefteå	844	20	0.98	0.67-1.42	40	11-69
23010	Växjö	1,013	27	0.99	0.71-1.39	41	14-68
10013	Södersjukhuset	2,715	72	1.02	0.81-1.27	42	22-62
41011	Trelleborg	6,351	156	1.02	0.87-1.19	43	27-58
41001	Lund	334	6	1.02	0.60-1.73	44	8-75
11010	Danderyd	1,320	35	1.06	0.79-1.44	45	20-70
54012	Arvika	1,487	37	1.06	0.79-1.43	46	20-70
50071	Frölunda Spec.	978	29	1.07	0.77-1.48	47	19-71
13012	Kullbergska sjukhuset	2,031	58	1.07	0.84-1.37	48	24-68
64011	Lycksele	644	16	1.09	0.73-1.63	49	15-74
64001	Umeå	1,283	40	1.09	0.82-1.45	50	22-70
42010	Halmstad	1,827	52	1.10	0.85-1.42	51	25-69
10015	Sophiahemmet	684	23	1.11	0.78-1.58	52	19-73
21014	Motala	3,825	109	1.13	0.94-1.36	53	34-68
21013	Norrköping	1,203	32	1.13	0.83-1.54	54	23-72
41012	Helsingborg	270	7	1.15	0.69-1.91	55	12-76
24010	Västervik	909	26	1.16	0.83-1.63	56	24-74
50010	Östra sjukhuset	286	12	1.17	0.75-1.82	57	17-75
57011	Mora	1,544	44	1.17	0.89-1.54	58	29-73
28012	Hässleholm	6,115	179	1.18	1.01-1.36	59	41-68
12001	Akademiska sjukhuset	937	33	1.18	0.86-1.60	60	27-74
30001	Malmö	68	4	1.18	0.67-2.10	61	11-76
53013	Skövde	1,052	30	1.19	0.86-1.64	62	28-74
11011	Södertälje	1,166	37	1.22	0.91-1.63	63	31-74
56012	Köping	344	16	1.22	0.81-1.82	64	22-76
57010	Falun	2,663	83	1.23	1.00-1.52	65	40-72
51011	Mölndal	2,319	63	1.24	0.98-1.57	66	38-73
51010	Uddevalla	1,847	56	1.25	0.97-1.60	67	38-74
63010	Östersund	1,217	38	1.27	0.95-1.70	68	35-75
10016	Ortopediska huset	4,100	138	1.29	1.09-1.52	69	49-73
11012	Norrtälje	795	28	1.32	0.95-1.83	70	35-76
61011	Bollnäs	2,714	92	1.35	1.11-1.65	71	50-74
26010	Visby	809	34	1.43	1.06-1.94	72	45-76
13010	Eskilstuna	393	18	1.44	0.98-2.12	73	38-76
62013	Sollefteå	942	40	1.53	1.15-2.04	74	53-76
23011	Ljungby	983	41	1.58	1.19-2.09	75	57-77
61010	Gävle	877	37	1.60	1.19-2.15	76	57-77
51012	Kungälv	1,511	89	2.20	1.79-2.69	77	75-77

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

** Lövenströmska 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 2007–2016 (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 7 of the 9 units with results better than the average keep their status after exclusion of insert exchanges. Sabbatsberg, Elisabetsjukhuset and Skene no longer are better than the average while Trelleborg has become better. Elisabetsjukhuset used monobloc components in 6% of their TKAs during the period, Skene in 17% of cases while Trelleborg almost exclusively used modular components. At the other end of the table, all the 7 units that were significantly inferior keep their status and additionally Uddevalla that used monobloc tibias in 16% of their cases. Other non-significant changes in the ranking order can also be seen. Thus, modularity of the tibia, allowing for change of insert, has an effect on the risk of revision. However, the use of monobloc tibias has diminished from 40% of cases in 2007 to 9% in 2016 and, if the trend continues, the problem of 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	1,865	10	0.40	0.25-0.63	1	1-10
10010	Sabbatsberg (Aleris)	711	4	0.51	0.29-0.90	2	1-31
11015	Nacka-Proxima	1,089	7	0.53	0.32-0.88	3	1-29
25011	Oskarshamn	2,512	26	0.60	0.43-0.84	4	2-26
42015	Movement Halmstad	2,518	25	0.60	0.43-0.85	5	2-26
12481	Elisabethsjukhuset	474	5	0.61	0.36-1.05	6	1-43
11002	Huddinge	1,234	14	0.64	0.42-0.98	7	2-38
25010	Kalmar	913	8	0.65	0.40-1.06	8	1-45
22010	Jönköping	1,389	15	0.66	0.44-1.00	9	2-40
52013	Skene	919	11	0.67	0.42-1.05	10	2-44
12010	Enköping	3,029	33	0.68	0.50-0.92	11	3-33
62011	Örnsköldsvik	1,099	12	0.68	0.44-1.05	12	2-46
50480	Carlanderska	969	11	0.71	0.45-1.11	13	2-49
62010	Sundsvall	830	11	0.73	0.47-1.15	14	3-53
65013	Piteå	2,502	35	0.75	0.55-1.01	15	5-42
42420	Spenshult	1,362	22	0.75	0.52-1.07	16	4-46
52011	Borås	863	14	0.78	0.51-1.19	17	4-57
11001	Karolinska	1,059	18	0.78	0.53-1.15	18	5-52
65012	Gällivare	659	9	0.81	0.50-1.30	19	4-62
41011	Trelleborg	6,351	97	0.82	0.67-0.99	20	11-40
50020	OrthoCenter IFK klin.*	948	15	0.82	0.54-1.23	21	5-58
53011	Lidköping	1,537	20	0.82	0.57-1.19	22	6-56
22012	Värnamo	1,235	25	0.82	0.57-1.18	23	7-56

(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
54010	Karlstad	1,750	27	0.83	0.60-1.16	24	7-53
55011	Karlskoga	1,056	16	0.84	0.56-1.25	25	6-60
22011	Eksjö (Höglandssjukh.)	1,481	20	0.86	0.59-1.24	26	7-60
57010	Falun	2,663	44	0.86	0.66-1.14	27	11-53
42011	Varberg	1,484	25	0.87	0.62-1.22	28	8-58
64010	Skellefteå	844	13	0.87	0.57-1.33	29	6-64
55010	Örebro	754	15	0.89	0.59-1.34	30	7-65
54014	Torsby	1,023	16	0.90	0.60-1.35	31	8-65
24010	Västervik	909	14	0.90	0.60-1.37	32	7-66
56010	Västerås	2,065	36	0.91	0.68-1.23	33	12-59
22405	Art Clinic Jönköping	69	0	0.92	0.46-1.82	34	3-76
55012	Lindesberg	1,609	25	0.96	0.68-1.36	35	13-65
50498	Art Clinic Göteborg	67	0	0.97	0.49-1.93	36	4-76
28011	Ängelholm	1,738	29	0.97	0.70-1.34	37	15-64
53010	Falköping	547	14	0.97	0.64-1.48	38	10-70
10015	Sophiahemmet	684	16	1.00	0.67-1.49	39	12-70
28012	Hässleholm	6,115	118	1.00	0.84-1.19	40	25-57
12001	Akademiska sjukhuset	937	23	1.01	0.71-1.44	41	15-68
61012	Hudiksvall	684	13	1.02	0.67-1.57	42	12-72
11013	Löwenströmska**	3,612	77	1.04	0.84-1.30	43	26-63
11010	Danderyd	1,320	27	1.05	0.75-1.46	44	18-69
13011	Nyköping	877	19	1.07	0.73-1.56	45	17-72
41001	Lund	334	5	1.08	0.63-1.85	46	10-76
10011	S:t Göran	3,260	70	1.09	0.87-1.37	47	28-66
63010	Östersund	1,217	25	1.10	0.78-1.54	48	21-72
41012	Helsingborg	270	5	1.11	0.65-1.90	49	10-76
42010	Halmstad	1,827	42	1.12	0.84-1.47	50	26-69
30001	Malmö	68	3	1.12	0.62-2.00	51	9-77
10013	Södersjukhuset	2,715	64	1.12	0.89-1.42	52	30-68
51011	Mölndal	2,319	44	1.14	0.86-1.49	53	28-70
13012	Kullbergska sjukhuset	2,031	50	1.15	0.89-1.49	54	30-70
50010	Östra sjukhuset	286	10	1.16	0.73-1.83	55	17-76
11012	Norrtälje	795	19	1.16	0.80-1.70	56	22-74
64001	Umeå	1,283	36	1.16	0.87-1.57	57	28-72
57011	Mora	1,544	34	1.17	0.86-1.58	58	28-72
21013	Norrköping	1,203	26	1.17	0.84-1.64	59	26-74
13010	Eskilstuna	393	11	1.18	0.75-1.84	60	18-76
23010	Växjö	1,013	27	1.18	0.85-1.64	61	26-73
27011	Karlshamn	2,189	49	1.18	0.91-1.53	62	32-71
21014	Motala	3,825	90	1.18	0.96-1.44	63	37-69
54012	Arvika	1,487	33	1.20	0.88-1.63	64	30-73
53013	Skövde	1,052	24	1.21	0.86-1.71	65	27-75
11011	Södertälje	1,166	30	1.21	0.88-1.67	66	29-74
50071	Frölunda Spec.	978	28	1.23	0.89-1.71	67	30-75
64011	Lycksele	644	15	1.25	0.83-1.87	68	25-76
56012	Köping	344	16	1.35	0.91-2.01	69	31-77
51010	Uddevalla	1,847	49	1.38	1.06-1.79	70	45-76
26010	Visby	809	31	1.55	1.13-2.12	71	52-77
61011	Bollnäs	2,714	84	1.55	1.26-1.91	72	60-77
10016	Ortopediska huset	4,100	135	1.56	1.32-1.85	73	63-77
61010	Gävle	877	29	1.56	1.13-2.16	74	52-77
23011	Ljungby	983	33	1.58	1.16-2.15	75	54-77
51012	Kungälv	1,511	51	1.61	1.24-2.08	76	60-77
62013	Sollefteå	942	36	1.65	1.23-2.22	77	58-77

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

** Lövenströmska 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 2017.

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, Motala Aleris och 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 while it is <2% in Skene and 0% in Kalmar. The proportion of patients with ASA ≥3 is twice the national average in Danderyd, Norrtälje, Södersjukhuset and Södertälje while it is half in Hässleholm, Kullbergska, Lindesberg and Skene.

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.

A previous surgery of the index knee (not shown in the table) was reported for 19.3% of the patients. Meniscal surgery was most common (6.9%) followed by arthroscopy (5.4%), cruciate ligament surgery (2.2%), osteotomy (1.4%), osteosynthesis (0.8%) and "other" (1.0%). For 2.8% of the patients more than one previous surgery was stated.

Patient characteristics and case-mix

Hospital 2017	Number of reports	Complete reports %	% OA	% Women	% <55 years	% BMI 35+	% ASA ≥3
Country	**14,964**	**99.9**	**97**	**55.8**	**7.1**	**9.5**	**18.4**
University hospitals							
Akademiska	86	99.6	93.0	60.5	10.5	19.8	28.6
Huddinge	111	100	91.0	62.2	6.3	17.1	51.4
Karolinska Solna	60	100	71.7	65.0	15	11.8	76.7
Lund	43	100	66.7	55.8	16.3	20.9	60.5
Umeå	119	99.7	85.7	49.6	9.2	13.5	32.5
Örebro	8	100	87.5	75.0	0.0	25.0	25.0
Private units							
Art Clinic Göteborg	108	99.6	98.2	49.1	15.7	4.7	1.0
Art Clinic Jönköping	90	100	100	35.6	10.0	7.8	3.3
Bollnäs Aleris	325	99.9	95.7	52.6	7.4	2.8	19.1
Capio Artro Clinic Stockholm	241	100	98.3	56.4	7.9	3.7	6.6
Carlanderska	224	99.9	97.8	39.7	10.3	8.0	2.2
Elisabethkliniken	6	100	100	33.3	0.0	0.0	16.7
Hermelinen-Luleå	19	98.9	94.7	31.6	5.3	5.6	38.9
Motala Aleris	605	99.9	96.4	54.6	7.9	7.0	24.8
Movement Halmstad	434	100	99.5	50.7	9.0	7.6	19.4
Nacka Aleris	174	99.8	100	56.9	4.6	1.2	0.6
OrthoCenter IFK-kliniken	162	99.9	98.2	49.4	11.1	2.5	5.6
OrthoCenter Stockholm	463	99.9	97.8	58.1	5.4	2.6	2.2
Ortopediska huset	720	100	99.7	57.9	6.8	3.6	5.0
Sophiahemmet	229	99.8	97.8	31.9	13.1	5.2	9.6
St Göran	521	100	98.3	60.5	5.6	8.9	33.2
Ängelholm Aleris	249	100	94.8	58.6	6.8	10.1	13.3

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 2017	Number of reports	Complete reports %	% OA	% Women	% <55 years	% BMI 35+	% ASA ≥3
< 100 operations/year							
Borås	69	100	95.7	55.1	1.5	17.4	40.6
Eskilstuna	69	100	95.7	55.1	14.5	23.2	34.8
Gällivare	54	100	94.4	50.0	1.9	9.3	31.5
Gävle	86	100	89.5	66.3	6.7	18.6	40.7
Helsingborg	19	100	94.7	52.6	0.0	26.3	68.4
Hudiksvall	56	100	96.4	57.1	1.8	10.7	23.2
Jönköping	11	100	90.9	81.8	18.2	0.0	27.3
Karlskoga	39	100	97.4	53.9	15.4	15.4	2.6
Skellefteå	77	99.7	98.7	53.3	6.5	7.9	21.1
Skövde	73	100	94.5	57.5	1.4	11.0	24.7
Sundsvall	5	100	100	100	0.0	40.0	60.0
Visby	97	100	100	50.5	6.2	13.4	14.4
Västervik	81	100	98.8	58.0	3.7	7.4	12.4
Växjö	78	100	96.2	64.1	6.4	10.3	14.1
Ängelholm	93	99.8	93.5	66.7	7.5	8.6	6.4
100-300 operations/year							
Alingsås	200	100	100	59.0	6.5	11.5	18.0
Arvika	193	100	99.0	49.7	7.8	11.4	22.8
Danderyd	176	100	93.2	61.9	6.8	13.1	41.5
Eksjö	217	100	94.9	51.6	10.1	10.1	15.7
Falun	215	100	98.6	57.2	5.6	14.4	24.7
Halmstad	185	99.9	97.3	60.5	7.0	14.1	20.0
Kalmar	100	100	93.0	48.0	0.0	0.0	16.0
Karlshamn	296	100	97.3	55.4	3.7	7.1	13.9
Karlstad	132	99.5	98.5	64.4	6.8	13.7	16.2
Kullbergska sjukhuset	244	99.7	98.0	54.9	6.2	11.9	6.6
Kungälv	207	100	97.1	58.5	7.7	15.0	14.5
Lidköping	250	100	98.0	54.8	6.0	9.2	10.4
Ljungby	135	100	97.0	51.1	5.9	8.9	14.1
Lycksele	150	100	97.3	59.3	4.0	13.3	14.0
Mora	195	99.9	98.0	51.3	3.1	6.7	14.9
Norrköping	175	100	95.4	57.1	8.6	6.9	20.0
Norrtälje	152	100	97.4	61.2	7.9	11.2	41.5
Nyköping	102	100	98.0	57.8	3.9	9.8	17.7
Skene	127	100	99.2	52.0	7.9	1.6	2.4
Sollefteå	206	99.9	97.6	56.3	3.4	9.8	20.1
Södersjukhuset	285	100	96.1	54.7	11.2	12.6	53.7
Södertälje	149	100	97.3	67.1	8.7	16.1	38.3
Torsby	134	100	97.8	51.5	5.2	9.0	28.4
Uddevalla	247	100	95.6	64.8	4.5	10.5	27.1
Varberg	215	100	99.1	57.7	9.8	12.1	16.3
Värnamo	194	100	98.5	61.3	7.7	12.9	22.2
Västerås	264	100	96.6	57.6	9.4	21.6	25.4
Örnsköldsvik	172	100	97.7	57.1	4.6	14.0	15.1
Östersund	164	100	95.1	55.2	5.5	11.0	15.3
> 300 operations/year							
Enköping	366	100	97.3	59.6	4.6	7.7	22.4
Hässleholm	884	100	97.2	50.8	8.0	6.9	7.2
Lindesberg	424	99.9	95.1	53.8	5.0	9.5	7.3
Mölndal	379	99.9	96.0	58.3	8.4	12.7	18.3
Oskarshamn	370	100	97.8	51.1	6.2	11.9	18.1
Piteå	305	100	95.7	59.7	5.6	9.5	25.3
Trelleborg	850	99.9	98.8	62.0	7.5	11.1	20.0

Prophylactic antibiotics for knee arthroplasties

The table shows what was reported for primary knee arthroplasties in 2017.

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 2017 recommendations of the PRISS project (Prosthetic Related Infections Shall be Stopped). These have however been updated 2018 (www. patientforsakringen.se).

In short, the recommendations are to give Cloxacilline 2g x 3 i.v.. The first dose 45-30 minutes before start of surgery or inflation of a tourniquet, the second dose 2 hours after the first one and the third after additional 4 hours. In case of penicillin allergy Clindamycin is used instead (600mg x 2) with the first dose administrated as for Cloxacilline and the second dose 4 hours after the first one.

The columns "% having Cloxacilline or Clindamycin", "% with dose 2g x 3 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. Most of those units that did not completely follow the dosage recommendations used Cloxacilline 2g x 4 and/or Clindamycin 600mg x 3.

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 2017	Number of reports	Complete reports %	% having Cloxacillin or Clindamycin	% with dose 2g x 3 or 600mg x 2	% having AB within 45-15 min	% having AB within 45-30 min
Country	**14,964**	**99.7**	**99.8**	**84.9**	**79.8**	**44.2**
University hospitals						
Akademiska	86	98.4	100	88.2	18.6	1.2
Huddinge	111	98	99.1	90.7	74.8	39.6
Karolinska Solna	60	99.4	98.3	78.0	78.3	50.0
Lund	43	100	100	88.4	79.1	51.2
Umeå	119	99.2	99.2	86.4	74.8	32.8
Örebro	8	100	100	100.0	100.0	87.5
Private units						
Art Clinic Göteborg	108	100	98.9	96.3	86.1	23.2
Art Clinic Jönköping	90	100	98.9	100.0	94.4	55.6
Bollnäs Aleris	325	99.8	100	99.1	89.9	44.0
Capio Artro Clinic Stockholm	241	99.6	99.6	80.4	92.1	45.6
Carlanderska	224	100	100	99.1	92.0	45.1
Elisabethkliniken	6	100	100	0.0	66.8	50.0
Hermelinen-Luleå	19	98.2	100	94.8	84.2	47.4
Motala Aleris	605	99.9	99.8	97.9	84.8	36.9
Movement Halmstad	434	99.9	99.8	96.5	82.5	12.9
Nacka Aleris	174	99.6	100	92.0	89.7	51.2
OrthoCenter IFK-kliniken	162	100	100	95.1	90.7	79.6
OrthoCenter Stockholm	463	99.7	100	97.2	94.6	55.9
Ortopediska huset	720	99.9	99.9	96.0	82.4	41.3
Sophiahemmet	229	99.1	99.6	95.2	70.3	46.7
St Göran	521	99.6	100	96.4	88.3	36.9
Ängelholm Aleris	249	99.7	99.6	93.2	90.8	44.2

within the recommended 45-15 minutes. However during 2013-2017 the proportion has lessened to 80%. Only few units have implemented the latest recommendation (Orthocenter-IFK and Lungby) and in 2017, only 44% of patients had their preoperative dose 45-30 min. prior to surgery. The adaption of the prior and present recommendation was still low at the Akademiska sjukhuset and in Uddevalla.

Prophylactic antibiotics

Hospital 2017	Number of reports	Complete reports %	% having Cloxacillin or Clindamycin	% with dosis 2g x 3 or 600mg x 2	% having AB within 45-30 min	% having AB within 45-15 min
< 100 operations/year						
Borås	69	100	100	92.8	71.0	44.9
Eskilstuna	69	99.5	100	88.4	76.8	43.5
Gällivare	54	100	100	98.2	75.9	29.6
Gävle	86	100	96.5	86.8	81.4	30.2
Helsingborg	19	98	100	100.0	68.4	42.1
Hudiksvall	56	100	98.2	96.4	69.6	55.4
Jönköping	11	100	100	72.7	81.8	72.7
Karlskoga	39	100	100	74.4	84.6	48.7
Skellefteå	77	100	100	97.4	74.0	33.8
Skövde	73	99.1	100	98.6	54.8	42.5
Sundsvall	5	100	100	100.0	60.0	60.0
Visby	97	99.1	100	89.7	72.2	34.0
Västervik	81	100	100	16.1	65.4	43.2
Växjö	78	100	100	97.9	84.6	34.6
Ängelholm	93	100	100	96.7	81.7	43.0
100-300 operations/year						
Alingsås	200	100	100	95.0	77.0	59.0
Arvika	193	99.8	100	97.9	71.5	62.7
Danderyd	176	99.1	98.9	87.9	77.8	43.8
Eksjö	217	99.8	100	97.7	83.4	63.6
Falun	215	99.5	99.1	44.1	83.3	37.2
Halmstad	185	98.9	99.5	90.8	77.8	37.3
Kalmar	100	99.9	100	97.0	84.0	32.0
Karlshamn	296	99.5	99.7	97.0	75.3	24.0
Karlstad	132	98.0	100	93.9	68.2	56.1
Kullbergska sjukhuset	244	99.9	100	96.3	73.0	52.9
Kungälv	207	99.7	100	97.1	80.7	47.8
Lidköping	250	99.9	100	97.2	92.4	69.0
Ljungby	135	99.5	100	94.0	94.8	85.9
Lycksele	150	100	100	95.3	68.7	47.3
Mora	195	99.8	99.5	4.1	81.0	52.8
Norrköping	175	100	100	95.4	71.4	52.6
Norrtälje	152	99.1	100	92.1	71.1	34.2
Nyköping	102	99.7	100	67.7	72.6	42.2
Skene	127	100	100	96.9	88.2	49.6
Sollefteå	206	98.2	100	98.5	77.7	56.3
Södersjukhuset	285	99.9	100	94.0	69.1	40.7
Södertälje	149	99.6	100	94.6	82.6	61.1
Torsby	134	100	100	96.3	86.6	59.0
Uddevalla	247	99.7	99.2	99.6	59.1	47.0
Varberg	215	100	100	80.5	73.0	45.6
Värnamo	194	100	100	97.9	80.9	52.6
Västerås	264	99.5	99.2	94.7	78.0	40.5
Örnsköldsvik	172	100	99.4	95.3	77.3	50.0
Östersund	164	99.8	99.4	93.2	87.7	41.1
> 300 operations/year						
Enköping	366	99.6	100	94.5	86.3	56.0
Hässleholm	884	99.9	99.8	1.9	66.2	33.1
Lindesberg	424	99.9	100	92.2	69.3	50.0
Mölndal	379	99.5	99.5	95.7	72.6	42.2
Oskarshamn	370	99.7	100	17.0	84.3	31.6
Piteå	305	99.8	100	97.4	92.5	29.9
Trelleborg	850	99.8	100	96.7	82.8	49.8

Antithrombotic prophylaxis for knee arthroplasties

The table ”Antithrombotic prophylaxis” shows what the hospitals reported having administrated for primary knee arthroplasties in 2017.

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 approx. 75% of the surgeries it was reported that the intention was to use injectable drugs but the proportion has varied between 78% and 83% since 2009.

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 2017	Number of reports	Complete reports %	Percent starting postoperatively	Percent having injection	Percent treated for 8-14 days
Country	**14,964**	**99.7**	**90.4**	**75.9**	**75.3**
University hospitals					
Akademiska	86	98.5	84.9	9.4	83.1
Huddinge	111	98.8	94.6	100	90.8
Karolinska Solna	60	98.3	58.6	100	0.0
Lund	43	97.8	92.9	100	40.5
Umeå	119	100	96.6	10.9	97.5
Örebro	8	100	100	25.0	62.5
Private units					
Art Clinic Göteborg	108	96	95.2	1.0	96.2
Art Clinic Jönköping	90	100	97.8	5.6	96.7
Bollnäs Aleris	325	100	96.6	99.7	96.3
Capio Artro Clinic Stockholm	241	99.6	93.4	99.2	94.5
Carlanderska	224	100	95.1	4.0	94.2
Elisabethkliniken	6	100	83.3	100	100
Hermelinen-Luleå	19	100	89.5	10.5	21.1
Motala Aleris	605	99.8	97.2	100	98.0
Movement Halmstad	434	99.8	96.1	99.5	0.5
Nacka Aleris	174	100	98.9	100	98.3
OrthoCenter IFK-kliniken	162	99.6	95.0	6.8	95.0
OrthoCenter Stockholm	463	100	96.1	100	97.8
Ortopediska huset	720	99.9	97.6	100	99.6
Sophiahemmet	229	99.4	91.7	99.6	77.2
St Göran	521	99.3	90.3	95.7	94.0
Ängelholm Aleris	249	100	95.6	94.6	97.2

Antithrombotic prophylaxis

Hospital 2017	Number of reports	Complete reports %	Percent starting postoperatively	Percent having injection	Percent treated for 8-14 days
< 100 operations/year					
Borås	69	99	89.7	100	88.4
Eskilstuna	69	100	89.9	30.4	97.1
Gällivare	54	100	94.4	100	31.5
Gävle	86	100	87.2	100	94.2
Helsingborg	19	100	100	100	89.5
Hudiksvall	56	100	67.9	100	89.3
Jönköping	11	94.0	40.0	20.0	90.9
Karlskoga	39	100	100	0.0	97.4
Skellefteå	77	100	100	100	100
Skövde	73	100	90.4	97.3	97.3
Sundsvall	5	100	80.0	40.0	100
Visby	97	100	93.8	99.0	95.9
Västervik	81	99.6	93.8	100	90.0
Växjö	78	99.1	20.8	100	97.4
Ängelholm	93	99.3	77.7	100	92.5
100-300 operations/year					
Alingsås	200	100	95.5	100	99.0
Arvika	193	99.8	93.3	13	95.3
Danderyd	176	99.6	90.3	98.9	90.8
Eksjö	217	100	94.0	99.1	98.6
Falun	215	100	93.0	99.5	0.9
Halmstad	185	99.1	84.2	100	2.2
Kalmar	100	100	90.0	100	86.0
Karlshamn	296	99.7	93.9	100	95.2
Karlstad	132	97.0	86.8	15.6	88.1
Kullbergska sjukhuset	244	99.9	95.5	16.8	93.4
Kungälv	207	100	94.2	92.8	95.2
Lidköping	250	100	94.8	6.0	92.4
Ljungby	135	99.8	8.9	100	97.0
Lycksele	150	98.7	17.3	100	40.5
Mora	195	100	90.8	5.1	94.9
Norrköping	175	99.8	91.4	100	98.3
Norrtälje	152	100	88.8	95.4	66.5
Nyköping	102	100	95.1	22.6	91.2
Skene	127	99.5	97.6	100	92.9
Sollefteå	206	98.5	89.3	100	98.0
Södersjukhuset	285	98.6	89.8	49.8	89.0
Södertälje	149	99.6	74.3	100	73.2
Torsby	134	100	94.8	11.9	92.5
Uddevalla	247	100	95.6	100	97.2
Varberg	215	99.5	84.6	99.5	18.4
Värnamo	194	100	80.4	99.5	86.6
Västerås	264	99.4	95.4	9.5	92.8
Örnsköldsvik	172	100	90.1	4.7	87.2
Östersund	164	99.6	94.4	100	94.4
> 300 operations/year					
Enköping	366	99.6	95.4	13.1	87.3
Hässleholm	884	100	99.3	100	2.7
Lindesberg	424	99.8	77.6	27.4	73.6
Mölndal	379	99.8	91.8	5.8	96.3
Oskarshamn	370	99.2	88.8	98.4	94.3
Piteå	305	99.9	60.3	99.7	89.5
Trelleborg	850	99.8	98.0	99.8	2.0

Surgical technique for knee arthroplasties

The table ”Surgical technique” shows what the hospitals reported for having used in their primary knee arthroplasties in 2017.

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%) but the proportion having general anesthesia has been increasing (31.6%) and has tripled since 2011. Art Clinic Jönköping, Bollnäs, Capio Arto Clinic Sophiahemmet, Hässleholm, Nacka, Karlshamn, Sophiahemmet and Södertälje reported that more than 80% of their arthroplasties were performed using general anesthesia.

The use of drains has decreased from 26% in 2011 to 1.7% in 2017. The number of surgeries performed using tourniquet decreased from 90% in 2011 to 43% in 2017.

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 71 min., for UKA's 67 min., for femoropatellar arthroplasties 67 min., for linked implants 148 min. and for partial implants 37 min. Since 2009, the median operating time for TKA's has varied between 71 and 82 min. and for UKA's between 67 and 80 min..

Bone transplantation is uncommon in primary arthroplasty and almost exclusively using auto transplantation. It was reported in 1.4% of the primaries and was slightly more common in the femur (55%) than in the tibia (49%).

Computer aided surgery (CAS) was only reported for 15 cases (0.1%) at 8 units (7 in 2016). No UKA's were reported using CAS.

Surgical technique

Hospital 2017	Number of reports	Complete reports %	Percent having General anesthesia	Percent Drainage	Percent Tourniquet	Percent LIA	Median Op-time
Country	**14,964**	**98.8**	**31.6**	**1.7**	**43.3**	**96.2**	**71**
University Hospitals							
Akademiska	86	98.5	20.2	0.0	85.9	98.8	80
Huddinge	111	98.9	16.4	0.0	24.8	94.6	116
Karolinska Solna	60	99.6	26.7	8.3	95.0	88.3	82
Lund	43	100	23.3	0.0	37.2	95.4	99
Umeå	119	97.7	13.5	0.0	56.5	73.7	99
Örebro	8	100	75.0	0.0	50.0	75.0	102
Private units							
Art Clinic Göteborg	108	99.3	74.1	2.8	30.8	95.3	67
Art Clinic Jönköping	90	100	100.0	0.0	36.7	97.8	88
Bollnäs Aleris	325	100	83.7	0.0	74.2	99.1	51
Capio Artro Clinic Stockholm	241	100	98.8	0.8	1.2	98.3	65
Carlanderska	224	100	13.0	1.3	99.1	99.1	54
Elisabethkliniken	6	100	16.7	0.0	100	100	69
Hermelinen-Luleå	19	100	5.3	0.0	5.3	100	65
Motala Aleris	605	99.9	7.1	0.0	32.5	98.5	35
Movement Halmstad	434	99.9	2.1	0.7	4.4	99.1	72
Nacka Aleris	174	100	100	0.6	0.6	99.4	59
OrthoCenter IFK-kliniken	162	99.8	17.3	0.0	0.6	95.7	82
OrthoCenter Stockholm	463	99.7	10.4	0.2	33.5	97.2	60
Ortopediska huset	720	99.8	47.6	0.3	78.1	99.2	47
Sophiahemmet	229	99.6	87.8	31.1	43.0	87.7	70
St Göran	521	100	12.5	0.6	97.3	95.0	60
Ängelholm Aleris	249	100	41.8	0.0	29.8	98.4	60

The number of cases using custom made instruments/cutting blocks was 181 (1.2%) or only half the number (351) reported in 2016 (2.5%). Use of such instruments was reported by 15 units (29 in 2016). Most reported having only performed a few surgeries while Movement Halmstad accounted for two thirds of of the cases (111).

Surgical technique

Hospital 2017	Number of reports	Complete reports %	Percent having General anaesthesia	Percent Drainage	Percent Tourniquet	Percent LIA**	Median Op-time
< 100 operations/year							
Borås	69	100	24.6	0.0	78.3	78.3	111
Eskilstuna	69	100	23.2	0.0	10.1	98.6	99
Gällivare	54	99.5	9.3	0.0	15.1	98.2	99
Gävle	86	98.8	39.8	7.0	87.2	98.8	75
Helsingborg	19	100	21.1	0.0	0.0	100	91
Hudiksvall	56	100	12.5	1.8	39.3	94.6	84
Jönköping	11	100	18.2	0.0	100	100	75
Karlskoga	39	99.3	20.5	0.0	82.1	97.4	93
Skellefteå	77	100	3.9	0.0	98.7	100.0	86
Skövde	73	99.3	18.1	2.7	32.9	97.3	82
Sundsvall	5	100	0.0	0.0	0.0	80.0	117
Visby	97	100	17.5	1.0	16.5	99.0	107
Västervik	81	100	34.6	1.2	27.2	97.5	87
Växjö	78	100	34.6	0.0	15.4	97.4	74
Ängelholm	93	99.7	20.2	1.9	1.1	80.9	82
100-300 operations/year							
Alingsås	200	99.9	7.5	0.5	6.0	95.5	79
Arvika	193	99.9	4.2	0.5	0.0	98.5	55
Danderyd	176	99.7	9.7	1.7	66.3	96.0	89
Eksjö	217	100	20.7	0.9	35.9	99.5	69
Falun	215	100	55.8	1.4	81.9	99.5	73
Halmstad	185	99.7	16.9	22.7	95.7	97.8	84
Kalmar	100	100	15.0	2.0	0.0	94.0	85
Karlshamn	296	99.9	89.5	0.7	88.5	98.0	73
Karlstad	132	99.1	18.3	0.8	0.8	98.5	64
Kullbergska sjukhuset	244	100	13.9	1.6	26.6	96.7	85
Kungälv	207	99.3	26.9	0.5	17.4	97.1	92
Lidköping	250	99.9	10.4	0.0	7.2	98.0	83
Ljungby	135	99.4	35.1	0.0	44.8	92.5	67
Lycksele	150	99.8	5.5	2.0	97.3	94.0	85
Mora	195	100	8.7	0.0	99.5	94.4	56
Norrköping	175	100	17.1	0.0	4.6	96.6	87
Norrtälje	152	100	25.0	1.3	40.1	88.8	75
Nyköping	102	99.5	17.8	1.0	22.8	96.1	81
Skene	127	100	11.0	0.8	98.4	97.6	98
Sollefteå	206	99.0	5.4	0.5	69.8	99.0	84
Södersjukhuset	285	99.8	14.0	13.3	2.5	94.4	78
Södertälje	149	99.8	91.3	2.7	0.0	93.2	61
Torsby	134	100	11.2	0.0	23.9	98.5	65
Uddevalla	247	100	9.3	2.0	53.0	98.8	87
Varberg	215	100	19.1	0.9	19.5	88.8	84
Värnamo	194	100	11.9	2.6	25.3	97.9	96
Västerås	264	100	8.0	0.0	1.9	94.7	70
Örnsköldsvik	172	100	9.3	0.6	99.4	97.7	83
Östersund	164	100	10.4	0.0	53.7	99.4	95
> 300 operations/year							
Enköping	366	99.9	16.7	0.3	81.4	98.4	78
Hässleholm	884	99.9	90.2	0.0	1.2	98.9	40
Lindesberg	424	99.8	61.2	0.2	40.6	98.6	88
Mölndal	379	99.9	24.0	0.3	0.5	97.1	83
Oskarshamn	370	99.8	12.5	0.8	92.4	67.0	74
Piteå	305	99.9	3.6	0.3	90.8	99.7	66
Trelleborg	850	99.9	27.0	0.1	46.3	99.7	72

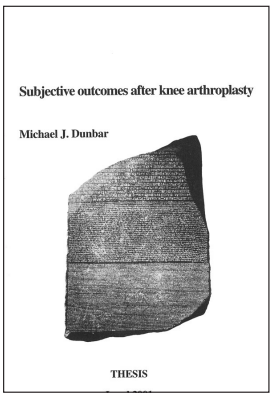
Patient reported outcome before and after knee arthroplasty

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 and in 2017 Norrtälje and Ortopediska huset. 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 2017 PROM data were registered for approximately 37% 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

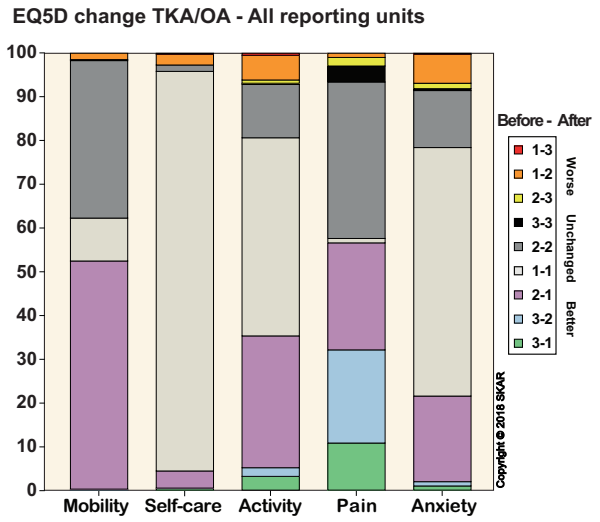
EQ5D

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 (0-14 points). This was true for units with a relatively high (≥75%) response rate (Bollnäs, Hässleholm, Kalmar, Kungälv, Mölndal, Norrköping, OrthoCenter 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 2016 estimated their knee pain, both pre- and postoperatively, the differnce between the units that had a relatively high response rate (see EQ-VAS above) was also relatively small both preoperatively (4-12 points) as well as 1 year postoperatively (2-13 points). For the other units the differences between the units were also similar; 0-14 points preoperatively and 0-15 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 2016. For patients operated in 2017 only the preoperative values are availiable.

VAS – Satisfaction with the surgery

One year postoperatively, 74 % of the patients operated in 2016 had reported their satisfaction with their arthroplasty surgery.

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

As described on page 69, the patient satisfaction one year after surgery was categorized into 5 groups based on the VAS scale marking. Using this definition, 86% of the patients operated in 2016 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 Oskarshamn (94%), OrthoCenter Stockholm (92%), Kalmar (91%), followed by Bollnäs (88%), Trelleborg (86%), Mölndal (83%), Hässleholm (81%), Kungälv (81%) and Norrköping (77%).. For the other hospitals the proportion of satisfied patients varied from 71-94%

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						
2016	4,042	74	65 (17)	18 (20)	65 (22)	76 (19)
2017	5,005	84	65 (18)		64 (22)	
Hospital :						
Alingsås						
2017	189	91	65 (18)		65 (22)	
Bollnäs						
2016	282	78	65 (19)	17 (20)	65 (23)	79 (18)
2017	273	98	62 (20)		62 (22)	
Eksjö						
2017	180	97	61 (18)		67 (21)	
Helsingborg						
2016	37	49	71 (15)	14 (19)	56 (18)	71 (18)
2017	18	83	71 (23)		53 (24)	
Huddinge						
2016 (june dec)	49	45	73 (19	21 (22)	60 (25)	68 (26)
2017	80	87	70 (19)		60 (24)	
Hässleholm						
2016	567	84	63 (17)	20 (20)	70 (21)	76 (20)
2017	719	96	63 (19)		70 (21)	
Kalmar						
2016	78	91	59 (20)	14 (17)	72 (21)	81 (17)
2017	91	100	65 (18)		70 (20)	
Karlskoga						
2016 (april-dec)	64	23	69 (14)	27 (28)	64 (23)	67 (28)
2017	27	74	67 (22)		64 (18)	
Karolinska						
2016	56	46	76 (14)	29 (28)	57 (23)	66 (21)
2017	39	64	71 (18)		58 (23)	
Kungälv						
2016	151	77	67 (18)	20 (23)	60 (23)	72 (21)
2017	164	88	67 (19)		61 (22)	
Lindesberg						
2016 (june dec)	201	46	69 (14)	19 (20)	61 (22)	72 (23)
2017	370	65	65 (17)		65 (22)	
Lund						
2016	79	73	62 (18)	17 (19)	67 (22)	77 (21)
2017	26	27	66 (24)		56 (22)	
Motala						
2016	259	66	67 (16)	18 (21)	65 (22)	76 (18)
2017	405	80	67 (17)		60 (22)	
Mölndal						
2016	423	79	65 (18)	19 (22)	63 (22)	73 (21)
2017	316	90	63 (19)		61 (22)	
Norrköping						
2016	147	78	71 (12)	24 (23)	58 (24)	72 (21)
2017	159	83	70 (16)		60 (23)	
Norrtälje						
2017	135	59	65 (18)		61 (22)	
OrthoCenter Sthlm						
2016	405	86	66 (17)	13 (19)	65 (21)	79 (17)
2017	413	94	67 (17)		64 (22)	
Ortopediska huset						
2017 (oct-dec)	231	63	62 (18)		67 (21)	
Oskarshamn						
2016	298	88	64 (17)	11 (14)	65 (21)	79 (17)
2017	343	95	63 (19)		63 (22)	
Piteå						
2016	235	51	71 (17)	14 (19)	58 (24)	76 (21)
2017	242	57	70 (18)		63 (21)	
Södertälje						
2016	151	64	68 (17)	23 (26)	65 (25)	76 (21)
2017	143	79	69 (17)		61 (24)	
Trelleborg						
2016	708	85	66 (18)	17 (19)	67 (22)	77 (19)
2017	699	86	64 (19)		67 (22)	
Ängelholm Aleris						
2016	227	66	62 (14)	18 (19)	53 (21)	78 (18)
2017	188	80	64 (15)		55 (25)	
Ängelholm						
2016	48	35	66 (14)	24 (22)	56 (29)	69 (20)
2017	88	69	71 (18)		60 (25)	

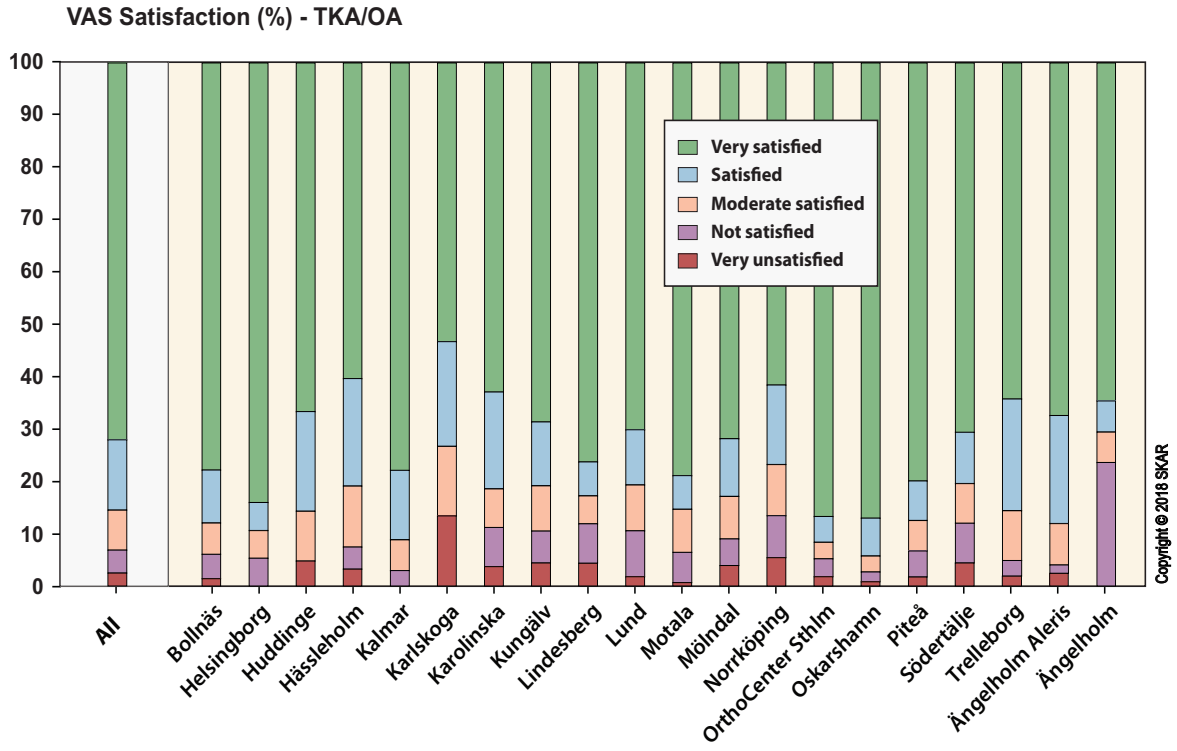
TKA/OA - Satisfaction one year after surgery (2016)
VAS (0-100) (worst - best)

Hospital	Number of reports	Complete reports (%)	Postop Mean (SD)
All units	4,465	74	18 (23)
Bollnäs	282	77	15 (22)
Helsingborg	37	49	14 (19)
Huddinge(jun-dec)	49	43	21 (22)
Hässleholm	567	83	20 (20)
Kalmar	78	87	14 (17)
Karlskoga (apr-dec)	64	23	27 (28)
Karolinska	56	48	29 (28)
Kungälv	151	76	20 (23)
Lindesberg(jun-dec)	201	46	19 (20)
Lund	79	72	17 (19)
Motala	259	66	18 (21)
Mölndal	423	79	19 (22)
Norrköping	147	76	24 (23)
OrthoCenter Sthlm	405	86	13 (19)
Oskarshamn	298	88	11 (14)
Piteå	235	51	14 (19)
Södertälje	151	61	23 (26)
Trelleborg	708	85	17 (19)
Ängelholm Aleris	227	56	18 (19)
Ängelholm	48	35	24 (22)

KOOS

The differences were small between those units having a relatively high response rate in 2016 (Bollnäs, Hässleholm, Kalmar, Kungälv, Norrköping, OrthoCenter Stockholm, Oskarshamn and Trelleborg) although the patients in Kungälv and Norrköping seem to report somewhat more problems. For units with few patients and/or low response rate the results vary and are difficult to interpret. The preoperative KOOS values in 2017 are similar to those reported in 2016.

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 2016 both the pre- and postoperative results are shown but for patients operated in 2017 only preoperative results are available (see table on page 74-75).



Proportion (%) of satisfied patients one year after surgery (in 2016) for all reporting units together (to the left) as well as for each unit seperately.

OMERACT-OARSI responder

In 90% of the reported surgeries in 2016, the patients became classified as responders acting to the OMERACT-OARSI criteria with 80% being high responders (see figure below). For the units with relatively high response rate the proportion of responders was 85-96%. In Oskarshamn 96% were responders of which 89% were high responders. For the OrthoCenter in Stockholm as well as for Bollnäs the corresponding resuts were 92% and 89% of which respectively 81% and 80% were high responders. For units with few surgeries and/or low response rate the proportion of responders ranged between 78-97% of which high responders were 72-88%.

Summary

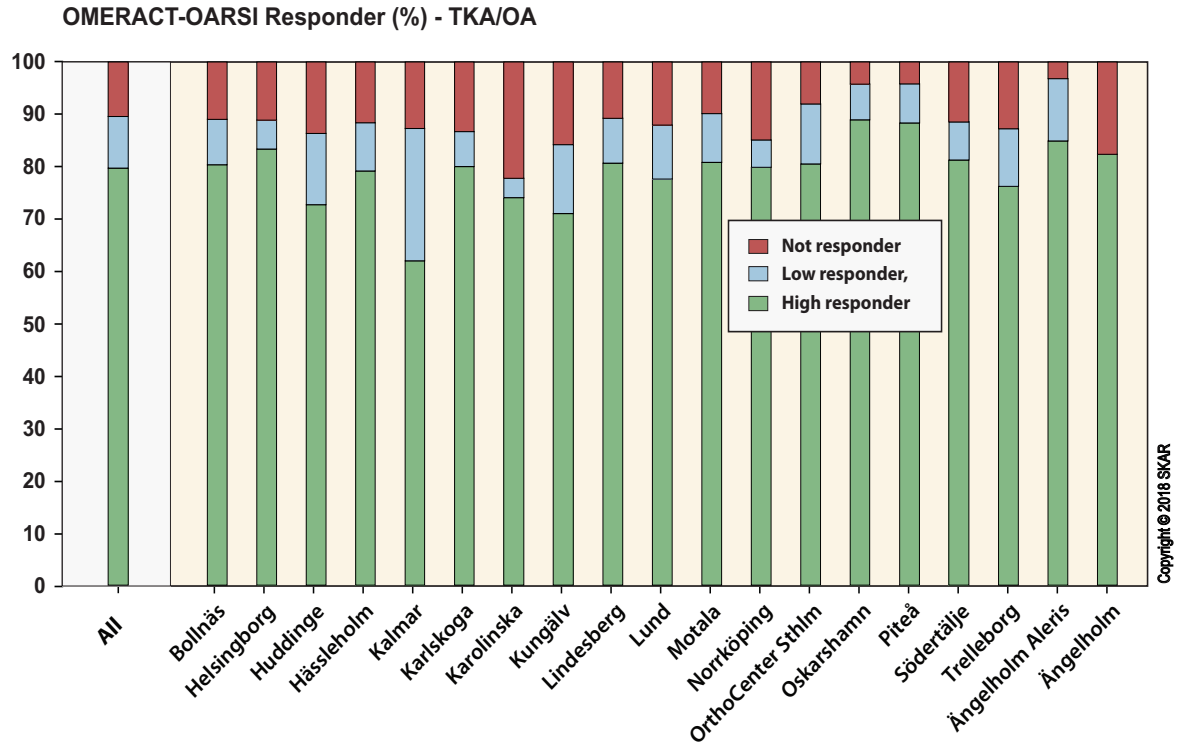
The result of the compilations showed again small variations between groups in spite of some differences in case-mix. However, it is worthwhile to point out that 94% of the patients in Oskarshamn, 92% of those in OrthoCenter Stockholm and 91% of those operated in Kalmar were very satisfied or satisfied one year after their knee arthroplasty surgery. Additionally, 96% of the patients in Oskarshamn and 92% of those in OrthoCenter Stockholm were classified as OMERACT-OARSI responders.

The results vary for units performing few surgeries and those that have 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 low response rate can vary. E.g. in Piteå there has been shortage of staff. Further, the data entering requires carfulness and accuracy.

In 2016 we became able to automatically link the PROM data with SKAR data. 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 2016) for all reporting units together (to the left) as well as for each unit seperately.

TKA/OA - Results for KOOS preoperatively (surgeries 2016 & 2017) as well as 1 year postoperatively (surgeries 2016)

				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 *													
2016	4,042	74	42,6	40 (15)	81 (19)	47 (18)	78 (17)	46 (16)	80 (19)	11 (14)	39 (28)	22 (14)	65 (23)
2017	5,005	85	42,6	40 (16)		46 (18)		46 (17)		11 (14)		22 (14)	
Hospital:													
Alingsås													
2017	189	91	38,6	42 (16)		48 (18)		48 (16)		15 (16)		24 (14)	
Bollnäs													
2016	282	78	39,7	41 (15)	82 (17)	46 (18)	78 (17)	47 (16)	81 (17)	12 (13)	43 (27)	21 (13)	67 (23)
2017	273	98	36,2	41 (16)		45 (17)		47 (17)		12 (15)		20 (13)	
Eksjö													
2017	180	97	36,8	45 (15)		50 (17)		51 (16)		14 (14)		25 (12)	
Helsingborg													
2016	37	49	61,1	39 (15)	81 (20)	46 (20)	74 (23)	39 (11)	74 (24)	5 (8)	29 (29)	16 (9)	65 (27)
2017	18	83	66,7	39 (17)		51 (19)		38 (17)		8 (12)		18 (15)	
Huddinge													
2016 (juni-dec)	49	45	54,6	36 (18)	74 (26)	41 (18)	74 (18)	42 (20)	69 (26)	13 (17)	23 (25)	22 (18)	53 (31)
2017	80	87	44,9	35 (20)		43 (18)		39 (21)		10 (16)		21 (16)	
Hässleholm													
2016	567	84	43	39 (14)	79 (19)	47 (17)	77 (17)	44 (15)	77 (19)	12 (14)	40 (29)	24 (14)	63 (24)
2017	719	96	38,7	40 (15)		47 (17)		45 (16)		12 (14)		24 (14)	
Kalmar													
2016	78	91	36,6	46 (14)	84 (17)	55 (16)	81 (14)	52 (15)	82 (17)	15 (17)	44 (29)	27 (13)	68 (23)
2017	91	100	34,1	43 (15)		52 (18)		49 (15)		13 (15)		23 (12)	
Karlskoga													
2016 (april-dec)	64	23	33,3	41 (17)	74 (27)	48 (20)	71 (26)	48 (22)	70 (24)	12 (13)	25 (20)	25 (14)	63 (31)
2017	27	74	35	38 (21)		42 (19)		44 (19)		9 (10)		24 (17)	
Karolinska													
2016	56	46	48,2	35 (14)	70 (24)	43 (19)	70 (19)	37 (17)	67 (27)	6 (9)	27 (28)	14 (11)	52 (25)
2017	39	64	68	34 (14)		44 (19)		34 (16)		8 (17)		14 (12)	
Kungälv													
2016	151	77	50	38 (17)	75 (22)	46 (20)	73 (19)	44 (19)	75 (21)	8 (12)	31 (25)	20 (14)	59 (25)
2017	164	88	49,3	39 (18)		45 (20)		45 (18)		10 (15)		21 (15)	
Lindesberg													
2016 (juni-dec)	201	46	35,9	37 (15)	77 (21)	44 (19)	73 (18)	44 (14)	74 (20)	10 (11)	32 (25)	20 (14)	59 (23)
2017	370	65	35,4	39 (14)		44 (18)		45 (15)		10 (13)		20 (12)	
Lund													
2016	79	73	43,1	42 (15)	85 (16)	50 (17)	80 (16)	46 (19)	80 (20)	15 (19)	45 (28)	23 (16)	70 (25)
2017	26	27	57	35 (15)		39 (17)		39 (10)		6 (9)		19 (13)	

* All except Mölndal and Ortopediska huset which do not report KOOS but Chamley class

TKA/OA - Results for KOOS preoperatively (surgeries 2016 & 2017) as well as 1 year postoperatively (surgeries 2016)

				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 *													
2016	4,042	74	42,6	40 (15)	81 (19)	47 (18)	78 (17)	46 (16)	80 (19)	11 (14)	39 (28)	22 (14)	65 (23)
2017	5,005	85	42,6	40 (16)		46 (18)		46 (17)		11 (14)		22 (14)	
Hospital :													
Motala													
2016	259	66	37,5	40 (15)	80 (18)	46 (16)	78 (18)	44 (18)	79 (18)	10 (13)	35 (27)	22 (14)	63 (24)
2017	405	80	40,7	38 (15)		42 (17)		44 (16)		9 (12)		20 (12)	
Mölndal													
2016	423	79	48,1										
2017	316	90	42,3										
Norrköping													
2016	147	78	49,1	34 (14)	74 (22)	39 (15)	72 (20)	39 (16)	71 (22)	6 (8)	24 (23)	18 (11)	55 (24)
2017	159	83	46,5	37 (13)		43 (16)		43 (14)		9 (12)		19 (13)	
Norrtälje													
2017	135	59	52,6	40 (16)		47 (18)		46 (17)		13 (17)		22 (16)	
OrthoCenter Sthlm													
2016	405	86	37,5	44 (15)	86 (16)	49 (18)	81 (15)	51 (15)	85 (14)	13 (14)	44 (26)	23 (13)	68 (22)
2017	413	94	41,3	41 (15)		45 (18)		49 (16)		12 (13)		21 (14)	
Ortopediska huset													
2017 (okt-dec)	231	63	42										
Oskarshamn													
2016	298	88	38	41 (14)	87 (13)	47 (17)	84 (13)	46 (14)	84 (15)	11 (13)	46 (28)	21 (13)	72 (21)
2017	343	95	42,5	42 (16)		47 (18)		46 (16)		12 (16)		21 (14)	
Piteå													
2016	235	51	49,2	34 (15)	85 (18)	40 (18)	79 (19)	41 (15)	82 (18)	8 (14)	43 (28)	17 (11)	66 (25)
2017	242	57	46,7	37 (14)		43 (16)		42 (15)		11 (15)		19 (12)	
Södertälje													
2016	151	64	48,4	38 (15)	77 (23)	49 (17)	74 (18)	43 (16)	77 (21)	10 (12)	38 (26)	22 (13)	60 (25)
2017	143	79	52,3	37 (17)		43 (18)		41 (18)		7 (10)		19 (14)	
Trelleborg													
2016	708	85	42,6	42 (17)	81 (19)	48 (18)	77 (17)	47 (18)	80 (19)	12 (16)	38 (26)	23 (14)	66 (23)
2017	699	86	45	42 (16)		49 (18)		48 (18)		13 (16)		24 (14)	
Ängelholm Aleris													
2016	227	66	44,5	38 (14)	85 (15)	46 (16)	80 (16)	43 (16)	83 (16)	10 (14)	43 (27)	18 (12)	66 (22)
2017	188	80	62,6	39 (15)		44 (17)		44 (16)		9 (10)		20 (13)	
Ängelholm													
2016	48	35	29,4	36 (18)	75 (20)	45 (14)	73 (21)	45 (20)	74 (19)	6 (12)	28 (22)	18 (13)	59 (27)
2017	88	69	55,9	38 (17)		44 (17)		41 (17)		10 (15)		18 (12)	

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

UKA

Patient repored result for UKAs are presented on this and next page for those units reporting. The number of UKAs varies between units as well as years from 0 to 250 cases and the respond rate lies between 29-100%. Motala accounts for approximately 50% of the reported UKA results. The outcome is similar as that for TKAs with small differences between units pre- and postoperatively. 88% of the UKA patients reported that they were satisfied or very satisfied with the surgery and 91% were classified as OMERACT-OARSI responders of which 80% were high responders.

UKA/OA - Satisfaction one year after surgery (2016)
Proportion of very satisvied or satisfied (VAS 0-40)

Hospital	Number of reports	Complete reports (%)	Postop: very satisfied or satisfied (%)
All reporting units	406	72	88
Bollnäs	28	68	89
Huddinge	14	29	75
Hässleholm	10	60	83
Kungälv	32	84	85
Motala	243	71	93
Mölndal	18	83	53
OrthoCenter Sthlm	17	82	93
Piteå	14	50	86
Trelleborg	20	100	85
Ängelholm Aleris	28	75	71

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						
2016	424	72	66 (16)	18 (19)	61 (23)	78 (18)
2017	423	83	65 (16)		63 (22)	
Hospital :						
Bollnäs						
2016	28	71	57 (20)	11 (11)	64 (28)	86 (10)
2017	28	89			63 (22)	
Eksjö						
2017	17	94	61 (18)		68 (23)	
Huddinge						
2016 (juni-dec)	14	29	64 (18)	23 (25)	75 (17)	67 (22)
2017	20	80	59 (25)		64 (23)	
Hässleholm						
2016	10	60	50 (19)	24 (19)	71 (15)	79 (16)
2017	<10	*				
Kungälv						
2016	32	84	61 (17)	22 (27)	66 (25)	76 (21)
2017	34	85	66 (16)		56 (23)	
Lindesberg						
2017	19	53	66 (12)		65 (29)	
Motala						
2016	243	71	66 (16)	15 (16)	61 (23)	80 (15)
2017	170	85	68 (15)		61 (23)	
Mölndal						
2016	18	83	72 (11)	41 (25)	52 (26)	59 (26)
2017	10	90	64 (12)		64 (19)	
OrthoCenter Sthlm						
2016	17	82	65 (18)	15 (21)	66 (21)	79 (19)
2017	20	95	65 (18)		72 (20)	
Piteå						
2016	14	57	77 (11)	15 (15)	60 (25)	81 (16)
2017	40	62	70 (16)		56 (23)	
Trelleborg						
2016	20	100	68 (20)	25 (20)	67 (20)	75 (21)
2017	31	90	65 (16)		69 (21)	
Ängelholm Aleris						
2016	28	75	65 (10)	24 (21)	48 (18)	76 (23)
2017	34	91	58 (15)		61 (22)	

UKA/OA - Results for KOOS preoperatively (surgeries 2016 & 2017) as well as 1 year postoperatively (surgeries 2016)

				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*													
2016	406	72	38,9	42 (16)	84 (16)	48 (18)	81 (14)	48 (16)	83 (17)	13 (14)	41 (26)	23 (14)	67 (22)
2017	413	83	44,8	41 (15)		48 (16)		48 (16)		14 (16)		23 (14)	
Hospital:													
Bollnäs													
2016	28	71	35	49 (14)	88 (11)	50 (16)	84 (10)	56 (16)	88 (11)	18 (16)	62 (19)	27 (13)	67 (23)
2017	28	89	40	46 (13)				54 (17)				27 (14)	
Eksjö													
2017	17	94	31,3	40 (21)		51 (18)		57 (23)		19 (26)		29 (19)	
Huddinge													
2016 (juni-dec)	14	29	25	40 (19)	79 (23)	60 (11)	77 (16)	44 (9)	70 (28)	24 (10)	38 (31)	31 (14)	72 (25)
2017	20	80	35,7	47 (16)		51 (18)		54 (18)		15 (19)		24 (19)	
Hässleholm													
2016	10	60	16,7	46 (17)	80 (18)	45 (22)	81 (19)	53 (12)	79 (20)	10 (7)	78 (23)	25 (9)	66 (20)
2017	<10	*											
Kungälv													
2016	32	84	33,3	47 (18)	84 (19)	54 (17)	81 (13)	51 (18)	80 (19)	15 (13)	45 (25)	24 (12)	69 (22)
2017	34	85	42,9	42 (15)		49 (17)		48 (14)		8 (11)		22 (13)	
Lindesberg													
2017	19	53	40	36 (12)		45 (13)		41 (15)		14 (16)		18 (16)	
Motala													
2016	243	71	42,1	41 (16)	85 (15)	45 (17)	81 (15)	47 (16)	84 (16)	13 (14)	39 (26)	22 (13)	68 (20)
2017	170	85	44,7	39 (14)		45 (16)		46 (15)		12 (15)		23 (15)	
Mölndal													
2016	18	83	26,7										
2017	10	90	33,3										
OrthoCenter Sthlm													
2016	17	82	50	42 (16)	84 (19)	50 (17)	83 (12)	50 (21)	82 (20)	13 (18)	48 (25)	24 (16)	66 (26)
2017	20	95	47,4	42 (16)		48 (20)		52 (19)		21 (18)		24 (13)	
Piteå													
2016	14	57	25	37 (19)	86 (9)	40 (18)	77 (16)	41 (13)	88 (10)	11 (11)	51 (29)	20 (16)	75 (19)
2017	40	62	52	37 (12)		40 (12)		45 (14)		10 (20)		17 (11)	
Trelleborg													
2016	20	100	30	39 (17)	78 (17)	52 (25)	79 (11)	45 (15)	77 (20)	16 (20)	35 (21)	28 (22)	59 (21)
2017	31	90	50	41 (15)		54 (16)		48 (16)		15 (17)		23 (14)	
Ängelholm Aleris													
2016	28	75	47,6	42 (15)	76 (19)	50 (15)	78 (16)	46 (15)	79 (18)	10 (12)	40 (27)	18 (15)	61 (30)
2017	34	91	58,3	43 (14)		53 (14)		48 (17)		15 (13)		24 (14)	

* All except Mölndal which does not report KOOS but Charnley class

The knee osteotomy register

Joint preserving surgery – Knee osteotomy

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

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

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

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

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

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

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

Open wedge osteotomy with staple fixation

Open wedge osteotomy with external fixation

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

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

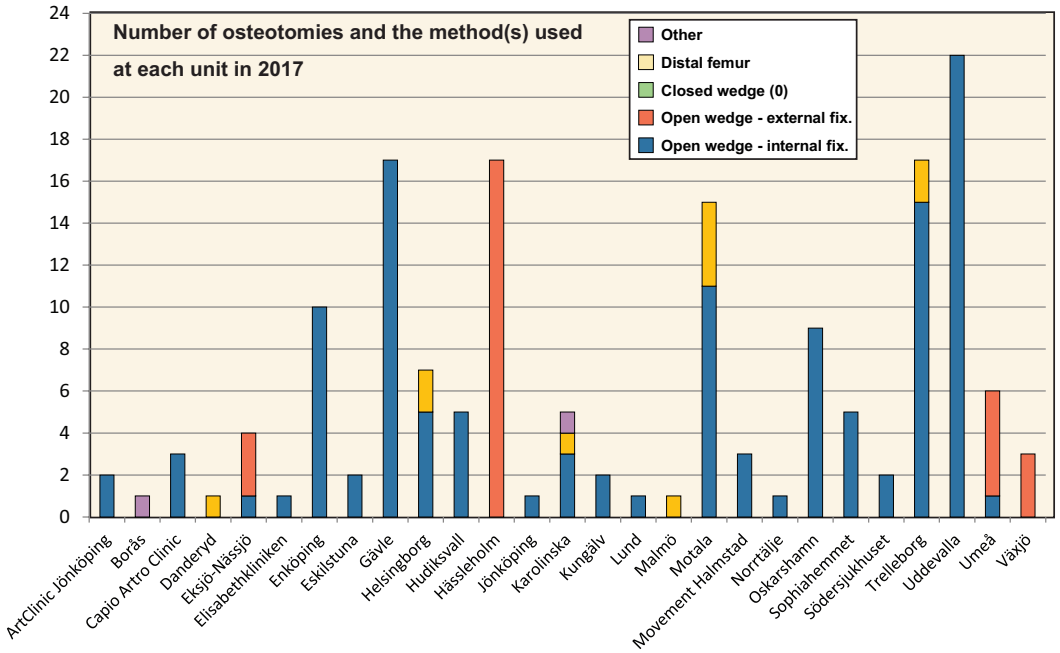
The choice of method and technique may have an effect on the short- and long-term risk for complications as well as influence a later knee replacement with respect to techniques used and outcome. The health economical perspective is also important for the health providers, the society and not least the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

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

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

In 2017, 164 osteotomies were reported from 27 hospitals. As the figure below shows, only 6 hospitals reported having performed 10 or more osteotomies during the year. The hospital performing most was Uddevalla that did 22. As compared to 2016 the number of reported osteotomies and reporting hospitals is somewhat fewer.

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 2014-2016 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 76-84% during 2014-2016.



Patient characteristics and case-mix in knee osteotomy surgery

Results

The following pages show the results for the knee osteotomies that were reported in 2017.

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

72% of the patients were males and the median age was 51 years that can be compared to the median age in 2017 for TKA patients (69) and UKA (65). Almost two thirds of the patients were reported as healthy (ASA class I) and having a mean BMI of 27 kg/m^2. The majority had medial osteoarthritis of grade 1-2 according to the Ahlbäck classification and the median axis deviation was 8 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=162	Prox. Tibia n=151 (93%)	Dist. Femur n=11 (7%)
Age (years)			
median (range)	51 (16-70)	51 (16-70)	31 (21-64)
Gender			
Men - n (%)	117 (68)	113 (75)	4
Women - n (%)	45 (28)	38 (25)	11
Preop HKA angle, n=161			
median (range)	8 (0-24)	7.5 (0-24)	9 (4-16)
ASA classification, n=159			
ASA I - n (%)	104 (65)	96 (64)	8
ASA II - n (%)	53 (34)	51 (35)	2
ASA III - n (%)	2 (1)	2 (1)	0
Compartment affected, n=161			
Medial n (%)	147 (91)	146 (97)	1
Lateral n (%)	14 (9)	4 (3)	10
OA grade, n=144			
Ahlbäck 1 - n (%)	70 (49)	67 (48)	3
Ahlbäck 2 - n (%)	58 (40)	56 (41)	2
Ahlbäck 3 - n (%)	16 (11)	15 (11)	1

* 1 double osteotomy and 1 unknown type are not included in All

Body Mass Index (kg/m^2)

BMI group	Number	Percent
<25	38	23
25-29.9	80	49
30-34.9	30	18
35-39.9	9	6
40+	2	1
Saknas	5	3
Total	164	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 57% of the patients and more than one surgery for 8%. 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	71	43.3
Fracture surgery	7	4.3
Meniscal surgery	26	15.8
Cruciate surgery	10	6.1
Arthroscopy	37	22.6
Other	7	4.3
Missing	6	3.6
Total	164	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. No closed wedge osteotomy was reported 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	90.9
Acquired deformity	7	4.3
Congenital deformity	4	2.4
Instability	2	1.2
Osteonecrosis	0	0
Other	0	0
Missing	2	1.2
Total	164	100

Type of osteotomy

Type	Number	Percent
Open wedge intern fixation	122	74.4
Open wedge extern fixation	28	17.1
Closed wedge	0	0
Curved/Dome	1	0.6
Distal femur	11	6.7
Double osteotomy	1	0.6
Missing	1	0.6
Total	164	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 two types of plates dominated in this type of surgeries (see below).

Type of fixation in open wedge osteotomy with internal fixation

Type	Number	Percent
Tomofix	64	52.5
CountureLock	1	0.8
Puddu	23	18.9
iBalance	15	12.3
OTIS	1	0.8
Peek power	17	13.9
Other	1	0.8
Missing	0	0
Total	122	100

Transplantation of bone

No bone transplantation was reported in almost half of the open wedge osteotomies that used internal fixation,. In case of bone transplantation, synthetic bone was most commonly used followed by auto transplantation and bank bone (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		60	49.2
Auto transplantation		15	12.3
Bank bone		12	9.8
Synthetic bone		34	27.9
Missing		1	0.8
	Total	137	100
Synthetic bone:			
DePuy/Synthes Chronos		6	
OSferion		14	
OTIS		2	
Quickset		9	
Missing		3	

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	25
Monotube	3
Taylor spatial frame	0
Missing	0
Total	28

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
Conturelock	0
Tomofix	5
Puddu	5
Annat	1
Missing	0
Totalt	11

Simultaneous surgery

An additional simultaneous surgery was reported to have been performed together with the osteotomy in 30 (18%) cases. Arthroscopy was the most common simultaneous procedure (see below).

Simultaneous surgery with the osteotomy

Surgery	Number	Percent
None	134	81.7
Arthroscopy	20	12.2
Cruciate surgery	2	1.2
Meniscal surgery	1	0.6
Other	0	0
Missing	7	4.3
Total	164	100

Type of anesthesia

General anesthesia which was used in 64% of cases was the most common method (see table).

.

Type of anesthesia

Type	Number	Percent
General	105	64
Epidural	0	0
Spinal	51	31,1
Combination	3	1,8
Missing	5	3,1
Total	164	100

Operating time

After excluding osteotomies performed with another simultaneous surgery, the median operating time was shorter for open wedge osteotomies with external fixation (46 min, 18-163) than for those with internal fixation (73 min, 20-180). The median time for distal femur osteotomies was 76 min, 45-172). 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 intern (122)	75	(25-180)
Open wedge extern (28)	50	(18-163)
Distal femur (11)	80	(45-172)
Dubbelosteotomi (1)	322	

Computer aided surgery (CAS)

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

Antithrombotic prophylaxis

Fragmin och Innohep were the most commonly used substances. When Fragmin, Innohep or Klexane was used, the prophylaxis more often started postoperatively. Nine 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	15	9.2
Fragmin preop	8	4.9
Fragmin postop	52	31.7
Innohep preop	5	3
Innohep postop	47	28.7
Klexane preop	3	1.8
Klexane postop	20	12.2
Eliqvis	7	4.3
Xarelto	2	1.2
Other	1	0.6
Combination	1	0.6
Missing	3	1.8
Total	164	100

Tromboprophylaxis - length of treatment

The planned length of treatment varied but ca 75% of the patients were planned to have 8-14 days of treatment (see table).

Thromboprophylaxis - length of treatment

Days	Number	Percent
No prophylaxis	15	9.2
1-7	17	10.4
8-14	119	72.6
15-21	0	0
22-28	2	1.2
29-35	5	3
>35	2	1.2
Missing	4	2.4
Total	164	100

Antibiotic drugs

Cloxacilline or Clindamicin were used in all the surgeries for which a substance name was reported. Clindamycin was used almost 5% of the surgeries which is somewhat lower proportion than seen for knee arthroplasties (7.5%). 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	151	92.1
Clindamicin	8	4.9
Other	1	0.6
Missing	4	2.4
Total	164	100

Cloxacillin dosage

For almost 45% of the osteotomies it was reported that the intention was to use 2g x 3 within 24 hours. lmost the same proportion was planned for a single 2g dose.

Cloxacillin dose

Dose	Number	Percent
Cloxacilline 2gx1	59	39.1
Cloxacilline 2gx2	15	9.9
Cloxacilline 2gx3	67	44.4
Cloxacilline 2gx4	9	6,0
Cloxacilline 1gx3	0	0
Other	1	0.6
Missing	0	0
Total	151	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 2013 the PRISS recommendations were published (see page 54 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 31% of the osteotomies it was reported that the preoperative dose had been given within the currently PRISS recommended time interval (table below) while 67% lied within the previously recommended time interval.

Antibiotic - time of administration (PRISS recommendation)

Min. before surgery	Number	Percent
0-29	66	40.3
30-45	51	31.1
>45	41	25
Start after surgery	1	0.6
No antibiotic administered	1	0.6
Missing	4	2.4
Totalt	164	100

Tourniquet and drainage

Use of tourniquet is popular among Swedish orthopedic surgeons and it was used in 68% of the osteotomies (table below) as compared to 43% of the knee arthroplasties. Drainage was used in 12% of the osteotomies as compared to less than 2% of the knee arthroplasties.

Tourniquet and drainage

Tourniquet	Number	Percent
Yes	112	68.3
No	50	30.5
Missing	2	1.2
Total	164	100

Drainage	Number	Percent
Yes	20	12.2
No	143	87.2
Missing	1	0.6
Total	164	100

Re-operations

Since the start of the osteotomy register in 2013 34 re-operations have been reported. The main reasons for the additional surgery have been pseudarthrosis, over- or under correction and infection.

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
Klinikgatan 22, Wigerthuset, floor 2
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
Klinikgatan 22, Wigerthuset, floor 2
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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