Akademiska sjukhuset
Alingsås
ArtClinic Göteborg
ArtClinic Jönköping
Arvika
Bollnäs
Borås
Carlanderska
Danderyd
Eksjö-Nässjö
Elisabethkliniken
Enköping
Eskilstuna
Falun
Gällivare
Gävle
Halmstad
Helsingborg
Huddinge
Hudiksvall
Hässleholm
Jönköping
Kalmar
Karlshamn
Karlskoga
Karlstad
Karolinska
Kullbergska
Kungälv
Kysthospitalet -DK
Lidköping
Lindesberg
Ljungby
Luleå-Sensia
Lund
Lycksele
Mora
Motala
Movement Halmstad
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 2017

Swedish Knee Arthroplasty Register

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

Primary knee arthroplasties 1975-2016
Revision knee arthroplasties 1975-2015
Knee osteotomies 2013-2016

To our contact surgeons

Since the previous report we have expanded the statistics section on our website (www.knee.se) so that besides patient profiles and perioperative data for the different counties and hospitals it is now possible to display patient reported outcome for the hospitals that report such data. We hope that you find the information interesting and relevant.

For the second 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 is responsible for 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.

We want to thank all our contact surgeons and associated staff for their dedicated work throughout the years. You're accurate in 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 2016 as well as analyses covering the 10-year period 2006-2015.

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 2016 (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, 2017.

On behalf of the Swedish Knee Arthroplasty Register

Otto Robertsson Annette W-Dahl Lars Lidgren Martin Sundberg

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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 2016, 70 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 20). However, in 2013-15 the number diminished slightly to increase again in 2016 by 9%, or from 12,886 primaries in 2015 to 14,040 in 2016, the largest ever number reported one year. We consider it likely that the volumes will continue to increase as the incidence in Sweden (see page 21) 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, 8 units from other parts of the country have joined. Results can be found on the pages 70-75.

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 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 2016). Analyses concerning the revision rate end one year earlier (2015). 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 comple 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 30 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 18.

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 6-9.

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 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.

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. However, we now provide a more detailed account of the information asked for on pages 10-11.

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 2015

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

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

The SKAR completeness was estimated by comparing it to the NPR and assuming that the true number of admissions is the combined number of admissions in both registers. There is a possibility for patients having knee arthroplasty surgery without being registered in any of the registers but they are presumably few. Using this method, we found that the SKAR had captured 97.2% of all admissions and the NPR 94.3%.

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 sjukhuset	110	97.3	98.2
Alingsås	198	96.5	98.0
Art Clinic Göteborg	16	100.0	0.0
Art Clinic Jönköping	29	100.0	0.0
Arvika	154	98.7	96.1
Blekingesjukhuset*	2	0.0	100.0
Bollnäs (Aleris)	352	100.0	98.3
Bollnäs sjukhus	16	0.0	100.0
Borås**	71	100.0	98.6
Carlanderska	133	100.0	0.0
Danderyd	193	94.8	96.9
Eksjö-Nässjö	204	99.0	98.5
Elisabethsjukhuset	1	100.0	100.0
Enköping	387	99.7	100.0
Eskilstuna Mälarsjh.	43	97.7	100.0
Falun	207	99.0	96.1
Frölunda spec. sjukhus	125	98.4	98.4
Gällivara	53	86.8	98.1
Gävle	144	91.7	96.5
Halmstad	189	98.4	97.9
Halmstad Movement Capio	447	95.3	65.8
Helsingborg	69	95.7	98.6
Huddinge	167	95.2	100.0
Hudiksvall	88	97.7	100.0
Hässleholm	620	99.8	98.9
Kalmar	90	98.9	96.7
Karlshamn*	249	100.0	99.2
Karlskoga	124	100.0	100.0
Karlstad	160	98.1	94.4
Karolinska Solna	98	94.9	94.9
Kristianstads sjukhus	1	100.0	100.0
Kullbergska	156	98.1	99.4
Kungsbacka	2	0.0	100.0
Kungälv	220	97.3	98.6
Lidköping***	234	100.0	97.9
Lindesberg	164	98.8	100.0
Ljungby	140	100.0	100.0
Luleå Sensia	6	100.0	0.0
Lund (SUS)****	84	97.6	100.0
Lycksele	42	100.0	100.0
Löwenströmska (Ortho Center)	436	98.6	96.8
Malmö (SUS)****	1	0.0	100.0
Mora lasarett	189	98.4	97.9
Motala	507	99.0	99.4
Nacka	147	97.3	100.0
Norrköping Vrinnevisjh.	138	93.5	99.3
Norrtälje sjukhus	95	98.9	98.9
NU-sjukvården*****	3	0.0	100.0
Nyköping	96	99.0	99.0
Ortho Center IFK Kliniken	112	99.1	49.1
Ortopediska Huset	473	97.3	68.5
Oskarshamns sjukhus	277	99.6	99.3
Piteå	248	98.8	98.4
Ryhov	144	97.9	99.3
S:t Göran	449	93.8	98.4
Sabbatsberg	23	100.0	60.9
Sahlgrenska******	419	90.7	98.6
Skaraborgs sjukhus***	15	0.0	100.0
Skellefteå	120	99.2	99.2
Skene**	97	100.0	93.8
Skånes universitetssjukhus****	1	0.0	100.0
Skövde***	120	100.0	99.2
Sollefteå	95	97.9	97.9
Sophiahemmet	140	97.1	92.9
Sundsvall	46	95.7	100.0
Södersjukhuset	285	97.2	98.9
Södertälje	116	96.6	99.1
Södra Älvsborgs sjukhus**	10	0.0	100.0
Torsby	131	98.5	97.7
Trelleborg	738	98.8	98.6
Uddevalla sjukhus*****	186	100.0	98.9
Umeå	149	98.7	96.6
Varberg	131	96.9	100.0
Visby	62	96.8	100.0
Värnamo	153	96.7	98.7
Västervik	106	84.9	99.1
Västerås	180	98.3	99.4
Växjö	117	96.6	98.3
Ängelholm	223	97.3	93.3
Örebro	31	96.8	100.0
Örnsköldsvik	117	98.3	99.1
Östersund	131	91.6	98.5

* Blekingesjukhuset is the combined name for the hospitals in Karlshamn (which is in the list) and Karlskrona.
** Södra Älvsborgs sjukhus containes Borås and Skene (which both are in the list).
*** Skaraborgs sjukhus also includes Lidköping and Skövde (which both are in the list) as well as Falköping och Mariestad.
**** Skånes Universitetssjukhus contains the hospitals in Lund and Malmö (which both are in the list).
***** NU-Sjukvården contains Norra Älvsborgs sjukhus (NÄL) as well as Uddevalla sjukhus (which is in the list).
****** Sahlgrenska also includes Mölndal and Östra (most of the surgeries were performed in Mölndal).

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.

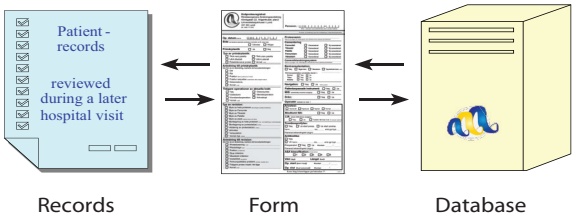
Method of validation at the hospital level

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 additional 26 hospitals have been 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 2012-2016 was 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.

When evaluating essential data (date of surgery, hospital, laterality and diagnosis), the information in the SKAR as compared to that of the original form and that gathered at the hospital differed in less than 1% of cases. No information was missing

Information on implants and their fixation contains part- and lot-numbers for any femoral, tibial patella, stem components used as well as their type of fixation (inclusive the cement brand for cemented cases). Less than 1% of the informa-

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)

tion in the SKAR differed from the found on the original form which in turn did not differ from that gathered during the hospital visit. However, in 196 cases (2.6%), information that had originally been reported to the register could not be re-discovered in the hospital records.

When evaluating the variable ”previous surgery of the index knee” the database and the original form differed in <1% if cases. However, the information on the original form and that found in hospital records differed in 14% of cases. An explanation may be that the hospital records are more detailed and may contain historical information. E.g. there were cases for which the form listed arthroscopy as being previous surgery while the hospital records stated arthroscopic meniscectomy.

With respect to the ”operation techniques” (use of bone transplants, navigation, minimally invasive surgery - MIS, drainage and tourniquet), the reported information and the SKAR database differed in 6 cases (<1%). while the reported information that extracted from the hospital records differed for 2.2%. Information for <1% could not be rediscovered in the hospital records.

In the operation theatre it is easy to document these variables but they may be difficult to verify in hospital records. To gather information about the use of MIS by reading an operation report depends on the knowledge of the reader of how orthopedic surgeons describe the method. Still the use of tourniquet and drains is often mentioned in the operation report and the former also in the anesthesia report.

Regarding the use of prophylactic drugs (pre- and postoperatively, inclusive the antibiotic and antithrombotic doses as well as the use of local infiltration analgesia (LIA), the information reported and what was entered in the SKAR database differed in <1%. However, the reported information and that gathered during the hospital visit differed for 4.8%.

Validation of data quality (cont.)

The reason was ea. that for a number of surgeries it had been indicated that LIA and a catheter had been used while the hospital visit could only find documentation for either LIA or a catheter. Furhter, in a number of cases it was indicated that thromboprophylaxis had been started preoperatively while interpretation of the hospital record classified it as postoperative start (or vice versa). Reported information was missing in hospital record for <1%).

The time for administration of the first dose of the prophylactic antibiotic drug could be found in the pharmaceutical records at most of the hospitals while some cases it had to be interpretated from anesthesia records that had been scanned with varying quality and could be hard to read. For 18.7% there was >15 min difference between the reported information and that gathered during the hospital visit. The difference lessened during the years from 25% to 11%.

According to the PRISS recommendations (Prosthetic Infections Shall be Stopped) that were introduced in 2013, the optimal timing for the first preoperative dose has been changed from being 45-15 minutes prior to start of surgery to being 45-30 minutes. 30 minutes prior to start of surgery was a common recommendation in hospital guidelines and when the register introduced the new form it was noticed that a number of hospitals specified for more than 50% of their cases that the dose had ben administrated exactly 30 minutes prior to surgery. This caused us beleive that the recommended time had been reported and not the actual time. The registry has noticed and informed the hospitals about the importance of providing the actual time.

During 2009-2010 the WHO checklist for safe surgery was introduced but it also concerns administration of antibiotics. This has improved the documentation of the time for administration as well as the change in the register form introduced in 2012, after which the exact time of administration was to be entered but not the number of minutes prior to surgery.

The planned length of antibiotic treatment did hardly differ between the original form and what had been entered into the database while it in 4.8% of cases it differed between the original form and the information gathered during the hospital visit. However, on the form, the planned length of treatment can be stated in hours or days. The form sometimes stated the planned length as being one day while the medical records stated the length as being 6 hours according to the PRISS recommendations for Cloxacillin, the most commonly used antibiotic. Sometimes it was vice-versa.

The planned length of antithrombotic treatment is a variable that can be expected to differ from what was planned and what eventually was the case as the treatment time is typically much longer than for antibiotics and plans may change during the hospital stay. We found that for 3.5% of the surgeries the information differed more than a week while the length of treatment could not be found in the medical records for almost 4%.

The type of anesthesia used did hardly differ between the original form and what had been entered into the database while it in 4.6% of cases it differed between the original form and the information gathered during the hospital visit. In 1.7% of the surgeries it was not possible to find information at the hospital on the form of anesthesia used.

In a good 2% of cases, information on the length and/or height of the patient was missing. The difference between the original and what was found during the visit was negligible

The weight of all the patients was available in the hospital records. The difference between what was documented on the original form and that found during the hospital records was negligible.

The operating time was missing in less than 4% of cases. For patients having bilateral simultaneous surgery the anesthesia records showed the total time while separate operating times for each side were registered on the original forms, filled in during surgery. In the case of bilateral simultaneous knee arthroplasties, only the total anesthetic time was registered in the anesthesia records while the separate time for each knee was documented on the reporting form. There was some time difference between what had been registered on the original form and what was later gathered from the anesthesia records. The mean difference was slightly larger for the end of surgery (14.5 min) as compared to start of surgery (4.8 min.).

The ASA rating reported on the original form as compared to that found retrospectively in the medical records differed for 4.6% of the cases. Some units reported for a number of cases a higher ASA in the anaesthesia journal than on the original form or vice versa. For almost 2% of the surgeries, an ASA grade could not been found during the visit.

What was learned

Our recommendation to the hospital is to collect the information asked for in the operation theatre, during surgery and when all relevant data are accessible, as this will increase the likelihood of correct information becoming registered.

During the validation visits at the hospitals we discovered that it could be difficult retrospectively to find specific information in the medical records as it could be in different location and be a matter of interpretation which depended on the knowledge and experience of the person performing the review.

We found the setup and the approach of the validation effort as being satisfactory. Besides the time needed for hospital staff to produce lists of the performed surgeries and develop the medical records, each validation visit lasted 3-4 hours.

An additional benefit of performing the validation visits was the engagement of register and hospital staff which encouraged further cooperation and gave an opportunity for exchange of information and education.

Summary

The latest comparison against the NPR indicated that the SKAR captured 97% of the hospital admissions for primary surgeries. In this case, 27 out of the 900 primary surgeries that the hospitals developed should be expected to be missing in the SKAR. That no primary was missing indicates a very good data capture. The information concerning the essential data as well as the inserted components and their fixation was very accurate with less than 1% being incorrectly entered into the database or not in agreement with the information gathered during the later hospital visit. However, in some cases, information about the implants and fixation could not be found during the hospital visit.

While the hospitals were successful in reporting essential as well as implant data, we also consider their accuracy to bee good with respect to the 13 new variables introduced in 2009 and which only had been registered for 14 months when the selection period for the first 9 hospitals started (March 1st 2010). For some of the variables where the original form differed from the information gathered retrospectively it is impossible to decide exactly what was done.

Regarding the variables "previous surgery of the index knee" and the timing for the first prophylactic antibiotic dose, the proportion of cases that differed between the original form and what was gathered later from the medical records was larger than for the other variables. As the original form is intended to be filled in the operation theater, the information on previous surgeries may differ based on what the orthopedic surgeon knows at the time and what can be gathered from medical records at a later time. Concerning the timing for the first dose of the prophylactic antibiotic, the information from the anesthesia records was sometimes difficult to read and interpret because of suboptimal scanning quality. However, the proportion of cases that differed diminished from 25% to 11% over the years.

The difference between the original form and what was entered into the database was less than 1% indicating high quality of the centralized data entering.

The validation has resulted in better registration routines and improved cooperation between register- and hospital staff. Thus, we hope to be able to continue with the project until we have visited all the hospitals.

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 2016, more than 14,000 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 17 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 17 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 using the Web. 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 more than 27,000 visits 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 world lowest revision rate. As compared to one of our closest neighbor 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

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 has resulted in a the classifaction of advers events used here but it is also used by the National Board of Health and Welfare in the 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 2013-2015 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 83.

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	354	11	31.1
Dalarna	758	24	31.7
Gotland	113	5	44.2
Gävleborg	826	11	13.3
Halland	1,267	47	37.1
Jämtland	232	14	60.3
Jönköping	790	27	34.2
Kalmar	742	34	45.8
Kronoberg	327	19	58.1
Norrbotten	508	19	37.4
Skåne	2,754	66	24.0
Stockholm	3,714	102	27.5
Sörmland	525	10	19.0
Uppsala	824	58	70.4
Värmland	711	25	35.2
Västerbotten	487	42	86.2
Västernorrland	449	22	49.0
Västmanland	371	17	45.8
Västra Götaland	2,728	60	22.0
Örebro	565	8	14.2
Östergötland	939	41	43.7
The Country	19,984	662	33.1

MEN in the counties

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

County	Surgeries	Events	Risk/1000
Blekinge	334	22	65.9
Dalarna	615	25	40.7
Gotland	93	4	43.0
Gävleborg	679	19	28.0
Halland	986	41	41.6
Jämtland	127	8	63.0
Jönköping	611	25	40.9
Kalmar	562	32	56.9
Kronoberg	241	13	53.9
Norrbotten	400	12	30.0
Skåne	1,988	56	28.2
Stockholm	2,847	114	40.0
Sörmland	390	18	46.2
Uppsala	583	45	77.2
Värmland	525	24	45.7
Västerbotten	348	29	83.3
Västernorrland	352	14	39.8
Västmanland	248	10	40.3
Västra Götaland	2,181	62	28.4
Örebro	412	13	31.6
Östergötland	632	38	60.1
The Country	15.154	624	41.2

Adverse cardiovascular events within 90 days (DC)

County	Surgeries	Events	Risk/1000
Blekinge	354	0	0.0
Dalarna	758	3	4.0
Gotland	113	1	8.8
Gävleborg	826	1	1.2
Halland	1,267	4	3.2
Jämtland	232	2	8.6
Jönköping	790	2	2.5
Kalmar	742	6	8.1
Kronoberg	327	2	6.1
Norrbotten	508	4	7.9
Skåne	2,754	13	4.7
Stockholm	3,714	23	6.2
Sörmland	525	3	5.7
Uppsala	824	9	10.9
Värmland	711	4	5.6
Västerbotten	487	3	6.2
Västernorrland	449	4	8.9
Västmanland	371	3	8.1
Västra Götaland	2,728	23	8.4
Örebro	565	3	5.3
Östergötland	939	6	6.4
The Country	19,984	119	6.0

Adverse cardiovascular events within 90 days (DC)

County	Surgeries	Events	Risk/1000
Blekinge	334	4	12.0
Dalarna	615	11	17.9
Gotland	93	0	0.0
Gävleborg	679	16	23.6
Halland	986	10	10.1
Jämtland	127	4	31.5
Jönköping	611	5	8.2
Kalmar	562	4	7.1
Kronoberg	241	3	12.4
Norrbotten	400	2	5.0
Skåne	1,988	21	10.6
Stockholm	2,847	26	9.1
Sörmland	390	3	7.7
Uppsala	583	7	12.0
Värmland	525	8	15.2
Västerbotten	348	5	14.4
Västernorrland	352	6	17.0
Västmanland	248	0	0.0
Västra Götaland	2,181	21	9.6
Örebro	412	5	12.1
Östergötland	632	8	12.7
The Country	15,154	169	11.2

Other adverse medical events within 90 days. (DM)

County	Surgeries	Events	Risk/1000
Blekinge	354	3	8.5
Dalarna	758	4	5.3
Gotland	113	1	8.8
Gävleborg	826	6	7.3
Halland	1,267	12	9.5
Jämtland	232	7	30.2
Jönköping	790	14	17.7
Kalmar	742	13	17.5
Kronoberg	327	4	12.2
Norrbotten	508	3	5.9
Skåne	2,754	26	9.4
Stockholm	3,714	51	13.7
Sörmland	525	3	5.7
Uppsala	824	11	13.3
Värmland	711	4	5.6
Västerbotten	487	10	20.5
Västernorrland	449	8	17.8
Västmanland	371	2	5.4
Västra Götaland	2,728	29	10.6
Örebro	565	3	5.3
Östergötland	939	11	11.7
The Country	19,984	225	11.3

Other adverse medical events within 90 days. (DM)

County	Surgeries	Events	Risk/1000
Blekinge	334	3	9.0
Dalarna	615	3	4.9
Gotland	93	2	21.5
Gävleborg	679	10	14.7
Halland	986	7	7.1
Jämtland	127	4	31.5
Jönköping	611	9	14.7
Kalmar	562	18	32.0
Kronoberg	241	4	16.6
Norrbotten	400	3	7.5
Skåne	1,988	31	15.6
Stockholm	2,847	49	17.2
Sörmland	390	5	12.8
Uppsala	583	11	18.9
Värmland	525	8	15.2
Västerbotten	348	24	69.0
Västernorrland	352	10	28.4
Västmanland	248	2	8.1
Västra Götaland	2,181	27	12.4
Örebro	412	3	7.3
Östergötland	632	14	22.2
The Country	15,154	247	16.3

WOMEN in the counties
Death within 90 days

County	Surgeries	Events	Risk/1000
Blekinge	354	1	2.8
Dalarna	758	1	1.3
Gotland	113	0	0.0
Gävleborg	826	1	1.2
Halland	1,267	0	0.0
Jämtland	232	1	4.3
Jönköping	790	0	0.0
Kalmar	742	2	2.7
Kronoberg	327	0	0.0
Norrbotten	508	1	2.0
Skåne	2,754	3	1.1
Stockholm	3,714	4	1.1
Sörmland	525	1	1.9
Uppsala	824	1	1.2
Värmland	711	0	0.0
Västerbotten	487	0	0.0
Västernorrland	449	1	2.2
Västmanland	371	0	0.0
Västra Götaland	2,728	4	1.5
Örebro	565	0	0.0
Östergötland	939	3	3.2
The Country	19,984	24	1.2

MEN in the counties
Death within 90 days

County	Surgeries	Events	Risk/1000
Blekinge	334	1	3.0
Dalarna	615	4	6.5
Gotland	93	0	0.0
Gävleborg	679	1	1.5
Halland	986	0	0.0
Jämtland	127	1	7.9
Jönköping	611	1	1.6
Kalmar	562	1	1.8
Kronoberg	241	0	0.0
Norrbotten	400	2	5.0
Skåne	1,988	10	5.0
Stockholm	2,847	4	1.4
Sörmland	390	2	5.1
Uppsala	583	1	1.7
Värmland	525	0	0.0
Västerbotten	348	0	0.0
Västernorrland	352	1	2.8
Västmanland	248	1	4.0
Västra Götaland	2,181	2	0.9
Örebro	412	1	2.4
Östergötland	632	1	1.6
The Country	15,154	34	2.2

All adverse events within 90 days (incl. death)

County	Surgeries	Events	Risk/1000
Blekinge	354	15	42.4
Dalarna	758	30	39.6
Gotland	113	6	53.1
Gävleborg	826	19	23.0
Halland	1,267	60	47.4
Jämtland	232	21	90.5
Jönköping	790	41	51.9
Kalmar	742	51	68.7
Kronoberg	327	24	73.4
Norrbotten	508	25	49.2
Skåne	2,754	106	38.5
Stockholm	3,714	167	45.0
Sörmland	525	16	30.5
Uppsala	824	76	92.2
Värmland	711	31	43.6
Västerbotten	487	50	102.7
Västernorrland	449	32	71.3
Västmanland	371	19	51.2
Västra Götaland	2,728	107	39.2
Örebro	565	13	23.0
Östergötland	939	56	59.6
The Country	19,984	965	48.3

All adverse events within 90 days (incl. death)

County	Surgeries	Events	Risk/1000
Blekinge	334	29	86.8
Dalarna	615	40	65.0
Gotland	93	6	64.5
Gävleborg	679	41	60.4
Halland	986	57	57.8
Jämtland	127	14	110.2
Jönköping	611	39	63.8
Kalmar	562	49	87.2
Kronoberg	241	19	78.8
Norrbotten	400	19	47.5
Skåne	1,988	106	53.3
Stockholm	2,847	183	64.3
Sörmland	390	25	64.1
Uppsala	583	59	101.2
Värmland	525	38	72.4
Västerbotten	348	47	135.1
Västernorrland	352	28	79.5
Västmanland	248	13	52.4
Västra Götaland	2,181	108	49.5
Örebro	412	22	53.4
Östergötland	632	55	87.0
The Country	15,154	997	65.8

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). Four % of the patients experience surgical events which may include aspirations, wound problems, manipulation under anesthesia, hematoma etc. The "true" 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. 0.9% have cardiovascular events, 1.3% have other adverse medical events while only 0.17% die within the first 90 days. The overall risk for a patient for experiencing an adverse event during this time is 5.9%.

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

It may be problematic to compare the number of adverse events between hospitals and counties as there may be a variation in the routines for coding events. However, 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	688	2	2.5
Dalarna	1,373	5	3.6
Gotland	206	0	0.0
Gävleborg	1,505	2	1.3
Halland	2,253	0	0.0
Jämtland	359	2	4.7
Jönköping	1,401	1	0.6
Kalmar	1,304	3	2.3
Kronoberg	568	0	0.0
Norrbotten	908	3	3.5
Skåne	4,742	13	2.6
Stockholm	6,561	9	1.3
Sörmland	915	3	3.2
Uppsala	1,407	2	1.5
Värmland	1,236	0	0.0
Västerbotten	835	0	0.0
Västernorrland	801	2	2.3
Västmanland	619	1	1.5
Västra Götaland	4,909	6	1.2
Örebro	977	1	0.9
Östergötland	1,571	3	2.2
The Country	35,138	58	1.7

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

County	Surgeries	Events	Risk/1000
Blekinge	688	42	61.5
Dalarna	1,373	70	50.9
Gotland	206	12	59.6
Gävleborg	1,505	59	39.3
Halland	2,253	119	52.6
Jämtland	359	37	102.1
Jönköping	1,401	79	56.1
Kalmar	1,304	100	76.4
Kronoberg	568	43	76.4
Norrbotten	908	45	49.5
Skåne	4,742	209	44.2
Stockholm	6,561	357	54.4
Sörmland	915	40	44.2
Uppsala	1,407	135	96.0
Värmland	1,236	68	54.8
Västerbotten	835	97	115.7
Västernorrland	801	60	74.9
Västmanland	619	32	52.2
Västra Götaland	4,909	216	44.0
Örebro	977	35	35.3
Östergötland	1,571	110	69.9
The Country	35,138	1962	55.8

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	242	16	66.1
Alingsås	595	11	18.5
Art Clinic Gbg	15	0	0.0
Art Clinic Jönköping	39	0	0.0
Arvika	430	14	32.6
Bollnäs	951	17	17.9
Borås	220	10	45.5
Carlanderska	357	3	8.4
Danderyd	368	15	40.8
Eksjö-Nässjö	533	26	48.8
Elisabethkliniken	55	2	36.4
Enköping	1,110	85	76.6
Eskilstuna	111	8	72.1
Falun	859	34	39.6
Frölunda Spec.	360	4	11.1
Gällivare	197	6	30.5
Gävle	343	6	17.5
Halmstad	585	38	65.0
Helsingborg	125	3	24.0
Huddinge	364	14	38.5
Hudiksvall	211	7	33.2
Hässleholm	1,810	63	34.8
Jönköping	437	10	22.9
Kalmar	255	8	31.4
Karlshamn	688	33	48.0
Karlskoga	370	6	16.2
Karlstad	446	23	51.6
Karolinska	257	19	73.9
Kullbergska sjukhuset	558	19	34.1
Kungälv	472	17	36.0
Lidköping	605	20	33.1
Lindesberg	502	13	25.9
Ljungby	302	19	62.9
Luleå-Sensia	15	1	66.7
Lund	175	8	45.7
Lycksele	199	11	55.3
Mora	514	15	29.2
Motala	1,191	59	49.5
Movement Halmstad	840	18	21.4
Mölndal	801	18	22.5
Nacka-Proxima/Aleris	396	9	22.7
Norrköping	380	20	52.6
Norrtälje	217	11	50.7
Nyköping	246	1	4.1
OrthoCenter Stockh.	1,201	18	15.0
OrthoCenter IFK Klin	284	1	3.5
Ortopediska huset	1,228	27	22.0
Oskarshamn	768	49	63.8
Piteå	696	24	34.5
S:t Göran	995	36	36.2
Sabbatsberg	284	2	7.0
Skellefteå	296	12	40.5
Skene	304	10	32.9
Skövde	354	10	28.2
Sollefteå	269	12	44.6
Sophiahemmet	204	4	19.6
Spenshult	428	14	32.7
Sundsvall	225	14	62.2
Södersjukhuset	747	45	60.2
Södertälje	300	16	53.3
Torsby	360	12	33.3
Trelleborg	2,028	28	13.8
Uddevalla	541	18	33.3
Umeå	340	48	141.2
Varberg	400	18	45.0
Visby	206	9	43.7
Värnamo	392	16	40.8
Västervik	281	9	32.0
Västerås	619	27	43.6
Växjö	266	13	48.9
Ängelholm	601	20	33.3
Örebro	105	2	19.0
Örnsköldsvik	307	10	32.6
Östersund	359	22	61.3
The Country	35,138	1 286	36.6

Adverse cardiovascular events within 90 days (DC)

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	242	4	16.5
Alingsås	595	4	6.7
Art Clinic Gbg	15	0	0.0
Art Clinic Jönköping	39	0	0.0
Arvika	430	3	7.0
Bollnäs	951	6	6.3
Borås	220	6	27.3
Carlanderska	357	3	8.4
Danderyd	368	3	8.2
Eksjö-Nässjö	533	5	9.4
Elisabethkliniken	55	0	0.0
Enköping	1,110	12	10.8
Eskilstuna	111	1	9.0
Falun	859	7	8.1
Frölunda Spec.	360	2	5.6
Gällivare	197	1	5.1
Gävle	343	8	23.3
Halmstad	585	2	3.4
Helsingborg	125	1	8.0
Huddinge	364	6	16.5
Hudiksvall	211	3	14.2
Hässleholm	1,810	10	5.5
Jönköping	437	1	2.3
Kalmar	255	3	11.8
Karlshamn	688	4	5.8
Karlskoga	370	4	10.8
Karlstad	446	4	9.0
Karolinska	257	7	27.2
Kullbergska sjukhuset	558	3	5.4
Kungälv	472	6	12.7
Lidköping	605	6	9.9
Lindesberg	502	4	8.0
Ljungby	302	4	13.2
Luleå-Sensia	15	2	133.3
Lund	175	2	11.4
Lycksele	199	1	5.0
Mora	514	7	13.6
Motala	1,191	10	8.4
Movement Halmstad	840	5	6.0
Mölndal	801	9	11.2
Nacka-Proxima/Aleris	396	1	2.5
Norrköping	380	4	10.5
Norrtälje	217	2	9.2
Nyköping	246	2	8.1
OrthoCenter Stockh.	1,201	2	1.7
OrthoCenter IFK Klin	284	1	3.5
Ortopediska huset	1,228	5	4.1
Oskarshamn	768	6	7.8
Piteå	696	3	4.3
S:t Göran	995	8	8.0
Sabbatsberg	284	1	3.5
Skellefteå	296	1	3.4
Skene	304	4	13.2
Skövde	354	1	2.8
Sollefteå	269	2	7.4
Sophiahemmet	204	1	4.9
Spenshult	428	1	2.3
Sundsvall	225	2	8.9
Södersjukhuset	747	8	10.7
Södertälje	300	5	16.7
Torsby	360	5	13.9
Trelleborg	2,028	16	7.9
Uddevalla	541	2	3.7
Umeå	340	6	17.6
Varberg	400	6	15.0
Visby	206	1	4.9
Värnamo	392	1	2.6
Västervik	281	1	3.6
Västerås	619	3	4.8
Växjö	266	1	3.8
Ängelholm	601	4	6.7
Örebro	105	0	0.0
Örnsköldsvik	307	6	19.5
Östersund	359	6	16.7
The Country	**35,138**	**288**	**8.2**

Other adverse medical events within 90 days. (DM)

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	242	5	20.7
Alingsås	595	5	8.4
Art Clinic Gbg	15	0	0.0
Art Clinic Jönköping	39	0	0.0
Arvika	430	2	4.7
Bollnäs	951	7	7.4
Borås	220	5	22.7
Carlanderska	357	2	5.6
Danderyd	368	19	51.6
Eksjö-Nässjö	533	11	20.6
Elisabethkliniken	55	0	0.0
Enköping	1,110	17	15.3
Eskilstuna	111	1	9.0
Falun	859	7	8.1
Frölunda Spec.	360	0	0.0
Gällivare	197	1	5.1
Gävle	343	5	14.6
Halmstad	585	10	17.1
Helsingborg	125	1	8.0
Huddinge	364	6	16.5
Hudiksvall	211	4	19.0
Hässleholm	1,810	25	13.8
Jönköping	437	8	18.3
Kalmar	255	8	31.4
Karlshamn	688	6	8.7
Karlskoga	370	4	10.8
Karlstad	446	6	13.5
Karolinska	257	7	27.2
Kullbergska sjukhuset	558	4	7.2
Kungälv	472	7	14.8
Lidköping	605	4	6.6
Lindesberg	502	1	2.0
Ljungby	302	3	9.9
Luleå-Sensia	15	0	0.0
Lund	175	5	28.6
Lycksele	199	6	30.2
Mora	514	0	0.0
Motala	1,191	11	9.2
Movement Halmstad	840	4	4.8
Mölndal	801	5	6.2
Nacka-Proxima/Aleris	396	0	0.0
Norrköping	380	14	36.8
Norrtälje	217	2	9.2
Nyköping	246	3	12.2
OrthoCenter Stockh.	1,201	9	7.5
OrthoCenter IFK Klin	284	3	10.6
Ortopediska huset	1,228	4	3.3
Oskarshamn	768	22	28.6
Piteå	696	5	7.2
S:t Göran	995	19	19.1
Sabbatsberg	284	1	3.5
Skellefteå	296	3	10.1
Skene	304	8	26.3
Skövde	354	3	8.5
Sollefteå	269	5	18.6
Sophiahemmet	204	2	9.8
Spenshult	428	1	2.3
Sundsvall	225	3	13.3
Södersjukhuset	747	26	34.8
Södertälje	300	5	16.7
Torsby	360	4	11.1
Trelleborg	2,028	23	11.3
Uddevalla	541	14	25.9
Umeå	340	25	73.5
Varberg	400	4	10.0
Visby	206	3	14.6
Värnamo	392	4	10.2
Västervik	281	1	3.6
Västerås	619	4	6.5
Växjö	266	5	18.8
Ängelholm	601	3	5.0
Örebro	105	1	9.5
Örnsköldsvik	307	10	32.6
Östersund	359	11	
The Country	**35,138**	**472**	**13.4**

Death within 90 days

Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	242	1	4.1
Alingsås	595	0	0.0
Art Clinic Gbg	15	0	0.0
Art Clinic Jönköping	39	0	0.0
Arvika	430	0	0.0
Bollnäs	951	0	0.0
Borås	220	2	9.1
Carlanderska	357	0	0.0
Danderyd	368	0	0.0
Eksjö-Nässjö	533	1	1.9
Elisabethkliniken	55	0	0.0
Enköping	1,110	1	0.9
Eskilstuna	111	1	9.0
Falun	859	4	4.7
Frölunda Spec.	360	1	2.8
Gällivare	197	1	5.1
Gävle	343	2	5.8
Halmstad	585	0	0.0
Helsingborg	125	5	40.0
Huddinge	364	2	5.5
Hudiksvall	211	0	0.0
Hässleholm	1,810	3	1.7
Jönköping	437	0	0.0
Kalmar	255	1	3.9
Karlshamn	688	2	2.9
Karlskoga	370	1	2.7
Karlstad	446	0	0.0
Karolinska	257	0	0.0
Kullbergska sjukhuset	558	1	1.8
Kungälv	472	0	0.0
Lidköping	605	0	0.0
Lindesberg	502	0	0.0
Ljungby	302	0	0.0
Luleå-Sensia	15	0	0.0
Lund	175	2	11.4
Lycksele	199	0	0.0
Mora	514	1	1.9
Motala	1,191	3	2.5
Movement Halmstad	840	0	0.0
Mölndal	801	1	1.2
Nacka-Proxima/Aleris	396	0	0.0
Norrköping	380	1	2.6
Norrtälje	217	1	4.6
Nyköping	246	1	4.1
OrthoCenter Stockh.	1,201	1	0.8
OrthoCenter IFK Klin	284	0	0.0
Ortopediska huset	1,228	0	0.0
Oskarshamn	768	2	2.6
Piteå	696	2	2.9
S:t Göran	995	2	2.0
Sabbatsberg	284	0	0.0
Skellefteå	296	0	0.0
Skene	304	0	0.0
Skövde	354	2	5.6
Sollefteå	269	0	0.0
Sophiahemmet	204	0	0.0
Spenshult	428	0	0.0
Sundsvall	225	0	0.0
Södersjukhuset	747	1	1.3
Södertälje	300	1	3.3
Torsby	360	0	0.0
Trelleborg	2,028	2	1.0
Uddevalla	541	0	0.0
Umeå	340	0	0.0
Varberg	400	0	0.0
Visby	206	0	0.0
Värnamo	392	0	0.0
Västervik	281	0	0.0
Västerås	619	1	1.6
Växjö	266	0	0.0
Ängelholm	601	0	0.0
Örebro	105	0	0.0
Örnsköldsvik	307	2	6.5
Östersund	359	2	5.6
The Country	35,138	58	1.7

All adverse events within 90 days (incl. death)

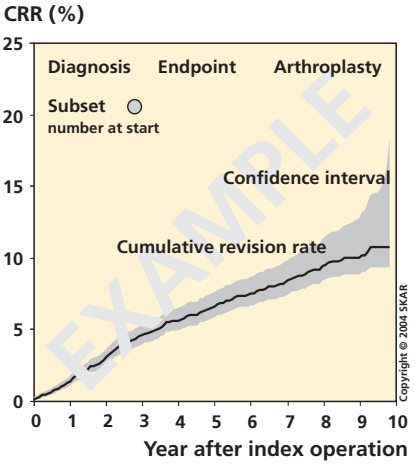
Hospital (men & women)	Surgeries	Events	Risk/1000
Akademiska sjukhuset	242	25	103.3
Alingsås	595	19	31.9
Art Clinic Gbg	15	0	0.0
Art Clinic Jönköping	39	0	0.0
Arvika	430	19	44.2
Bollnäs	951	30	31.5
Borås	220	20	90.9
Carlanderska	357	7	19.6
Danderyd	368	35	95.1
Eksjö-Nässjö	533	40	75.0
Elisabethkliniken	55	2	36.4
Enköping	1,110	108	97.3
Eskilstuna	111	10	90.1
Falun	859	47	54.7
Frölunda Spec.	360	7	19.4
Gällivare	197	9	45.7
Gävle	343	17	49.6
Halmstad	585	48	82.1
Helsingborg	125	9	72.0
Huddinge	364	27	74.2
Hudiksvall	211	13	61.6
Hässleholm	1,810	94	51.9
Jönköping	437	19	43.5
Kalmar	255	17	66.7
Karlshamn	688	44	64.0
Karlskoga	370	15	40.5
Karlstad	446	32	71.7
Karolinska	257	32	124.5
Kullbergska sjukhuset	558	25	44.8
Kungälv	472	28	59.3
Lidköping	605	30	49.6
Lindesberg	502	17	33.9
Ljungby	302	25	82.8
Luleå-Sensia	15	3	200.0
Lund	175	15	85.7
Lycksele	199	16	80.4
Mora	514	23	44.7
Motala	1,191	76	63.8
Movement Halmstad	840	27	32.1
Mölndal	801	31	38.7
Nacka-Proxima/Aleris	396	10	25.3
Norrköping	380	35	92.1
Norrtälje	217	14	64.5
Nyköping	246	6	24.4
OrthoCenter Stockh.	1,201	28	23.3
OrthoCenter IFK Klin	284	4	14.1
Ortopediska huset	1,228	35	28.5
Oskarshamn	768	73	95.1
Piteå	696	32	46.0
S:t Göran	995	62	62.3
Sabbatsberg	284	4	14.1
Skellefteå	296	13	43.9
Skene	304	22	72.4
Skövde	354	14	39.5
Sollefteå	269	19	70.6
Sophiahemmet	204	7	34.3
Spenshult	428	16	37.4
Sundsvall	225	18	80.0
Södersjukhuset	747	69	92.4
Södertälje	300	27	90.0
Torsby	360	18	50.0
Trelleborg	2,028	66	32.5
Uddevalla	541	33	61.0
Umeå	340	68	200.0
Varberg	400	26	65.0
Visby	206	12	58.3
Värnamo	392	21	53.6
Västervik	281	10	35.6
Västerås	619	32	51.7
Växjö	266	18	67.7
Ängelholm	601	27	44.9
Örebro	105	3	28.6
Örnsköldsvik	307	23	74.9
Östersund	359	35	97.5
The Country	35,138	1 962	55.8

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.

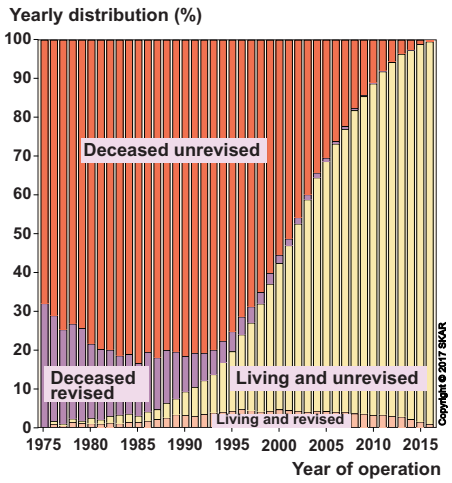
Cox regression allows for taking into account different factors that may vary within groups. The results are expressed as risk ratios (RR) between factors. If a factor is a category (e.g. implant model), one category is defined as a reference with a risk of 1 to which the other categories are compared.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



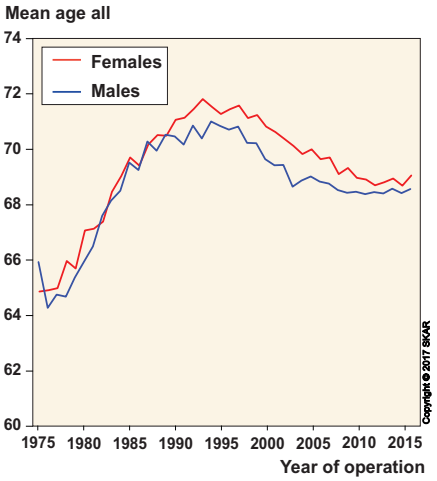
The present status for each yearly batch of patients operated since 1975.

Gender and age distribution

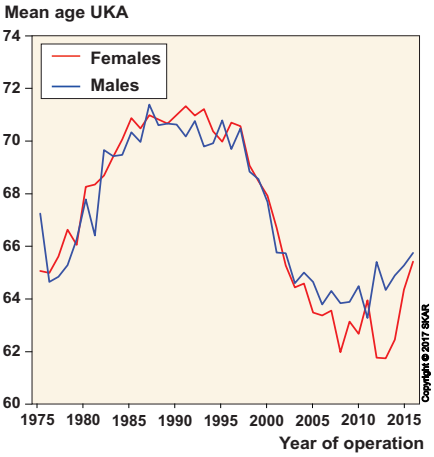
Between 1975 and 1994, the mean age at primary operation increased from 65 years to almost 72 years. The main reason was a relatively large increase in number of operations among the older age groups. Probable explanations are improvements in anesthetic techniques as well as a changed age distribution 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 2016 was 68.8 years (figure on the right).

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

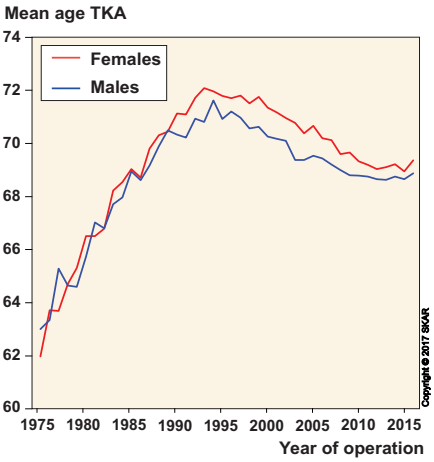
When comparing a series of patients operated on during different periods, the changes in the mean age make it necessary to account for age by use of regression or to analyze different age groups separately.



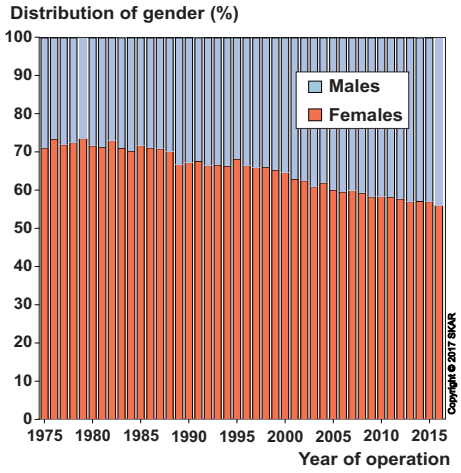
The mean age of patients at surgery (all types of implants) increased until the mid-nineties when it started to decrease.



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).



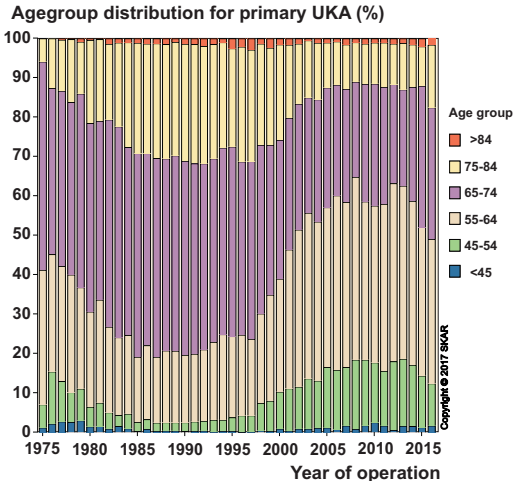
The proportion of males has increased slightly over the years.

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 2016 they accounted for 43%. 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.

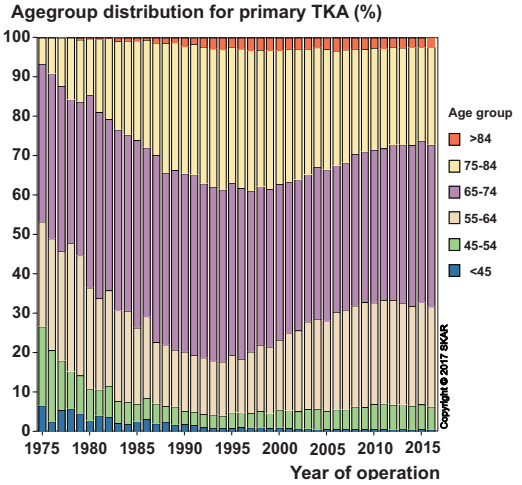
The figure to the right shows the relative number of operations performed in the different age groups over a period of thirty five years. In a somewhat different manner than the mean age (previous page) it shows how the relative proportion of the older groups increased until the mid-nineties after which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

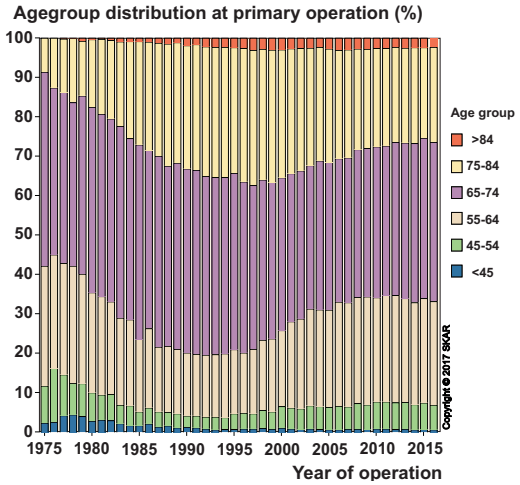
In UKA the relative proportion of patients less than 65 years of age doubled during 1998-2002, i.e. during the time when mini-invasive surgery caught on in Sweden. However, it has to be kept in mind that the actual number of UKA´s is now less than half of what it was in 1998 while the number of TKA has more than doubled. This implies that although the relative number of TKA among younger age groups has not increased as much as for UKA, the actual number of TKA patients younger than 65 years of age has more than tripled while the number of UKA patients less than 65 is almost unchanged.



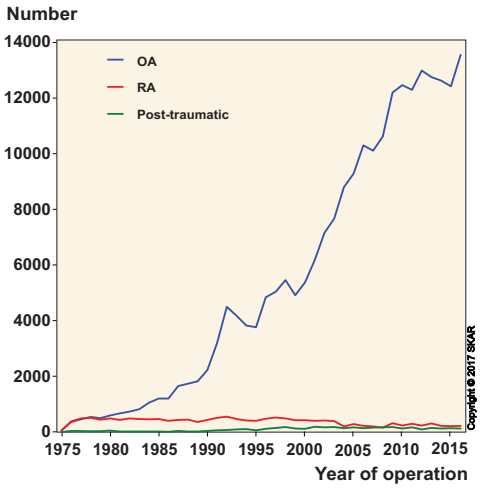
The relative distribution of primary UKA arthroplasties among different age groups.



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



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



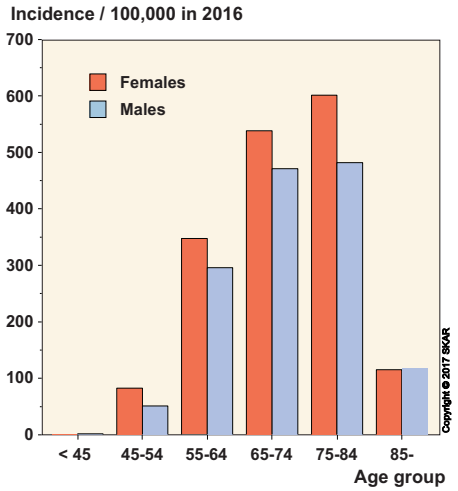
The yearly number of arthroplasties for different diagnoses

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

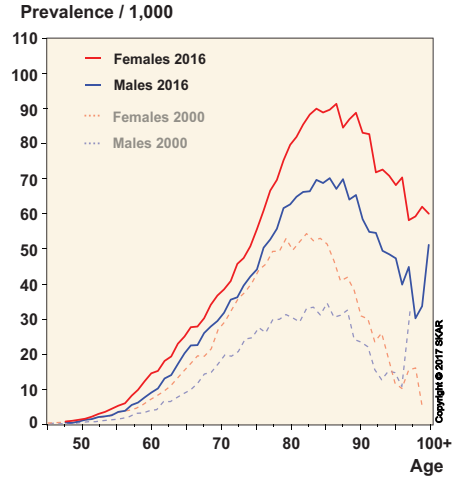
Incidence and prevalence

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.

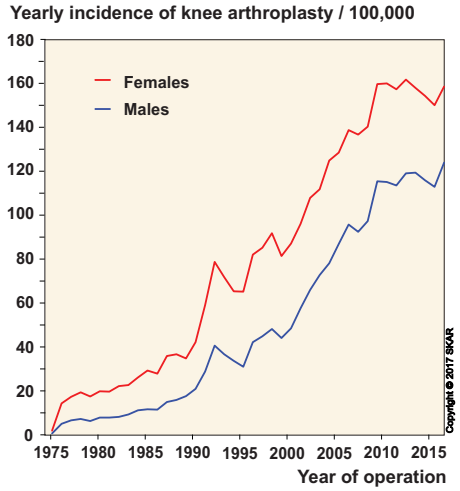
The figure below shows the incidence among different age groups during 2016. It is highest in the group of with those 65-84 years of age. At this age, knee arthroplasty is 8 times more common than among those 45-54 years old and 4.5 times more common than among those 85 years or older. In 2016, women 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 24.



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 2000 and 2016. 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.

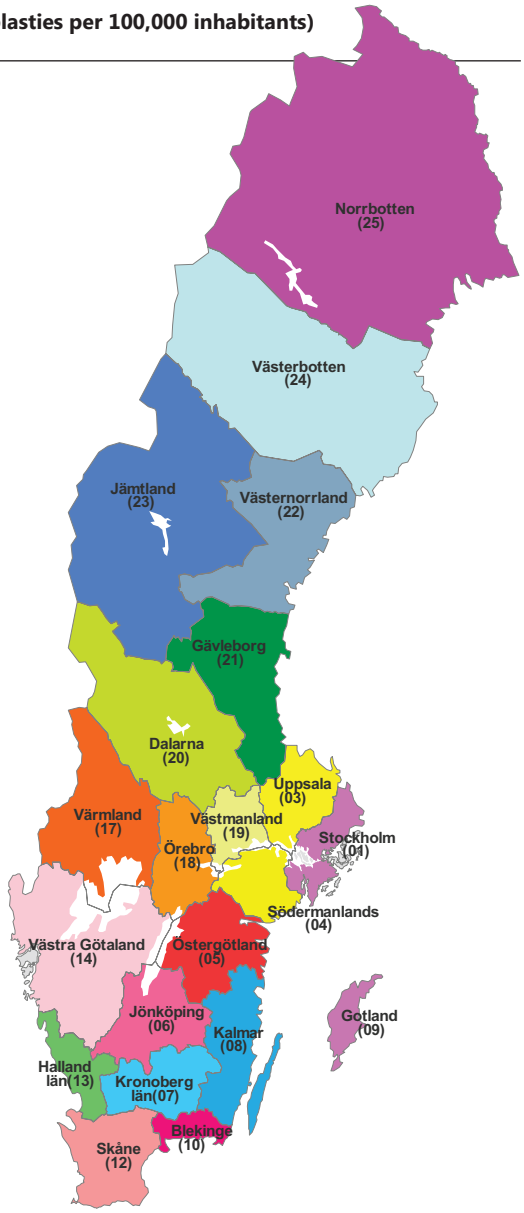
For both men and women in 2016, the prevalence peaks around 80-85 years of age at which 9% of the women and 7% of the men had at least one knee arthroplasty. Comparing the prevalence in 2016 with that in 2000, it can be seen that it has increased in all age groups. The fact that a large proportion of 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 2010-2016 (knee arthroplasties per 100,000 inhabitants)

County and number of inhabitants 2016

No	County	Inhabitants
01	Stockholm	2,250,250
03	Uppsala	357,769
04	Södermanland	285,905
05	Östergötland	448,883
06	Jönköping	350,286
07	Kronoberg	192,999
08	Kalmar	239,990
09	Gotland	57,697
10	Blekinge	157,353
12	Skåne	1,314,096
13	Halland	317,559
14	Västra Götaland	1,660,233
17	Värmland	277,619
18	Örebro	292,977
19	Västmanland	265,953
20	Dalarna	282,780
21	Gävleborg	283,201
22	Västernorrland	244,735
23	Jämtland	128,025
24	Västerbotten	264,630
25	Norrbotten	250,152

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



Knee arthroplasties per 100,000 inhabitants

County	2010	2011	2012	2013	2014	2015	2016
01 Stockholm	106.4	106.4	103.9	104.9	99.5	93.3	111.5
03 Uppsala	145.9	136.7	154.9	174.8	142.9	161.6	123.8
04 Södermanland	154.9	150.9	151.7	157.2	161.9	145.3	140.3
05 Östergötland	165.7	146.9	157.5	154.2	135.0	132.9	137.2
06 Jönköping	131.7	142.6	168.4	147.6	172.4	153.7	150.2
07 Kronoberg	146.6	123.7	158.7	115.3	150.4	154.5	175.1
08 Kalmar	146.8	154.3	168.4	175.9	167.0	172.4	174.6
09 Gotland	164.2	249.6	165.9	178.3	134.6	106.4	150.8
10 Blekinge	155.0	169.2	178.8	177.7	161.6	165.6	206.5
12 Skåne	117.3	122.3	125.8	137.2	142.5	144.3	158.4
13 Halland	153.9	150.0	177.3	165.6	168.4	155.4	177.0
14 Västra Götaland	140.3	139.1	132.0	130.7	125.5	127.8	126.1
17 Värmland	172.4	170.0	179.9	180.3	195.4	184.5	181.5
18 Örebro	138.4	125.7	146.3	120.3	116.8	104.6	152.2
19 Västmanland	141.2	128.2	156.7	125.4	134.8	109.1	118.4
20 Dalarna	208.5	219.6	217.0	231.4	199.5	174.7	199.1
21 Gävleborg	191.1	174.8	191.4	188.6	213.6	206.5	202.3
22 Västernorrland	182.8	143.2	145.4	141.3	132.3	141.3	155.3
23 Jämtland	161.8	162.1	175.0	138.5	95.6	120.4	144.5
24 Västerbotten	144.8	119.9	123.1	126.2	117.3	117.9	120.2
25 Norrbotten	122.2	150.1	165.7	150.2	131.0	120.9	143.5
The whole country	137.9	135.8	140.8	139.0	135.5	131.8	141.5

Information on domicile is by the Swedish Tax Agency

For age-standardized incidence see page 33

The incidence in the counties 2010-2016 (knee arthroplasties per 100,000 inhabitants)

Incidence for women

County	2010	2011	2012	2013	2014	2015	2016
01 Stockholm	128.9	129.3	130.4	123.0	113.3	106.4	127.3
03 Uppsala	188.8	155.3	178.6	193.1	170.6	186.2	134.5
04 Södermanland	164.2	173.6	176.8	180.4	184.5	154.4	159.7
05 Östergötland	184.6	165.2	182.6	172.5	159.9	156.9	154.1
06 Jönköping	153.1	174.3	202.3	174.4	202.1	176.1	164.5
07 Kronoberg	182.4	147.8	183.1	148.4	166.7	168.3	186.1
08 Kalmar	158.1	148.9	209.0	201.2	193.1	199.7	206.7
09 Gotland	200.8	273.4	162.7	208.1	128.5	114.5	169.2
10 Blekinge	168.7	188.5	188.9	187.5	182.3	168.9	235.6
12 Skåne	131.3	140.8	140.1	154.3	165.9	169.6	177.9
13 Halland	178.9	173.5	197.8	188.4	186.6	173.0	190.2
14 Västra Götaland	162.5	160.1	146.9	148.2	140.6	146.4	140.9
17 Värmland	214.8	182.2	202.9	190.1	233.5	204.5	194.4
18 Örebro	162.4	152.0	157.7	129.6	135.7	127.0	176.9
19 Västmanland	159.9	147.9	173.6	140.3	157.5	128.1	148.0
20 Dalarna	232.2	248.3	242.1	260.7	222.4	195.0	215.7
21 Gävleborg	206.1	198.9	207.7	206.4	232.6	222.1	221.6
22 Västernorrland	233.5	172.3	163.6	165.4	149.7	155.2	181.0
23 Jämtland	206.8	212.0	206.2	179.4	107.9	153.6	156.1
24 Västerbotten	161.4	141.0	150.9	151.4	131.0	137.4	138.9
25 Norrbotten	136.2	184.7	190.6	170.8	150.2	142.1	162.6
The whole country	160.3	157.6	162.1	158.3	154.7	150.4	159.0

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 2016 can be found on page 33.

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	2010	2011	2012	2013	2014	2015	2016
01 Stockholm	83.4	83.0	76.9	86.5	85.5	80.1	95.6
03 Uppsala	102.4	117.9	131.0	156.5	115.0	136.9	113.1
04 Södermanland	145.4	128.1	126.3	133.7	139.3	136.2	120.9
05 Östergötland	147.0	128.7	132.6	136.1	110.3	109.3	120.7
06 Jönköping	110.1	110.9	134.6	120.8	143.0	131.6	136.0
07 Kronoberg	111.3	100.0	134.8	82.8	134.5	141.1	164.5
08 Kalmar	135.5	159.7	127.8	150.5	141.0	145.4	143.0
09 Gotland	127.0	225.4	169.1	148.0	140.7	98.2	132.3
10 Blekinge	141.7	150.5	169.1	168.1	141.4	162.4	178.5
12 Skåne	103.0	103.3	111.3	119.7	118.7	118.8	138.8
13 Halland	128.8	126.4	156.6	142.7	150.1	137.7	163.7
14 Västra Götaland	118.0	117.9	117.0	113.1	110.4	109.1	111.3
17 Värmland	129.8	157.7	156.9	170.5	157.4	164.7	168.7
18 Örebro	114.0	99.0	134.7	110.9	97.9	82.3	127.6
19 Västmanland	122.5	108.4	139.8	110.4	112.1	90.3	89.1
20 Dalarna	184.8	191.1	191.9	202.3	176.8	154.6	182.8
21 Gävleborg	176.0	150.6	175.1	170.8	194.7	190.9	183.2
22 Västernorrland	132.0	114.0	127.2	117.2	115.1	127.5	129.9
23 Jämtland	116.8	112.2	143.9	97.9	83.4	87.6	133.1
24 Västerbotten	128.4	98.9	95.6	101.4	103.8	98.8	101.8
25 Norrbotten	108.5	116.5	141.7	130.3	112.4	100.4	125.3
The whole country	115.4	113.8	119.4	119.7	116.2	113.2	124.2

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	1976-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016
<45	1.0	0.9	1.1	1.5	1.8	2.1	2.3	1.8
45-54	13.2	11.4	15.7	27.5	49.9	76.1	87.0	82.9
55-64	42.5	57.4	104.1	133.8	199.0	289.3	337.7	348.5
65-74	92.0	158.0	306.8	373.1	476.5	562.5	533.7	539.4
75-84	65.1	144.0	305.8	385.0	479.1	585.8	597.4	602.3
>84	5.5	19.2	54.4	82.6	92.4	121.4	116.1	115.8
Total	21.1	35.9	68.5	85.8	114.4	147.5	156.6	159.0

Men

Age group	1976-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016
<45	0.4	0.4	0.4	0.7	0.9	1.5	1.5	1.6
45-54	5.4	4.5	8.8	14.4	30.0	46.5	51.5	51.3
55-64	18.8	28.4	64.9	81.5	149.0	222.7	266.8	296.7
65-74	41.1	81.6	176.7	239.5	346.9	442.0	448.8	472.0
75-84	32.3	91.9	193.2	246.3	342.2	458.8	478.4	482.7
>84	6.3	22.4	51.2	71.3	89.4	125.3	114.5	118.8
Total	8.4	16.5	34.5	45.9	72.8	103.6	116.5	124.2

Number of primary arthroplasties per unit and year

Hospital	1975-2010	2012	2013	2014	2015	2016	Totalt	Percent
Akademiska sjukhuset	2,804	108	90	86	108	88	3,284	1.3
Alingsås	1,813	193	214	204	193	160	2,777	1,.1
Art,Clinic Göteborg	.	.	.	.	16	55	71	0
Art,Clinic Jönköping	.	8	2	13	29	24	76	0
Arvika	1,402	156	129	193	171	189	2,240	0.9
Avesta	67	.	.	.	.	.	67	0
Boden	1,622	.	.	.	.	.	1,622	0.6
Bollnäs	2,800	327	305	402	353	344	4,531	1.8
Borås	2,738	103	91	78	72	74	3,156	1.2
Carlanderska	411	126	108	137	136	156	1,074	0.4
Dalslands Sjukhus	81	.	.	.	.	.	81	0
Danderyd	3,043	200	196	185	185	187	3,996	1.6
Eksjö-Nässjö (Höglandssjukh.)	2,753	182	173	211	202	220	3,741	1.5
Elisabethsjukhuset	711	58	58	7	1	7	842	0.3
Enköping	2,154	342	415	373	392	346	4,022	1.6
Eskilstuna	1,818	32	43	41	42	55	2,031	0.8
Fagersta	71	.	.	.	.	.	71	0
Falköping	1,688	.	.	.	.	.	1,688	0.7
Falun	4,491	356	364	356	205	270	6,042	2.4
Frölunda Spec.	1,067	121	120	120	124	.	1,552	0.6
Gällivare	1,350	79	94	68	46	53	1,690	0.7
Gävle	3,091	155	164	129	132	147	3,818	1.5
Halmstad	2,898	241	232	190	186	208	3,955	1.5
Helsingborg	1,761	15	21	44	66	41	1,948	0.8
Huddinge	2,663	150	147	166	159	168	3,453	1.4
Hudiksvall	1,500	79	73	60	87	74	1,873	0.7
Hässleholm	6,783	664	698	683	669	707	10,204	4
Jönköping	2,602	173	167	168	141	135	3,386	1.3
Kalix	215	.	.	.	.	.	215	0.1
Kalmar	2,457	93	106	91	89	90	2,926	1.1
Karlshamn	2,569	264	260	242	249	305	3,889	1.5
Karlskoga	1,759	143	129	124	124	102	2,381	0.9
Karlskrona	1,118	.	.	.	.	.	1,118	0.4
Karlstad	3,938	168	192	193	182	162	4,835	1.9
Karolinska	2,412	128	140	101	93	98	2,972	1.2
Kristianstad	1,297	.	.	.	1	.	1,298	0.5
Kristinehamn	252	.	.	.	.	.	252	0.1
Kullbergska sjukhuset	2,117	228	227	201	153	156	3,082	1.2
Kungsbacka	38	.	.	.	.	.	38	0

(cont.)

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

Hospital	1975-2010	2012	2013	2014	2015	2016	Total	Percent
Kungälv	1,857	142	155	197	215	197	2,763	1.1
Köping	1,605	.	.	.	.	.	1,605	0.6
Landskrona	1,918	.	.	.	.	.	1,918	0.8
Lidköping	1,761	196	200	199	234	224	2,814	1.1
Lindesberg	1,790	199	192	172	162	320	2,835	1.1
Linköping	1,735	.	.	.	.	.	1,735	0.7
Linköping medical center	15	.	.	.	.	.	15	0
Ljungby	1,656	136	81	151	141	150	2,315	0.9
Ludvika	339	.	.	.	.	.	339	0.1
Luleå	2	.	7	4	7	9	29	0
Lund	2,631	51	87	98	82	122	3,071	1.2
Lycksele	689	63	69	93	42	130	1,086	0.4
Löwenströmska*	2,687	432	443	403	431	444	4,840	1.9
Malmö	2,224	13	3	.	.	.	2,240	0.9
Mora	1,893	172	186	150	186	202	2,789	1.1
Motala	3,921	536	519	470	511	552	6,509	2.6
Movement Halmstad	1,260	222	218	250	430	416	2,796	1.1
Mölndal	2,082	206	237	386	404	505	3,820	1.5
Nacka	203	.	.	.	.	.	203	0.1
Nacka-Proxima	518	122	145	111	143	154	1,193	0.5
Norrköping	2,469	146	144	140	129	160	3,188	1.2
Norrtälje	1,215	89	74	85	94	123	1,680	0.7
Nyköping	1,584	124	79	100	101	74	2,062	0.8
OrthoCenter IFK klin.**	811	109	96	108	113	129	1,366	0.5
Ortopediska huset	3,273	375	390	418	460	624	5,540	2.2
Oskarshamn	2,469	263	260	268	276	316	3,852	1.5
Piteå	2,181	321	273	259	245	279	3,558	1.4
S:t,Göran	6,997	347	400	387	424	470	9,025	3.5
Sabbatsberg (Aleris)	1,762	125	125	141	23	.	2,176	0.9
Sahlgrenska	1,543	2	1	4	2	1	1,553	0.6
Sala	115	.	.	.	.	.	115	0
Sandviken	301	.	.	.	.	.	301	0.1
Sergelkliniken	160	.	.	.	.	.	160	0.1
Simrishamn	1,021	.	.	.	.	.	1,021	0.4
Skellefteå	1,370	90	97	107	119	80	1,863	0.7
Skene	1,414	139	135	104	97	131	2,020	0.8
Skövde	2,786	206	145	115	120	114	3,486	1.4
Sollefteå	1,305	103	97	89	93	102	1,789	0.7
Sophiahemmet	1,465	112	121	98	138	126	2,060	0.8
Spenshult	789	331	330	155	.	.	1,605	0.6
Sunderby	395	3	.	.	.	.	398	0.2
Sundsvall	2,820	123	114	95	44	12	3,208	1.3
Säffle	484	.	.	.	.	.	484	0.2
Söderhamn	279	.	.	.	.	.	279	0.1
Södersjukhuset	4,664	285	270	317	281	320	6,137	2.4
Södertälje	1,388	87	88	110	113	163	1,949	0.8
Torsby	1,520	121	131	114	130	108	2,124	0.8
Trelleborg	5,746	673	707	759	791	823	9,499	3.7
Uddevalla	3,551	166	229	207	187	243	4,583	1.8
Umeå	2,768	161	155	102	147	111	3,444	1.3
Varberg	2,741	206	173	149	127	185	3,581	1.4
Visby	1,398	93	88	70	60	76	1,785	0.7
Vänersborg-NÄL	939	.	.	.	.	.	939	0.4
Värnamo	1,942	137	142	163	148	142	2,674	1.0
Västervik	1,844	114	113	94	90	99	2,354	0.9
Västerås	2,750	309	256	246	177	217	3,955	1.5
Växjö	2,128	141	98	109	115	101	2,692	1.1
Ystad	1,169	.	.	.	.	.	1,169	0.5
Ängelholm	2,091	172	201	233	221	338	3,256	1.3
Örebro	3,290	72	51	54	30	47	3,544	1.4
Örnsköldsvik	1,994	102	112	88	115	143	2,554	1.0
Östersund	2,134	182	164	106	120	141	2,847	1.1
Östra sjukhuset	2,100	.	.	.	.	.	2,100	0.8
Total	**188,305**	**13,411**	**13,359**	**13,144**	**12,924**	**14,044**	**255,187**	**100**

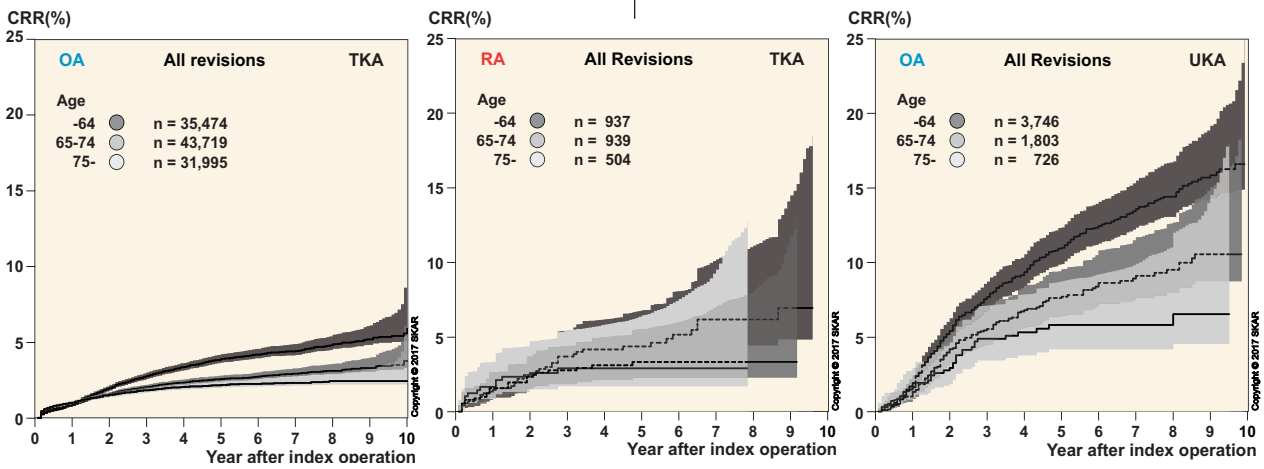
* Lövenströmska was taken over by Stockholms Specialistvård in 2001 and OrthoCenter Stockholm in 2008.

** 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 20) making statistical differences more difficult to detect.

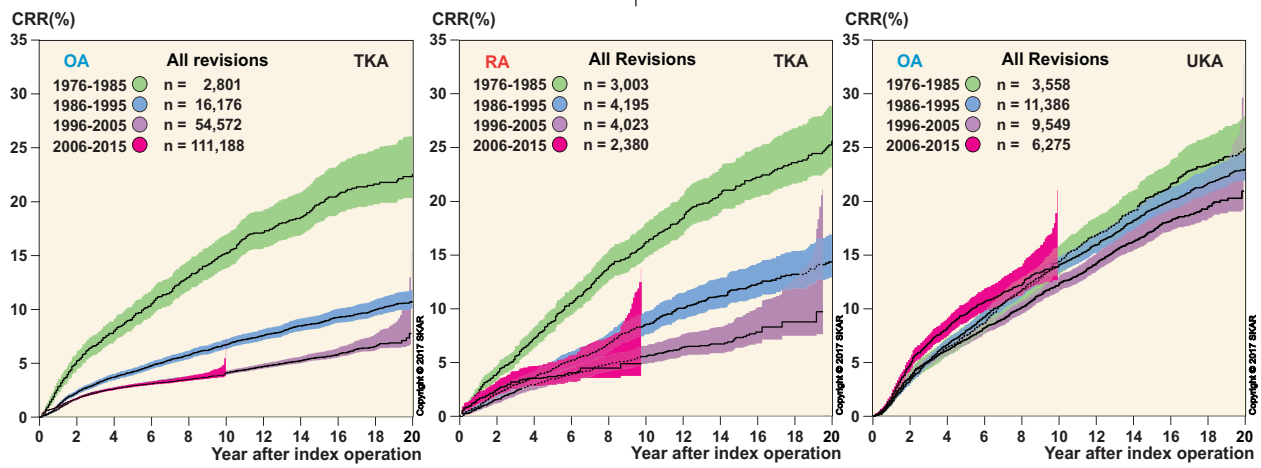
Age – The effect of age at primary surgery can be illustrated by dividing patients into separate age groups. This shows for both TKA and UKA that that the risk is higher for the younger groups (see figures below). Possible explanations are that the younger have higher physical activity, higher expectancy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



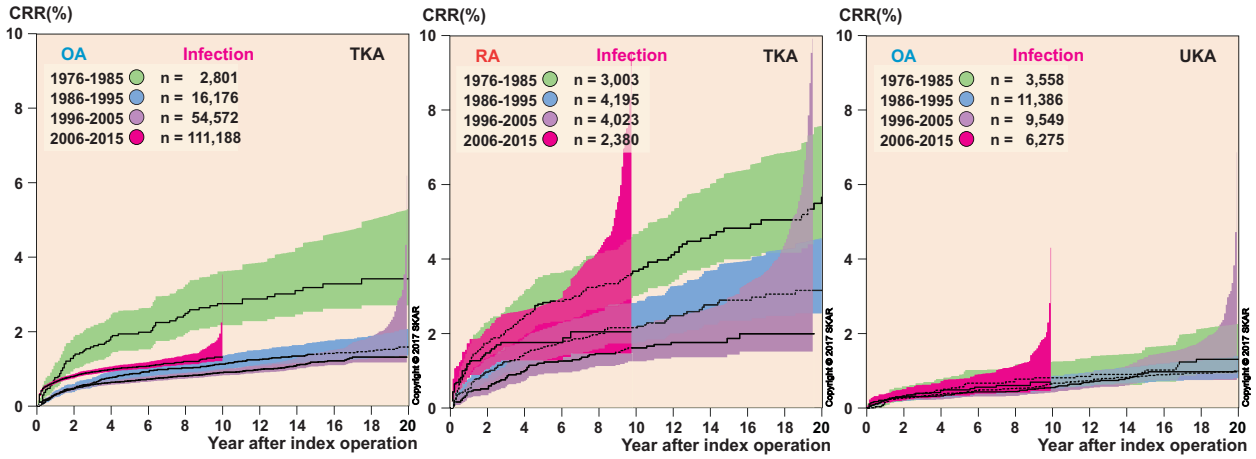
The CRR (2006–2015) for the 3 age groups (<65, 65–75, >75) shows an increase in revision rate with younger age. In TKA/OA those younger than 65 have 1.7 times the risk of those over 75 and 2.2 times higher risk in UKA/OA. The difference in TKA/RA is not significant.

Year of operation – For TKA we see a large reduction in risk for revision during the first 3 decennia that is not as obvious for UKA (figures below). However, since 2006 we have observed an increase in early revisions for TKA that mainly has been caused by an increase in early revisions for manifest or suspected infection (see next page).

For UKA, the CRR increased during 2006-2015 mainly because of a relatively higher proportion of younger patients with higher risk. However, using Cox regression with adjustment for sex and age, we found no significant difference between the two last 10-year periods (all revisions) for any of the groups (TKA/OA, TKA/RA and UKA/OA).



CRR for surgeries performed during 4 different 10-year periods. One finds for TKA, that the risk for the 2 latest is considerably lower than for the 2 first. In TKA early revision increased during the latest period because of increased number of revisions for early revisions for infection. For UKA/OA the reduction of risk with time is not as obvious as for TKA and the risk increased in the latest period which is mainly explained by a higher proportion of younger patients.



Comparing the CRR, using only revision for infection as end-point, we find an improvement with time for both TKA and UKA. However, in TKA (OA & RA) the risk has invreased in 2006-2015 as compared to the period 1996-2005.

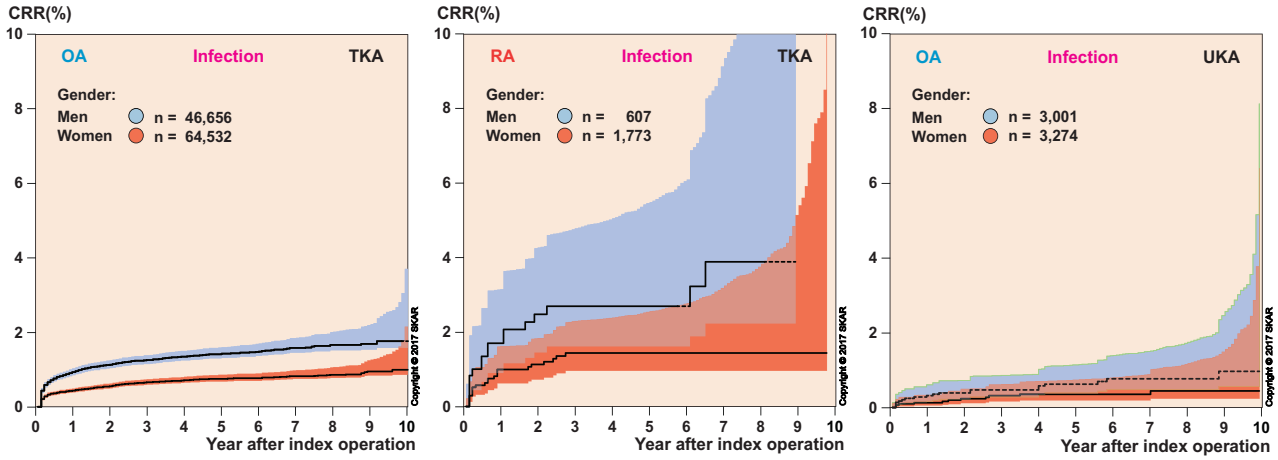
When the Knee Register estimates the risk of revision due to infection, it counts the first revision due to infection in the affected knee. It does not matter if it is the primary or any subsequent revision. Over time we have seen a reduction in this risk both for OA and RA. However, for the period 2006-2015 we see a significant increase in the risk of revisions. The increase is mainly due to early liner exchanges performed for infections or suspected infections.

The reason for this may be that surgeons have become more proactive in suspected early infections; among other things because of the PRISS project (Prosthetic Related Infections Shall be Stopped) in which all the hospitals have participated.

TKA have significantly higher risk of infection than UKA (RR 2.1) and patients with RA have a higher risk than those with OA (RR 2.0). This is independent of if changes of inlays due to infection are considered being revisions or not.

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. Until last year, we could not find any significant difference in the overall 10-year CRR between the genders. However, due to increase in revisions for infection we again this year find that TKA/OA has a higher overall 10-year risk (RR 1.1) and a still higher risk (RR 2.0) when the end-point is only revision for infection (figures below).

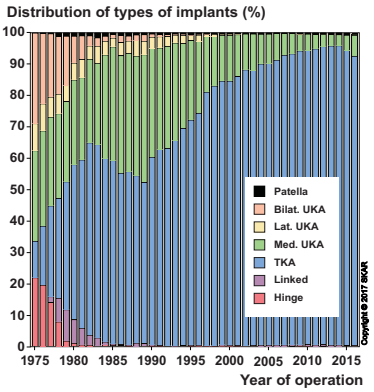
While it is well known that RA patients have a higher risk of infection, being ascribed to the effect of corticosteroid and immunosuppressive medications, it is not obvious why men, more often have their knee arthroplasties revised for infection.



Using the end-point; revision for infection, the CRR (2006–2015) we find men having a higher risk than women (TKA/OA: RR 1.9 and TKA/RA: RR 2.2). In UKA, which has a lower risk of infection than TKA, men also have a tendency of higher risk than women although the difference is not significant for the current period. In TKA, patients with RA are more affected than those with OA (RR 2.0).

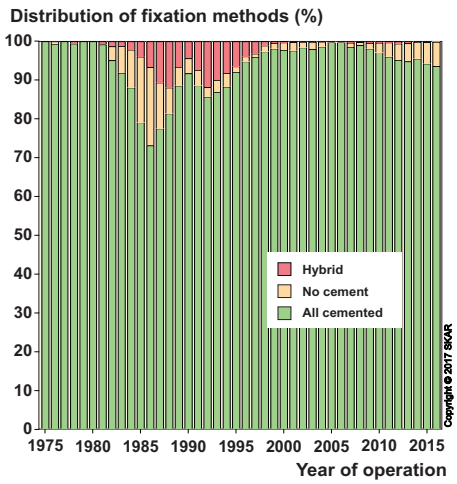
Type of implant – The modern condylar tricompartmental knee implant (TKA) was developed in the seventies when hinged and unicondylar implants were already available. When the register started in 1975, TKA had just been introduced in Sweden, why hinges and UKA's were used for the majority of the primary 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 26). However, it has to be kept in mind that in an UKA, only one compartment in the knee is resurfaced. Thus, besides that the unresurfaced compartments of the knee may be affected by disease this implies that it can be tempting to offer a revision of an UKA to a TKA in patients with knee pain of unclear reason. An advantage of the UKA is that the risk of revision for infection is considerably lower than for TKA (RR 0.5) as well as the need for revision with stabilized implants, arthrodesis or amputation (see page 41)

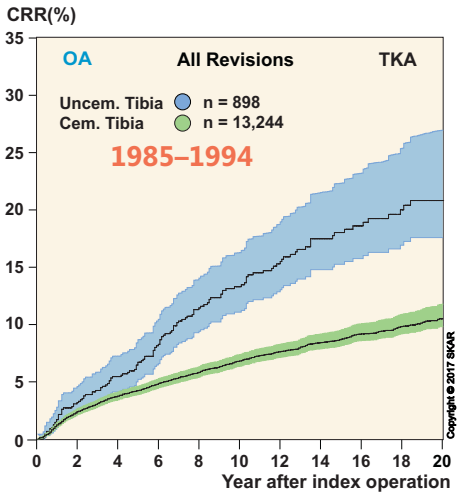


The relative yearly distribution of implant types used for primary surgery.

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 2015, 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.

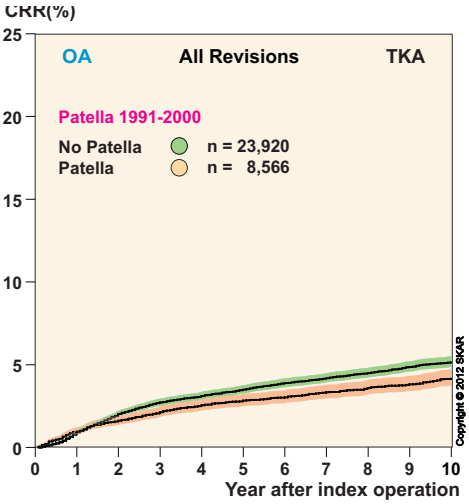


The relative yearly distribution regarding the use of cement for fixation.

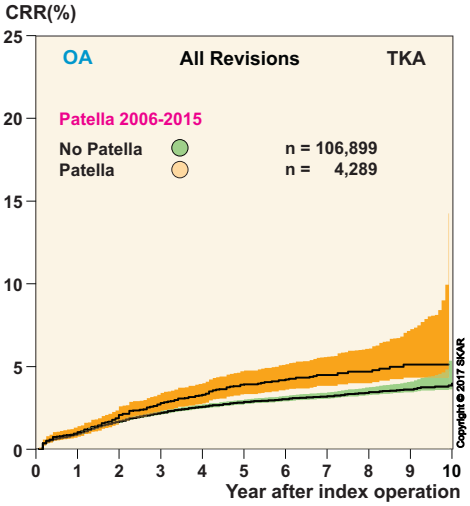


The CRR for TKA inserted 1985-1994 in which the tibial component was fixed with or without cement.
(note that in the 2015 report the y-scale was wrong (went to 25))

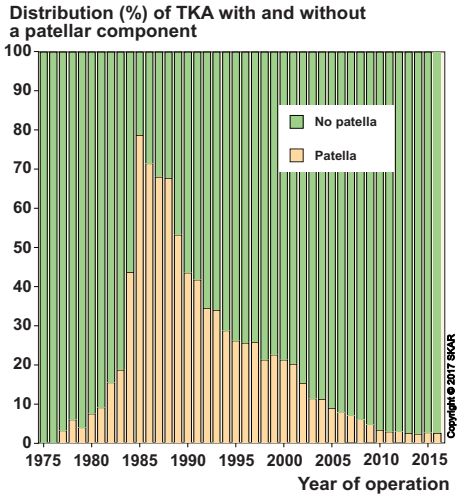
Patellar button in TKA – Estimating how the use of a patellar button affects the revision rate is complex. The use of a patellar button varies with the brand of prosthesis used and its use also has lessened in recent years. During the eighties, when patellar button was used in a good half of the cases, its use had a negative effect. Since then its use has diminished so that it was only used in 2.4% if the TKA cases in 2016 (see figure right). In our 2002 annual report (for the period 1991-2000) we for the first time observed 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, 2006-2015 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 2006-2015 (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 1.2-1.6)).

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 50-53), 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 58-61), 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-2016.pdf) reports that a patellar button was used in 83% of TKA cases (2015) 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 2016 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 61% in 2015. They also reported for TKA's inserted during the last 15 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 2016

Types of primary arthroplasties

	Number	Percent
Linked	49	0.4
TKA	12,950	92.2
UKA Medial	942	6.7
UKA Lateral	42	0.3
Fem-Pat	52	0.4
Partiell (PRKA)	9	0.1
Total	14,044	100

In primary knee arthroplasty the TKA is the standard treatment accounting for 92% of the surgeries (table above). In 1989 UKAs accounted for 44% of the knee arthroplasties, diminishing to 3.5% in 2014. In 2016 it was used in 7% of the cases. Use of femoro-patellar and partial (PRKA) implants increased a little, but the extent of their use is limited.

72 hospitals performing elective knee arthroplasties reported to the registry during 2016 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, 14,044 primaries had been reported for 2016 which is 9% more than at the same time in 2015 (12,886).

Primary TKA implants

	Number	Percent
NexGen MBT	6,330	48.9
PFC-MBT	2,622	20.3
Triathlon	1,530	11.8
PFC-APT	1,046	8.1
Legion/Genesis II	338	2.6
Vanguard	319	2.5
Genesis II	304	2.4
NexGen TM	176	1.4
Journey	24	0.2
PFC-RP	10	0.1
Persona	9	0.1
Attune	1	0.0
Other*	241	1.9
Total	12,950	100

*Mainly revision models (see separate table) except 13 knee for which part numbers are missing

As compared to last year, the number of TKA increased by 7%. As last year, 3 TKA brands dominate. NexGen from Zimmer was used in half of the primaries, PFC from DePuy in 28% and Triathlon from Stryker in 12%. The use of Legion/GenesisII (Legion femur and Genesis tibia) and GenesisII (femur and tibia) from Smith & Nephew increased while Vanguard from Biomet decreased sharply. The group "Others" mainly stands for revision models (see table right).

After having diminished for many years the use of UKA has increased sharply since 2014 and now accounts for 7% of the primary knee arthroplasties. Oxford accounts for two thirds of the UKA surgeries while the use of LIN has decreased to 12%. For the first time, more ZUK than Link were used.

Primary UKA implants

	Number	Percent
Oxford	648	65.9
ZUK	132	13.4
Link	120	12.2
Triathlon PKR	48	4.9
Sigma PKR	27	2.7
Ibalanc	5	0.5
Genesis	3	0.3
Missing	1	0.1
Total	984	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, 49 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

	Antal	Procent
PFC Revision	81	36.5
NexGen Revision	72	32.4
Triathlon Revision	52	23.4
Legion/Genesis Revision	12	5.4
Vanguard Revision	5	2.3
Total	222	100

49 linked prostheses not included (22 NexGen RHK, 15 RotaLink and 12 other)

919 revisions were reported in 2016 of which 232 were secondary (not the first revision). In 719 cases the primary was a TKA, in 184 it was an UKA, in 8 a linked implant in 7 cases a Femoro-Patellar implant and one case a PRKA.

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. Because 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 2015.

The most common implants in the counties in 2016

TKA in the counties

	Model 1	n	Model 2	n	Model 3	n	Other
01 Stockholm	NexGen	1,314	PFC Sigma	1,047	Triathlon	160	84
03 Uppsala	PFC Sigma	346	NexGen	85	Other	3	
04 Södermanland	PFC Sigma	207	NexGen	61	Other	5	3
05 Östergötland	NexGen	263	Leg/Genesis II	153	Triathlon	9	12
06 Jönköping	NexGen	488	Other	6	Vanguard	1	
07 Kronoberg	PFC Sigma	88	Vanguard	88	Other	20	1
08 Kalmar	NexGen	492	Other	6			
09 Gotland	PFC Sigma	75	Other	1			
10 Blekinge	NexGen	279	Other	1			
12 Skåne	Triathlon	1,344	PFC Sigma	269	NexGen	259	83
13 Halland	NexGen	733	Other	5			
14 Västra Götaland	NexGen	994	PFC Sigma	635	Vanguard	197	47
17 Värmland	NexGen	441	Other	1			
18 Örebro	GenesisII	304	NexGen	129	Journey	6	3
19 Västmanland	NexGen	196	Other	10			
20 Dalarna	NexGen	259	PFC Sigma	202	Other	8	
21 Gävleborg	PFC Sigma	486	NexGen	17			
22 Västernorrland	NexGen	248	Other	1			
23 Jämtland	NexGen	129	Triathlon	8	Other	1	
24 Västerbotten	Leg/Genesis II	185	NexGen	119	Other	8	
25 Norrbotten	PFC Sigma	313	Triathlon	9	Other	3	

The table above shows that only 14 of 21 counties reported having used more than one ordinary TKA model (revision models not counted) and that only a 3 counties used 3 models to a greater extent.
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	131	ZUK	46	Triathlon	30	41
03 Uppsala	Oxford	7					
04 Södermanland	Oxford	7	Link	2			
05 Östergötland	Oxford	257	Sigma	2			
06 Jönköping	Oxford	17	Link	4	ZUK	4	
07 Kronoberg	Oxford	49					
08 Kalmar	Link	5					
09 Gotland							
10 Blekinge	Oxford	22					
12 Skåne	Oxford	30	Link	27	Triathlon	10	
13 Halland	ZUK	47	Oxford	17			
14 Västra Götaland	Oxford	86	ZUK	20			
17 Värmland	Oxford	16					
18 Örebro	ZUK	11	Link	9	Oxford	2	
19 Västmanland	Triathlon	8	Genesis	3			
20 Dalarna	ZUK	1					
21 Gävleborg	Link	47					
22 Västernorrland	Oxford	7					
23 Jämtland	ZUK	2					
24 Västerbotten	Link	1	ZUK	1			
25 Norrbotten	Sigma	15					

In 2016, five counties reported more than 50 UKA's (Stockholm, Östergötland, Skåne, Halland and Västra Götaland). Three counties reported between 25 and 50 UKA's, while the remaining twelve reported from 1 to 24 procedures. Gotland did not report any UKA procedures.

Bone cement and minimally invasive surgery in 2016

Use of cement in primary surgery

	Primary TKA	Primary UKA
No component without cement	12,093	448
Only the femoral component without cement	3	42
Only the tibial component without cement	18	5
The femur- and tibial components without cement	807	488
Unknown	29	1
Total	12,950	984

	Primary TKA		Primary UKA	
	Number	Percent	Number	Percent
Refobacin (gentamicin)	7,165	59.0	284	57.3
Palacos R+G (gentamicin)	4,658	38.4	186	37.5
Smartset GHV (gentamicin)	275	2.3	18	3.6
Optipac Refobacin Revision (genta+clinda)	11	0.1	6	1.2
Copal (genta+vanco)	6	0.0		0.0
Copal (genta+clinda)	3	0.0		0.0
CMW med gentamicin	1	0.0	1	0.2
Uppgift saknas	24	0.2	1	0.2
Subtotals	12,143	100	496	100
Alla protesdelar cementfria	807		488	
Total	12,950		984	

NB The units are encouraged to use the stickers that comes with the cement packages

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 9.2% of the TKA's in 2016 while 0.5% were hybrids. In UKA the Oxford cementless version has become common and it was used cementless in 50% of the UKA's and as hybrid in 5%.
Practically all the cement that was used for the primary knee arthroplasties contained gentamicin.

Previously when the brand name for the cement was handwritten on the form it became difficult to discern the brands because the name Palacos had almost become generic for any cement including antibiotics. However, since 2007, almost all the hospitals have used stickers allowing for identification of the cement brands.

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 miniarthrotomy since 1999. Our definition of MIS implies that the surgeon gains access to the knee joint by the use of a small arthrotomy (no specific length) without dislocating / everting the patella.

From the start of the registration in 1999, 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 645 primary UKA

	Standard incision	Mini-incision	Missing
Oxford	200	443	5
ZUK	114	18	
Link	113	7	
Triathlon PKR	30	18	
Sigma PKR	27		
Genesis	3		
Ibalance		5	
Other		1	
Total	487	492	5

In 2016, 51% of the UKA were inserted using MIS. Initially MIS seemed to be associated with a higher revision rate that may have been caused by the learning curve when beginning to use a new method. However, with the present 15-year follow-up, we cannot find that miniarthrotomy negatively affects the overall revision rate.

The use of patella button for TKA in 2016

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 2016 a button was most commonly used in the counties of Gävlsborg and Västerbotten but not at all in Uppsala, Jönköping, 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 2016, a button was most often used in primary arthroplasty together with the PFC APT, NexGen TM and Legion/GenesisII.

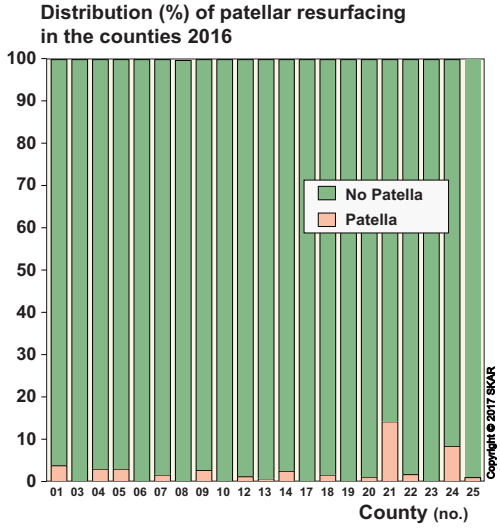
In Sweden, females have their patella resurfaced slightly more often than males whcih some have explained by femoropatellar pain being more common in women. In the whole material, from 1975 to the end of 2016,12.9% of the women had their patella resurfaced compared to 9.6% of the men, which is a significant difference. It has been attempted to explain this difference by femoropatellar pain being more common in women. In 2016 1.4% 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

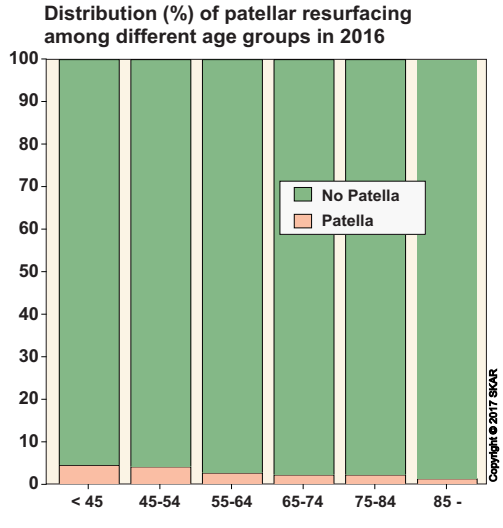
	No patella button	%	Patella button	%
NexGen MBT	6,240	98.6	90	1.4
NexGen TM	165	93.8	11	6.3
PFC-MBT	2,537	96.8	85	3.2
PFC-APT	971	92.9	74	7.1
Triathlon	1,513	98.9	17	1.1
Legion/GenII	317	93.8	21	6.2
Vanguard	319	100.0	0	0.0
Genesis II	300	98.7	4	1.3
Journey	23	95.8	1	4.2
PFC-RP	10	100.0	0	0.0
Persona	9	100.0	0	0.0
Attune	1	100.0	0	0.0
Others	232	95.9	10	4.2
Total	12,637	97.6	313	2.4

Looking at the relative use of patella button among the different age groups (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 29 where curves can be found showing the CRR during the current period of 2006-2015, 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 22 and a list on page 38).



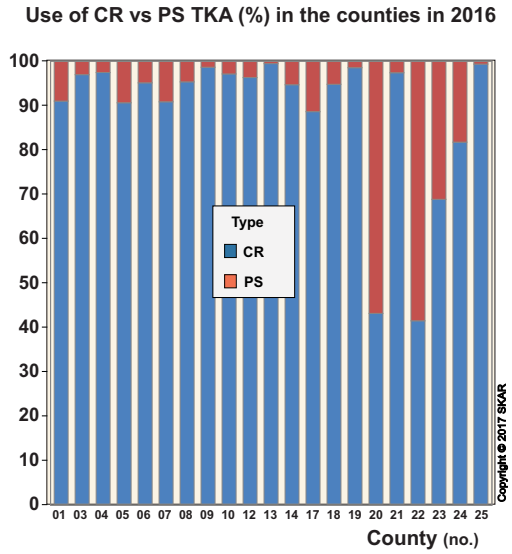
The figure shows the relative proportion of TKA with and without patella button in the different age-groups.

Posterior stabilized prostheses during 2016

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.

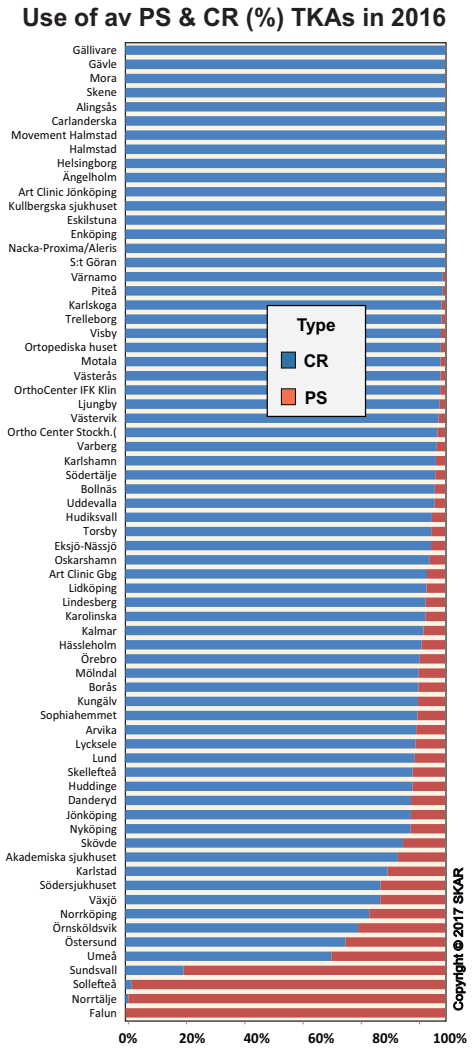


The figure shows the relative use of CR and PS implants in the different counties.

As can be seen from the figure above, the counties are different with respect to their use of PS implants. During 2016, PS implants were most commonly used in 4 counties; Dalarna, Västernorrland, Jämtland and Västerbotten (a list and a chart for the counties can be found on page 22 and a list on page 38).

During 2016 almost 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, 88% 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 similar with the exemption that PS was more common in the youngest group. However, the number of surgeries in that group was small.

As can be seen from the table below, the use of PS implants is most common in the group of "other" implants but the group consists mainly of stemmed and revisions models (see page 40). Among the "ordinary" TKAs, the use of PS is most frequent among the users of NexGen implants.

The relative proportion of CR and PS implants among the brands used for primary TKA in 2016

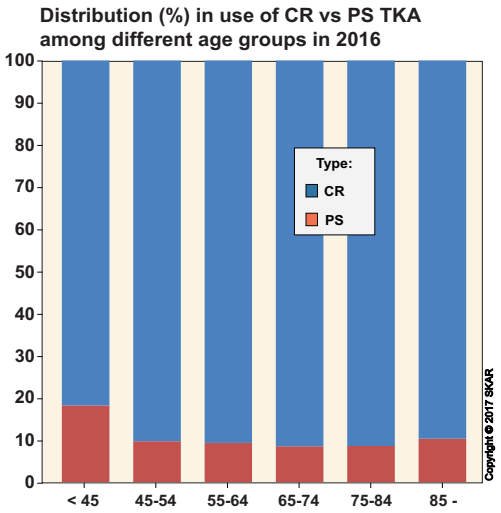
	CR	%	PS	%
NexGen MBT	5,581	88.2	749	11.8
PFC-MBT	2,542	96.9	80	3.1
Triathlon	1,527	99.8	3	0.2
PFC-APT	1,045	100.0	0	0.0
Legion/GenII	300	88.8	38	11.2
Vanguard	318	99.7	1	0.3
Genesis II	292	96.1	12	3.9
NexGen TM	82	46.6	94	53.4
Journey	0	0.0	24	100.0
PFC-RP	4	40.0	6	60.0
Persona	9	100.0	0	0.0
Attune	1	100.0	0	0.0
Others	102	41.9	140	58.1
Total	11,803	91.1	1,147	8.9

Unfortunately it is not straightforward to compare the results of the two types. The reason is that because of their greater stability, many surgeons reserve the use of PS knees for cases having insufficient ligaments 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).

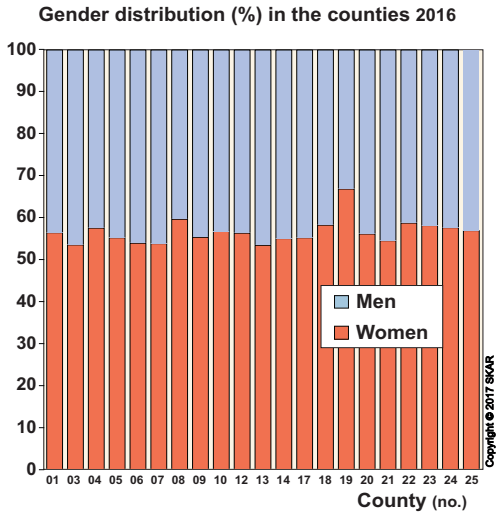
It is probably necessary to perform a randomized trial in order to estimate the differences in survival between the types.



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

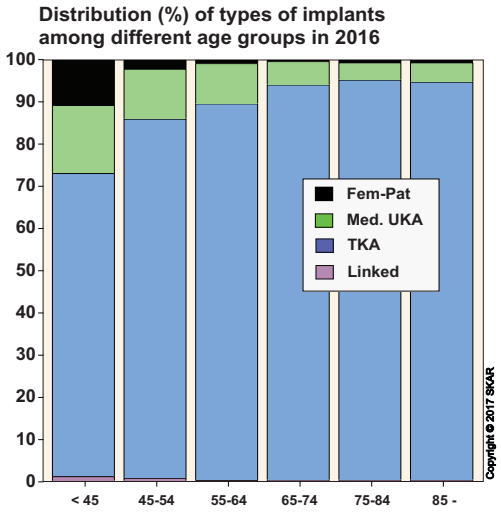
Please note that tibia components that in order to increase stability use an anterior lip or an extra concave polyethylene (deep dish) are not considered being PS implants. Some can be used both with an intact cruciate ligament as well as when the cruciate is insufficient or absent. However, there are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



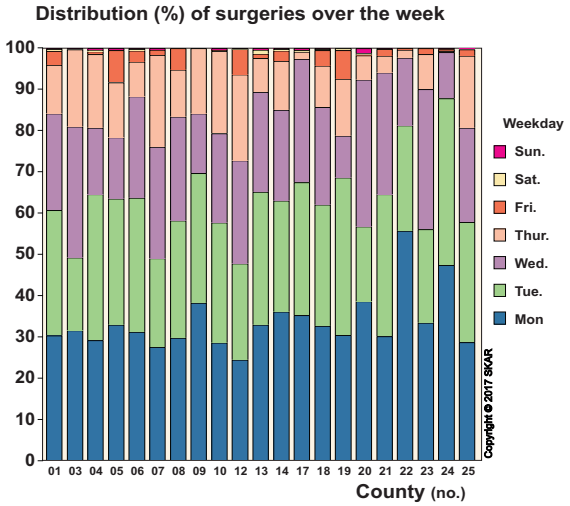
The proportion of females having surgery in the different counties was similar, varying between 52% and 67% .

Type of implants in different age groups

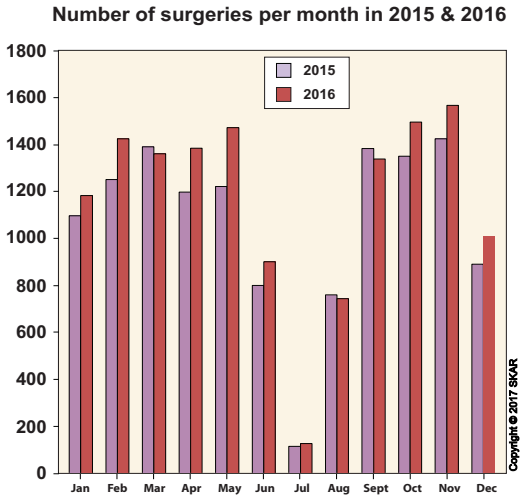


Uncommon models are most often used in younger patients. The use of linked implant in primaries is limited, but these are mainly used for serious conditions (tumors. trauma etc.)

Distribution of surgery on the weekdays and months



Distribution of surgery on the weekdays during 2015. Surgery on Fridays and weekends is uncommon.



The mean number of primary knee arthroplasties inserted each month during 2014 and 2015.

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

All the counties perform at least 93% of their surgeries Monday to Thursday. Skåne is the county that most frequently operates on Fridays.

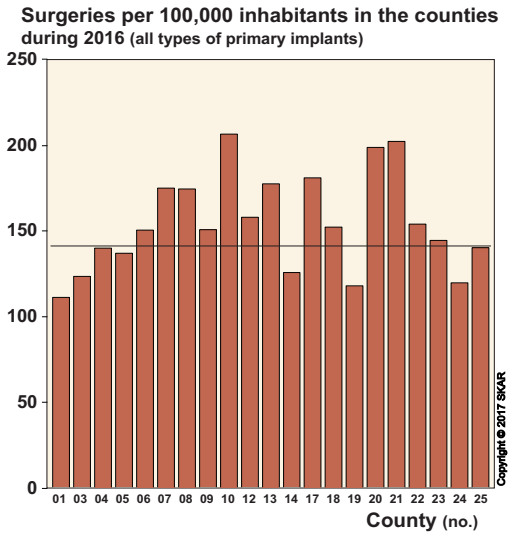
The figure above shows the number of surgeries during the different months of 2015 and 2016. It is evident how the production drops during the summer as around Christmas.

Age distribution and incidence in the counties 2016

County, number of inhabitants and incidence in 2016

Nr	County	No. of inhabitants	no. of primaries	Incidence/ 100.000
01	Stockholm	2,250,250	2 509	111.5
03	Uppsala	357,769	443	123.8
04	Södermanland	285,905	401	140.3
05	Östergötland	448,883	616	137.2
06	Jönköping	350,286	526	150.2
07	Kronoberg	192,999	338	175.1
08	Kalmar	239,990	419	174.6
09	Gotland	57,697	87	150.8
10	Blekinge	157,353	325	206.5
12	Skåne	1,314,096	2 082	158.4
13	Halland	317,559	562	177.0
14	Västra Götaland	1,660,233	2 093	126.1
17	Värmland	277,619	504	181.5
18	Örebro	292,977	446	152.2
19	Västmanland	265,953	315	118.4
20	Dalarna	282,780	563	199.1
21	Gävleborg	283,201	573	202.3
22	Västernorrland	244,735	380	155.3
23	Jämtland	128,025	185	144.5
24	Västerbotten	264,630	318	120.2
25	Norrbotten	250,152	359	143.5
Country		**9,923,085**	**14,044**	**141.5**

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

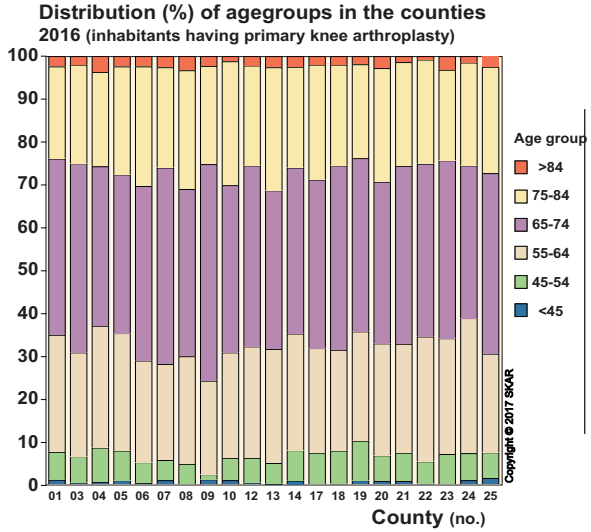


Incidence (no. of arthroplasties per 100.000 inhabitants)

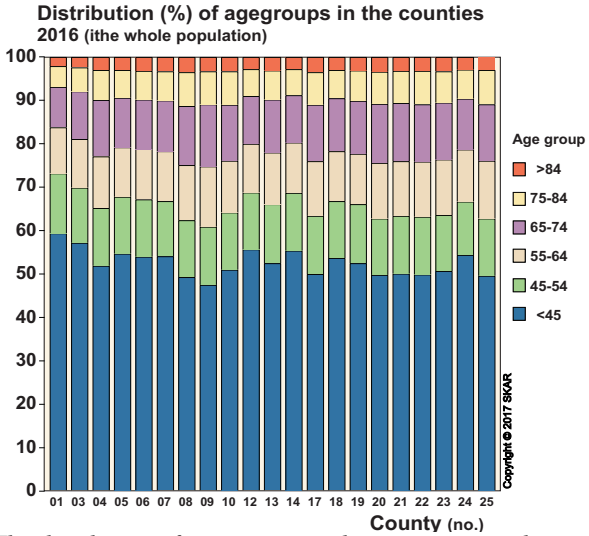
The table and figure above show the number of primary knee arthroplasties per 100.000 inhabitants in each county in 2016. The calculations are based on the domicile of patients at surgery. The incidence (not age-standardized) is highest in Blekinge county and lowest in the county of Stockholm.

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. Kalmar and Halland 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 Kalmar has the highest proportion of those 65 years and older (25%). When the 2 figures are compared it does not seem that the age distribution in the counties consistently decides to how many in each age group are provided with a knee arthroplasty.



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 2016

Distribution (%) of age groups in the counties in 2016 (whole population)

Age group:	0-44	45-54	55-64	65-74	75-84	85-
Stockholm	59.3	13.8	10.6	9.3	4.7	2.2
Uppsala	57.1	12.8	11.2	11.1	5.5	2.5
Sörmland	51.8	13.3	12.0	13.0	6.9	3.0
Östergötland	54.6	13.0	11.4	11.5	6.4	3.0
Jönköping	53.9	13.3	11.6	11.4	6.6	3.2
Kronoberg	54.0	12.8	11.5	11.7	6.7	3.4
Kalmar	49.2	13.1	12.7	13.6	7.9	3.5
Gotland	47.4	13.5	13.9	14.3	7.7	3.3
Blekinge	50.9	13.3	11.9	12.9	7.7	3.4
Skåne	55.6	13.2	11.2	11.0	6.1	2.9
Halland	52.4	13.7	11.9	12.1	6.8	3.1
Västra Götaland	55.4	13.3	11.6	10.9	6.1	2.8
Värmland	49.9	13.4	12.7	13.0	7.6	3.5
Örebro	53.6	13.1	11.6	12.2	6.6	3.0
Västmanland	52.4	13.6	11.7	12.2	7.0	3.2
Dalarna	49.7	13.0	12.9	13.6	7.5	3.4
Gävleborg	50.0	13.4	12.6	13.4	7.4	3.2
Västernorrland	49.8	13.3	12.7	13.3	7.7	3.2
Jämtland	50.6	12.9	12.8	13.1	7.1	3.4
Västerbotten	54.3	12.3	12.0	11.7	6.8	2.9
Norrbotten	49.5	13.3	13.3	13.0	7.9	3.0
Country	54.8	13.3	11.5	11.3	6.2	2.8
ESP (Europeisk 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 112.1 in Västmanland and highest 184.9 in Blekinge county.

In 2015 Uppsala had 50% higher incidence than Stockholm but has now roughly the same incidene. This because the number of surgeries in inhabitants of Uppsala decreased by 22% while it increased 21% for the inhabitants of Stockholm.

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

Age standardized incidence in the counties
(primaries per 100.000 inhabitants in 2015)

Nr	County	Incidence
1	Stockholm	131.9
3	Uppsala	130.7
4	Södermanland	129.8
5	Östergötland	137.1
6	Jönköping	147.1
7	Kronoberg	168.7
8	Kalmar	169.3
9	Gotland	121.3
10	Blekinge	184.9
12	Skåne	162.2
13	Halland	167.5
14	Västra Götaland	129.3
17	Värmland	176.5
18	Örebro	146.1
19	Västmanland	112.1
20	Dalarna	173.3
21	Gävleborg	177.6
22	Västernorrland	135.8
23	Jämtland	143.9
24	Västerbotten	117.0
25	Norrbotten	123.7
	Country	142.3

Implants for primary arthroplasty 2006–2015

In the tables below, the implants used during the investigated period 2006-2015 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. Vanguard which has replaced the AGC that no longer is used was in the third place followed by Triathlon the successor to Duracon.

Implants for primary TKA

	Number	Percent
NexGen	48,200	41.5
PFC Sigma	31,197	26.9
Vanguard	10,559	9.1
Triathlon	9,487	8.2
AGC	5,889	5.1
Duracon	3,121	2.7
Profix	1,832	1.6
Free-Sam MIII	1,707	1.5
PFC-RP	1,022	0.9
Genesis II	713	0.6
Natural	232	0.2
Legion/Genesis II	216	0.2
Journey TKA	84	0.1
Link Gemini	68	0.1
Kinemax	60	0.1
Attune	26	0.0
Missing	88	0.1
Other*	1,649	1.4
Total	116,150	100

* For revision models. see table right.

Among the UKA's, 2 models account for the majority of surgeries. Of the ten models listed below, seven were used in 2016.

Implants for primary UKA

	Number	Percent
Oxford	2,657	41.1
Link	1,789	27.7
ZUK	731	11.3
MillerGalante	573	8.9
Genesis	367	5.7
Triathlon PKR	171	2.7
Preservation	93	1.4
Sigma PKR	71	1.1
Ibalance	5	0.1
EIUS	2	0.0
Missing	4	0.1
Total	6,463	100

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

Revision Models* for primary TKA

	Number	Percent
NexGen Rev	478	29.2
Triathlon Rev	383	23.4
PFC Rev	378	23.1
Vanguard Rev	125	7.6
Duracon Rev	87	5.3
AGC Rev	81	4.9
Profix Rev	71	4.3
Legion/Genesis II Rev	36	2.2
Total	1,639	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
Link RHK	226	38.0
Nexgen RHK	186	31.3
MUTARS Tumor impant	55	9.3
S-ROM Noiles RHK	44	7.4
Stryker/Howmedica RHK	30	5.1
METS	29	4.9
Stanmore	7	1.2
Biomet RHK	6	1.0
Missing	3	0.5
Other	8	1.3
Total	594	100

Femoro-patellar implants are uncommon. Only 380 cases using 8 different brands were reported during the 10 year period.

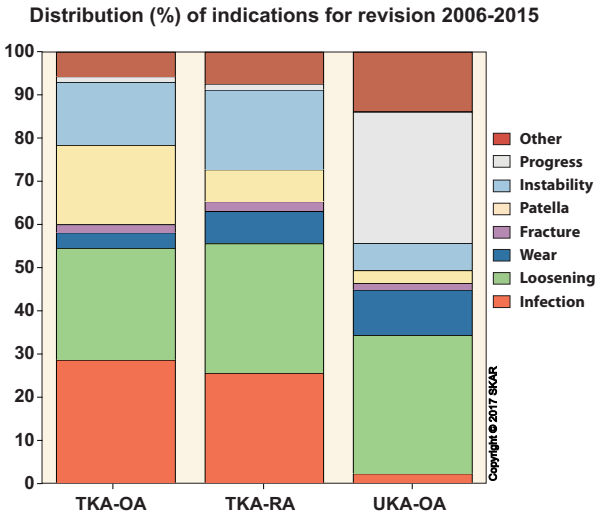
Femoro-Patellar implants

	Number	Percent
Zimmer P-F	235	61.8
Avon P-F	53	13.9
PFC P-F	51	13.4
Link P-F	19	5.0
Journey P-F	7	1.8
Vanguard P-F	6	1.6
Richard/Blazina	3	0.8
LCS P-F	3	0.8
Missing	3	0.8
Total	380	100

Revisions during 2006–2015

During the 10-year period, 6,311 first time revisions were performed. 4,050 were revisions of TKAs for OA, 217 of TKAs for RA and 1,598 were revisions of UKAs for OA. The reasons for the revisions are shown in the diagram 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 2006-2015. There are separate tables depending on if the primary surgery



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

For TKA the proportion of revisions in which the poly is exchanged has increased as compared to previously (25% in OA and 23% 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)	394	9.7
TKA	1,098	27.1
Exchange of femur comp.	46	1.1
Exchange of tibia comp.	274	6.8
Exchange of disc/inlay	1,004	24.8
Patella addition	748	18.5
Patella removal	10	0.2
Patella exchange	37	0.9
Total implant removal	389	9.6
Arthrodesis	11	0.3
Amputation	29	0.7
Other	3	0.1
Missing	6	0.1
Total	4,049	100

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

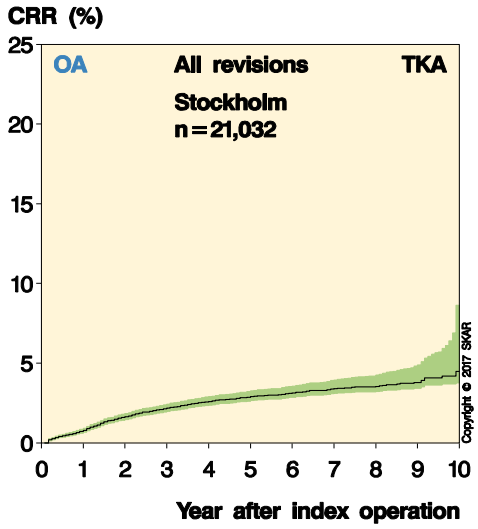
	Number	Percent
Linked (rot. hinge)	35	2.2
TKA	1,457	91.2
UKA	4	0.3
Exchange of femur comp.	6	0.4
Exchange of tibia comp.	7	0.4
Exchange/reposition of poly	65	4.1
Patella addition	3	0.2
Total implant removal	17	1.1
Amputation	3	0.2
Totalt	1,597	100

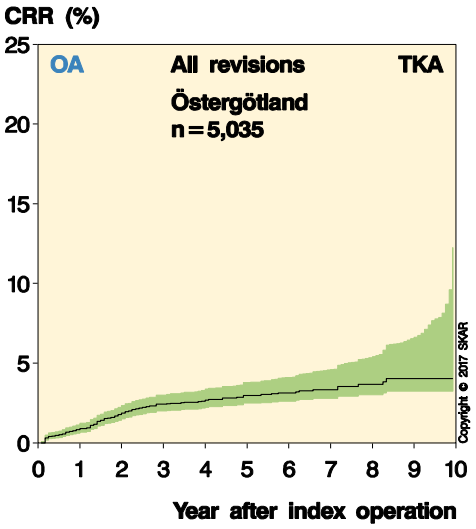
Type of revision in which the primary was a TKA/RA

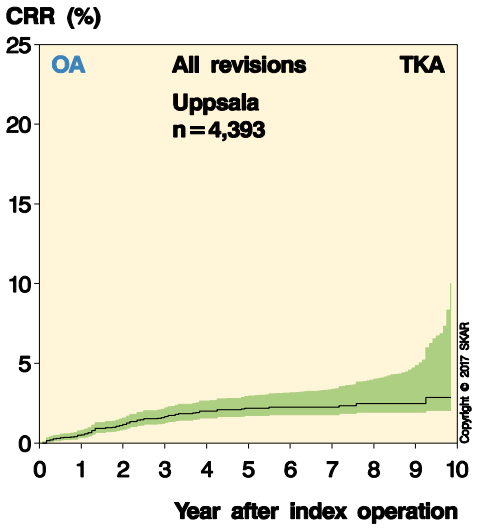
	Number	Percent
Linked (rot. hinge)	43	19.9
TKA	65	30.1
Exchange of femur comp.	5	2.3
Exchange of tibia comp.	6	2.8
Exchange of disc/inlay	50	23.1
Patella addition	18	8.3
Total implant removal	25	11.6
Arthrodesis	1	0.5
Amputation	3	1.4
Total	216	100

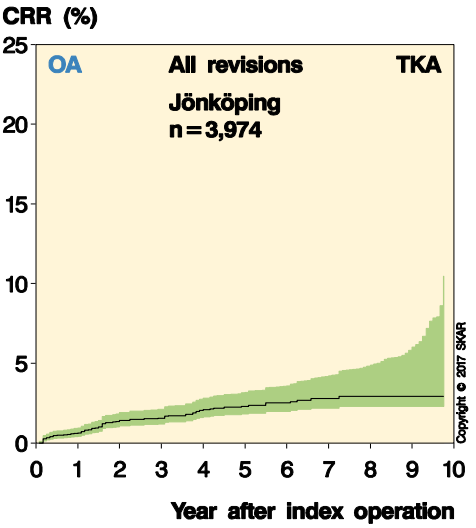
When evaluating the survival curves it should be noted that as the part of the curve to the right contains implants with long follow-up it also to a larger extent reflects older models.

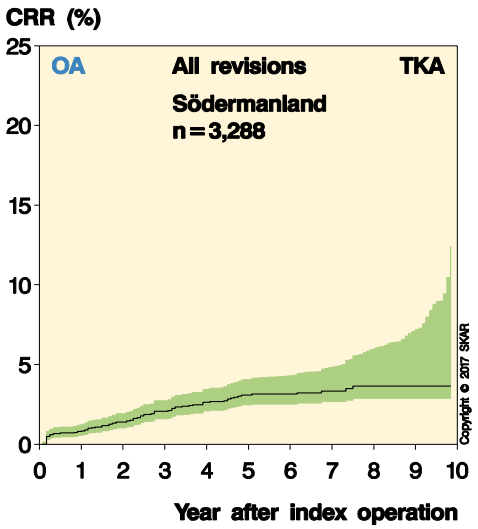
CRR in the counties after primary TKA for OA 2006–2015

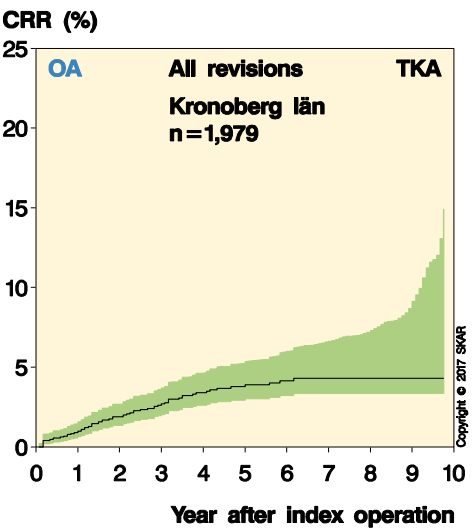




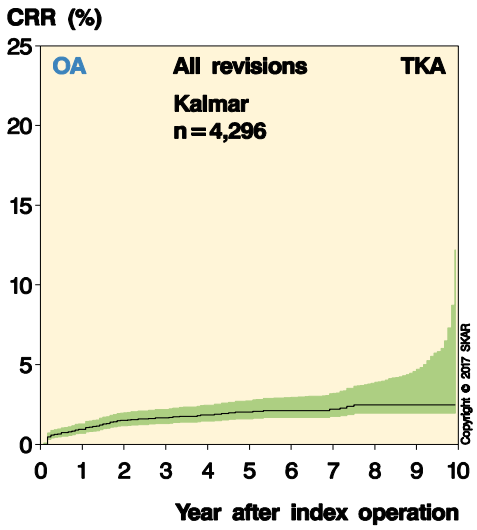


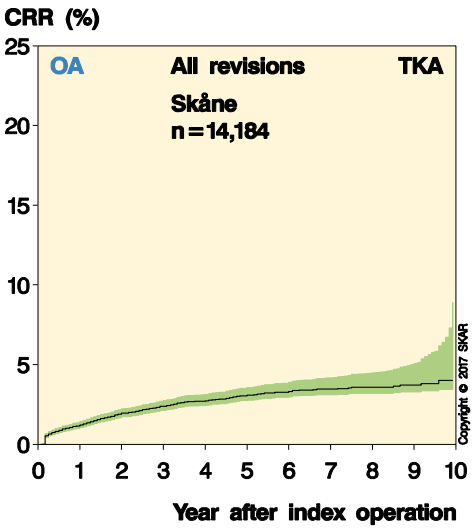


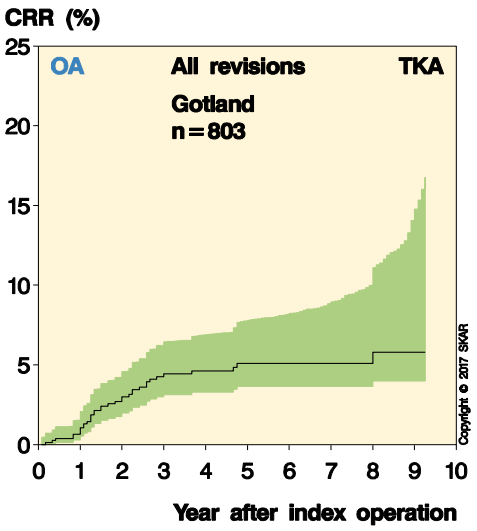


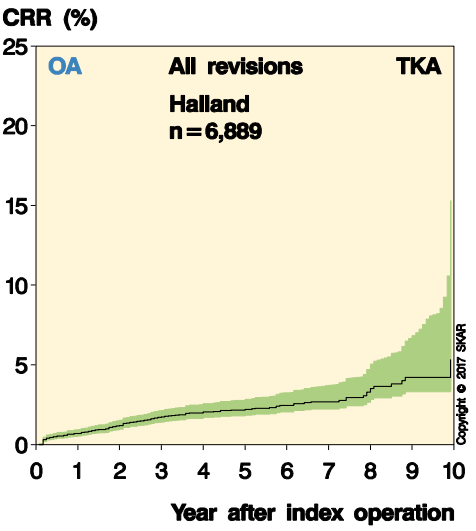


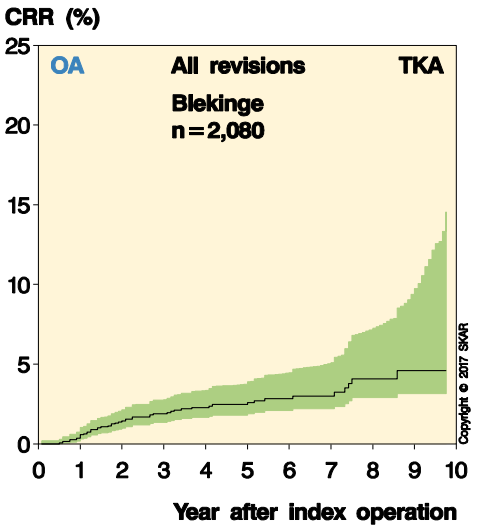
The curves are cut when less than 40 patients are left "at risk"

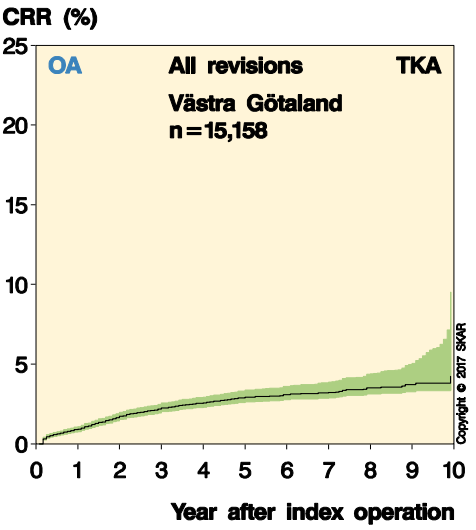






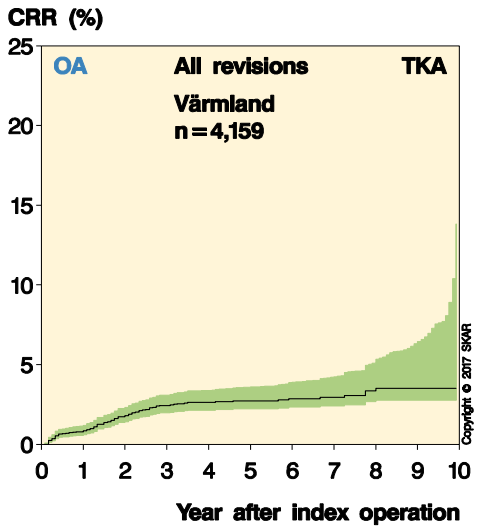


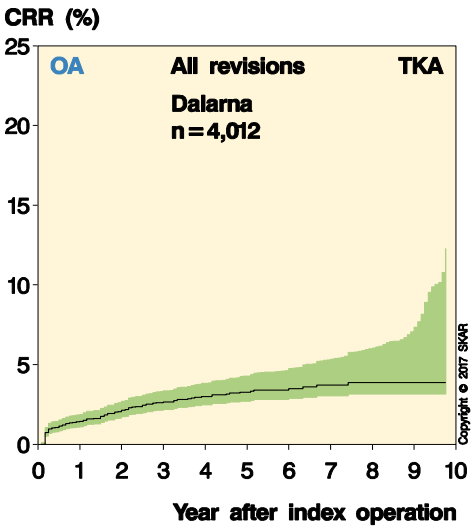


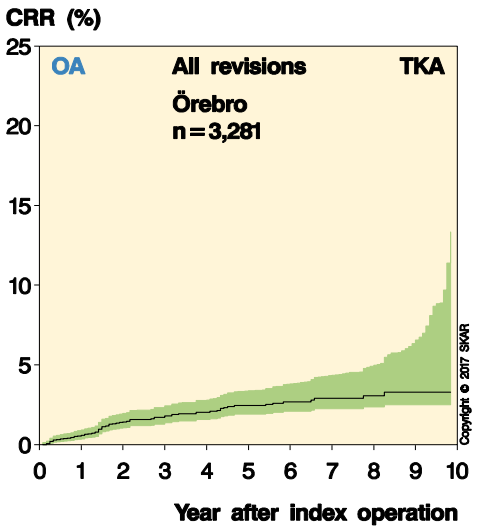


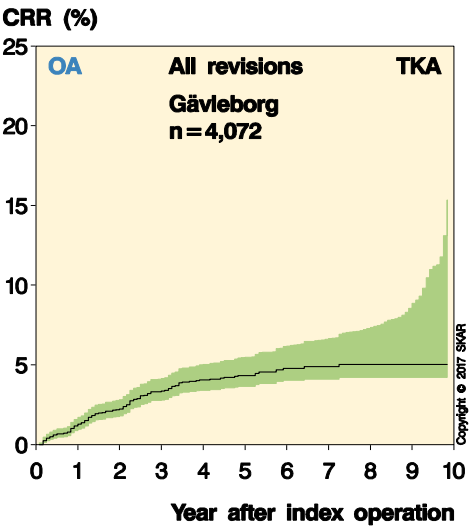
The curves are cut when less than 40 patients are left "at risk"

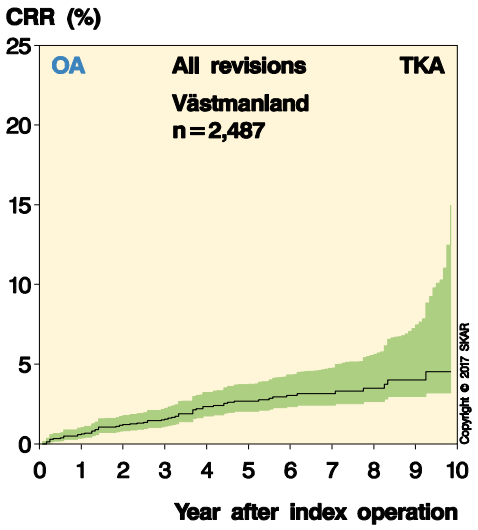
CRR in the counties after primary TKA for OA 2006–2015

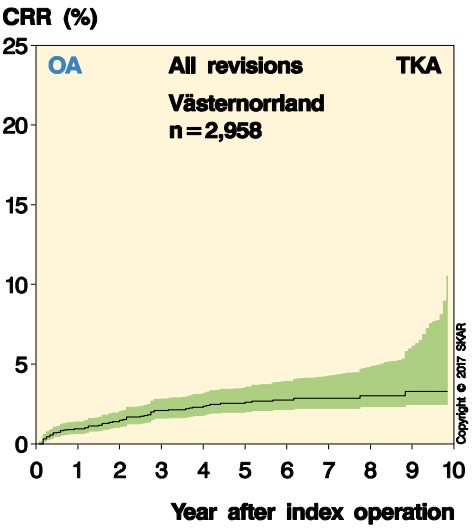




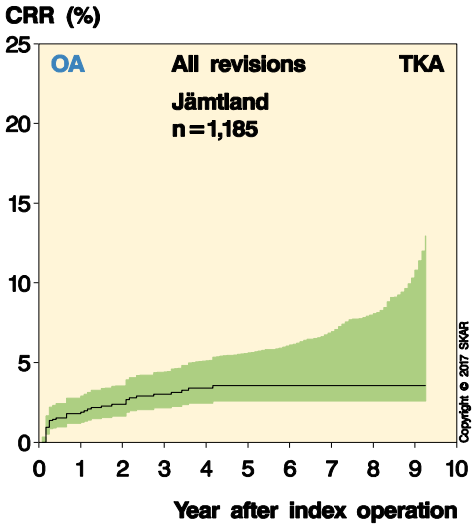


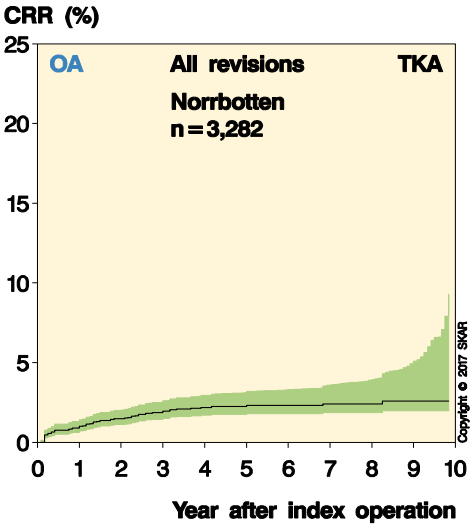


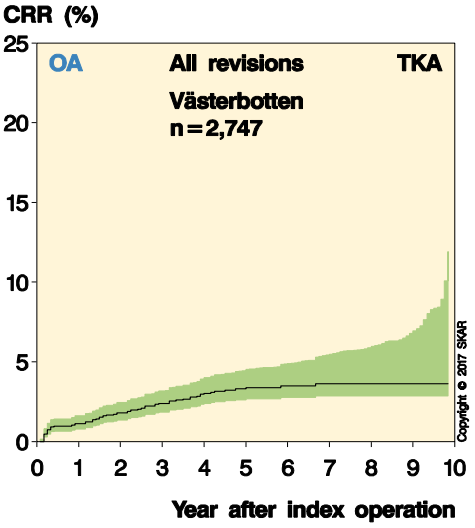




The curves are cut when less than 40 patients are left "at risk"

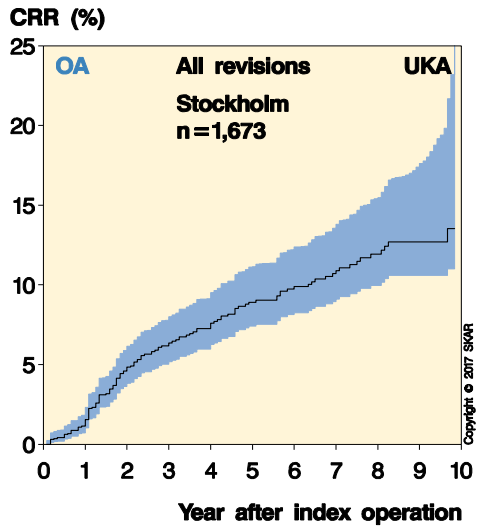


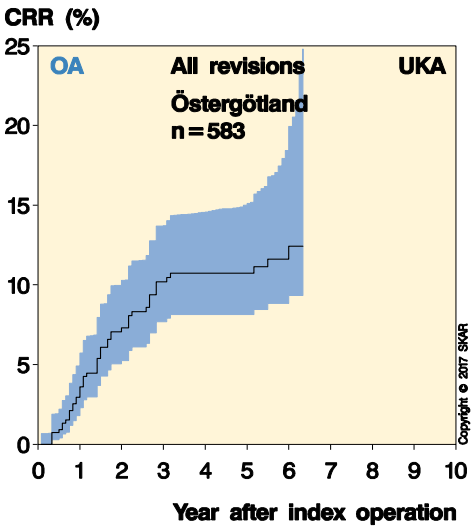


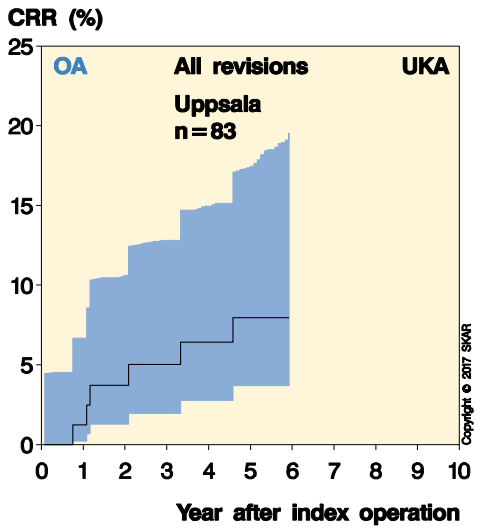


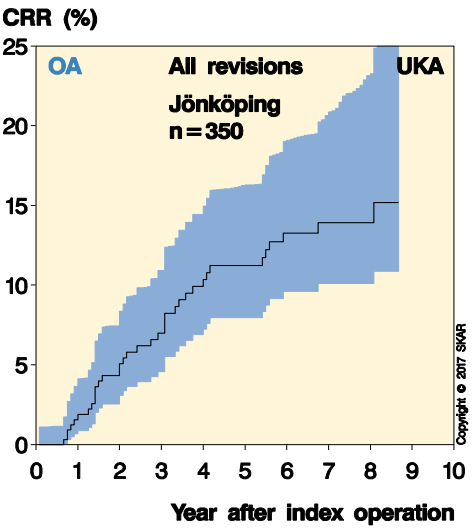
The curves are cut when less than 40 patients are left "at risk"

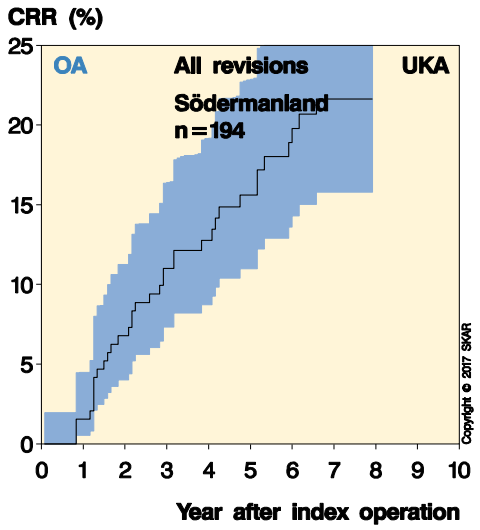
CRR in the counties after primary UKA for OA 2006–2015

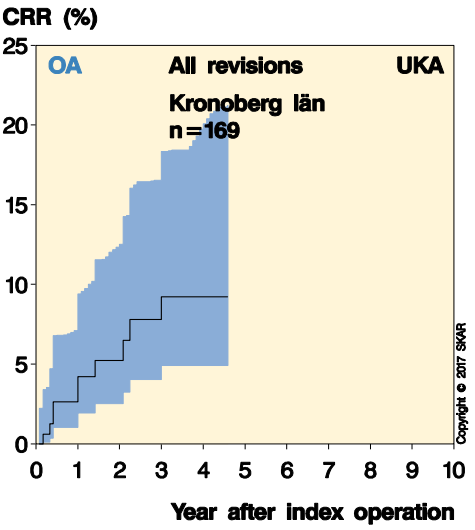




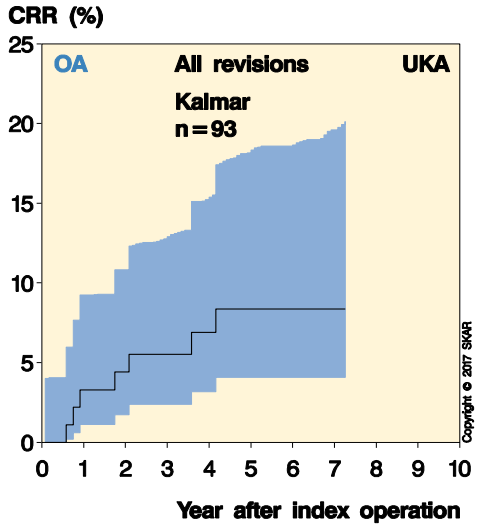


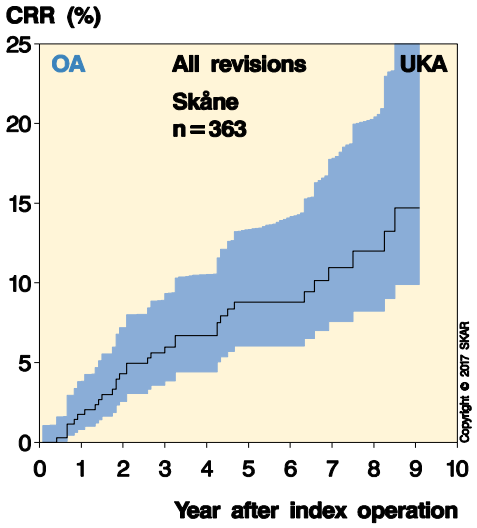


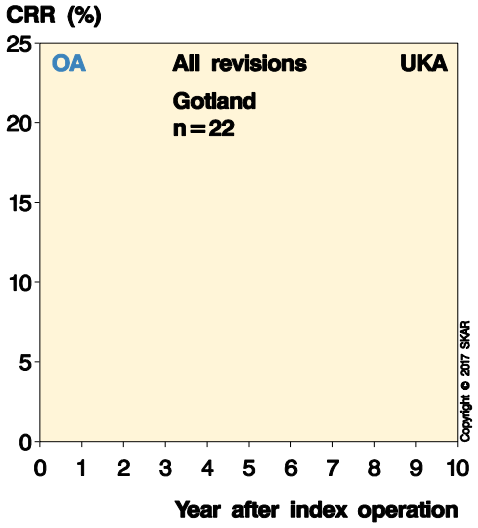


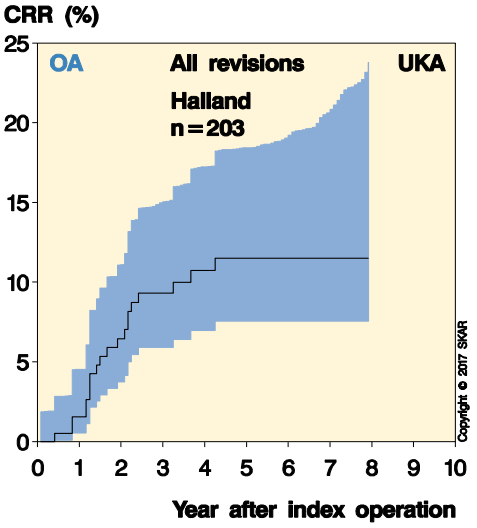


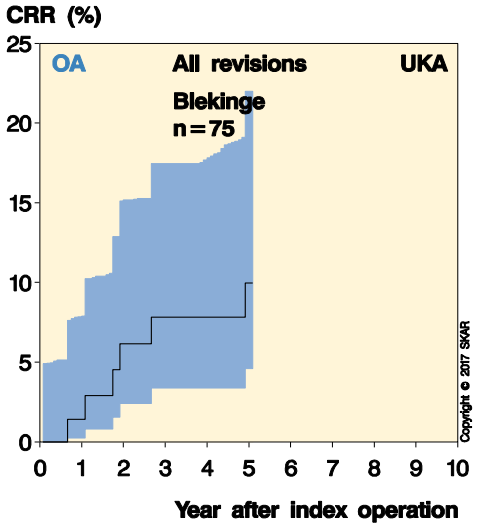
The curves are cut when less than 40 patients are left "at risk"

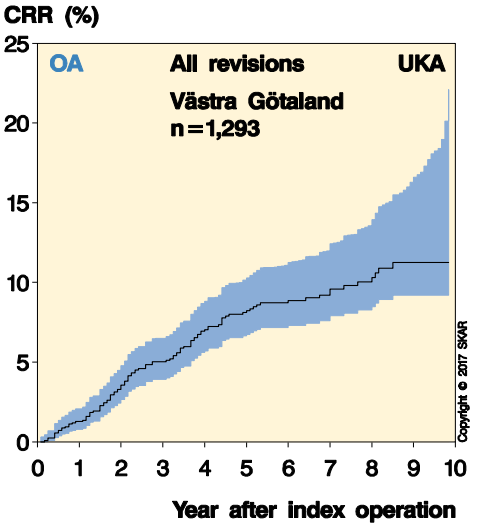






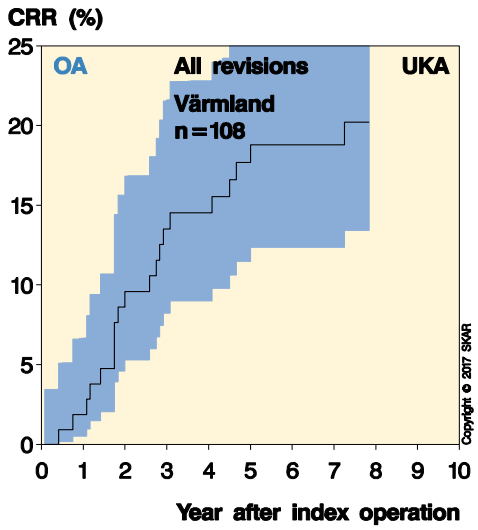


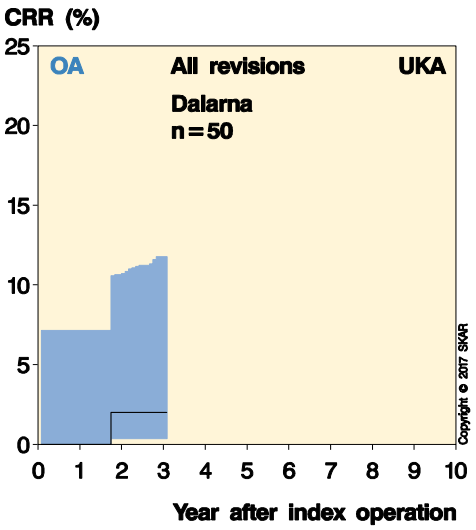


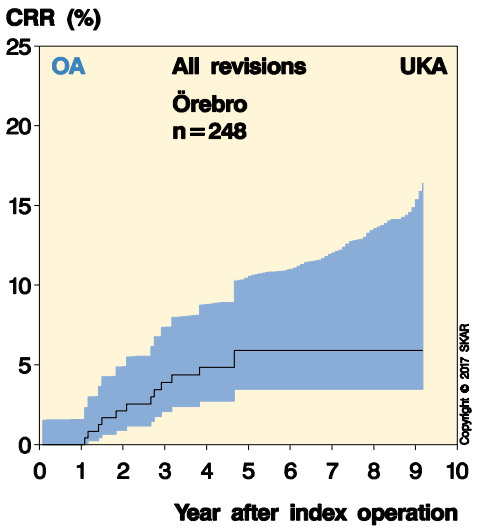


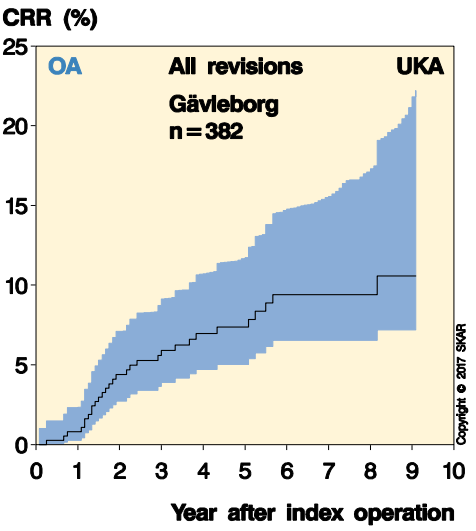
The curves are cut when less than 40 patients are left "at risk"

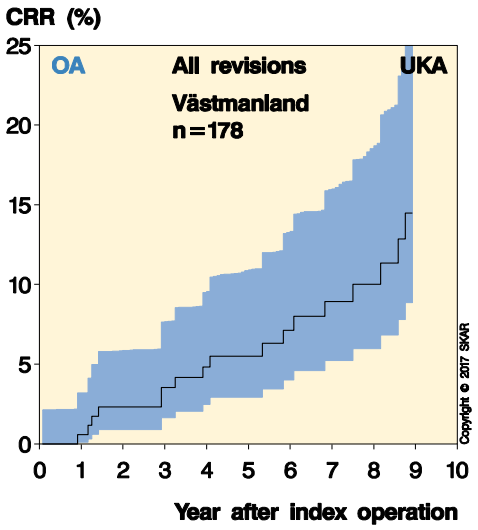
CRR in the counties after primary UKA for OA 2006–2015

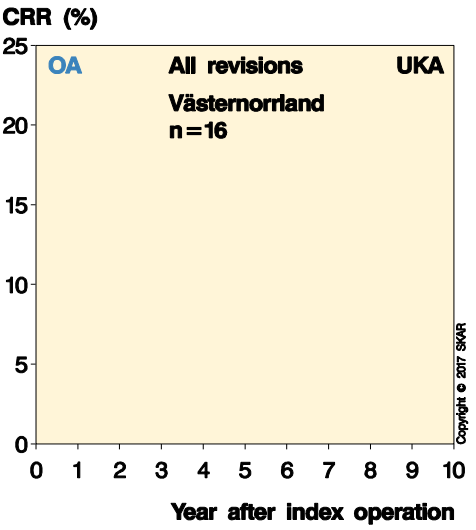




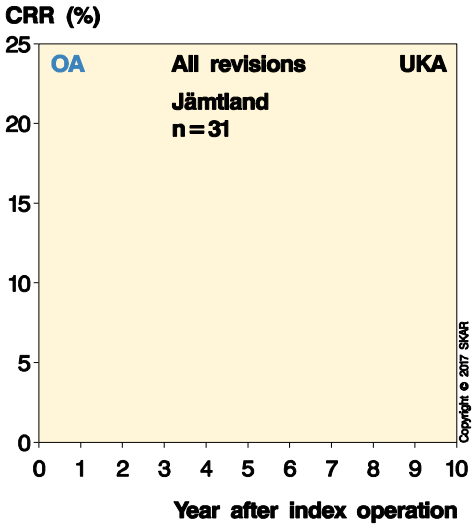


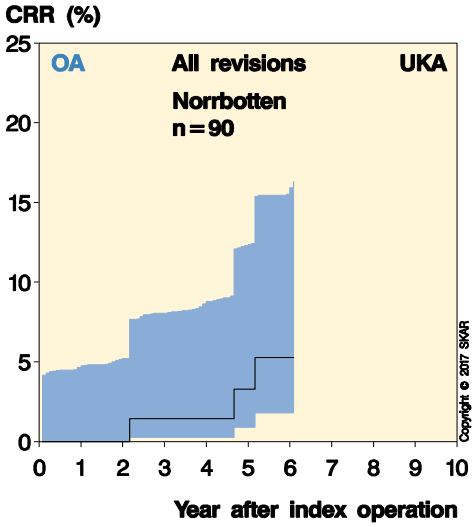


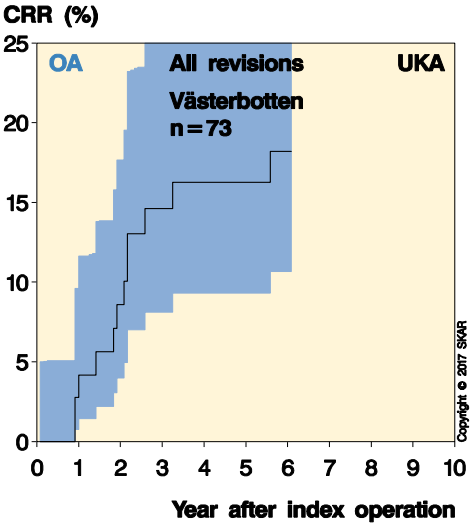




The curves are cut when less than 40 patients are left "at risk"







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

The relative risk for implants used in primary arthroplasty during 2006–2015

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.

Thus, 90% of the PFC Sigma use the same type of a ”non-porous C/R” femur component which in 41% of cases was inserted with a cemented metal backed tibia component (MBT) and in 39% with an all-poly tibia (APT) component. NexGen had more femoral variants of which 40% were CR Option and 28% CR Flex Precoat. On the tibia side, 88% were MBT (of which Option was 87%), 9% had an AP tibia and in 3% had a trabecular metal (TM) tibia component.

The PFC Sigma-MBT is again 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 (92%) together with the same type of tibia baseplate (77%) and with a curved inlay (98%).

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. For the third time we also make separate calculations in which isolated exchanges of inlays due to infection are not considered being revisions. The explanation for doing so is discussed together with the tables on page 52-53.

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 as previously.

For TKA implants inserted for OA (table below, left), we have very similar results as last year where the AGC, F/S MIII, Duracon, PFC RP and the combination of “Other” models have significantly higher risk than the reference PFC-MBT. The F/S

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	18,353		ref.	
AGC	5,679	0.02	1.23	1.04-1.46
Duracon	2,972	0.02	1.29	1.05-1.60
F/S MIII	1,664	<0.01	2.08	1.67-2.58
GenesisII	700	0.22	0.64	0.32-1.30
NexGen HPT	4,056	0.46	0.92	0.74-1.14
NexGen MBT	41,055	0.05	0.89	0.79-1.00
NexGen TM	1,246	0.02	0.63	0.43-0.93
PFC-Sigma HPT	11,723	<0.01	0.74	0.63-0.86
PFC RP	954	<0.01	2.01	1.56-2.59
Profix	1,735	0.35	1.14	0.86-1.51
Triathlon	9,148	0.77	0.97	0.82-1.15
Vanguard	10,108	0.25	1.10	0.94-1.28
Other	1,901	<0.01	1.71	1.34-2.18
Gender (male is ref.)		0.06	0.93	0.86-1.00
Age (per year)		<0.01	0.97	0.97-0.97
Year of op. (per year)		<0.01	1.03	1.01-1.05

OA / UKA	n	p–value	RR	95% CI
Link	1,755		ref.	
Genesis	360	0.37	1.16	0.84-1.61
MillerGalante	552	0.59	1.08	0.82-1.43
Oxford	2,588	0.28	0.89	0.72-1.10
Preservation	92	0.37	1.28	0.74-2.22
Triathlon PKR	166	0.86	1.05	0.59-1.86
ZUK	686	0.90	0.98	0.73-1.32
Other	78	0.31	0.48	0.12-1.96
Gender (male is ref.)		0.40	1.07	0.91-1.27
Age (per year)		<0.01	0.97	0.96-0.98
Year of op. (per year)		0.02	1.05	1.01-1.09

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	17 868		ref.	
AGC	4,805	<0.01	1.31	1.10-1.58
Duracon	2,555	0.10	1.21	0.96-1.53
F/S MIII	1,395	<0.01	2.25	1.79-2.84
Genesis II	690	0.16	0.59	0.28-1.24
NexGen HPT	3,985	0.75	0.97	0.78-1.20
NexGen MBT	40,481	0.15	0.92	0.81-1.03
NexGen TM	1,212	0.05	0.68	0.46-1.00
PFC-Sigma HPT	11,329	<0.01	0.76	0.65-0.90
PFC RP	739	<0.01	1.95	1.46-2.61
Profix	1,574	0.26	1.18	0.88-1.59
Triathlon	8,953	0.91	1.01	0.85-1.20
Vanguard	9,621	0.03	1.18	1.01-1.39
Övriga	1,795	<0.01	1.76	1.37-2.27
Gender (male is ref.)		0.14	0.94	0.87-1.02
Age (per year)		<0.01	0.97	0.97-0.98
Year of op. (per year)		<0.01	1.03	1.01-1.05

With patella button OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	485		ref.	
AGC	874	<0.01	0.39	0.23-0.69
Duracon	417	0.43	0.79	0.45-1.41
F/S MIII	269	0.12	0.58	0.29-1.16
Genesis II	10	0.25	3.27	0.43-24.7
NexGen HPT	71	0.12	0.2	0.03-1.48
NexGen MBT	574	0.13	0.62	0.34-1.14
NexGen TM	*34*	*0.97*	*<0.01*	
PFC-Sigma HPT	394	0.02	0.37	0.16-0.85
PFC RP	215	0.68	0.88	0.48-1.60
Profix	161	0.15	0.5	0.19-1.30
Triathlon	195	0.06	0.39	0.15-1.02
Vanguard	487	<0.01	0.1	0.03-0.34
Övriga	106	0.52	0.73	0.27-1.93
Gender (male is ref.)		0.04	0.72	0.53-0.99
Age (per year)		<0.01	0.96	0.94-0.97
Year of op. (per year)		1.00	1.00	0.92-1.09

Implants lacking sufficient numbers for analysis are shown in italics

MIII and Duracon 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 10 inserted in 2016. Implants with lower risk than the reference were as last year the PFC-APT, NexGen TM and NexGen MBT, which this year is a fraction above the significance limit.

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

With respect to UKA inserted for OA (table on the previous page) one can see that 2 models account for the majority of surgeries. The risk increases with time (Op. year) which may indicate that the UKA revision rate has increased over the 10-year period. This year, the Preservation does not have a higher risk than the Link reference. However, the number si low as the Preservation has not been reported being used since 2011.

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.

Without a patellar button, the PFC-Sigma APT and NexGen TM have significantly lower risk of revision than the reference, the latter a fraction below the significance limit. Besides Duracon that no longer has significantly higher risk and Vanguard that without patella has a higher risk, the models with higher risk than the reference are the same as when all TKA's are analyzed (table on the previous page).

With a patellar button, the number of arthroplasties is rather small which makes it more difficult to show significant differences. However, it is interesting to see that the AGC and Vanguard 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 2006–2015 if the exchange of inlay, in case of infection, is not considered to be a revision

The SKAR defines a revision being a secondary surgery (reoperation) in a knee having an implant during which implant components are exchanged, added or removed.

The reason for other types not being considered is that it was noted early on that many surgeons did not report reoperations which they did not consider directly related to a prior knee arthroplasty. This resulted in different types of soft tissue surgeries never being reported and thus, the register decided to use a stricter definition of revision which surely had something to do with the implant.

It has been claimed that in infected revisions, the strict definition may treat certain implants unfairly. The reason is that almost half of all the revisions for infection are synovectomies during which the inlay is also exchanged (defining them as being revisions). However, a synovectomy in a knee having an implant in which the inlay cannot be exchanged is not counted as a revision, which in turn may favor the type. Thus, the argument has been made that an exchange of inlay in infection should not be considered a revision but a synovectomy.

On the opposite it can be claimed that infected TKA´s with fixed inlays will be treated with a complete exchange of components, as a comprehensive synovectomy is not considered possible without removal of the inlay. This could result in a reversed bias when the exchange of an inlay is not considered as being a revision.

Without being able to give a definite answer regarding what is most reasonable, we decided to also produce tables in which the exchange of inlays (for infection) are not considered being revisions. 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 we accordingly excluded 633 TKA and 9 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 50 that the same implants have an increased risk. Of the two that had lower risk than the reference (NexGen TM and PFC-Sigma APT) the PFC-APT no longer is significantly different while the NexGen TM is just below the significance limit. It should be noted that the poly cannot be exchanged in the PFC-APT or in the Monoblock NexGen TM (2/3 of the TMs). These, as well as the NexGen APT will therefore not benefit from the exclusion of inlay exchanges.

After the exclusion the negative effect of time (year of op.) has disappeared. The cause is probably the increased aggressiveness in recent years in treating early or suspected infections by debridement and exchange of inlay when possible. This has resulted in increased number of inlay revisions in recent years causing the negative effect of time in the previous table.

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

OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	17 780		ref.	
AGC	7,294	0.00	1.57	1.32-1.86
Duracon	3,911	0.00	1.38	1.12-1.70
F/S MIII	2,434	0.00	2.11	1.71-2.61
Genesis II	545	0.82	1.11	0.46-2.69
NexGen APT	4,089	0.08	1.23	0.98-1.54
NexGen MBT	37,041	0.05	0.87	0.75-1.00
NexGen TM	1,106	0.09	0.67	0.42-1.06
PFC-Sigma APT	11,972	0.96	1.00	0.84-1.18
PFC-RP	1,019	0.00	2.41	1.87-3.12
Profix	1,855	0.02	1.44	1.07-1.93
Triathlon	7,883	0.44	0.92	0.73-1.14
Vanguard	9,092	0.02	1.27	1.05-1.54
Others	1,811	0.00	1.65	1.24-2.18
Gender (male is ref.)		0.07	1.08	0.99-1.18
Age (per year)		<0.01	0.96	0.95-0.96
Year of op. (per year)		0.75	1.00	0.98-1.02

OA / UKA	n	p–value	RR	95% CI
Link	2.020		ref.	
Genesis	398	0.34	1.17	0.85-1.61
MillerGalante	788	0.13	1.20	0.95-1.51
Oxford	2,437	0.29	0.90	0.73-1.10
Preservation	120	0.05	1.57	1.00-2.46
Triathlon PKR	138	0.54	1.21	0.65-2.26
ZUK	621	0.62	0.92	0.67-1.27
Others	46	0.69	0.75	0.19-3.06
Gender (male is ref.)		0.91	0.99	0.85-1.16
Age (per year)		<0.01	0.97	0.96-0.98
Year of op. (per year)		0.03	1.05	1.01-1.09

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 inlay. 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	17,302		ref.	
AGC	6,246	<0.01	1.71	1.43-2.04
Duracon	3,411	0.04	1.27	1.01-1.60
F/S MIII	1,901	<0.01	2.48	1.98-3.09
Genesis II	540	0.91	0.94	0.35-2.54
NexGen APT	4,016	0.02	1.31	1.04-1.65
NexGen MBT	36,509	0.16	0.90	0.78-1.04
NexGen TM	1,077	0.18	0.72	0.45-1.16
PFC-Sigma APT	11,645	0.67	1.04	0.87-1.24
PFC-RP	803	<0.01	2.46	1.84-3.28
Profix	1,684	0.01	1.52	1.12-2.07
Triathlon	7,696	0.88	0.98	0.79-1.23
Vanguard	8,619	<0.01	1.40	1.15-1.70
Others	1,654	<0.01	1.68	1.24-2.26
Gender (male is ref.)		0.03	1.11	1.01-1.21
Age (per year)		<0.01	0.96	0.95-0.96
Year of op. (per year)		0.52	0.99	0.97-1.01

With patella button OA / TKA	n	p–value	RR	95% CI
PFC-Sigma MBT	478		ref.	
AGC	1,048	0.01	0.46	0.26-0.81
Duracon	500	1.00	1.00	0.57-1.77
F/S MIII	533	0.04	0.49	0.25-0.96
Genesis II	5	0.06	7.30	0.95-56.09
NexGen APT	73	1.00	0.00	
NexGen MBT	532	0.14	0.58	0.28-1.19
NexGen TM	*29*	*1.00*	*0.00*	
PFC-Sigma APT	327	0.08	0.44	0.18-1.09
PFC-RP	216	0.88	0.95	0.5-1.81
Profix	171	0.19	0.49	0.17-1.43
Triathlon	187	0.03	0.11	0.01-0.79
Vanguard	473	0.00	0.09	0.02-0.40
Others	157	0.68	0.83	0.35-1.99
Gender (male is ref.)		0.18	0.80	0.57-1.11
Age (per year)		<0.01	0.95	0.94-0.97
Year of op. (per year)		0.23	1.06	0.96-1.17

Implants lacking sufficient numbers for analysis are shown in italics

In case of UKA (table previous page right), there were only 9 exchanges of inlays because of manifest or suspected infection and the table is almost identical to the table on page 50.

Above, we have as on page 51 divided the TKA for OA into those that are used without respective with a patellar button.

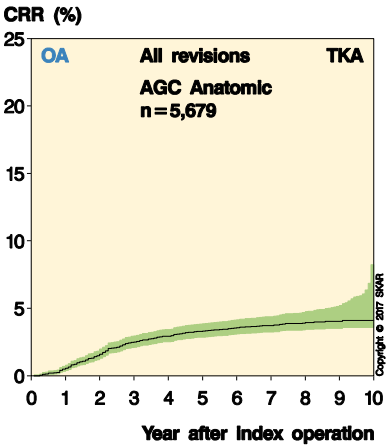
When table above to the left (in which no patella button was used) is compared to the that when all the TKA's were included (table on the previous page to the left) We see that the Profix and Vanguard without a patella have a significant higher risk than the reference. Duracon ha no longer a significantly higher risk while NexGen TM has no longer a significantly lower risk.

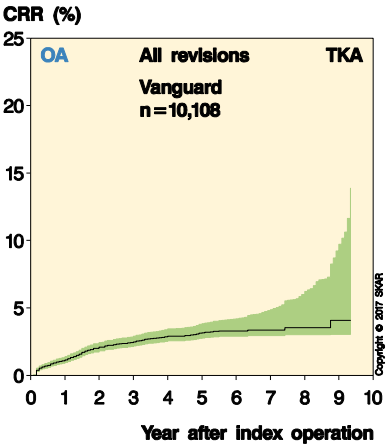
As compared to the table on page 51 where change of inlays for infection were considered revisions the difference is that PFC-Sigma APT and NexGen TM are no longer better than the reference and that Profix now has significantly higher risk.

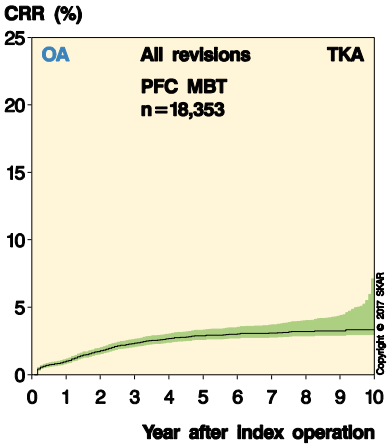
The table above concerns TKA's in which a patellar button was used. When this table is compared to the table on page 51 the only difference is that the PFC-Sigma APT no longer has a lower risk while Triathlon has instead now has a lower risk as compared to the reference..

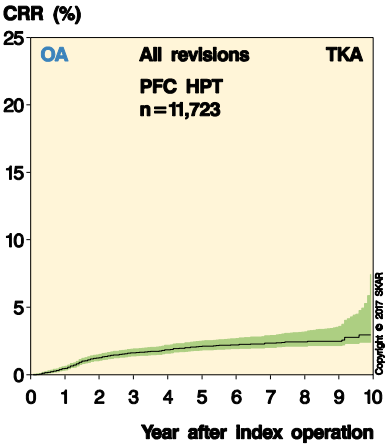
In summary one can establish that excluding an exchange of inlay in infected cases does affect the results and that the effect negatively affects non-modular implants as compared to modular ones. One explanation may be that a number of debridement's without exchange of inlays in non-modular TKA's have 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 inlay can be exchanged may have resulted in knees becoming revised that would have maked it without.

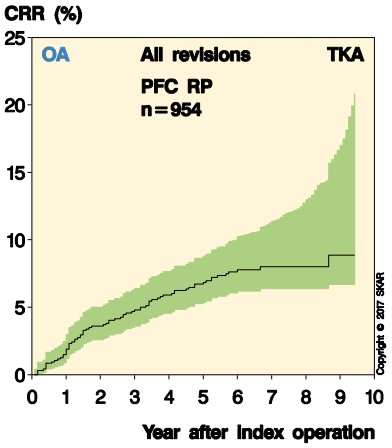
CRR for commonly used TKA implants for OA 2006–2015

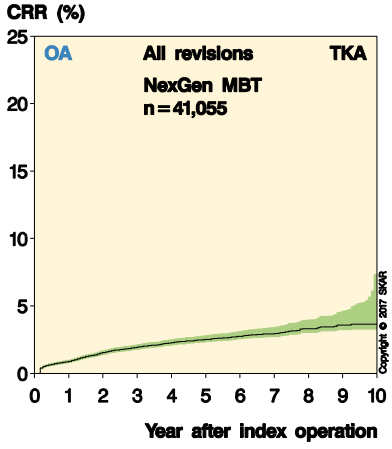


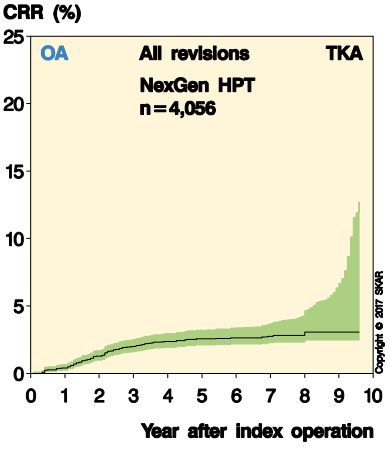


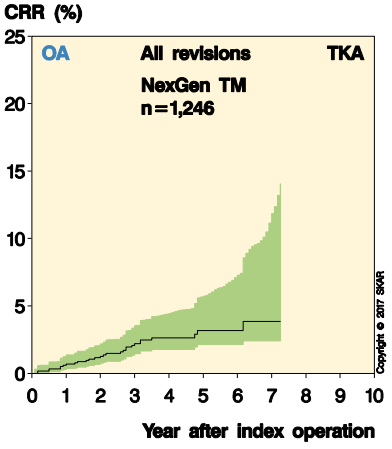


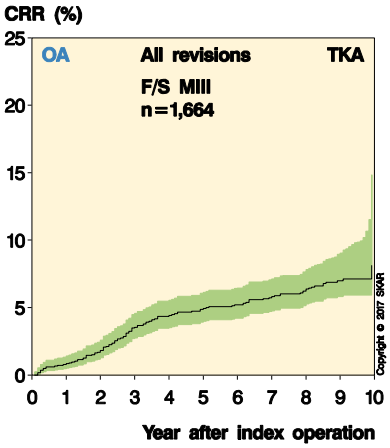











CRR (%)
OA
All revisions
TKA
F/S MIII
n=1,664
Year after index operation
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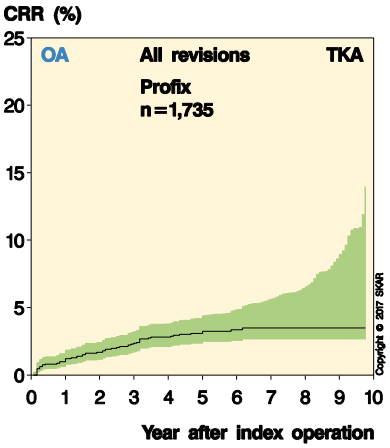
CRR (%)
OA
All revisions
TKA
Profix
n=1,735
Year after index operation
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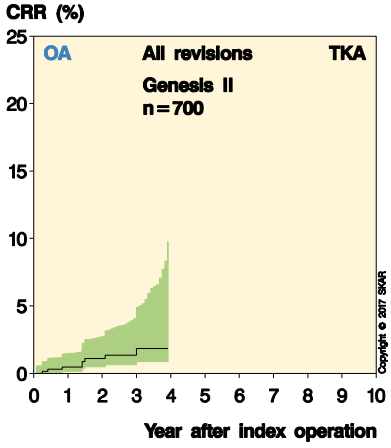
CRR (%)
OA
All revisions
TKA
Genesis II
n=700
Year after index operation
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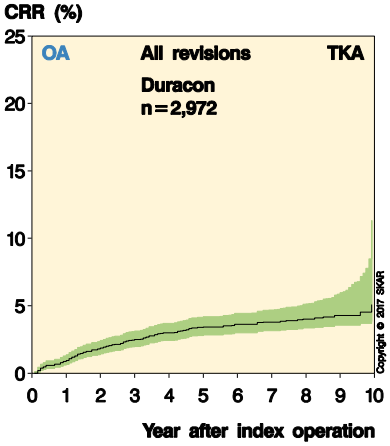
CRR (%)
OA
All revisions
TKA
Duracon
n=2,972
Year after index operation
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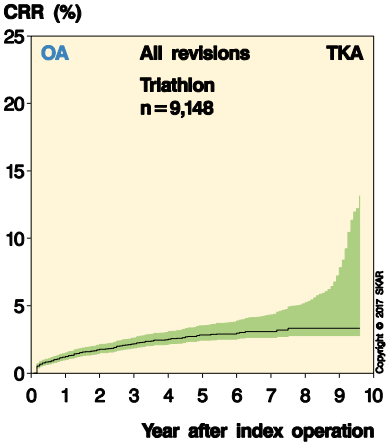
CRR (%)
OA
All revisions
TKA
Triathlon
n=9,148
Year after index operation
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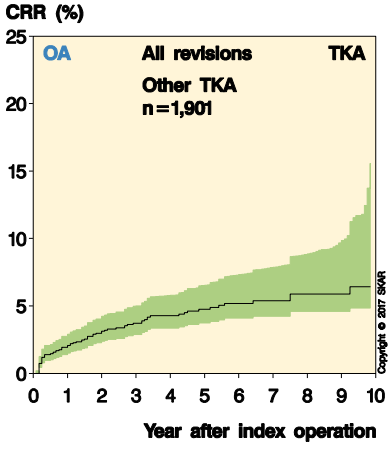
CRR (%)
OA
All revisions
TKA
Other TKA
n=1,901
Year after index operation
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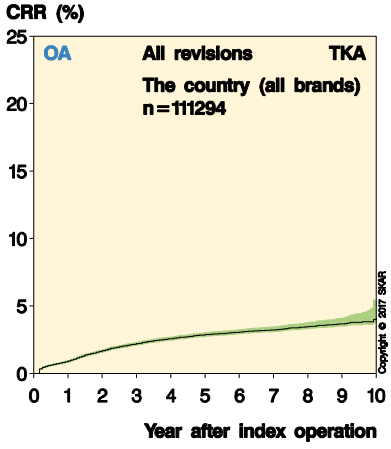
CRR (%)
OA
All revisions
TKA
The country (all brands)
n=111294
Year after index operation
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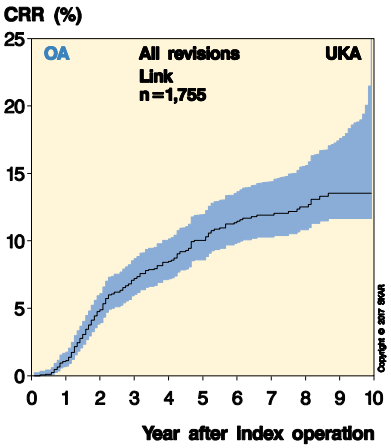
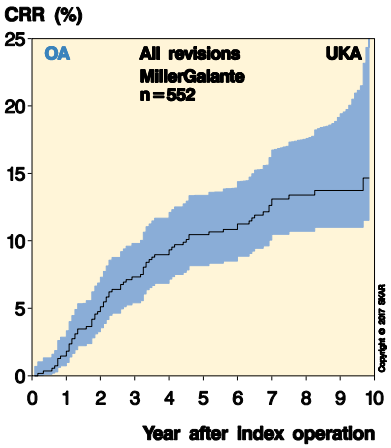
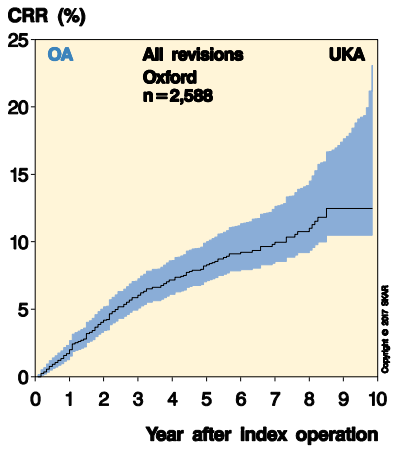
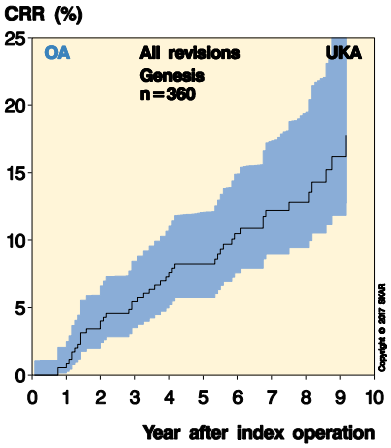
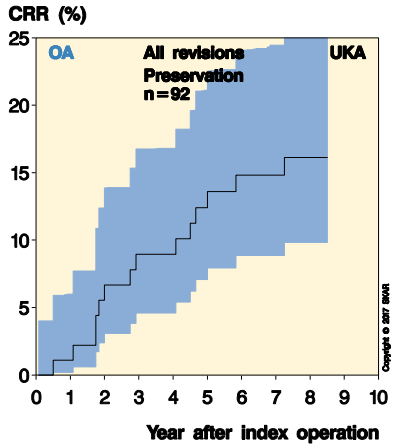
CRR for commonly used UKA implants for OA 2006–2015

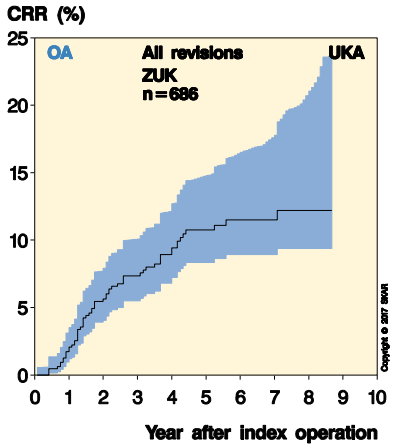


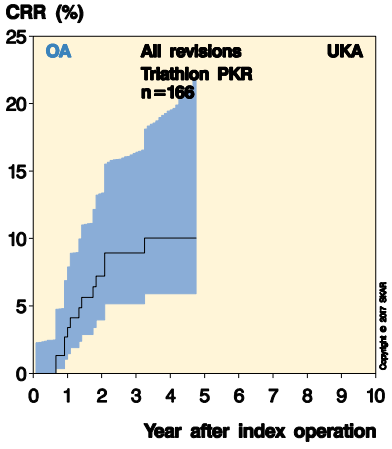


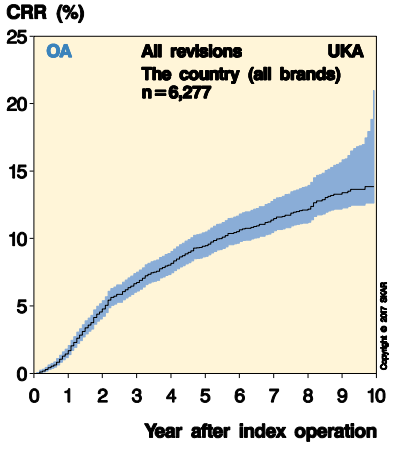












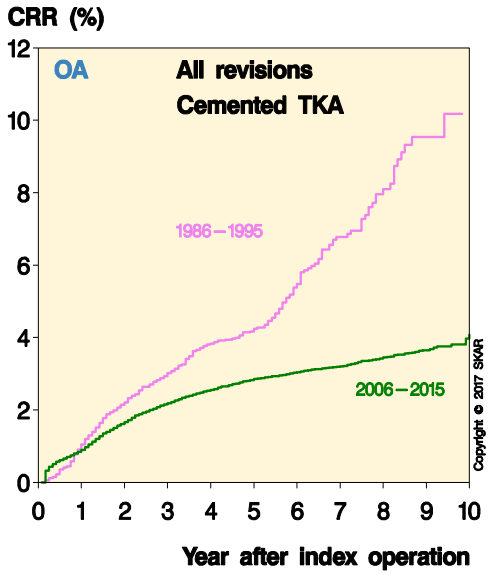
Changes in risk of revision over time (TKA for OA)

The figure below shows the overall risk of revision for the current 10-year period, 2006-2015, as compared to the period 1986-1995. It can be observed that the risk for the current period is considerably lower than for the earlier period.

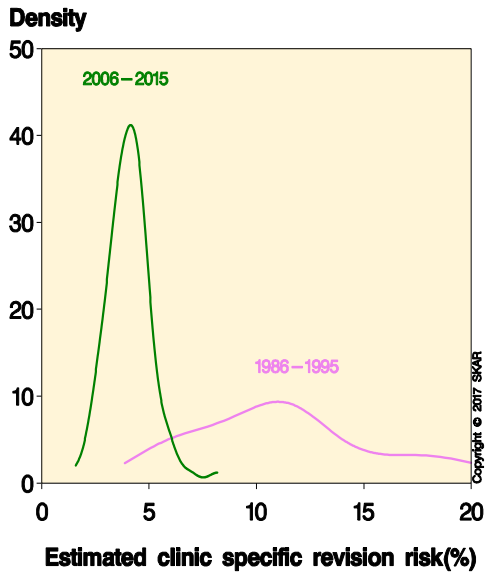
When the absolute specific risk of revision for the units is plotted for both periods (figure below left), it can be seen that the risk has become lower and the distribution has diminished. This implies that the results have improved overall and at the same time the results for the different units have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

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

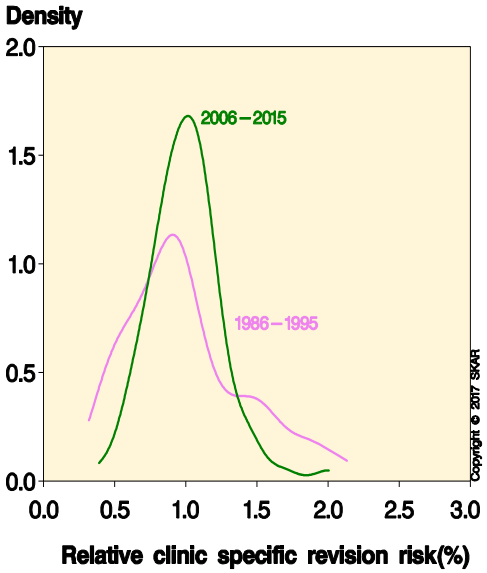
The register is requested to account for hospital specific results which can be found on the next pages. This year, there were 8 hospitals having significantly better results than the average hospital and 6 with inferior results. One can only speculate on the causes for these differences. An unfortunate 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 1986–1995 and 2006–2015 shows a considerable reduction in CRR over time.



Plotting the estimated absolute clinicspecific risk of revision shows that the absolute distribution has diminished between 1986-1995 and 2006–2015 (x-axis = absolute risk of revision)



Plotting the relative clinicspecific risk of revision, as compared to the national mean, shows that the distribution of relative risk among the hospitals has not changed between 1986–1995 and 2006–2015 (x-axis = relative risk).

Relative risk of revision for hospitals 2006–2015 (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	1,861	12	0.39	0.26-0.60	1	1-5
10010	Sabbatsberg (Aleris)	711	5	0.56	0.34-0.93	2	1-31
52013	Skene	867	10	0.58	0.37-0.90	3	1-29
11015	Nacka-Proxima	972	10	0.61	0.39-0.95	4	1-34
12010	Enköping	2,871	35	0.61	0.46-0.82	5	2-22
11002	Huddinge	1,169	15	0.63	0.42-0.93	6	2-33
12481	Elisabethsjukhuset	541	8	0.66	0.41-1.04	7	2-43
42015	Movement Halmstad	2,222	34	0.70	0.52-0.95	8	3-34
25010	Kalmar	951	13	0.70	0.47-1.06	9	2-46
25011	Oskarshamn	2,446	42	0.73	0.56-0.96	10	4-36
50480	Carlanderska	843	13	0.75	0.50-1.13	11	3-53
62011	Örnsköldsvik	1,106	19	0.75	0.52-1.09	12	3-48
42420	Spenshult	1,362	25	0.77	0.55-1.08	13	4-49
22010	Jönköping	1,354	23	0.78	0.56-1.10	14	4-52
65012	Gällivare	708	12	0.79	0.52-1.20	15	3-58
11013	Löwenströmska*	3,343	64	0.79	0.63-1.00	16	6-40
11001	Karolinska	1,102	24	0.83	0.59-1.17	17	5-57
28011	Ängelholm	1,588	29	0.83	0.61-1.14	18	6-55
22012	Värnamo	1,211	31	0.83	0.60-1.16	19	5-55
22011	Eksjö-Nässjö (Höglandssjukh.)	1,362	23	0.84	0.60-1.18	20	5-57
53011	Lidköping	1,415	25	0.86	0.62-1.20	21	6-59
62010	Sundsvall	891	18	0.86	0.60-1.25	22	5-63
42011	Varberg	1,489	32	0.87	0.64-1.17	23	8-57

(cont.)

Relative risk of revision for units (continued)

Code	Hospital	no. of TKA	Revised	RR	95% CI	Rank	95% CI
50020	OrthoCenter IFK klin.**	896	20	0.87	0.61-1.24	24	6-61
65013	Piteå	2,507	54	0.88	0.69-1.12	25	10-52
52011	Borås	891	22	0.88	0.62-1.25	26	6-62
55010	Örebro	818	19	0.89	0.62-1.27	27	6-63
56010	Västerås	1,933	40	0.89	0.67-1.18	28	9-57
55012	Lindesberg	1,413	28	0.90	0.65-1.24	29	8-61
53010	Falköping	662	18	0.91	0.63-1.32	30	7-66
10013	Södersjukhuset	2,705	64	0.93	0.74-1.17	31	13-57
13011	Nyköping	898	20	0.93	0.65-1.34	32	8-66
65016	Sunderby	51	1	0.94	0.52-1.69	33	3-74
10011	S:t Göran	3,279	77	0.94	0.76-1.16	34	15-56
55011	Karlskoga	1,050	23	0.94	0.67-1.32	35	9-65
54010	Karlstad	1,772	40	0.94	0.71-1.25	36	12-62
27011	Karlshamn	2,076	49	0.99	0.77-1.28	37	16-64
23010	Växjö	1,036	27	1.00	0.72-1.38	38	12-68
13010	Eskilstuna	390	11	1.02	0.66-1.56	39	9-73
61012	Hudiksvall	656	16	1.03	0.70-1.51	40	11-72
50071	Frölunda Spec.	1,080	28	1.03	0.75-1.42	41	15-69
13012	Kullbergska sjukhuset	2,000	54	1.03	0.81-1.32	42	19-66
10015	Sophiahemmet	706	22	1.04	0.74-1.48	43	14-71
11010	Danderyd	1,361	35	1.05	0.78-1.41	44	18-69
64001	Umeå	1,315	39	1.06	0.80-1.40	45	19-69
54014	Torsby	1,005	25	1.06	0.76-1.48	46	16-71
64010	Skellefteå	854	22	1.06	0.75-1.50	47	15-71
64011	Lycksele	578	15	1.06	0.72-1.57	48	12-73
50010	Östra sjukhuset	402	14	1.07	0.72-1.60	49	12-73
21014	Motala	3,979	106	1.08	0.90-1.30	50	29-66
28012	Hässleholm	5,935	159	1.09	0.93-1.27	51	32-64
21013	Norrköping	1,056	26	1.09	0.79-1.52	52	18-72
54012	Arvika	1,382	35	1.10	0.82-1.47	53	20-71
42010	Halmstad	1,816	53	1.10	0.86-1.41	54	24-69
41011	Trelleborg	6 047	163	1.12	0.96-1.31	55	35-66
24010	Västervik	899	25	1.12	0.80-1.56	56	20-73
30001	Malmö	105	5	1.13	0.68-1.87	57	10-75
51011	Mölndal	1,882	46	1.15	0.88-1.50	58	27-72
57010	Falun	2,568	73	1.15	0.93-1.43	59	32-70
56012	Köping	554	23	1.17	0.83-1.64	60	22-74
41001	Lund	262	7	1.17	0.72-1.87	61	13-75
57011	Mora	1,444	41	1.17	0.89-1.54	62	28-72
41012	Helsingborg	246	7	1.18	0.73-1.89	63	13-75
11011	Södertälje	1,105	36	1.20	0.90-1.60	64	28-73
53013	Skövde	1,016	29	1.21	0.89-1.66	65	28-74
62013	Sollefteå	960	32	1.22	0.90-1.66	66	30-74
12001	Akademiska sjukhuset	981	37	1.23	0.92-1.64	67	31-74
51010	Uddevalla	1,800	55	1.25	0.98-1.59	68	37-73
63010	Östersund	1,185	37	1.26	0.95-1.68	69	34-74
11012	Norrtälje	763	30	1.33	0.97-1.82	70	37-75
61011	Bollnäs	2,606	90	1.40	1.15-1.71	71	54-75
26010	Visby	803	35	1.44	1.07-1.93	72	48-75
23011	Ljungby	943	36	1.44	1.08-1.93	73	48-75
10016	Ortopediska huset	3 816	152	1.47	1.26-1.72	74	62-75
61010	Gävle	810	36	1.65	1.23-2.20	75	61-76
51012	Kungälv	1,482	81	2.01	1.63-2.47	76	74-76

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

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

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

Relative risk of revision for hospitals 2006–2015 (cemented and uncemented TKA for OA) if the exchange of inlay, 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 52) 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 inlay is exchanged (classifying them as revisions). However, a debridement in a knee with a monobloc tibia, in which no inlay 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 inlay 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 inlays are generally treated with a complete exchange of components, as a comprehensive debridement is not considered possible without removal of an inlay. This would result in a reversed bias if the exchange of an inlay is not considered as a revision. However, on page 50-53 we saw that excluding exchange of the tibia inlay seemed to negatively affect the results of at least some implants with monobloc tibia.

Therefore we also show risk calculations when an exchange of inlay (for infection) is not, considered as being a revision.

If the table below is compared to the one on the previous page, it can be seen that 4 of the 8 units with results better than the average keep their status. Sabbatsberg, Nacka, Enköping and Huddinge are no longer better than the average while Kalmar, has become better than the average. At the other end, the units that were significantly inferior to the average keep their status. Trelleborg and Akademiska disappear while Uddevalla appears. As can be expected there are changes in the ranking of units occur.

Uddevalla that became worse than the average used monobloc tibia in 25% their cases. Of the four units that lost their status as being better than the average, two used mainly modular components while the other two used non-modular components in half of their cases. Thus, although modularity may affect the risk of revision, other factors also play a role.

Relative risk of revision for units. Exchange of inlay, 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	1,861	9	0.39	0.25-0.63	1	1-8
10010	Sabbatsberg (Aleris)	711	4	0.59	0.34-1.01	2	1-40
25010	Kalmar	951	7	0.6	0.37-0.99	3	1-39
52013	Skene	867	9	0.62	0.39-0.99	4	1-38
42015	Movement Halmstad	2,222	23	0.63	0.45-0.90	5	2-31
62011	Örnsköldsvik	1,106	12	0.66	0.43-1.01	6	2-42
11015	Nacka-Proxima	972	9	0.67	0.42-1.06	7	2-46
22010	Jönköping	1,354	14	0.67	0.44-1.00	8	2-41
12481	Elisabethsjukhuset	541	7	0.68	0.41-1.10	9	2-49
11002	Huddinge	1,169	14	0.68	0.45-1.03	10	2-44
53011	Lidköping	1,415	14	0.7	0.47-1.06	11	2-46
25011	Oskarshamn	2,446	32	0.71	0.53-0.97	12	3-38
62010	Sundsvall	891	11	0.74	0.48-1.14	13	2-53
12010	Enköping	2,871	34	0.74	0.55-1.00	14	4-41
42420	Spenshult	1,362	19	0.74	0.51-1.07	15	3-48
50480	Carlanderska	843	10	0.76	0.48-1.19	16	2-56
65013	Piteå	2,507	37	0.78	0.58-1.04	17	5-44
57010	Falun	2,568	37	0.78	0.58-1.05	18	5-45
22011	Eksjö-Nässjö (Höglandssjukh.)	1,362	16	0.79	0.53-1.17	19	4-55
52011	Borås	891	16	0.81	0.54-1.20	20	4-58
65012	Gällivare	708	10	0.82	0.52-1.28	21	3-62
42011	Varberg	1,489	25	0.85	0.61-1.19	22	7-56
11001	Karolinska	1,102	21	0.86	0.60-1.24	23	7-60

(cont.)

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

Code	Hospital	no. of TKA	Revised	RR	95% CI	Rank	95% CI
28011	Ängelholm	1,588	24	0.87	0.62-1.22	24	7-58
22012	Värnamo	1,211	28	0.87	0.62-1.23	25	7-59
55011	Karlskoga	1,050	17	0.9	0.61-1.32	26	7-64
54010	Karlstad	1,772	30	0.9	0.66-1.23	27	10-59
13010	Eskilstuna	390	7	0.9	0.55-1.47	28	4-69
41011	Trelleborg	6,047	106	0.92	0.76-1.11	29	17-51
10015	Sophiahemmet	706	15	0.93	0.62-1.39	30	8-66
24010	Västervik	899	15	0.93	0.63-1.39	31	8-67
50020	OrthoCenter IFK klin.*	896	18	0.94	0.64-1.37	32	8-66
55010	Örebro	818	17	0.94	0.64-1.38	33	8-66
55012	Lindesberg	1,413	23	0.94	0.67-1.34	34	10-65
28012	Hässleholm	5,935	109	0.95	0.79-1.14	35	19-53
65016	Sunderby	51	1	0.95	0.51-1.77	36	3-75
11013	Löwenströmska**	3,343	64	0.96	0.76-1.21	37	17-58
53010	Falköping	662	16	0.96	0.65-1.42	38	9-68
64010	Skellefteå	854	15	0.96	0.64-1.44	39	9-68
11010	Danderyd	1,361	25	0.96	0.69-1.35	40	12-65
56010	Västerås	1,933	36	0.99	0.74-1.33	41	15-64
10013	Södersjukhuset	2,705	57	1.01	0.79-1.29	42	20-63
30001	Malmö	105	3	1.02	0.58-1.79	43	6-75
50010	Östra sjukhuset	402	11	1.04	0.67-1.61	44	11-72
54014	Torsby	1,005	19	1.05	0.72-1.52	45	14-70
21013	Norrköping	1,056	19	1.05	0.72-1.52	46	14-70
13011	Nyköping	898	19	1.06	0.73-1.53	47	15-70
41012	Helsingborg	246	4	1.06	0.62-1.83	48	8-75
13012	Kullbergska sjukhuset	2,000	45	1.06	0.81-1.39	49	22-67
12001	Akademiska sjukhuset	981	27	1.09	0.79-1.52	50	20-70
42010	Halmstad	1,816	43	1.1	0.83-1.44	51	24-68
61012	Hudiksvall	656	14	1.1	0.73-1.66	52	15-73
10011	S:t Göran	3,279	75	1.11	0.89-1.38	53	29-66
63010	Östersund	1,185	25	1.11	0.79-1.55	54	21-71
64001	Umeå	1,315	36	1.14	0.85-1.53	55	26-71
50071	Frölunda Spec.	1,080	26	1.15	0.82-1.60	56	23-72
51011	Mölndal	1,882	36	1.15	0.86-1.54	57	26-71
21014	Motala	3,979	91	1.16	0.95-1.42	58	35-68
23010	Växjö	1,036	27	1.17	0.84-1.62	59	25-73
11011	Södertälje	1,105	29	1.18	0.86-1.62	60	26-72
64011	Lycksele	578	14	1.18	0.79-1.78	61	19-75
57011	Mora	1,444	33	1.19	0.87-1.61	62	27-72
41001	Lund	262	6	1.21	0.73-2.01	63	15-76
27011	Karlshamn	2,076	49	1.21	0.93-1.57	64	33-72
54012	Arvika	1,382	32	1.24	0.91-1.68	65	31-74
11012	Norrtälje	763	23	1.26	0.88-1.78	66	29-75
53013	Skövde	1,016	24	1.26	0.89-1.77	67	29-74
56012	Köping	554	23	1.33	0.94-1.88	68	35-76
62013	Sollefteå	960	29	1.33	0.97-1.83	69	37-75
23011	Ljungby	943	29	1.45	1.05-2.00	70	45-76
51010	Uddevalla	1,800	52	1.45	1.13-1.87	71	51-76
51012	Kungälv	1,482	48	1.52	1.17-1.98	72	55-76
26010	Visby	803	32	1.56	1.15-2.12	73	52-76
61011	Bollnäs	2,606	83	1.6	1.30-1.97	74	62-76
61010	Gävle	810	29	1.64	1.20-2.26	75	57-76
10016	Ortopediska huset	3,816	149	1.75	1.49-2.06	76	69-76

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

** Gothenburg Medical Center was discontinued and OrthoCenter IFK kliniken was started 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 2016.

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 and shows the proportion of patients having their surgery for OA, of women, of those younger than 55, those with BMI of 35 and over and those having been classified with ASA III or higher. Please note that the percentages may be misleading for units having reported few surgeries.

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

The private hospitals generally report a lower proportion of patients with ASA ≥3, Bollnäs, Motala, Movement Halmstad and S:t Göran 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 half that in Hässleholm an in Skene <1%. The proportion of patients with ASA ≥3 is twice the national average in Danderyd, Norrtälje, S:t Göran, Södersjukhuset and Södertälje while it is half in Karlshamn, Kullbergska and Trelleborg. In Skene there were no patients with ASA ≥3.

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 19.6% of the patients. Meniscal surgery was most common (7%) followed by arthroscopy (5.4%), cruciate ligament

Patient characteristics and case-mix

Hospital	Number of reports	Complete reports %	% OA	% Women	% <55 years	% BMI 35+	% ASA ≥3
Country	**14,023**	**99.9**	**96.1**	**56.1**	**6.9**	**9.7**	**17.2**
University hospitals							
Akademiska	88	100.0	86.4	47.7	15.9	5.7	21.6
Huddinge	168	98.9	86.3	63.1	7.1	13.1	41.9
Karolinska Solna	98	99.0	62.2	66.3	18.4	12.4	65.3
Lund	122	100.0	74.6	50.0	10.7	14.8	32.8
Umeå	111	99.1	90.1	51.4	13.5	18.9	24.6
Örebro	47	100.0	93.6	63.8	17.0	12.8	25.5
Private units							
ArtClinic Göteborg	55	100.0	100.0	50.9	1.8	3.6	9.1
ArtClinic Jönköping	24	100.0	100.0	33.3	12.5	4.2	0.0
Bollnäs Aleris	344	100.0	97.4	54.7	7.3	3.2	19.5
Carlanderska	156	100.0	97.4	42.3	7.1	8.3	0.0
Elisabethkliniken	7	100.0	100.0	42.9	0.0	0.0	0.0
Kysthospitalet - DK	21	95.3	100.0	52.4	9.5	0.0	0.0
Motala Aleris	552	99.8	96.7	54.0	8.7	9.8	23.2
Movement Halmstad	417	99.5	98.8	53.0	7.9	6.7	20.0
Nacka Aleris	154	100.0	100.0	58.4	3.3	2.0	2.0
OrthoCenter IFK-kliniken	129	99.2	97.7	38.8	7.8	3.9	5.4
OrthoCenter Sthlm	444	99.8	98.4	50.5	7.2	4.7	0.9
Ortopediska huset	623	100.0	99.7	55.2	7.7	5.6	0.6
Sophiahemmet	117	98.3	98.3	38.5	13.7	5.2	12.1
St Göran	470	100.0	96.6	57.5	7.2	6.8	26.4
Ängelholm Aleris	284	100.0	95.4	57.0	5.3	6.0	9.5

*** Kysthospitalet in Denmark reports Swedish patients that they opererate but these are not included in the country results**

surgery (2.1%), osteotomy (1.6%), osteosynthesis (1%) and "other" (1.6%). For 3.3% of the patients more than one previous surgery was stated. The previous surgeries reported are not comprehensive but illustrate what the surgeon knew at the time of the primary arthroplasty.

Patient characteristics and case-mix

Hospital	Number of reports	Complete reports %	% OA	% Women	% <55 years	% BMI 35+	% ASA ≥3
< 100 operations/year							
Borås	74	98.6	94.6	62.2	2.7	23.0	28.8
Eskilstuna	55	100.0	90.9	54.6	9.1	23.6	50.9
Gällivare	53	100.0	100.0	41.5	1.9	11.3	15.1
Helsingborg	41	100.0	97.6	56.1	7.3	24.4	24.4
Hudiksvall	74	100.0	98.7	50.0	5.4	16.2	14.9
Kalmar	90	100.0	88.9	60.0	1.1	7.8	15.6
Nyköping	74	100.0	93.2	55.4	5.4	10.8	16.2
Skellefteå	80	98.8	98.8	55.0	7.5	7.6	28.8
Sundsvall	12	100.0	100.0	58.3	0.0	0.0	41.7
Visby	76	97.4	98.7	55.3	1.3	16.2	18.4
Västervik	99	100.0	99.0	59.6	0.0	12.1	9.1
Ängelholm	53	100.0	94.3	71.7	20.8	15.1	5.7
100-300 operations/year							
Alingsås	160	100.0	99.4	57.5	6.7	17.5	12.5
Arvika	188	100.0	98.4	53.2	3.2	6.4	25.5
Danderyd	187	100.0	91.4	57.2	4.3	10.2	41.7
Eksjö-Nässjö	221	100.0	96.8	56.1	6.8	8.6	12.7
Falun	270	100.0	97.4	58.2	8.2	14.4	25.6
Gävle	147	100.0	91.8	56.5	7.5	13.6	31.3
Halmstad	208	99.5	97.6	58.2	4.3	11.1	18.3
Jönköping	135	100.0	99.3	55.6	5.2	8.2	20.0
Karlskoga	102	99.0	95.1	55.9	8.8	12.9	11.8
Karlstad	162	100.0	97.5	63.0	11.1	10.5	16.7
Kullbergska sjukhuset	156	100.0	96.8	59.0	5.8	10.9	1.3
Kungälv	197	100.0	96.5	54.8	9.6	14.7	9.6
Lidköping	224	100.0	97.8	52.2	8.9	14.7	13.4
Ljungby	150	100.0	95.3	56.0	3.3	6.0	15.3
Lycksele	130	100.0	96.9	64.6	6.6	13.1	9.2
Mora	203	100.0	97.5	53.7	4.4	11.3	9.9
Norrköping	160	99.4	93.8	59.4	5.0	6.3	14.4
Norrtälje	123	99.2	100.0	56.1	3.3	11.5	42.3
Piteå	279	100.0	91.8	59.9	7.2	9.7	24.5
Skene	131	100.0	100.0	53.4	12.2	0.8	0.0
Skövde	114	99.1	93.9	57.9	2.6	10.5	12.47
Sollefteå	102	99.0	95.1	59.8	4.9	14.9	14.7
Södertälje	163	100.0	99.4	68.7	11.0	14.7	33.7
Torsby	108	100.0	98.2	47.2	8.3	10.2	19.4
Uddevalla	244	99.5	93	60.7	2.5	10.3	29.1
Varberg	186	98.4	97.3	49.5	10.2	8.2	11.4
Värnamo	148	95.8	95.1	52.8	2.8	11.3	18.3
Västerås	217	100.0	94.9	66.8	7.8	20.3	22.6
Växjö	101	100.0	97.0	50.5	8.9	9.9	23.8
Örnsköldsvik	143	100.0	95.1	58.0	4.2	9.8	14.0
Östersund	141	100.0	96.6	58.2	7.1	5.7	16.3
> 300 operations/year							
Enköping	346	100.0	95.2	55.2	4.1	9.8	27.8
Hässleholm	707	99.4	98.1	50.5	3.8	5	17.4
Karlshamn	305	99.7	94.8	56.7	5.9	6.6	8
Lindesberg	320	100.0	98.8	58.1	5.6	11.2	13
Mölndal	501	99.4	92.4	60.2	9	8.8	14.6
Oskarshamn	316	99.4	96.7	59.5	6.7	11.4	12.4
Södersjukhuset	320	100.0	94.6	57.8	12.2	10.3	41.8
Trelleborg	823	100.0	99.1	61.1	6.6	14.5	5.9

Prophylactic antibiotics for knee arthroplasties

The table shows what was reported for primary knee arthroplasties in 2016.

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 recommendations of the PRISS project (Prosthetic Related Infections Shall be Stopped). The updated final report is available at 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" thus 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 within the recommended 45-15 minutes. However during 2013-2016 the proportion has lessened to 80%.

Prophylactic antibiotics

Hospital	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	**14,023**	**99,9**	**99,7**	**83,4**	**80,4**	**42**
University hospitals						
Akademiska	88	99.6	100.0	87.5	19.3	1.1
Huddinge	168	100.0	100.0	87.5	72.0	39.3
Karolinska Solna	98	99.5	99.0	84.5	88.8	57.1
Lund	122	100.0	100.0	57.4	63.1	28.7
Umeå	111	99.5	99.1	90.9	86.5	37.8
Örebro	47	100.0	100.0	87.2	70.2	34.0
Private units						
ArtClinic Göteborg	55	100.0	100.0	94.6	89.1	45.5
ArtClinic Jönköping	24	100.0	100.0	100	95.8	62.5
Bollnäs Aleris	344	100.0	100.0	97.4	92.7	43.3
Carlanderska	156	100.0	100.0	96.8	89.7	26.9
Elisabethkliniken	7	100.0	100.0	0.0	71.4	74.4
Kysthospitalet - DK*	21	92.6	95.2	55.0	90.5	0.0
Motala Aleris	552	99.8	99.8	98.9	87.3	39.7
Movement Halmstad	417	99.6	99.3	98.3	79.9	14.9
Nacka Aleris	154	100.0	100.0	95.5	75.3	60.4
OrthoCenter IFK	129	99.6	99.2	89.8	89.9	79.8
OrthoCenter Sthlm	444	100.0	100.0	99.6	98.4	48.9
Ortopediska huset	623	100.0	100.0	97.0	80.7	23.0
Sophiahemmet	117	100.0	100.0	92.3	59.0	42.7
St Göran	470	99.9	99.8	97.7	89.6	23.6
Ängelholm Aleris	284	99.9	99.7	91.9	89.8	37.2

*** Kysthospitalet in Denmark reports Swedish patients that they opererate but these are not included in the country results**

Only few units have implemented the latest recommendation (Orthocenter-IFK and Sollefteå) and in 2016, only 42% 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 Skövde.

Prophylactic antibiotics

Hospital	Number of reports	Complete reports %	% having Cloxacillin or Dalacine	% 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	74	99.3	98.7	91.8	73.0	40.5
Eskilstuna	55	100.0	100.0	96.4	76.4	41.8
Gällivare	53	100.0	100.0	100.0	69.8	32.1
Helsingborg	41	100.0	100.0	95.1	80.5	53.7
Hudiksvall	74	100.0	100.0	94.6	83.8	35.1
Kalmar	90	100.0	100.0	93.3	94.4	30.0
Nyköping	74	100.0	100.0	60.8	82.4	44.6
Skellefteå	80	100.0	100.0	93.8	82.5	38.8
Sundsvall	12	100.0	100.0	100.0	66.7	66.7
Visby	76	100.0	100.0	92.1	72.4	44.7
Västervik	99	99.5	99.0	4.1	80.8	54.6
Ängelholm	53	100.0	100.0	92.5	73.6	34.0
100-300 operations/year						
Alingsås	160	100.0	100.0	98.1	84.4	70.0
Arvika	188	100.0	100.0	97.3	58.5	47.3
Danderyd	187	99.2	98.4	85.9	73.3	38.5
Eksjö-Nässjö	221	100.0	100.0	94.6	86.0	60.2
Falun	270	100.0	100.0	6.3	86.3	43.0
Gävle	147	100.0	95.9	93.6	79.6	37.4
Halmstad	208	100.0	100.0	94.7	77.4	34.6
Jönköping	135	100.0	100.0	98.5	74.0	54.1
Karlskoga	102	100.0	100.0	94.1	80.4	42.2
Karlstad	162	99.7	99.4	95.7	70.4	56.2
Kullbergska sjukhuset	156	99.4	99.4	94.8	78.2	58.3
Kungälv	197	100.0	100.0	98.0	83.3	46.7
Lidköping	224	100.0	100.0	95.1	93.8	64.7
Ljungby	150	99.0	98.0	95.2	84.0	62.7
Lycksele	130	100.0	100.0	98.5	60.0	40.8
Mora	203	100.0	100.0	1.5	79.8	52.7
Norrköping	160	98.4	100.0	95.0	85.0	48.1
Norrtälje	123	98.9	100.0	93.5	78.7	41.5
Piteå	279	99.8	100.0	97.5	93.2	27.2
Skene	131	100.0	100.0	99.2	89.3	56.5
Skövde	114	100.0	100.0	95.6	36.0	28.1
Sollefteå	102	100.0	100.0	96.1	93.1	86.3
Södertälje	163	100.0	100.0	93.9	79.1	43.6
Torsby	108	99.1	98.2	100.0	83.3	57.4
Uddevalla	244	99.4	99.2	97.1	82.4	54.9
Varberg	186	100.0	99.5	75.7	83.3	50.5
Värnamo	148	98.0	100.0	97.2	77.5	53.5
Västerås	217	99.8	100.0	89.4	76.0	49.8
Växjö	101	100.0	100.0	96.0	81.2	45.5
Örnsköldsvik	143	99.7	99.3	92.3	83.2	48.3
Östersund	141	99.6	100.0	94.3	91.5	44.0
> 300 operations/year						
Enköping	346	99.9	99.7	89.9	86.4	46.0
Hässleholm	707	99.7	99.7	2.0	70.7	38.7
Karlshamn	305	100.0	99.7	67.1	86.6	23.9
Lindesberg	320	99.8	99.7	90.6	73.8	39.7
Mölndal	501	99.6	99.4	91.8	71.8	45.0
Oskarshamn	316	99.7	99.4	15.3	80.1	31.3
Södersjukhuset	320	100.0	100.0	95.6	73.1	50.6
Trelleborg	823	99.9	100.0	96.4	78.4	49.9

Antithrombotic prophylaxis for knee arthroplasties

The table ”Antithrombotic prophylaxis” shows what the hospitals reported having administrated for primary knee arthroplasties in 2016.

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. 80% of the surgeries it is reported that it the intention is to use injectable drugs but since 2009 the proportion has varied between 78% and 83%.

The duration of the planned prophylaxis has been relatively constant since SKAR started registering this variable in 2009 with 77-79% of the surgeries having a planned duration of 8-14 day antithrombotic prophylaxis (see previous reports). However, in 2016 the proportion was somewhat lower (73%) with a larger proportion being planned to have a shorter prophylaxis (19.5%).

Antithrombotic prophylaxis

Hospital	Number of reports	Complete reports %	Percent starting postoperatively	Percent having injection	Percent treated for 8-14 days
Country	**14,023**	**99.0**	**88.7**	**79.8**	**72.8**
University hospitals					
Akademiska	88	100.0	45.4	46.5	81.6
Huddinge	168	99.6	98.2	100.0	94.0
Karolinska Solna	98	99.0	44.3	100.0	5.2
Lund	122	99.2	94.2	99.2	26.5
Umeå	111	99.7	98.2	9.0	99.1
Örebro	47	100.0	91.5	4.3	93.6
Private units					
ArtClinic Göteborg	55	100.0	98.2	5.5	96.4
ArtClinic Jönköping	24	100.0	100.0	0.0	100.0
Bollnäs Aleris	344	99.6	94.8	100.0	97.1
Carlanderska	156	99.6	93.6	2.6	98.1
Elisabethkliniken	7	100.0	85.7	100.0	100.0
Kysthospitalet - DK	21	100.0	90.5	100.0	0.0
Motala Aleris	552	99.6	97.5	99.8	98.0
Movement Halmstad	417	99.9	97.8	99.8	0.2
Nacka Aleris	154	100.0	98.7	100.0	100.0
OrthoCenter IFK	129	100.0	98.5	3.9	96.9
OrthoCenter Sthlm	444	100.0	93.7	100.0	97.8
Ortopediska huset	623	100.0	96.6	100.0	99.0
Sophiahemmet	117	99.1	93.2	100.0	61.4
St Göran	470	99.9	93.2	99.8	96.2
Ängelholm Aleris	284	100.0	96.5	88.0	98.2

*** Kysthospitalet in Denmark reports Swedish patients that they opererate but these are not included in the country results**

Antithrombotic prophylaxis

Hospital	Number of reports	Complete reports %	Percent starting postoperatively	Percent having injection	Percent treated for 8-14 days
Country	14,023	99.0	88.7	79.8	72.8
< 100 operations/year					
Borås	74	100.0	89.2	98.7	91.9
Eskilstuna	55	100.0	90.9	100.0	92.7
Gällivare	53	99.4	81.1	100.0	51.9
Helsingborg	41	100.0	82.9	100.0	100.0
Hudiksvall	74	100.0	73.0	100.0	100.0
Kalmar	90	99.3	90.0	100.0	88.6
Nyköping	74	99.5	98.7	100.0	97.3
Skellefteå	80	100.0	98.8	100.0	100.0
Sundsvall	12	97.0	91.7	16.7	90.9
Visby	76	99.6	89.5	100.0	92.0
Västervik	99	98.7	90.9	100.0	91.6
Ängelholm	53	100.0	90.6	90.6	94.3
100-300 operations/year					
Alingsås	160	100.0	98.8	100.0	98.1
Arvika	188	99.5	94.1	10.2	92.0
Danderyd	187	99.3	86.6	100.0	88.1
Eksjö-Nässjö	221	100.0	93.2	89.1	98.6
Falun	270	99.9	92.6	57.8	42.0
Gävle	147	99.1	90.3	100.0	89.1
Halmstad	208	99.5	91.4	99.5	2.0
Jönköping	135	100.0	80.0	18.5	91.2
Karlskoga	102	100.0	66.7	36.3	96.1
Karlstad	162	99.4	96.9	6.8	93.7
Kullbergska sjukhuset	156	100.0	98.7	99.4	93.0
Kungälv	197	99.5	91.4	98.9	93.8
Lidköping	224	99.4	88.8	14.3	90.9
Ljungby	150	99.8	6.7	100.0	96.0
Lycksele	130	100.0	12.3	99.2	92.9
Mora	203	100.0	91.6	4.9	94.6
Norrköping	160	99.8	95.0	100.0	93.8
Norrtälje	123	99.7	89.4	78.9	23.0
Piteå	279	100.0	38.7	99.6	3.2
Skene	131	100.0	98.5	100.0	74.1
Skövde	114	99.4	93.8	96.5	96.5
Sollefteå	102	99.7	97.1	100.0	99.0
Södertälje	163	100.0	96.9	100.0	76.7
Torsby	108	99.4	93.5	12.2	86.1
Uddevalla	244	99.6	92.2	99.6	95.4
Varberg	186	100.0	88.2	98.9	26.9
Värnamo	148	95.5	44.7	100.0	90.9
Västerås	217	98.8	92.6	7.5	93.5
Växjö	101	98.7	30.3	100.0	87.1
Örnsköldsvik	143	100.0	88.8	7.7	90.9
Östersund	141	100.0	89.4	100.0	96.5
> 300 operations/year					
Enköping	346	99.5	88.7	88.4	70.8
Hässleholm	707	99.8	99.2	100.0	1.4
Karlshamn	305	100.0	95.7	99.7	94.1
Lindesberg	320	99.8	70.9	30.9	70.8
Mölndal	501	99.5	92.0	9.6	95.8
Oskarshamn	316	99.7	87.9	100.0	96.8
Södersjukhuset	320	99.3	90.6	94.7	89.5
Trelleborg	823	99.9	98.4	100.0	4.7

Surgical technique for knee arthroplasties

The table ”Surgical technique” shows what the hospitals reported for having used in their primary knee arthroplasties in 2016.

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 (69.7%) but the proportion having general anesthesia has been increasing (29.5%) has tripled since 2011. Bollnäs, Hässleholm. Nacka, Karlshamn and Södertälje report more than 80% of their arthroplasties being performed using general anesthesia.

The use of drains has lessened from 26% in 2011 to 3.2% in 2016. The number of surgeries performed using tourniquet lessened from 90% in 2011 to 55% in 2016.

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 from 40 minutes to almost two hours. For TKA's it was 74 min., for UKA's 68 min., for femoropatellar arthroplasties 67 min. and for linked implants 159 min. Since 2009, the median operating time for TKA's has varied between 71 and 82 min. and for UKA's between 68 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 (58%) than in the tibia (49%).

Computer aided surgery (CAS) was only reported for 11 cases (0.1%) at 7 units (14 in 2015).
No UKA's were reported having been performed using CAS.

Surgical technique

Hospital	Number of reports	Complete reports %	Percent having General anesthesia	Percent Drainage	Percent Tourniquet	Percent LIA	Median Op-time
Country	**14,023**	**99.9**	**29.5**	**3.2**	**54.5**	**95.2**	**73**
University Hospitals							
Akademiska	88	99.7	22.1	1.1	92.1	95.5	77
Huddinge	168	99.6	16.7	1.2	16.1	89.2	120
Karolinska Solna	98	99.7	12.2	8.3	91.8	82.7	86
Lund	122	99.6	61.2	1.6	23.8	93.4	76
Umeå	111	99.5	22.5	4.5	85.5	84.6	113
Örebro	47	100.0	61.7	0.0	89.4	93.6	94
Private units							
ArtClinic Göteborg	55	100.0	1.8	0.0	96.3	94.6	79
ArtClinic Jönköping	24	100.0	83.3	0.0	100.0	100.0	91
Bollnäs Aleris	344	100.0	88.1	0.6	74.7	97.7	53
Carlanderska	156	99.7	12.8	1.9	100.0	98.1	50
Elisabethkliniken	7	100.0	0.0	0.0	100.0	100.0	112
Kysthospitalet - DK*	21	100.0	81.0	0.0	100.0	95.2	75
Motala Aleris	552	100.0	6.5	32.7	45.8	98.9	46
Movement Halmstad	417	99.9	7.2	0.5	11.1	97.8	69
Nacka Aleris	154	99.5	100.0	0.0	1.3	98.0	61
OrthoCenter IFK	129	99.6	16.3	0.0	0.0	59.7	78
OrthoCenter Sthlm	444	99.9	3.8	0.5	71.2	96.8	63
Ortopediska huset	623	100.0	70.8	0.8	84.0	97.3	56
Sophiahemmet	117	99.6	29.9	45.7	61.5	80.2	73
St Göran	470	99.8	14.3	0.9	98.1	94.0	61
Ängelholm Aleris	284	100.0	48.2	0.7	56.5	98.6	57

*** Kysthospitalet in Denmark reports Swedish patients that they opererate but these are not included in the country results**

The number of cases using custom made instruments/cutting blocks increased from 280 in 2015 to 351 (2.5%) in 2016. 29 units reported having used such instruments, most having only done a few. Movement Halmstad accounted for two thirds of of the cases (240).

Surgical technique

Hospital	Number of reports	Complete reports %	Percent having General anaesthesia	Percent Drainage	Percent Tourniquet	Percent LIA**	Median Op-time
< 100 operations/year							
Borås	74	100.0	24.3	0.0	82.4	73.0	102
Eskilstuna	55	100.0	10.9	0.0	14.6	98.2	111
Gällivare	53	100.0	3.8	1.9	28.3	98.1	109
Helsingborg	41	100.0	22.0	4.9	2.4	100.0	86
Hudiksvall	74	100.0	21.6	1.4	41.9	93.2	84
Kalmar	90	100.0	24.4	0.0	0.0	88.9	86
Nyköping	74	99.7	5.4	6.8	1.4	96.0	85
Skellefteå	80	99.7	3.8	0.0	100.0	97.5	93
Sundsvall	12	100.0	8.3	16.7	0.0	91.7	130
Visby	76	100.0	15.8	0.0	61.8	97.4	107
Västervik	99	100.0	31.3	3.0	22.2	98.0	87
Ängelholm	53	100.0	67.9	1.9	7.6	98.1	84
100-300 operations/year							
Alingsås	160	100.0	10.6	0.6	63.8	93.8	78
Arvika	188	99.9	7.5	1.1	0.5	97.9	62
Danderyd	187	100.0	10.2	1.1	64.2	91.4	93
Eksjö-Nässjö	221	100.0	23.1	0.9	36.2	99.1	69
Falun	270	100.0	36.3	2.6	96.3	98.5	69
Gävle	147	100.0	33.3	7.5	85.7	95.2	70
Halmstad	208	100.0	13.0	23.6	95.7	96.6	83
Jönköping	135	100.0	21.5	0.0	98.5	100.0	95
Karlskoga	102	99.5	20.8	0.0	73.3	98.0	102
Karlstad	162	100.0	21.0	1.2	0.6	97.5	62
Kullbergska sjukhuset	156	100.0	19.2	3.9	48.7	95.5	101
Kungälv	197	99.9	28.6	1.0	17.3	98.5	93
Lidköping	224	100.0	10.3	0.9	16.1	98.2	88
Ljungby	150	100.0	34.0	0.0	48.0	96.7	73
Lycksele	130	100.0	5.4	3.1	97.7	73.9	86
Mora	203	99.9	8.4	0.5	99.0	98.5	54
Norrköping	160	100.0	15.0	0.0	20.6	94.4	89
Norrtälje	123	100.0	18.7	0.0	73.2	85.4	82
Piteå	279	100.0	7.2	1.4	92.8	98.2	68
Skene	131	100.0	13.0	0.8	82.4	93.9	95
Skövde	114	100.0	28.1	0.9	38.6	96.5	82
Sollefteå	102	98.8	8.9	2.0	90.2	97.1	80
Södertälje	163	100.0	90.8	1.2	0.6	100.0	62
Torsby	108	100.0	9.3	0.0	16.7	98.2	62
Uddevalla	244	100.0	7.4	6.6	96.7	98.4	86
Varberg	186	100.0	15.1	1.1	31.7	78.0	88
Värnamo	148	95.9	16.2	0.7	90.1	97.9	100
Västerås	217	100.0	12.4	0.5	41.0	96.8	79
Växjö	101	100.0	25.7	0.0	16.8	95.1	94
Örnsköldsvik	143	100.0	12.6	0.0	100.0	99.3	79
Östersund	141	100.0	12.8	0.7	63.8	98.6	108
> 300 operations/year							
Enköping	346	99.5	17.1	0.6	95.3	98.6	75
Hässleholm	707	99.9	87.7	0.3	1.8	98.4	40
Karlshamn	305	100.0	90.2	0.3	87.9	97.1	75
Lindesberg	320	100.0	25.3	0.9	97.2	98.4	92
Mölndal	501	99.9	29.6	0.8	1.0	95.0	91
Oskarshamn	316	100.0	9.8	0.3	88.0	70.9	73
Södersjukhuset	320	99.8	15.6	10.3	0.9	94.7	76
Trelleborg	823	99.9	29.0	0.0	51.3	99.5	7

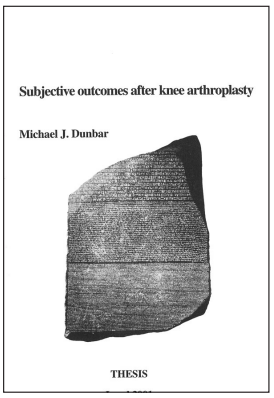
Patient reported outcome before and after knee arthroplasty

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 2013 Oskarshamn joined and their one-year results for patients operated in 2013 are presented in this report (see page 63). Kalmar, Karolinska in Solna and OrthoCenter Stockholm started 2014 to report and their preoperative data can also be found in this report. Mölndal has however chosen to only register EQ-5D, VAS pain and satisfaction with the surgery one year postoperatively and not the disease specific KOOS. Still more units joined in 2015 and additional ones have expressed their interest and started the work to establish the project at their hospitals and to find resources for the gathering of PROM data. Below there is a summary of the PROM data of patients having primary knee arthroplasty which are presented descriptively for the respective hospitals and the year of surgery.

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).

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 76-77.

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 74, 76 and 77.

Case-mix

A summary of case-mix factors such as gender, age, diagnosis, BMI and comorbidity is shown for the respective hospitals on page 62-63.

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

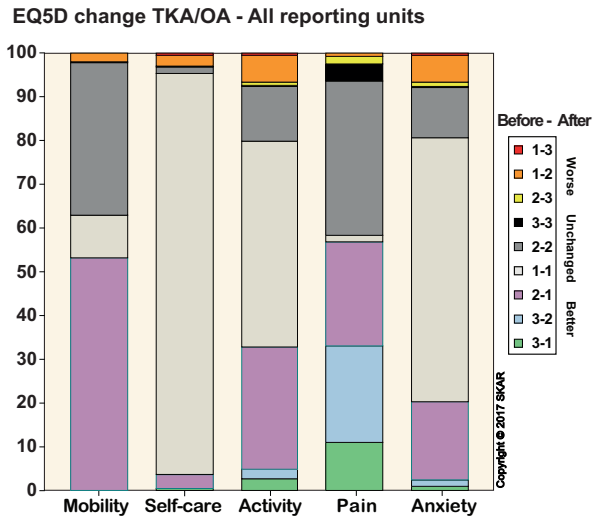
EQ5D

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 a good 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

For units with high response rates (Hässleholm, Norrköping, OrthoCenter Stockholm, Oskarshamn and Trelleborg) the differences between the units were small (0-10 points) both pre- and postoperatively when the patients operated 2015 estimated their general health. For units with few patients and/or low response rate the variation in the patient estimates was slightly larger (0-11 points). In 2016, the preoperative differences were also small (0-18 points).

VAS – Knee pain

The difference in preoperative knee pain of patients operated 2016 in Hässleholm, Kalmar, OrthoCenter Stockholm, Oskarshamn och Trelleborg was small between the units (0-3 points). One year postoperatively the differences were also similar (0-5 points). For the other units the differences were also small, 0-7 points preoperatively and 0-13points one year postoperatively.

VAS – Satisfaction with the surgery

One year postoperatively, 71 % of the patients had reported their satisfaction with their arthroplasty surgery.

The table below shows the number of complete reports, together with the mean and standard deviation (SD) for the satisfaction with the surgery one year after it had been performed (in 2015).

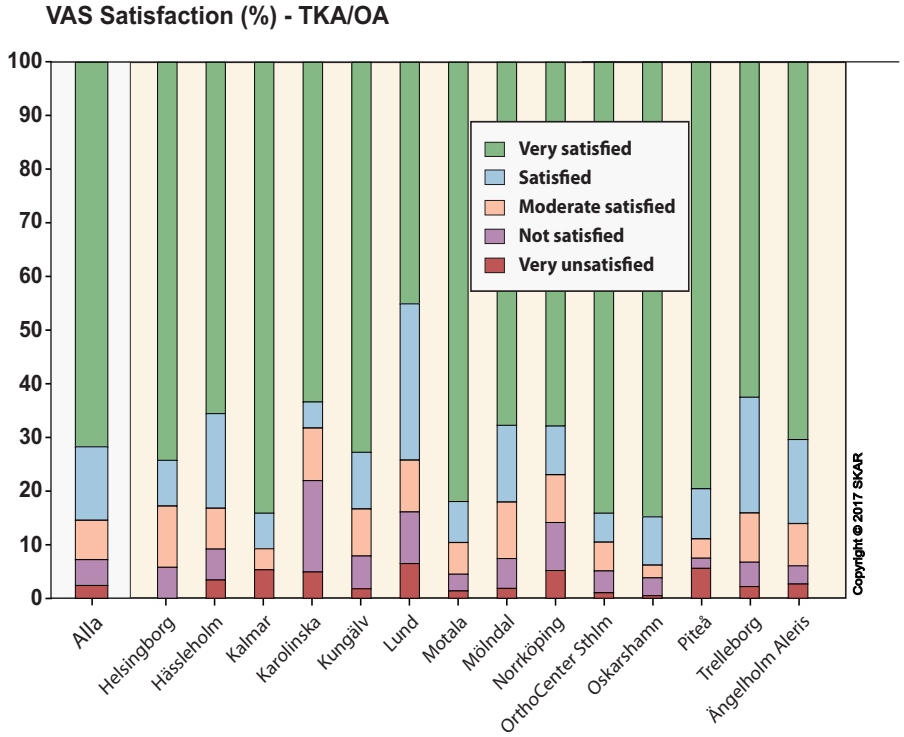
Satisfaction one year after surgery (2015)
VAS (0-100) (worst - best)

Hospital	Number of reports	Complete reports (%)	Postop Mean (SD)
All units	3,562	71	18 (23)
Helsingborg	63	56	17 (24)
Hässleholm	579	82	20 (24)
Kalmar	80	95	14 (23)
Karolinska	72	57	28 (31)
Kungälv	171	68	19 (23)
Lund	54	59	30 (26)
Motala	357	62	14 (20)
Mölndal	331	61	19 (24)
Norrköping	117	68	24 (29)
OrthoCenter Sthlm	389	81	13 (22)
Oskarshamn	258	82	11 (18)
Piteå	210	27	14 (24)
Trelleborg	691	81	20 (22)
Ängelholm Aleris	191	61	18 (22)

As described on page 71, the patient satisfaction one year after surgery was categorized into 5 groups based on the VAS scale marking.

Using this definition, 85% of the patients reported that the were satisfied or very satisfied with the surgery.

The figure below shows that among the hospitals with a relatively complete reporting, the highest proportion of satisfied patients was in Oskarshamn (94%), Kalmar (91%) and OrthoCenter Stockholm (90%) followed by Trelleborg (84%) and Hässleholm (83%). For the other hospitals the proportion of satisfied patients varied from 69-90%



The preoperative as well as the 1-year postoperative EQ-VAS and VAS knee pain are shown for patients operated in 2015 in the table on the next page. For patients operated in 2016 there are at present only preoperative data.

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						
2015	3,562	71	65 (18)	17 (20)	66 (22)	76 (20)
2016	4,561	84	65 (17)		65 (22)	
Hospital:						
Alingsås						
2016 (nov-dec)	20	85	47	41 (14)		48 (17)
Bollnäs						
2016	288	92	41	41 (15)		45 (18)
Eksjö-Nässjö						
2016 (maj-dec)	136	92	52,9	44 (16)		50 (19)
Helsingborg						
2015	63	56	51,4	39 (15)	75 (23)	42 (19)
2016	40	78	51,6	41 (13)		46 (19)
Huddinge						
2016 (juni-dec)	46	52	54,6	35 (18)		41 (18)
Hässleholm						
2015	579	82	40,9	39 (15)	80 (19)	47 (17)
2016	572	95	44,5	38 (14)		46 (17)
Kalmar						
2015	80	95	38,7	43 (16)	83 (18)	50 (16)
2016	78	97	37,8	46 (14)		55 (15)
Karlskoga						
2016 (april-dec)	58	38	27,3	41 (14)		49 (18)
Karolinska						
2015	72	57	53,7	37 (15)	73 (20)	40 (16)
2016	57	58	51,5	34 (15)		42 (18)
Kungälv						
2015	171	68	56,2	39 (14)	79 (19)	44 (18)
2016	152	89	49,6	38 (17)		45 (20)
Lindesberg						
2016 (juni-dec)	173	62	37,7	36 (15)		43 (18)
Lund						
2015	54	59	65,6	39 (15)	74 (18)	55 (20)
2016	82	78	46,9	41 (14)		48 (17)
Motala						
2015	357	62	42,9	39(15)	82 (18)	43 (17)
2016	260	77	39,9	40 (16)		45 (17)
Mölndal						
2015	331	0	46,6			
2016	423	0	47,3			
Norrköping						
2015	117	68	46,8	39 (14)	78 (21)	45 (19)
2016	147	87	49,6	33 (14)		38 (16)
OrthoCenter Sthlm						
2015	389	81	37,7	41 (16)	83 (18)	46 (18)
2016	407	96	37,7	44 (15)		48 (18)
Oskarshamn						
2015	258	82	47,3	41 (15)	84 (16)	48 (17)
2016	297	89	41,7	40 (14)		47 (17)
Piteå						
2015	210	27	49,1	35 (14)	82 (20)	42 (16)
2016	237	8	60	35 (14)		39 (18)
Södertälje						
2016	152	87	50,8	38 (13)		47 (17)
Trelleborg						
2015	691	81	37,8	41 (15)	80 (18)	48 (17)
2016	709	93	42,6	41 (16)		47 (18)
Ängelholm Aleris						
2015	190	61	64 (15)	20 (21)	58 (25)	78 (19)
2016	227	99	62 (15)		57 (22)	

KOOS

The differences were small between those units having a relatively high response rate in 2015 (Hässleholm, Kalmar, OrthoCenter Stockholm, Oskarshamn and Trelleborg). For units with few patients and/or low response rate the results vary and are difficult to interpret. In 2015, the preoperative differences were small with the exception of Karolinska in Solna and Norrköping where the patients reported slightly worse outcome.

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 2015 both the pre- and postoperative results are shown but for patients operated in 2016 only preoperative results are available (see table on next page).

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, 91% of those in Kalmar and 90% of those operated in OrthoCenter Stockholm were very satisfied or satisfied one year after their knee arthroplasty surgery.

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.

Results for KOOS preoperatively (surgeries 2015 & 2016) as well as 1 year postoperatively (surgeries 2015)

				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													
2015	3,231	72	43.8	40 (15)	81 (19)	46 (18)	78 (17)	46 (16)	80 (19)	12 (15)	39 (28)	22 (13)	65 (24)
2016	4,138	84	44.8	40 (15)		46 (18)		45 (16)		11 (14)		22 (14)	
Hospital:													
Alingsås													
2016 (nov-dec)	20	85	47.0	41 (14)		48 (17)		44 (18)		14 (14)		23 (13)	
Bollnäs													
2016	288	92	41.0	41 (15)		45 (18)		46 (16)		11 (14)		21 (13)	
Eksjö-Nässjö													
2016 (maj-dec)	136	92	52.9	44 (16)		50 (19)		50 (19)		14 (15)		25 (15)	
Helsingborg													
2015	63	56	51.4	39 (15)	75 (23)	42 (19)	73 (21)	43 (14)	74 (21)	8 (12)	30 (27)	16 (11)	59 (28)
2016	40	78	51.6	41 (13)		46 (19)		40 (12)		10 (18)		19 (11)	
Huddinge													
2016 (juni-dec)	46	52	54.6	35 (18)		41 (18)		37 (21)		12 (17)		21 (17)	
Hässleholm													
2015	579	82	40.9	39 (15)	80 (19)	47 (17)	78 (17)	44 (16)	79 (19)	12 (15)	42 (28)	23 (13)	66 (23)
2016	572	95	44.5	38 (14)		46 (17)		44 (15)		11 (13)		23 (14)	
Kalmar													
2015	80	95	38.7	43 (16)	83 (18)	50 (16)	81 (16)	48 (15)	80 (19)	17 (19)	42 (28)	24 (14)	71 (23)
2016	78	97	37.8	46 (14)		55 (15)		52 (14)		15 (17)		27 (13)	
Karlskoga													
2016 (april-dec)	58	38	27.3	41 (14)		49 (18)		47 (18)		11 (11)		25 (13)	
Karolinska													
2015	72	57	53.7	37 (15)	73 (20)	40 (16)	70 (19)	40 (18)	65 (23)	9 (13)	28 (27)	19 (13)	53 (26)
2016	57	58	51.5	34 (15)		42 (18)		37 (17)		8 (19)		13 (12)	
Kungälv													
2015	171	68	56.2	39 (14)	79 (19)	44 (18)	76 (18)	46 (16)	78 (20)	11 (16)	34 (27)	21 (14)	60 (24)
2016	152	89	49.6	38 (17)		45 (20)		46 (19)		7 (11)		19 (14)	
Lindesberg													
2016 (juni-dec)	173	62	37.7	36 (15)		43 (18)		43 (14)		10 (13)		19 (13)	

Results for KOOS preoperatively (surgeries 2015 & 2016) as well as 1 year postoperatively (surgeries 2015)

				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													
2015	3,231	72	43.8	40 (15)	81 (19)	46 (18)	78 (17)	46 (16)	80 (19)	12 (15)	39 (28)	22 (13)	65 (24)
2016	4,138	84	44.8	40 (15)		46 (18)		45 (16)		11 (14)		22 (14)	
Hospital													
Lund													
2015	54	59	65.6	39 (15)	74 (18)	55 (20)	74 (16)	41 (15)	68 (21)	12(21)	34 (30)	20 (16)	60 (22)
2016	82	78	46.9	41 (14)		48 (17)		44 (18)		13 (17)		22 (15)	
Motala													
2015	357	62	42.9	39(15)	82 (18)	43 (17)	80 (17)	44 (16)	80 (19)	11 (14)	39 (28)	21 (13)	66 (23)
2016	260	77	39.9	40 (16)		45 (17)		45 (17)		11 (15)		22 (14)	
Mölndal													
2015	331	0	46.6										
2016	423	0	47.3										
Norrköping													
2015	117	68	46.8	39 (14)	78 (21)	45 (19)	74 (18)	44 (17)	72 (21)	9 (11)	23 (23)	21 (13)	58 (27)
2016	147	87	49.6	33 (14)		38 (16)		40 (15)		6 (8)		17 (11)	
OrthoCenter Sthlm													
2015	389	81	37.7	41 (16)	83 (18)	46 (18)	79 (16)	49 (17)	83 (17)	12 (16)	41 (28)	21 (14)	66 (23)
2016	407	96	37.7	44 (15)		48 (18)		51 (16)		13 (14)		23 (13)	
Oskarshamn													
2015	258	82	47.3	41 (15)	84 (16)	48 (17)	81 (15)	46 (16)	82 (16)	11 (14)	40 (27)	21 (13)	69 (22)
2016	297	89	41.7	40 (14)		47 (17)		45 (14)		11 (13)		22 (14)	
Piteå													
2015	210	27	49.1	35 (14)	82 (20)	42 (16)	79 (20)	43 (15)	81 (21)	10 (15)	45 (27)	19 (11)	67 (26)
2016	237	8	60.0	35 (14)		39 (18)		41 (15)		5 (7)		15 (11)	
Södertälje													
2016	152	87	50.8	38 (13)		47 (17)		43 (15)		9 (11)		21 (14)	
Trelleborg													
2015	691	81	37.8	41 (15)	80 (18)	48 (17)	77 (16)	47 (16)	80 (19)	12 (15)	37 (28)	24 (13)	65 (23)
2016	709	93	42,6	41 (16)		47 (18)		47 (17)		11 (15)		23 (14)	
Ängelholm Aleris													
2015	190	61	-	39 (14)	80 (20)	42 (16)	80 (17)	43 (15)	81 (18)	8 (10)	41 (29)	19 (13)	65 (24)
2016	227	99	-	39 (15)		46 (17)		44 (16)		9 (13)		19 (13)	

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 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.

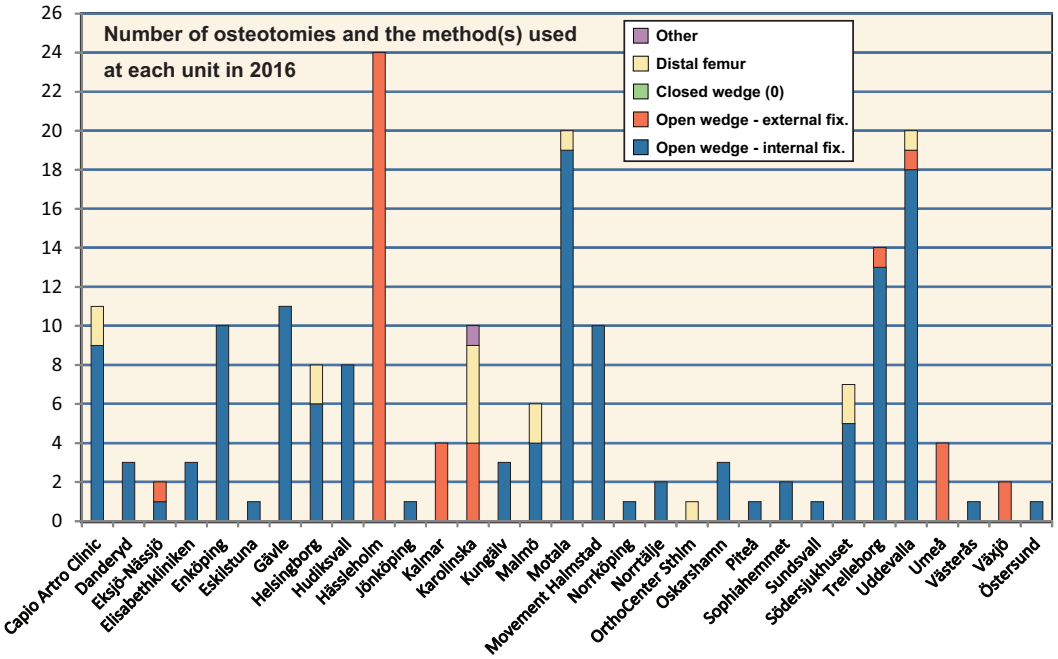
Sweden became the first country in the world to start a national osteotomy registration as a complement to the knee arthroplasty registry (W-Dahl et al. 2014).

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 2016, 196 osteotomies were reported from 31 hospitals. As the figure below shows, only 9 hospitals reported having performed 10 or more osteotomies during the year.

The hospital performing most was Hässleholm that did 24. As compared to 2015 more osteotomies have been reported from somewhat fewer hospitals.

It is difficult to know how many of the osteotomies performed in the country are captured by the register. The surgical codes NGK59 and NFK59 that the health authorities register 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 principal diagnoses that had been used together with these codes. With help of the Registerservice by the Swedish Association of Local Authorities and Regions we have started a project of selecting reasonable ICD10 diagnostic codes that have to be combined with the surgical codes above in order to better be able to assess the completeness of the osteotomy register.



Patient characteristics and case-mix in knee osteotomy surgery

Results

The following pages show the results for the knee osteotomies that were reported in 2016.

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

68% of the patients were males and the median age was 50 years that can be compared to the median age in 2016 for TKA patients (69) and UKA (64). Almost two thirds of the patients were reported as healthy (ASA class I) and having a BMI less than 30 kg/m^2. The majority had medial osteoarthritis of grade 1-2 according to the Ahlbäck classification and the median axis deviation was 7 degrees. Patients having distal femur osteotomy were younger, most were women and the axis deviation was similar as for those having proximal tibia osteotomy (see below).

Patient characteristics - osteotomies

	All n=196	Prox. Tibia n=179 (91%)	Dist. Femur n=16 (8%)
Age (years)			
median (range)	50 (18-75)	51 (18-75)	36 (21-55)
Gender			
Men - n (%)	133 (68)	126 (70)	6
Women - n (%)	63 (32)	53 (30)	10
Preop HKA angle, n=192			
median (range)	7 (0-45)	7 (0-45)	7 (4-15)
ASA classification, n=190			
ASA I - n (%)	117 (61)	106 (61)	11
ASA II - n (%)	66 (35)	65 (37)	1
ASA III - n (%)	7 (4)	3 (2)	3
OA type, n=170			
Medial n (%)	153 (90)	153 (94)	0
Lateral n (%)	11 (6)	4 (3)	7
OA grade, n=177			
Ahlbäck 1 - n (%)	69 (39)	65 (38)	4
Ahlbäck 2 - n (%)	91 (51)	88 (52)	3
Ahlbäck 3 - n (%)	17 (10)	16 (10)	1

Body Mass Index (kg/m^2)

BMI group	Number	Percent
<25	40	20
25-29.9	96	49
30-34.9	45	23
35-39.9	10	5
40+	0	0
Missing	5	3
Total	196	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 60% of the patients and more than one surgery for 14%. This can be compared to the knee arthroplasty patients ow 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 arthroplasty.

Previous surgery in the index knee

Surgery	Number	Percent
None	77	39.3
Fracture surgery	6	3
Meniscal surgery	36	18.4
Cruciate surgery	16	8.2
Arthroscopy	40	20.4
Other	11	5.6
Missing	10	5.1
Total	196	100

Reason for and type of osteotomy

The majority of the surgeries (87%) 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 but for a long time this was the standard treatment for osteoarthritis in Sweden.

Reason for the osteotomy

Diagnosis	Number	Percent
Osteoarthritis	170	86.7
Acquired deformity	11	5.7
Congenital deformity	3	1.5
Instability	5	2.6
Osteonecrosis	2	1
Other	3	1.5
Missing	2	1.0
Total	196	100

Type of osteotomy

Type	Number	Percent
Open wedge intern fixation	137	69.9
Open wedge extern fixation	42	21.4
Closed wedge	0	0
Curved/Dome	0	0
Distal femur	16	8.2
Double osteotomy	1	0.5
Missing	0	0
Total	196	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	67	48.9
CountureLock	8	5.8
Puddu	38	27.8
iBalance	8	5.8
OTIS	3	2.2
Peek power	12	8.8
Other	1	0.7
Missing	0	0.0
Total	137	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 bank bone and auto transplantation (see table). OSferion was the most commonly used synthetic bone.

Transplantation of bone in open wedge osteotomy with internal fixation

Bone transplantate		Number	Percent
None		63	46.0
Auto transplantation		10	7.3
Bank bone		11	8.0
Synthetic bone		52	38.0
Missing		1	0.7
	Total	137	100
Synthetic bone:			
DePuy/Synthes Chronos		7	
OSferion		33	
OTIS		4	
Quickset		7	
Missing		1	

Open wedge osteotomy with external fixation

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

Type of fixation in open wedge osteotomy with external fixation

Type	Number
Orthofix	34
Monotube	2
Taylor spatial frame	5
Missing	1
Total	42

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	1
Tomofix	7
Puddu	4
Annat	3
Missing	1
Totalt	16

Simultaneous surgery

An additional simultaneous surgery was reported to have been performed together with the osteotomy in 41 (21%) cases. Arthroscopy was the most common simultaneous procedure (see below).

Simultaneous surgery with the osteotomy

Surgery	Number	Percent
None	145	74.0
Arthroscopy	29	14.7
Cruciate surgery	6	3.1
Meniscal surgery	0	0.0
Other	10	5.1
Missing	6	3.1
Total	196	100

Type of anesthesia

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

.

Type of anesthesia

Type	Number	Percent
General	127	64.8
Epidural	1	0.5
Spinal	62	31.6
Combination	0	0.0
Missing	6	3.1
Total	196	100

Operating time

After excluding osteotomies performed with another simultaneous surgery, the median operating time was somewhat shorter for open wedge osteotomies with external fixation (38 min, 19-163) than for those with internal fixation (68 min, 20-165) as well as for distal femur osteotomies (78 min, 65-186). The table below shows the median operating times including those osteotomies done with simultaneous surgeries.

Operating time

Type of osteotomy	Median (min)	Range (Min)
Open wedge internal (137)	74	(20-170)
Open wedge external (42)	38	(19-163)
Distal femur (16)	123	(65-209)
Double osteotomy (1)	296	

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. Eight 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	17	8.7
Fragmin preop	12	6.1
Fragmin postop	60	30.6
Innohep preop	2	1.0
Innohep postop	67	34.2
Klexane preop	3	1.5
Klexane postop	25	12.8
Eliqvis	2	1.0
Combination	2	1.0
Missing	6	3.1
Total	196	100

Tromboprophylaxis - length of treatment

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

Thromboprophylaxis - length of treatment

Days	Number	Percent
No prophylaxis	17	8.7
1-7	22	11.2
8-14	129	65.8
15-21	10	5.1
22-28	5	2.6
29-35	4	2.0
>35	3	1.5
Missing	6	3.1
Total	196	100

Antibiotic drugs

Cloxacilline or Clindamicin were used in all the surgeries for which a substance name was reported. Clindamycin was used in 10% of the surgeries which is similar proportion as seen for knee arthroplasties and which can be interpreted as the percentage of patients being suspected of having penicillin allergy.

Antibiotic drug

Substance	Number	Percent
Cloxacilline	181	92.4
Clindamicin	10	5.1
Missing	5	2.5
Total	196	100

Cloxacillin dosage

For almost half of the osteotomies a single dose of 2g was reported and almost the same proportion received 2g x 3 within 24 hours.

Cloxacillin dose

Dose	Number	Percent
Cloxacilline 2gx1	83	46.0
Cloxacilline 2gx2	14	7.7
Cloxacilline 2gx3	76	42.0
Cloxacilline 2gx4	4	2.2
Cloxacilline 1gx3	2	1.1
Other	1	0.5
Missing	1	0.5
Total	181	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 35% of the osteotomies it was reported that the preoperative dose had been given within the currently PRISS recommended time interval (table below) while 60% lied within the previously recommended time interval.

Antibiotic - time of administration (PRISS recommendation)

Min. before surgery	Number	Percent
0-29	65	33.1
30-45	68	34.7
>45	45	23.0
Start after surgery	11	5.6
Missing	7	3.6
Totalt	196	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 55% of the knee arthroplasties. Drainage was used in 6% of the osteotomies as compared to 3% of the knee arthroplasties.

Tourniquet and drainage

Tourniquet	Number	Percent
Yes	133	67.9
No	57	29.0
Missing	6	3.1
Total	196	100

Drainage	Number	Percent
Yes	12	6.1
No	178	90.8
Missing	6	3.1
Total	196	100

Re-operations

Since the start of the osteotomy register in 2013 almost 30 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, inlay, 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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Manager
Otto Robertsson, MD, PhD

Deputy Manager
Annette W-Dahl, RN, associate professor

Register holder
Martin Sundberg, MD, associate professor

Register Associates
Anna Stefánsdóttir, MD, PhD
Kaj Knutson, MD, associate professor
Lars Lidgren, MD, professor

Project Secretary
Catharina Nilsson

Consulting Statisticians
Jonas Ranstam, CStat, biostatistician, Ystad
Tomasz Czuba, MSc, RC Syd

Steering group
Martin Sundberg,MD, associate professor, Skåne University Hospital, Lund
Ingela Adler, patient representantive. The Swedish Rheumatism Association
Johan Kärrholm, MD, professor, Sahlgrenska University Hospital, Göteborg
Helene Andersson Molina, MD, Vinnevrisjukhuset, Norrköping
Kjell G. Nilsson, MD, professor, Norrland University Hospital, Umeå
Jonas Ranstam, CStat, independent biostatistician, Ystad
Otto Robertsson, MD, PhD, Skåne University Hospital, Lund
Annette W-Dahl, RN, associate professor, Skåne University Hospital, Lund
Anna Wilhelmsson Sahlin, physiotherapist, Skåne University Hospital
Per Wretenberg, MD, professor, Örebro University Hospital

Visiting address
Remissgatan 4, Wigerthuset, 2nd floor
Skånes University Hospital, Lund, SE-221 85.

Phone: +46-(0)46-171345, e-mail: knee@med.lu.se

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