Akademiska sjukhuset
Alingsås
Arvika
Bollnäs - Söderhamn
Borås
Carlanderska
Danderyd
Eksjö-Nässjö
Elisabethsjukhuset
Enköping
Eskilstuna
Falköping
Falun
Frölunda Spec. Sjh.
Gällivare
Gävle
Halmstad
Helsingborg
Huddinge
Hudiksvall
Hässleholm/Kristianstad
Jönköping
Kalmar
Karlshamn
Karlskoga
Karlstad
Karolinska
Kullbergska
Kungälv
Köping
Lidköping
Lindesberg
Ljungby
Lund
Lycksele
Malmö
Mora
Motala
Movement Halmstad
Mölndal
Nacka / Proxima
Norrtälje
Nyköping
Orthocenter Göteborg
Orthocenter Stockholm
Oskarshamn
Piteå
S:t Göran
Skellefteå
Skene
Skövde
Sollefteå
Sophiahemmet
Spenshult
Sunderby
Sundsvall
Södersjukhuset
Södertälje
Torsby
Trelleborg
Uddevalla
Umeå
Varberg
Visby
Värnamo
Västervik
Västerås
Växjö
Ängelholm
Örebro
Örnsköldsvik
Östersund
Östra sjukhuset

Annual Report 2010

The Swedish Knee Arthroplasty Register

Dept. of Orthopedics, Lund University Hospital

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To the orthopedic surgeon, locally responsible for the Swedish Knee Arthroplasty Register

Our new form has been in use at the hospitals since January 1st, 2009. When new routines are introduced, it often takes time before everybody has adapted to the changes. However, altogether we have established that the reporting from this first year has been better than expected.
In this report we summarize the first results and it is our hope that new questions regarding previous surgery, methods used (tourniquet, drainage, CAS, MIS), prophylaxis (infection, thrombosis) will help contribute to continuous quality improvement as well as to scientific studies in the long term. The new form can be viewed on the last page of this report.

Again, we would like to emphasize that the new information being reported are not the general routines of the hospital, but events, drugs, planning and timing concerning individual patients.

As previously, the report consists of 3 parts. The first part describes the routines of the register, epidemiology and general results.

The second part contains information regarding what has been reported to the register during 2009 as well as analyses covering the 10-year period 1999-2008.

The third part is specific for each reporting unit and is only delivered to their respective contact surgeons and directors. It contains information concerning the new variables and lists containing information on all the operations reported by the unit in 2009. One list is sorted by ID and the other by the date of surgery.

It is our hope that the lists will be compared to locally available information, in an attempt to find and correct any errors in the registration. Further, we consider it important that the information about this report is spread at the hospital meetings, so the content can be discussed, analyzed and ultimately result in improvements.

We like to issue a reminder that SKAR is prospective and any revision reported to the register is only included in the analyses if the primary operation has previously been reported to the register according to prevalent routines. Thus, if a primary operation is discovered at a later time only because it was revised; neither the primary nor the revision will be taken into account.
Late reporting of primary procedures is only allowed in cases, in which there is a reasonable explanation for why the reporting was missed in the first place and when there is no suspicion of a bias. Late reporting may also occur when the register retroactively requests information regarding primaries performed during a certain time period.

The Knee Register in Lund would like to thank our contact physicians and secretaries for their important contribution during the years and request that information presented be analyzed and circulated.

Lund, October 7th, 2010
On behalf of the Swedish Knee Arthroplasty Register

Lars Lidgren Martin Sundberg Annette W-Dahl Otto Robertsson

CONTENT

Introduction

The beginning – In the early seventies, endoprosthetic surgery of the knee was a relatively uncommon procedure restricted for those with severe disabilities. Little information was found in the literature and there was an abundance of implant choices, 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 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 knee registration in 1975, participation has been voluntary. Only 24 units were reported during the first year. In 1980 the number was 47, in 1985 51, in 1990 66 and in 1996 82 units. In the late nineties, the number of units that reported to the register lessened somewhat due to the merger of hospitals, only to increase and diminish again. In 2009, 76 hospitals reported to the register, i.e. all units that routinely performed knee arthroplasty surgery in Sweden.

Volumes – Since the start of the registrating there has been an exponential increase in the number of operations (see page 8). In 2009, 12,707 primary arthroplasties were reported which was an increase of 16% from 2008. The sharp increase in the number of operations we have experienced in recent decades seems to continue, although 2007 was an exception. It seems the top has not yet been reached as the incidence in Sweden (see page 9) is still considerably lower than in countries such as USA and Germany. However, even without further increase in age specific incidence, the expected changes in the age distribution of the population will still increase the demand for surgery.

Reporting – Registration is continuous and the knee arthroplasty register has recommended that the form (page 47) be filled in the operation room. As on the old form, one set of the stickers found in the implants and cement packages are to be placed on the form. The form is then sent to the SKAR office at Lund´s University Hospital where the final registration occurs. In case of revisions, a copy of the operation report and discharge letter is required. The register recommends that units with a high volume of surgeries report at least once a month. The majority of the units follow the recommendations. The reasons for Internet registration not having been introduced to replace the forms, are many. E.g. there are legal, technical and security issues and we consider it to be important that the registration is done in the operation room. Further, the technology and the flow of information from the implant distributors to the register is not sufficient. In our opinion, the present paper-based system has essential advantages such as less workload for the surgical units, more reliable information and the least chance of input error. Further, during the input of data the register staff is able to check "part numbers" against a local database and in case of new numbers turning up, directly contact the distributors.

Annual report – Each annual report accounts for the primary arthroplasties that were reported during the previous year (this report: 2009). Analyses concerning the revision rate end one year prior to that (this report: 2008).
The reason for the survival analyses ending one year earlier is that a few errors in the registration of revisions may have a large impact on the final results. The extra year allows for the most complete and correct information of the revisions possible. Revisions are often complicated procedures in which forms, discharge letters and operation reports have to be examined thoroughly. Supplementary information is often needed before correct classification of type and reason for revision is possible. It also happens that units, after examining the annual report and accompanying lists, discover that their previous reporting was incomplete and complement with additional data.

10-year analyses – There have been some who have wondered why the register most often presents 10-year revision results while the knee 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 the younger part of the 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 more detailed description on how the register compares implants can be found on page 6.

Cooperation – The collaboration with NKO (National Competence Centre within the area of musculoskeletal disorders) has developed and is facilitated by the fact that the SKAR and NKO share premises at the Lund University Hospital. The Nordic countries cooperate through the framework of NARA (Nordic Arthroplasty Register Association) where joint analyses of knee arthroplasty data (Denmark, Norway, Sweden) are being performed. The SKAR and AOANJRR (Australian Orthopedic Association National Joint Replacement Register) have a common research project and the SKAR also collaborates with individual scientists in different countries.
Such collaborative projects may result in interesting findings but more importantly they give the participants insight into each other´s registration methods, selections, analyses and reporting. In turn, this hopefully will result in more similar methodologies so it will be easier to compare their results in scientific papers and reports in the future.

The new form –
Our new form, which been in use at the hospitals since January 1st, 2009, was introduced to allow for monitoring of process quality and facilitate systematic improvement of the health care in the short and long term. The new form contributes with new information on surgical techniques, preventive treatment and other relevant information concerning the patients.
The majority of units started using the new form immediately after it was introduced while others started later during the year. In 2009, 77 of 78 units reported their surgeries on the new form although the completeness varied somewhat.
For the 13 new variables, it can be seen from the compilation on page 43 that for each of the variables, the proportion filled was 89-90%. This is better than was expected during the first year and inspires high expectation for the coming years.
The form as well as the manual describing how it should be filled is found at the end of this report.

Feedback – The register produces reports in several ways; verbally, in writing and using modern computer technology. 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.
The register has a Web-site (www.knee.se) were annual reports can be downloaded and where a list of publications is available. There is also a secure server where participating units have their individual folder in which they are provided with their own data in a computerized form including revisions of their patients performed elsewhere.
Hitherto, the register has not seen the cost-benefits in using the Web-site to provide the units with updated current information. The reason for this is that the units report to the register irregularly and that there may be a delay in registration of revision information (see annual report above). It can also be assumed that the individual units have access to local computer systems containing information concerning their own patients. Further, the supplementary information that the SKAR might have on revisions performed elsewhere is of restricted use as long it is not certain that it is complete (all units have reported).
However, the new process variables we have started to register may be more important for the units in a shorter term. The first results are found at the end of this report and we hope that in the future we will be able to provide continuous reporting through our web-site.

Comparison of coverage in 2008

It is difficult to give an exact estimate of the percentage of operations accounted for in the SKAR. The register can only compare itself with the National Patient Register (NPR), an official inpatient-care register based on ICD coding. During the first 12 years of SKAR, NPR did not have nationwide coverage. Further, it complicates the comparison of these registers because they have registered different variables (operations vs admissions) and the laterality of the surgery has not been observed in NPR.

During the late eighties, the coverage of the SKAR was estimated at 85%. However, after validation in 1997 using mail enquires to all patients and performing a search of missing operations in the PAR followed by improved routines for reporting, coverage was estimated at 95%.

To estimate the percentage of primary surgeries captured by the SKAR in 2008 it was compared to the NPR. By comparing the number of admissions, assuming that the true number is the combined number of admissions in both registers, it is possible to estimate the "coverage". Although there is a possibility for patients having knee arthroplasty surgery without being registered in any of the registers, they are presumably few.

Using this method in the previous report we found in 2007 that 96.3% of the admissions had been registered in SKAR. This year we found in 2008 that 97.1% of the admissions had been registered by SKAR and 93.7% by NPR.

Below is a list of units containing the combined number of operations in both registers as well as the coverage of respective register.

Those units who do not reach 96% coverage are marked in red. Units with low coverage have a reason to investigate if they missed reporting surgeries and if their ICD-10 coding is unsatisfactory.

Hospital	Number	SKAR percent	NPR percent
Akademiska sjukhuset	109	98.2	95.4
Alingsås lasarett	190	96.3	98.4
Arvika	134	96.3	98.5
Bollnäs	251	98	95.2
Borås &Skene	189	94.2	94.7
Calanderska	22	100	9.1
Capio S:t Görans	6	0	100
Danderyd	245	92.2	95.5
Eksjö-Nässjö	121	98.3	100
Elisabethkliniken	108	100	0
Enköping	195	96.9	98.5
Eskilstuna	73	98.6	94.5
Falköping+Lidköping+Skövde	342	98	97.4
Falun	199	99	99.5
Gällivare	47	97.9	100
Gävle	48	97.9	95.8
Halmstad	133	95.5	97.7
Helsingborg	13	100	100
Huddinge	158	97.5	98.1
Hudiksvall	64	95.3	98.4
Hässleholm+Kristianstad	553	99.8	99.3
Jönköping	145	97.2	98.6
Kalmar	121	98.3	99.2
Karlshamn	213	95.8	97.7
Karlskoga	99	99	100
Karlstads	177	96	96.6
Karolinska	246	95.1	99.2
Kullbergska	292	95.2	94.9
Kungälv	143	97.9	98.6
Köping	104	99	97.1
Lindesberg	87	94.3	100
Linköping	2	0	100
Ljungby	69	94.2	100
Lund	24	91.7	95.8
Lycksele	39	100	100
Malmö	23	100	95.7
Mora	118	96.6	99.2

Hospital	Number	SKAR percent	NPR percent
Motala lasarett	389	95.9	98.7
Movement Halmstad	170	100	96.5
Movement medical AB	6	0	100
Nacka-Proxima	16	100	43.8
Norrköping	121	97.5	97.5
Norrtälje	93	95.7	98.9
Nyköping	117	97.4	95.7
Orthocenter Göteborg	74	100	0
Orthocenter Stockholm	195	100	99.5
Ortopediska Huset	397	96.0	60.5
Oskarshamn	311	97.7	98.7
Piteå	291	95.5	97.6
S:t Göran	323	97.5	98.5
Sahlgrenska+Mölndal+Östra	269	96.7	97.8
Skellefteå	77	98.7	94.8
Sollefteå	87	93.1	90.8
Sophiahemmet	100	100	1
Spenshult	141	95.7	95.7
Sunderbyn	7	100	100
Sundsvall	87	98.9	98.9
Södersjukhuset	358	96.1	96.9
Södertälje	150	94.7	96.7
Torsby	91	97.8	100
Trelleborg	460	99.1	99.1
Uddevalla	182	97.3	92.9
Umeå	123	97.6	97.6
Varberg	152	97.4	98
Visby	90	97.8	100
Värnamo	135	97	98.5
Västervik	98	100	99
Västerås	179	95	94.4
Västra Frölunda	129	95.3	98.4
Växjö	110	89.1	95.5
Ängelholm	142	99.3	95.8
Örebro	156	98.1	97.4
Örnsköldsvik	109	97.2	98.2
Östersund	88	94.3	98.9

Definitions

Revision is defined as a new operation in a previously resurfaced knee during which one or more of the components are exchanged, removed or added (inc. arthrodesis or amputation). This means that soft tissue operations such as arthroscopy and lateral release are not considered revisions. The reason for this stringent definition is that some minor operations are not necessarily related to the primary surgery and thus cannot be considered a complication or failure.

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) is 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, it is named bilateral UKA.

Patello-femoral arthroplasty is used to resurface only the femoropatellar compartment. Even if this arthroplasty is unicompartmental by definition, it is accounted for separately.

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´s, 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, which can be contained by a box in the femoral component which lies between the medial and lateral sliding surfaces. With 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 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 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 not used for such implants, but only those that are more stabilized by use of the above mentioned camshaft construction.

TKA-revision models are TKA´s that are mainly used for revisions or difficult primary cases. As mentioned above, these are often stabilized implants, which additionally are often used with stems. Many have proper names that make them easy to distinguish from common TKA's. However, due to the modularity of the modern TKA, a TKA brand can represent either a common TKA or a stabilized stemmed TKA depending on which components have been assembled. For the primary surgeries, this means some TKA brands have only been used for standard cases while other brands have also been used for difficult primary cases. This can result in bias when comparing models. In order to make a fair comparison of revision rates after primary surgery, the SKAR classifies certain TKA´s 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) but also those modular TKA's that have been inserted using extra long stems (5 cm. or more).

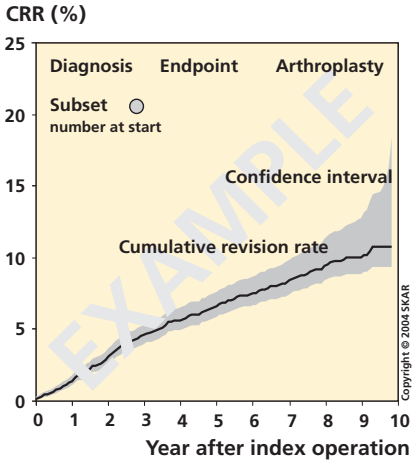
For those interested there is an excellent article on the history and the developement of the TKA; Robinson RP; The Early Innovators of Today's Resurfacing Condylar Knees. J of Arthroplasty 2005 (suppl 1); 20: 1.

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 were expected to become revised with time. The calculation is based on the sum of all the revisions and expresses the rate of surviving patients. Most often the time axis shows a 10-year period. It should 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 means 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 have 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.

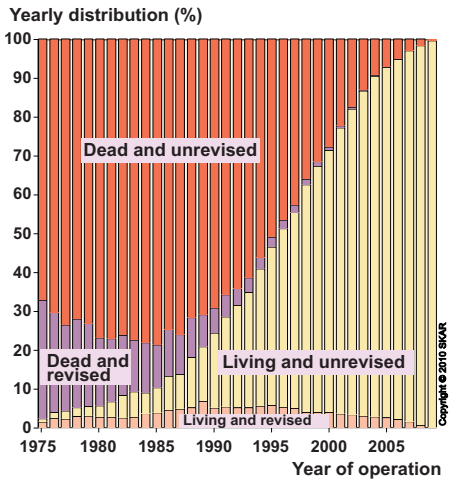
Cox regression takes into account how different factors may vary within groups. The results are expressed as risk ratios (RR) between factors. If a factor is a category (e.g. implant model), one category is defined as a reference with a risk of 1 to which the other categories are compared. An implant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



CRR curve example.

It is important to note that as an individual patient is also at risk of dying, the real proportion of revisions is lower than the CRR. As the figure below shows, more than 3/4 of the patients that were operated on in 1980 deceased without having been revised. Half of those still alive have suffered a revision.

When one tries to estimate differences in the risk of revision between units it becomes more complicated by the variation in volume. The reason is that units with few operations are more likely to have overly good or bad results. Thus the register receives help from NKO statisticians to calculate the risk using a "shared gamma frailty model" which takes volume into consideration. However, one has to remember that the units may have different "case-mix", i.e. patients with different grades of joint destruction or differences in general health and activity. These factors, which we presently are unable to take into account, may influence the risk of revision and thus the results of individual units.

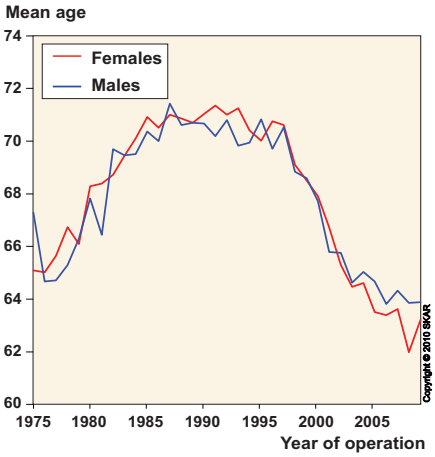


The status in 2009 for each yearly batch of patients operated since 1975.

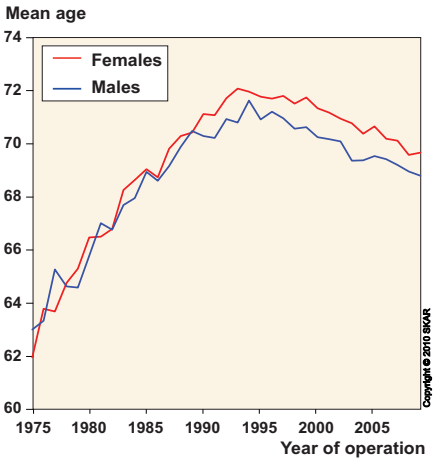
Gender and age distribution

Between 1975 and 1994, the mean age at primary operation increased from 65 years to almost 72 years. The main reason was the relatively large increase in the number of operations for the older age groups. Probable explanations are improvements in anesthetic techniques as well as a changed age distribution of the population. Since 1994 the proportion of patients less than 65 years of age has increased again, so the mean age has started to decrease. In 2009, the mean was barely 69 years and slightly higher for females (figure on the right).

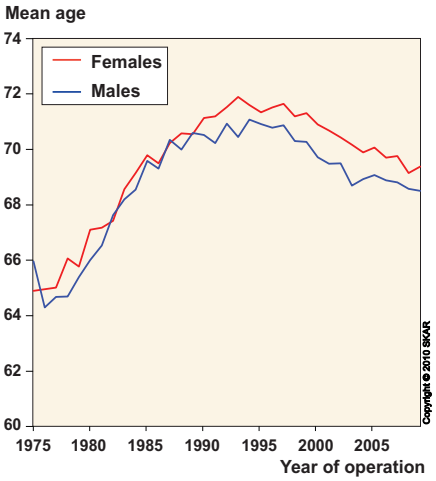
When TKA and UKA are analyzed separately, it is apparent that when TKA was introduced in the seventies it was used to a larger extent in young patients rather than the UKA, which at the time was the standard treatment (figures below and on the next page). On the other hand, in recent years



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



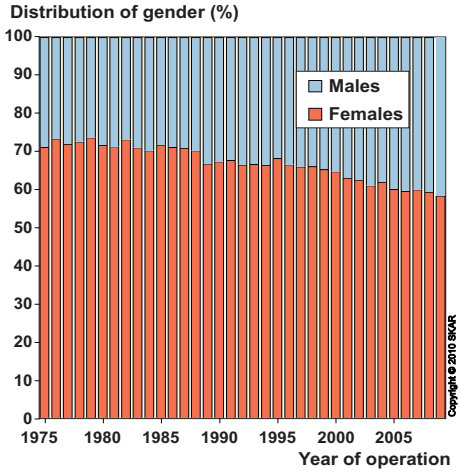
The mean age at surgery was lower for TKA than UKA when TKA was introduced in the seventies (cp the figure above).



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

the mean age of UKA surgery has fallen considerably, which coincides with the introduction of mini-invasive surgery. An interpretation of these observations may be that the new technology is being tested in younger patients in general.

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



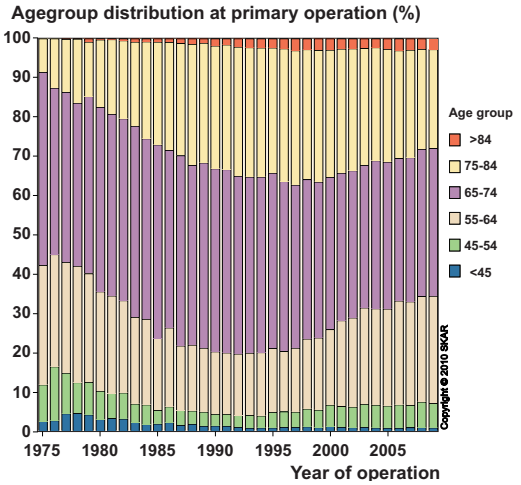
The proportion of males has increased slightly over the years.

Knee arthroplasty is more common in females than in males. When knee registration began, females accounted for about 70% of the operations. As the figure above shows, the proportion of men has been slowly increasing. At present they account for 42%. Separate analyses of OA and RA show that it is mainly in OA that the proportion of men has increased. In RA men account for only one fourth of the operations and the proportion has not changed.

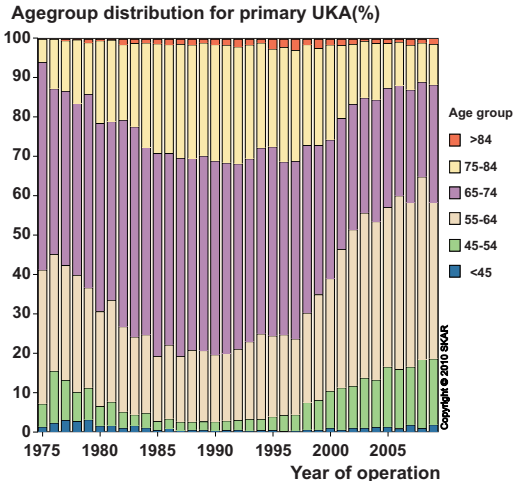
The figure to the right shows the relative number of operations performed on the different age groups over a period of thirty five years. In a somewhat different manner than the mean age (last page) it shows how the relative proportion of the older groups increased until the mid-nineties after which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

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

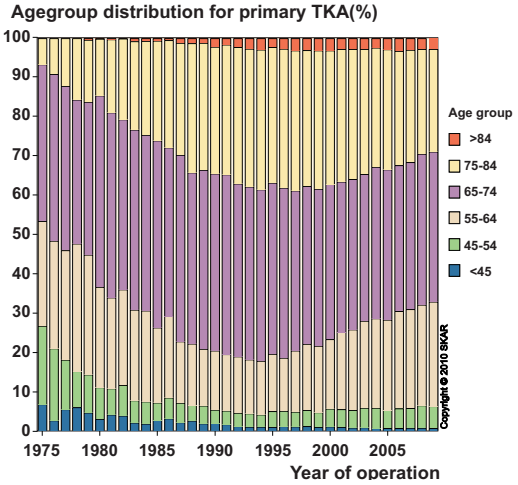
In UKA the relative proportion of patients less than 64 years of age has doubled after 1998, i.e. during the time when mini-invasive surgery catches on in Sweden. It should be kept in mind that the actual number of UKA´s has diminished by 31% since 1998 in contrast to the number of TKA, which has more 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 patients 45-65 years of age having a TKA has tripled. This can be explained by an increased confidence that knee arthroplasty is of benefit for younger patients.



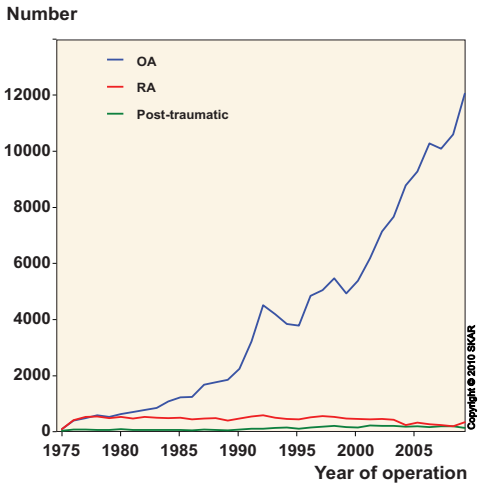
The relative distribution of primary arthroplasties among different age groups (all types of implants).



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



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



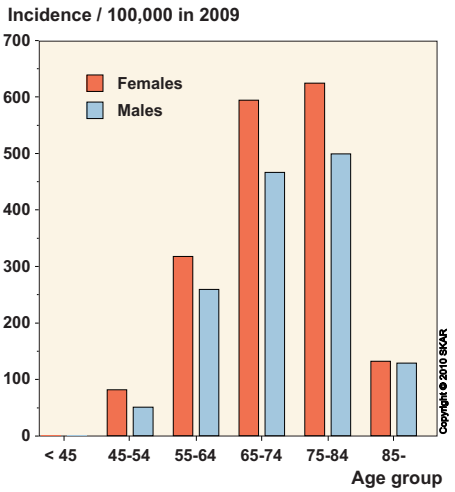
The yearly number of arthroplasties for different diagnoses.

In the eighties, the use of knee arthroplasty really started to increase (graph above) mainly because of the increased treatment of osteoarthritic patients. On the other hand, the number of operations for rheumatoid arthritis lessened, especially during the last few years which may be explained by the advance of new types of medical treatment. The number of operations for posttraumatic 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.

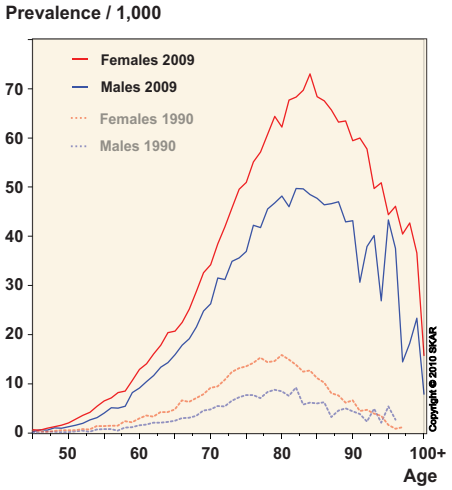
Incidence and prevalence

When the number of primary knee arthroplasties is divided by the number of inhabitants it can be characterized as the incidence of knee arthroplasty. As the graph to the right shows, the increase in incidence which started in the late eighties has still not culminated. As this is the incidence for the whole population (all ages) a small part of the increase in incidence reflects the aging of the population over time.

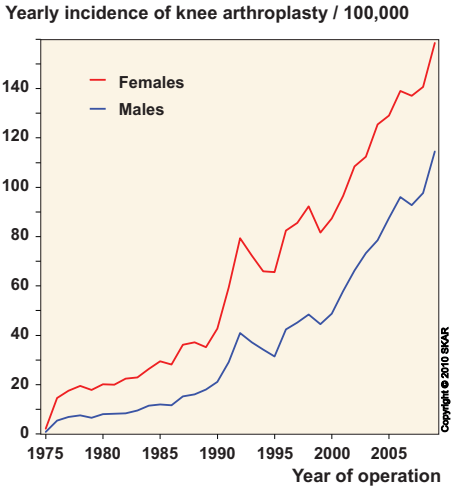
In 2000, the register published an article in which it was estimated how projected changes in the age distribution in Sweden could affect the demand for knee arthroplasty surgery. Using the incidence observed during 1996-1997, it was found that by 2030 aging of the population alone would call for an increase in the number of operations by 36% to 7,580 operations. This number was already reached in 2002 and shows that aging only explains a small part of the observed increase in incidence.



Incidence of primary knee arthroplasty in 2009 per 100,000 inhabitants (males and females) in the different age groups.



The prevalence of knee arthroplasty in 1990 and 2009. One of fourteen elderly women has a knee arthroplasty.



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

The figure to the left shows the age-specific incidence for different age groups in 2009. It is highest among those between 65 and 84 years of age. At this age, knee arthroplasty is almost 10 times more common than among those 45-54 years of age and 3-5 times more common than among those 85 years or older. Knee arthroplasty is more common in women in all age groups. 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 graph on the left demonstrates the prevalence in 2009 i.e. the number of patients per 1,000 inhabitants in different age groups with a knee implant. For both men and women it peaks around 80-85 years of age. Comparing the prevalence in 1990 and 2009 (figure left) shows the large increase observed during the last 19 years. In 1990, 1.6% of all older women and 0.9% of the men had at least one knee arthroplasty. In 2009 the numbers were 7.3% and 5.0% respectively, an increase by 4-5. In the future this will be reflected in the need for revisions and the risk of periprosthetic fractures.

In 2007, the increase in incidence seemed to have halted, only to increase again (figure above). Thus, it looks like the top of the curve has still not been reached.

Incidence in Sweden over time (number of arthroplasties/100,000 inhabitants)

Women

Age group	1976–1980	1981–1985	1986–1990	1991–1995	1996–2000	2000–2005	2006–2009
<45	1.1	1.0	0.9	1.1	1.5	1.8	1.8
45-54	14.6	11.6	11.4	15.7	27.5	49.9	71.6
55-64	40.1	44.6	57.4	104.1	133.8	199.0	281.9
65-74	75.6	107.9	158.0	306.8	373.3	476.5	554.5
75-84	45.9	81.9	143.7	305.7	385.0	479.2	574.6
>84	2.7	7.9	19.2	54.5	82.6	92.4	120.7
Total	17.9	24.2	35.9	68.5	85.9	114.4	143.9

Men

Age group	1976–1980	1981–1985	1986–1990	1991–1995	1996–2000	2000–2005	2006–2009
<45	0.5	0.3	0.4	0.4	0.7	0.9	1.5
45-54	6.0	4.8	4.5	8.9	14.4	30.0	45.1
55-64	17.4	20.3	28.4	64.8	81.5	149.0	213.3
65-74	31.4	50.6	81.5	176.6	239.5	347.1	435.5
75-84	20.9	42.5	91.7	193.1	246.3	342.4	445.6
>84	3.9	8.4	22.4	51.2	71.3	89.4	125.7
Total	6.9	9.9	16.5	34.5	45.9	72.8	100.3

Number of primary arthroplasties per unit and year

Hospital	1975-2004	2005	2006	2007	2008	2009	Totalt	Procent
Akademiska sjukhuset	1,970	109	131	119	109	125	2,561	1,6
Alingsås	548	145	164	187	183	188	1,415	0.9
Arvika	492	120	84	74	156	155	1,081	0.7
Avesta	67						67	0.0
Boden	1,620						1,620	1.0
Bollnäs / Söderhamn	960	242	230	228	248	285	2,193	1.4
Borås	1,920	125	112	143	95	69	2,464	1.5
Carlanderska		21	31	28	22	51	153	0.1
Dalslands sjukhus	81						81	0.0
Danderyd	1,723	172	186	218	227	179	2,705	1.7
Eksjö-Nässjö	1,817	114	98	118	119	168	2,434	1.5
Elisabethsjukhuset	122	88	76	107	108	90	591	0.4
Enköping	586	144	183	194	197	253	1,557	1.0
Eskilstuna	1,479	40	57	48	72	48	1,744	1.1
Fagersta / Västerås	71						71	0.0
Falköping	866	122	132	122	113	144	1,499	0.9
Falun	2,835	150	180	223	202	245	3,835	2.4
Frölunda Spec.Sjukhus	247	94	127	120	123	125	836	0.5
Gällivare	795	81	120	93	46	73	1,208	0.7
Gävle	2,590	67	63	68	48	60	2,896	1.8
Halmstad	1,685	160	196	161	127	189	2,518	1.6
Helsingborg	1,606	43	18	14	13	23	1,717	1.1
Huddinge	1,749	80	76	162	156	171	2,394	1.5
Hudiksvall	916	79	73	86	62	85	1,301	0.8
Hässleholm	2,627	529	528	518	557	708	5,467	3.4
Jönköping	1,622	105	107	100	142	205	2,281	1.4
Kalix	215						215	0.1
Kalmar	1,643	134	130	102	119	120	2,248	1.4
Karlshamn	1,131	184	178	169	205	221	2,088	1.3
Karlskoga	1,099	73	92	105	98	94	1,561	1.0
Karlskrona	1,104	6	6				1,116	0.7
Karlstad	2,563	170	214	232	212	192	3,583	2.2
Karolinska	1,263	280	121	162	234	120	2,180	1.3
Kristianstad	1,297						1,297	0.8
Kristinehamn	252						252	0.2
Kullbergska sjukhuset	700	121	125	96	291	310	1,643	1.0
Kungsbacka	21	12	4			1	38	0.0
Kungälv	750	164	134	183	140	149	1,520	0.9

(cont.)

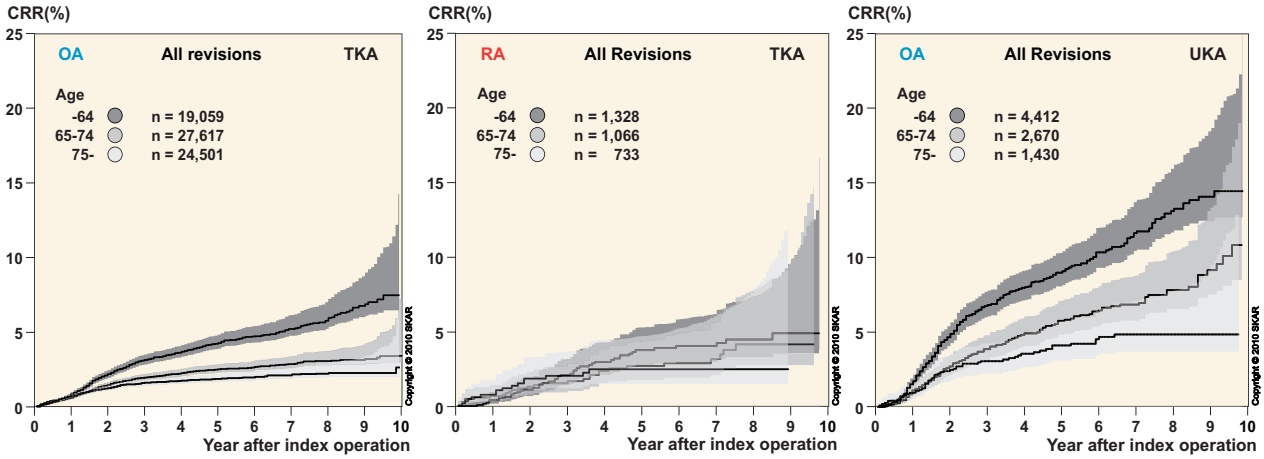
Number of primary arthroplasties per unit and year (cont.)

Hospital	1975-2004	2005	2006	2007	2008	2009	Totalt	Procent
Köping	863	99	246	215	103	79	1,605	1.0
Landskrona	1,918						1,918	1.2
Lidköping	659	186	160	147	136	149	,437	0.9
Lindesberg	897	117	119	95	84	150	1,462	0.9
Linköping	1,732						1,732	1.1
Linköping medical cent	12						12	0.0
Ljungby	970	86	83	73	66	112	1,390	0.9
Ludvika	338						338	0.2
Luleå	2						2	0.0
Lund	2,362	51	40	26	23	39	2,541	1.6
Lycksele	308	61	59	35	39	62	564	0.3
Löwenströmska	410						410	0.3
Malmö	2,010	46	56	27	26	25	2,190	1.3
Mora	1,025	98	98	99	115	129	1,564	1.0
Motala	761	409	447	357	392	547	2,913	1.8
Movement Halmstad	13	63	98	132	172	243	721	0.4
Mölndal	1,018	88	2	107	140	194	1,549	1.0
Nacka / Södersjukhuset	203						203	0.1
Nacka-Proxima		8	68	37	16	100	229	0.1
Norrköping	1,892				118	148	2,158	1.3
Norrtälje	615	79	95	79	89	91	1,048	0.6
Nyköping	805	96	105	102	120	115	1,343	0.8
OrthoCenter IFK klin.	125	91	87	20	83	122	528	0.3
Ortopediska huset	661	228	411	422	381	437	2,540	1.6
Oskarshamn	808	187	252	265	304	225	2,041	1.3
Piteå	373	179	261	292	280	278	1,663	1.0
S:t Göran	4,476	419	471	224	318	319	6,227	3.8
Sabbatsberg	629					99	728	0.4
Sabbatsbergs närsjh	821						821	0.5
Sahlgrenska	1,346	99	70	4	5	2	1,526	0.9
Sala	115						115	0.1
Sandviken	301						301	0.2
Sergelkliniken Gbg	160						160	0.1
Simrishamn	817	204					1,021	0.6
Skellefteå	745	90	96	51	77	105	1,164	0.7
Skene	774	68	72	89	85	105	1,193	0.7
Skövde	2,003	104	107	94	87	99	2,494	1.5
Sollefteå	577	107	119	108	81	37	1,029	0.6
Sophiahemmet	714	176	112	107	102	97	1,308	0.8
Spenshult				54	135	141	330	0.2
Stockholms Specialistvård	335	143	158	185	197	404	1,422	0.9
Sunderby sjukhus	283	38	32	23	7	6	389	0.2
Sundsvall	2,132	75	85	89	87	109	2,577	1.6
Säffle	484						484	0.3
Söderhamn	279						279	0.2
Södersjukhuset	2,516	127	311	330	353	357	3,994	2.5
Södertälje	577	81	103	124	143	122	1,150	0.7
Torsby	880	92	77	92	90	99	1,330	0.8
Trelleborg	2,006	396	524	553	480	579	4,538	2.8
Uddevalla	2 143	185	185	180	177	288	3,158	1.9
Umeå	1 ,593	139	162	138	120	216	2,368	1.5
Varberg	1,601	125	173	179	150	199	2,427	1.5
Visby	803	46	80	101	88	88	1,206	0.7
Vänersborg-NÄL	939						939	0.6
Värnamo	1,126	94	114	125	131	120	1,710	1.1
Västervik	1,169	118	98	88	98	102	1,673	1.0
Västerås	1,498	82	86	84	172	228	2,150	1.3
Växjö	1,368	81	107	127	102	121	1,906	1.2
Ystad	1,121	48					1,169	0.7
Ängelholm	1,105	54	168	163	145	149	1,784	1.1
Örebro	2,339	119	139	156	154	140	3,047	1.9
Örnsköldsvik	1,121	150	146	105	106	118	1,746	1.1
Östersund	1,270	111	110	94	84	135	1,804	1.1
Östra sjukhuset	1,605	75	120	149	116	31	2,096	1.3
Total	**107,583**	**9,792**	**10,688**	**10,526**	**11,001**	**12,707**	**162,297**	**100.0**

Factors that influence the revision rate

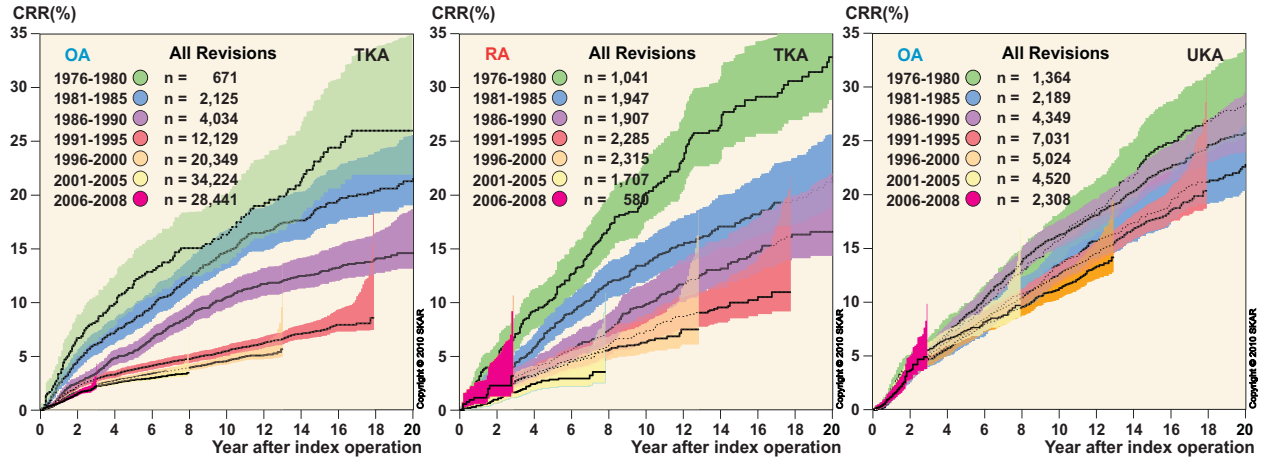
Primary disease – It became evident early that patients with different primary diseases, e.g. rheumatoid arthritis (RA) and osteoarthritis (OA), were different with respect to outcome. This was especially evident after UKA for which the CRR was much higher in RA than OA. Therefore, the register has always produced separate curves for these diagnoses.

Age – The effect that the age of the patients has on the CRR can be illustrated by analyzing different age groups separately. For OA the age has a considerable effect on the rate of revision both in TKA and UKA. One can wonder why this is the case. A possible explanation is that younger patients have a higher level of activity, higher demand of pain-relief and a state of health that more often allows for revision surgery. In RA (TKA), there is no similar effect. This may be due to the fact that the younger RA patients have multiple joint diseases, a lower physical level, a higher pain threshold and poorer general health, which may reduce the likelihood of being offered revision surgery.

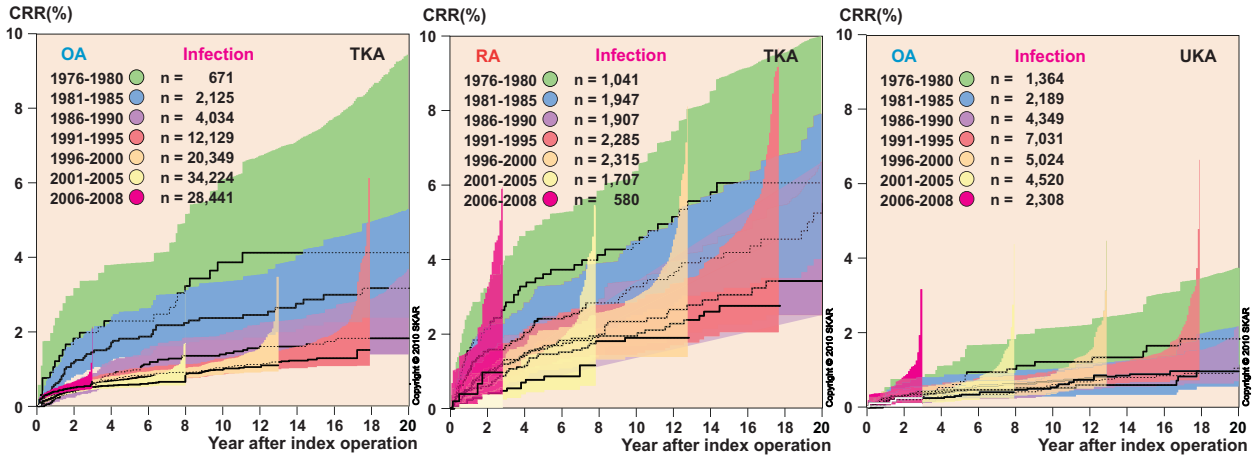


The differences in CRR (1999–2008) between the 3 age groups <65, 65–75, >75 were significant for OA operated on with TKA and UKA but nor for RA operated on with TKA..

Year of operation – For TKA there has been a constant reduction in risk of revision over time. The reduction can not only be explained by an increasing mean age of the patients (at surgery). Even if improved implants may provide some explanation, a reduction has also been seen for unchanged implants (Lewold et al. 1993). This indicates improvement in techniques (cementing/seating) or patient selection. Therefore, we take into account the time-period during which the operations were made, when comparing implants by Cox regression. Improvement with time has not been seen for the UKA, which probably is caused by some newer models with inferior results. Further, the number of



Comparing the CRR of different time periods, one finds for TKA, that the revision rate has decreased over the years. This is not at all as obvious for UKA. For TKA in RA, it seems that the CRR has increased somewhat 2006-2009 compared to the previous period.



Comparing the CRR, using only revision for infection as end-point, we find an improvement with time for both TKA and UKA. However, the CRR for infektion in 2006-2008 seems to have increased somewhat as compared to 2001-2005.

UKA operations has decreased, reducing the surgical routine which has been found to affect the revision rate. Furthermore, changes in implants, instruments, surgical technique and approach may have resulted in a new or prolonged learning curve.

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 2006-2009 as compared to 2001-2005, a slight increase in the risk of early revision can be seen (p=0.04).

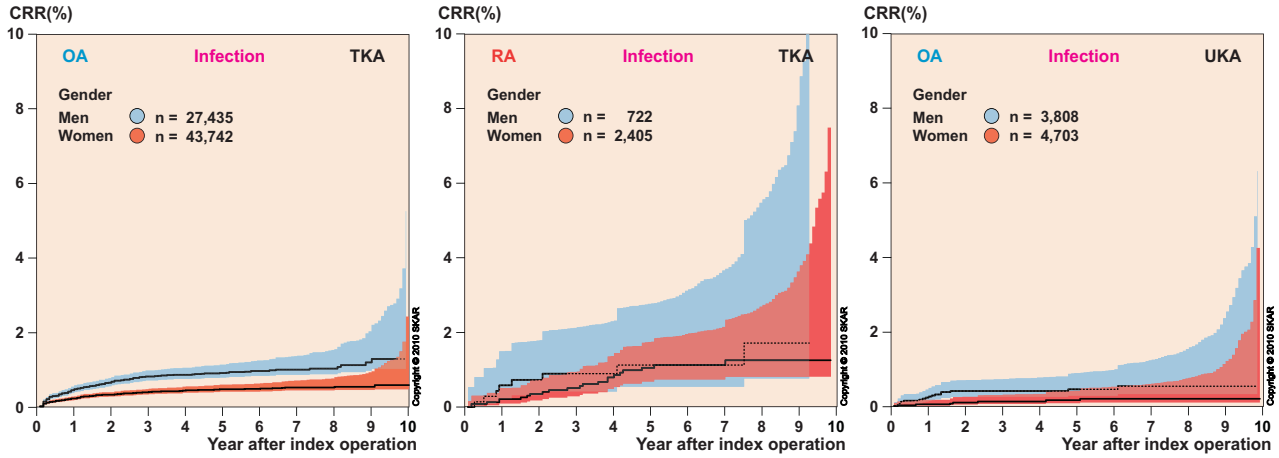
This is also true after excluding infected revisions in which only the inlay was changed.

Unicompartmental implants and patients with OA are found to have significantly lower risk for infection than TKA and patients with RA.

Gender – Analyzing OA during 1999-2008 (Cox regression), no significant difference in CRR was found between the sexes, whether it was for TKA or UKA. For RA (TKA), no overall significant difference between the sexes could be found.

However, regarding revisions for infection there was a considerable gender difference (see below).

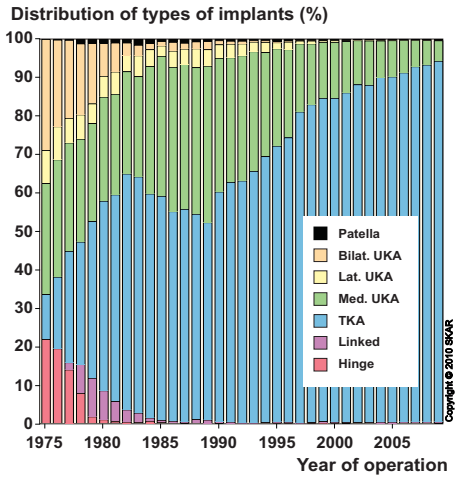
While it is well known that RA patients have a higher risk of infection, being ascribed to the effect of corticosteroid and immunosuppressive medications, it is not obvious why men, more often than women, have their knee arthroplasties revised for infection. Either male are more prone to infections or they more often than females are being offered revision surgery for their infected knee implants. The latter is contradicted by the fact that in other contexts men have also been found to be more susceptible to infections than women.



Using the end-point; revision for infection, the CRR (1999–2008) shows in TKA for OA that men are more affected than women (RR 2.0). The same tendency is true for RA, although not significant. UKA with its smaller implant size does better than the larger TKA but even in UKA men have 2.9 times the risk of women of becoming revised for infection. In TKA, patients with RA are more affected than those with OA (RR 1.7).

Type of implant – The modern condylar tricompartmental knee implant (TKA) was developed in the seventies when hinged and unicondylar implants were already available. When the register started in 1975, TKA had just been introduced in Sweden, which is the reason for hinges and uni's amounting for the larger part of the surgery at the time (figure right). It was also common to combine two uni's (bilateral UKA) when the knee disease affected more than one compartment. As the use of TKA became customary, the surgeons quit using two UKA's in one knee. Today, hinges, linked and stabilized implants are mainly used for difficult primary cases, trauma, malignancies and revisions.

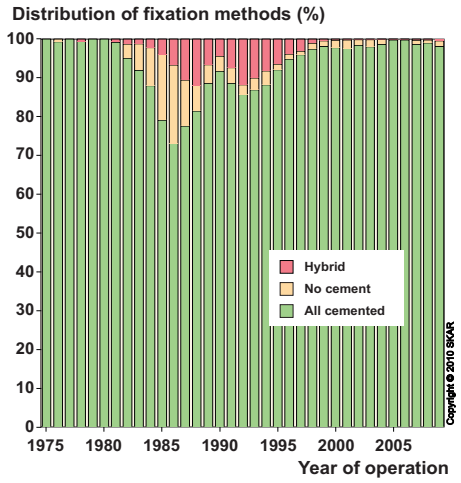
The use of UKA has diminished during the years. At present, TKA is used for the majority of primary cases, but UKA is mainly used for a subgroup of patients with unicompartmental disease. The reason may be that UKA has been found to have a substantially higher CRR than TKA (see figures on page 12). However, serious complications (infections/arthrodeses/amputations) are less common after UKA. When patients were asked in a mail inquiry how satisfied they were with their knee, it did not seem to be any difference between TKA and UKA.



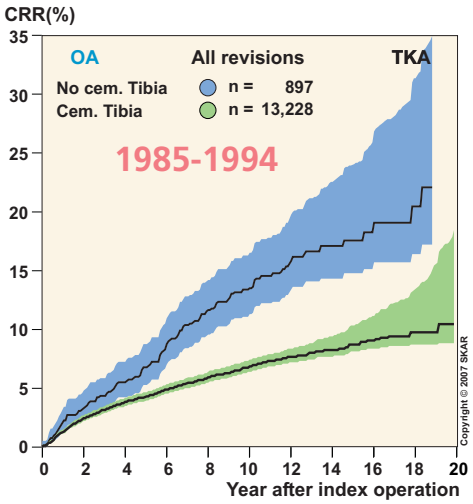
The relative yearly distribution of implant types used for primary surgery.

For an UKA being revised to a TKA, we found earlier that the risk of additional revision was not significantly increased, as compared to the risk for primary TKA's inserted at the time the primary UKA's had been performed. At the time there was a rapid improvement in the TKA results and the UKA conversions had the benefit of being compared to older TKA results. This is no longer true and now we find UKA conversions to have almost 2 times the risk of primary TKA's.

Use of bone-cement – As the figure below shows, bone-cement has been used in the majority of arthroplasties inserted in recent years. The number of uncemented cases has become so small that it is no longer possible to perform meaningful comparisons. However, for the period 1985–1994, when uncemented implants were relatively common, we found that the risk of revision was higher if the tibial component was left uncemented (figure to the right).



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

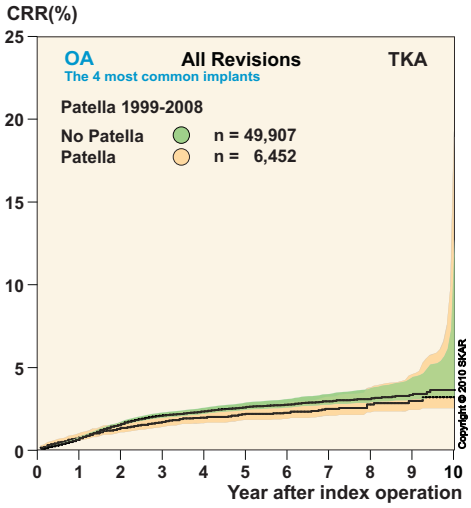


The CRR for TKA inserted 1985-1994 in which the tibial component was fixed with or without cement.

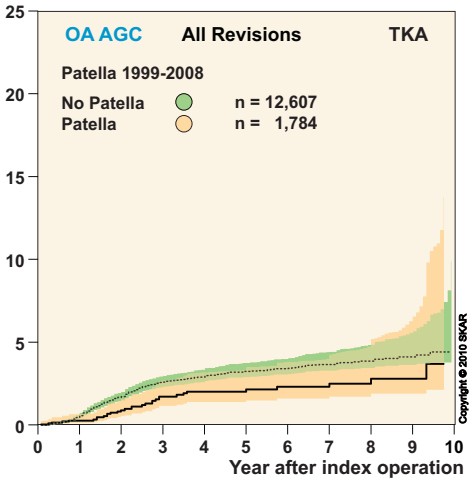
Cox regression, adjusting for age, gender, year of operation and use of patellar component shows that the risk for TKA with uncemented tibia component was 1.5 (1.2-2.8) times higher than for those cemented. This is in agreement with the results of the Finnish implant registry, which also has found a substantial increased risk of revision for uncemented implants.

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 has also lessened in recent years. When analyzing different time periods, one finds that during the eighties, when patellar buttons were used in about half of the cases, its use had a negative effect. Since then its use has continuously diminished and in 2009 a button was used in less than 5% of the TKA cases. At the same time, as we have described in previous reports, the curves have turned to the advantage of the patellar button.

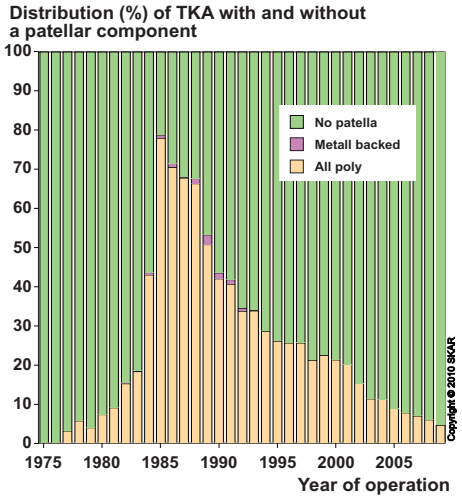
However, it has to be kept in mind that revisions for femoropatellar symptoms generally are performed relatively soon after the primary operation



CRR (1999-2008) for the 4 most common TKA (OA) implants, with and without patellar component respectively.



CRR (1999-2008) only for AGC (OA), with and without patellar component respectively.



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

while revisions for wear or loosening of the patellar component occur later on. This in combination with our previous finding that patients who have had patellar resurfacing more often are satisfied with their knee, at least initially, speaks for a more liberal use of the patellar button, at least in the elderly.

For the current period (1999–2008), as in recent years, we find a tendency for a higher risk of revision after TKA if a button is not used. This year the difference is not significant when analyzing all TKA together. However, when limiting the analysis to the 4 most common implants (all used both with and without a button) the difference is significant with patients without a patellar button having 1.37 (1.11-1.69) times higher risk for revision than those with a button (see figure left). When only AGC implants are analyzed, the risk for revision without a patellar button was 1.59 (1.10-2.29) times higher. The increased frequency of revisions is caused by the need for secondary patellar resurfacing because of femoropatellar pain and the main part occurs during the first 2-3 years.

It can then be debated if one should take the use of patellar button into consideration when units and implants are compared with respect to the risk of revision. In the figures, we have chosen to describe the total CRR of all implants (with and without a button). That way one can get a general picture of the results for certain groups of patients and implants. When comparing the risk-ratios of the implants (page 30-33), we separately account for the results of TKA with, and without, a patellar button. Finally, when comparing the risk of revision for the different units (page 38-41), we include the use of patellar button in the regression analysis.

cont. Use of patellar button – The use of patellar button varies between countries. In its annual report, the Danish knee arthroplasty register (http://www.dkar.dk) reports that a patellar button was used in 73% of TKA cases (2007) while it was only used in 5% of cases in Norway (2007) according to the Norwegian arthroplasty register report 2008 (http://www.haukeland.no/nrl/).
According to the 2008 annual report of the Australian Joint replacement Register (http://www.dmac.adelaide.edu.au/aoanjrr/index.jsp), the use of patellar button has increased in recent years from 41% of the TKA cases in 2005 45% in 2007. It was also reported that compared to TKA using a patellar button, TKA without a button had 1.3 (1.2-1.4) times higher risk of becoming revised which is similar to the Swedish findings.

It is unclear why the surgeons in the mentioned countries and regions differ so much with respect to use of patellar button. Probably, there is a combination of reasons such as education, tradition, experience (good or bad) or marketing policies governed by the manufacturers.

Implant model (brand) – The model is the factor that generates most interest and most often is related to the result after knee arthroplasty. 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.
An 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 experienced with that particular model. The final result is determined by a combination of factors including design, material, durability, accompanying instruments, user-friendliness, safety marginal's (how the implant behaves if it is not inserted exactly) together with the surgeon's skill and training of 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 most of these factors. Therefore, it can't be considered inappropriate to associate the model to the result, in spite of the outcome being affected not only by design, material and durability.

Historically, the most commonly used implants in Sweden have also been those with the lowest CRR. This may be due to a good design but also due to the increased surgical routine when the same implant is used often. Models that have been found to have considerably inferior results have most often been withdrawn from the Swedish market. An exception is the Oxford implant that initially had inferior results, but after modifications and increased training of surgeons showed improved results leading to continued use.

Type of operations and implants in 2009

12,707 primary arthroplasties reported in 2009 by type and region

TYPE	Stockholm Gotland	Uppsala Örebro	Southeast	South	West	North
Hinges	6	–	–	–	–	–
Linked (rotating hinges)	2	14	1	10	15	8
TKA	2,411	2,751	1,478	1,895	2,290	1,100
UKA medial	147	116	152	62	178	29
UKA lateral	1	–	–	–	2	–
Patella	12	2	4	10	4	2
Total:	2,584	2,883	1,635	1,977	2,489	1,139

Implants for primary TKA in 2009

	Number	Percent
NexGen	4,634	38.8
PFC Sigma	3,194	26.8
Vanguard	1,272	10.7
Triathlon TKA	863	7.2
AGC	759	6.4
Duracon	399	3.3
Profix	379	3.2
PFC Rotating Platform	255	2.1
Other*	175	1.5
Total :	11,930	100

*Mainly revision models

Implants for primary TKA in 2009

	Number	Percent
Oxford-UKA	281	40.9
Link UKA	181	26.4
MillerGalante-UKA	78	11.4
ZUK	72	10.5
Genesis	55	8.0
Triathlon PKR	15	2.2
Other	5	0.6
Total :	687	100

All the 76 units performing elective knee arthroplasty surgery reported to the registry during 2009. Although a few reports may turn up at a later time, they are only expected to have a small effect on the number of operations. The number of reported primary arthroplasties increased from 10,936 in 2008 to 12,707, or by 16.2%. For TKA there was an increase of 17.5% while UKA decreased by 3,2%.

This year, we are not able to give a meaningful account of the number of revisions reported in 2009. The reason is that we are in the process of changing our data platform and we started by entering data on revisions performed in 2009. The new platform has been associated with some practical delays, therefore the information regarding the 2009 revisions are uncertain for now.

The 3 most common implants for primary TKA in each region in 2009

	Model 1	n	Model 2	n	Model 3	n	Other
Stockholm/Gotland	NexGen	1,018	PFC Sigma	959	Duracon	166	273
Uppsala/Örebro	NexGen	1,310	PFC Sigma	779	AGC	389	273
Southeast	NexGen	624	PFC Sigma	334	Vanguard	300	220
South	Triathlon	666	PFC Sigma	618	Vanguard	260	351
West	NexGen	1,272	Vanguard	592	PFC Sigma	207	219
North	NexGen	403	PFC Sigma	336	Profix	125	236

The 3 most common implants for primary UKA in each region in 2009

	Model 1	n	Model 2	n	Model 3	n	Other
Stockholm/Gotland	Oxford	70	MillerGalante	50	Link	27	1
Uppsala/Örebro	Link	73	Genesis	28	MillerGalante	9	6
Southeast	Oxford	114	Genesis	27	Link	7	4
South	Link	33	Triathlon PKR	15	Oxford	13	1
West	Oxford	84	ZUK	65	Link	23	8
North	Link	18	MillerGalante	7	ZUK	4	

Bone cement and minimally invasive surgery in 2009

Use of cement in primary surgery during 2009

	Primary TKA	Primary UKA
No component without cement	11,686	678
Only the femoral component without cement	10	6
Only the tibial component without cement	41	–
The femur- and tibial components without cement	172	–
Only the patellar button without cement	1	–
Unknown	20	3
Total	11,930	687

	Number	Percent	Number	Percent
Refobacin-bonecement	6,033	51.3	430	62.6
Palacos Genta	4,877	41.5	244	35.5
Cemex Genta	687	5.8	8	1.2
CMW SmartSet Genta	78	0.7	–	–
CMW SmartSet	8	0.1	–	–
Mixed by surgeon	3	0	–	–
Refobacin plus	2	0	–	–
Refobacin revision	1	0	–	–
Unknown	69	0.6	5	0.5
Total:	11,755	100.0	687	100.0
All components without cement	172	–	0	–
Grand Total	11,930		687	

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. Almost all the cement used contains antibiotics, mostly gentamicin.

During 2009, only 1.4% of the TKA´s were inserted without the use of cement for fixation (0.8% in 2008) while all the UKA´s were cemented. As the use of cement has become so common, the variation is minimal and statistical comparisons are not meaningful.

To ensure that we can discern the different cement types, we want to remind the surgeons to use the stickers found in the cement packages.

Minimally invasive surgery in UKA

For UKA, we have registered the use of mini-arthrotomy since 1999.

Our definition of mini-incision is when the surgeon gains access to the knee joint by the use of a small arthrotomy and without the need for dislocating / everting the patella. The benefit of the procedure has been claimed to result in less traumatic surgery, quicker rehabilitation and shorter hospital stay.

From the start of the registration in 1999, the popularity of minimally invasive surgery for UKA continued to increase until 2003 when it was being used in 58% of cases. In 2004 the proportion of MIS diminished to 53% after which it increased again to 61% of the cases in 2007. In 2009, MIS was used in 52% of the cases but information was missing for 12%, which is somewhat higher than previously (6% in 2008). The use of MIS varies somewhat depending on the implant brand used (see table below). The distribution is similar among men and women.

Initially, MIS seemed to be associated with higher revision rate. However, with the present 10-year follow-up, we cannot find that the type of arthrotomy significantly affects the results.

Previous analyses have however shown that new implants/methods may initiate a new learning process which can be shortened if the surgeons are offered training before starting to use them.

The type of incision for 687 primary UKA in 2009

	Standard incision	Mini-incision	Missing
Link UKA	104	61	16
Oxford-UKA	66	195	20
ZUK	26	37	9
Genesis	19	28	8
MillerGalante	16	37	25
Triathlon PKR	10	1	4
Other	4	.	1
Total	245	359	83

The use of patellar button for TKA in 2009

The use of patellar button is heavily related to the implant model used. As can be seen from the table to the right, surgeons who use the NexGen and Vanguard infrequently use a patellar button while its use is more common with AGC and PFC rotating platform.

As last year, patellar button was most infrequently used in the Uppsala-Örebro and North regions. The two regions that most often used a button were the Southeast and South (see figure below).

Geographical variations are not only found in Sweden. In 2009, the Australian arthroplasty register (http://www.dmac.adelaide.edu.au/aoanjrr/index) reported that the difference in use of patellar button between the different states approached 30%.

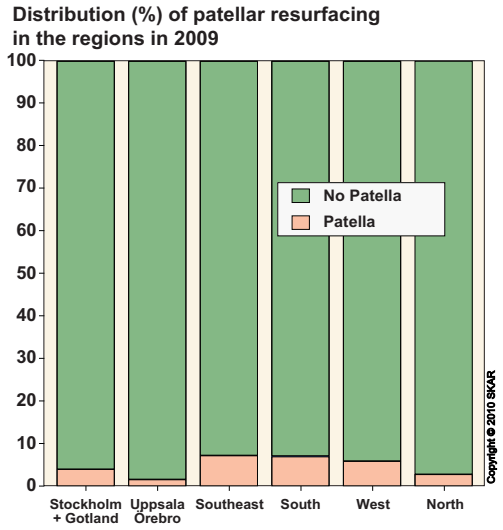
In Sweden, females operated on with TKA have their patella resurfaced slightly more often than males. In the whole material, from the start to the end of 2009, 18.9% of the women had their patella resurfaced compared to 15.6% of the males, which is a significant difference. A suggested explanation is that femoropatellar pain is more common in females. During 2009 4.0% of the men had a patellar button compared to 5.1% of the women, a non-significant difference.

Looking at the relative use of patellar button in the different age groups during 2009 (figure below), it can be seen that the use of patellar resurfacing was similar in all the age groups except the youngest, in which it was most common. This has varied somewhat in recent years dependent on the few number of patients less than 45 years of age.

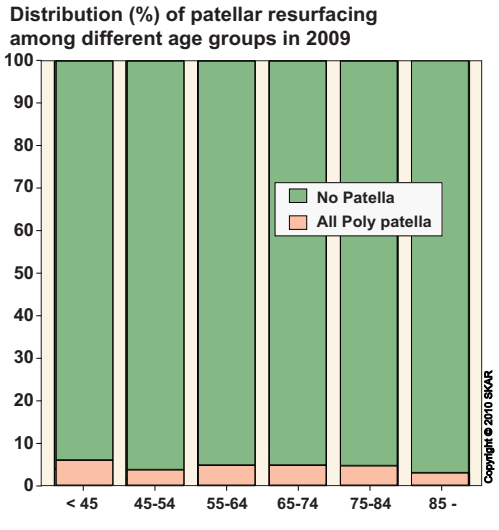
Some discussion regarding how the frequency of revisions is influenced by the use of patellar button can be found on page 15 together with CRR curves for TKA inserted during the current period of 1999-2008, with and without a button respectively.

Use of patellar button with different TKA implants in 2009

	No patella button	%	Patella button	%
NexGen	4,565	98.5	69	1.5
PFC Sigma	3,164	97.9	69	2.1
Vanguard	1,214	95.4	58	4.6
Triathlon TKA	813	94.2	50	5.8
AGC	616	81.2	143	18.8
Duracon	344	86.2	55	13.8
Profix	338	89.4	40	10.6
PFC mobile bearing	205	80.4	50	19.6
Other	123	90.4	13	9.6
Total	11,382	95.4	547	4.6

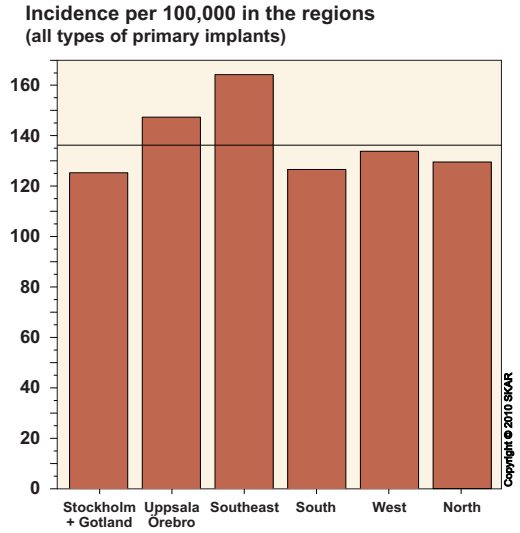


The figure shows the relative proportion of TKA with and without patellar button in the different regions during 2009.

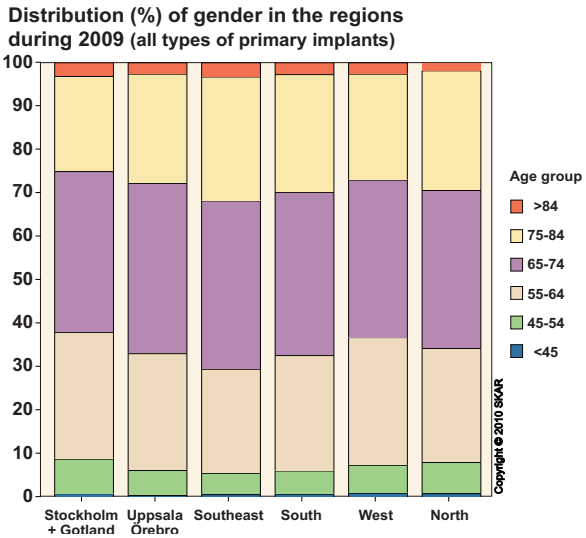


The figure shows the relative proportion of TKA with and without patellar button in the different age-groups during 2009.

Age distribution and incidence in the regions 2009



The incidence/100,000 inhabitants in the regions. It is highest in the Southeast and lowest in the South & North regions (the black line shows the mean for the whole country (136,6)).

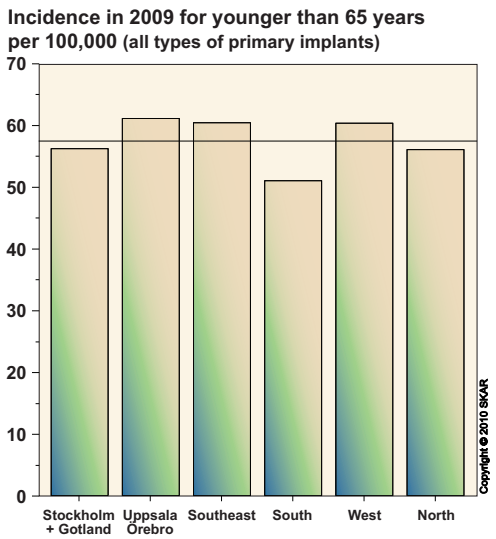


The age distribution varied less in the regions during 2009 than in 2007. The Southeast region still has the relatively lowest proportion of patients less than 64 years of age.

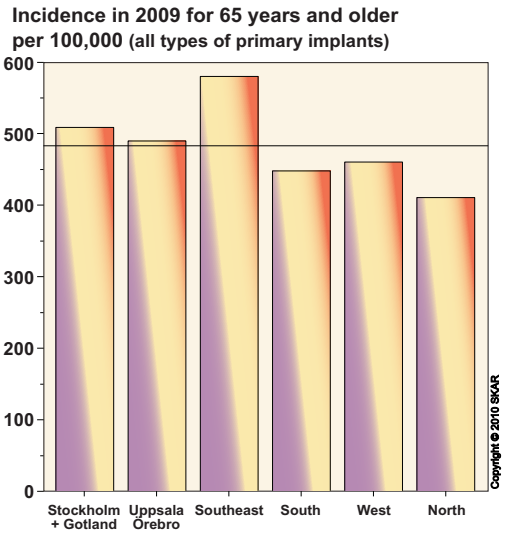
The figure above shows the incidence of primary knee arthroplasty per 100,000 inhabitants in the respective regions. As of last year, the incidence is the highest in the Southeast and Uppsala-Örebro. As compared to 2008 the incidence in the whole country has increased from 118.6 to 136.6 or 15.2%.

The figure above to the right shows the relative distribution of primary operations among the different age groups for each region. Even if such a summary provides information regarding the distribution of resources, it can't be used to decide if the principles of treatment differ in the regions as it may be caused by variations in the age of their inhabitants.

The figures below show the incidence of knee arthroplasty among patients less than 65 years of age (left) and those 65 years and older (right). As compared to 2008, the incidence for those younger has increased by 15.7% and for those older by 13.1%. As of last year, the incidence for those less than 65 years of age is lowest in the South region but otherwise the difference between the regions is small. For those 65 and older, the Southeast has the highest incidence and the North the lowest.

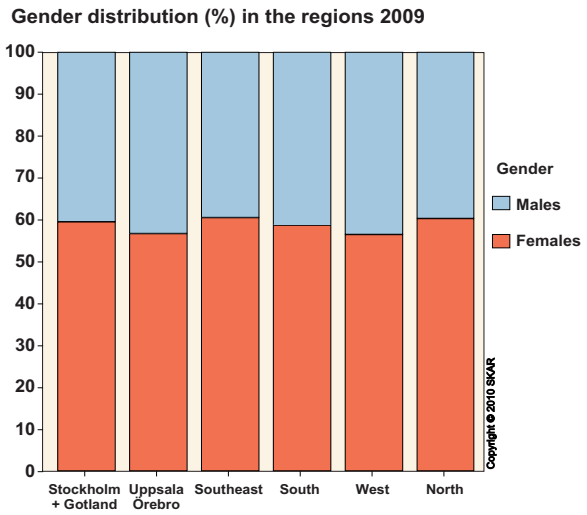


The incidence per 100,000 inhabitants among those younger than 65 years of age is highest in the Uppsala Örebro region. (the black line shows the mean for the whole country (57,6)).



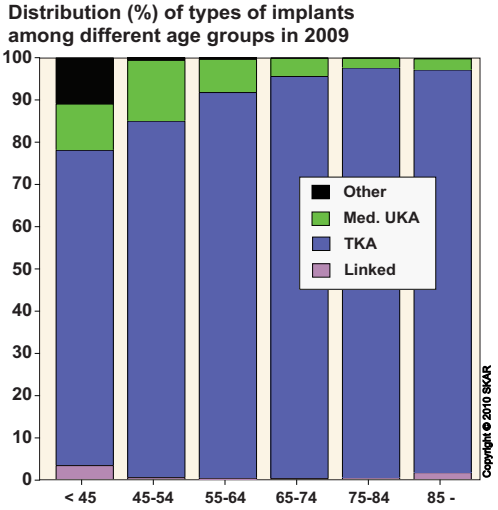
The incidence per 100,000 inhabitants amonge those 65 years or older is lowest in the North and South regions. (the black line shows the mean for the whole country (482,2)).

Gender distribution in the regions



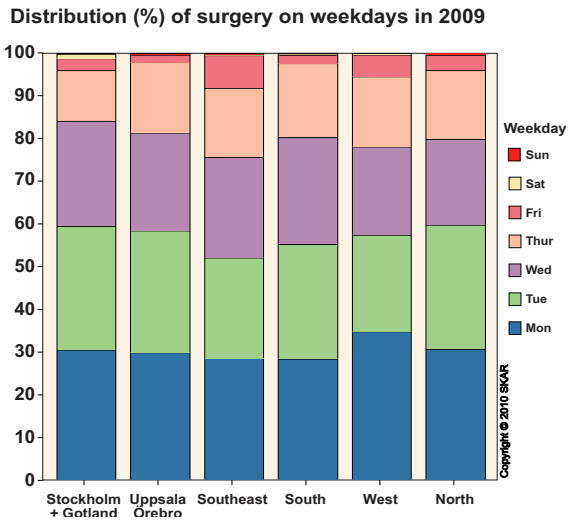
The proportion of females is around 60% in all the regions.

Type of implants in different age groups

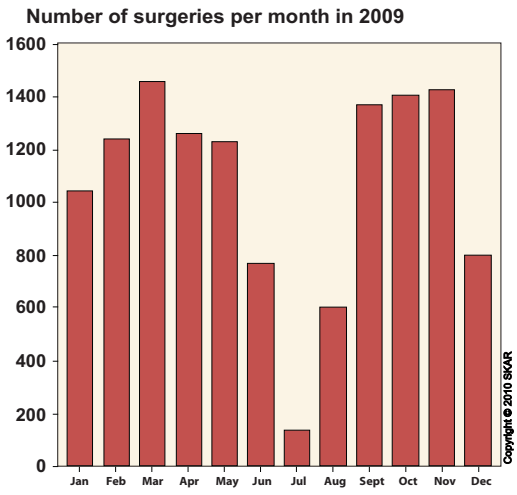


Uncommon models are relatively most often used in patients younger the 45 years. The relative high proportion of linked implant is caused by serious conditions (tumors, trauma etc.)

Distribution of surgery on the weekdays and months in 2009



Distribution of surgery on the weekdays during 2009. Surgery on Fridays and weekends is uncommon.



The mean number of primary knee arthroplasties inserted each month during 2009.

Knee arthroplasty is infrequently performed on Fridays and weekends. The reasons are among other, reduced working hours on Fridays and the lack of rehabilitation during the weekends. During 2009, surgeries on Fridays were most common in the Southeast and least common in Uppsala-Örebro and South regions.

The picture above shows the mean number of operations per month during 2009 and it is obvious how the production diminishes during the summer months. The number of operations is also low during December and January. If every other day of the week had the same number of surgeries as on Mondays, during the whole year, the number of arthroplasties would double.

Implants for primary arthroplasty 1999–2008

To be able to give adequate long-term results, of relatively modern implant types, the register usually uses the latest 10-year period available for analysis.

As there is always some delay related to the control of reported revisions, and because a low number of failures may have a large effect on the results, the period used for analysis ends one year prior to the year for which primaries are reported.

Operations performed early on in the analyzed period have a relatively large influence on the final cumulative revision rate. Subsequently, older models have a large impact on results.

Implants, especially made for revision surgery or standard models with extra long stems (5cm or longer) are classified as revision models and are not included in the analysis of standard models.

Implants for primary TKA during 1999–2008

	Number	Percent
PFC Sigma	22,700	29.6
AGC	15,498	20.4
NexGen	15,168	20.0
Duracon	8,054	10.6
F/S MIII	7,016	9.2
Kinemax	1,501	2.0
Triathlon	1,252	1.6
Profix	1,085	1.4
Vanguard	999	1.3
Scan	851	1.1
PFC mobile bearing	545	0.7
Natural	502	0.7
LCS	320	0.4
AMK	207	0.3
MillerGalante2	72	0.1
NexGen mobile bearing	28	0.0
Oxford rotating TKA	26	0.0
PFC	17	0.0
Performance	14	0.0
Evolution	12	0.0
Other	22	0.0
Total	75,889	100

Revision Models* for primary TKA during 1999–2008

	Number	Percent
PFC revision	190	25.0
AGC Revision	190	25.0
Duracon revision	142	18.7
NexGen Revision	123	16.2
Profix Revision	61	8.0
Freeman revision	29	3.8
Other	24	3.2
Total	759	100

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

Hinged implants (primary) during 1999–2008

	Number	Percent
Rotalink	226	63,7
NexGen rotating hinge	41	11,5
Noiles rotating hinge	27	7,6
Stryker/Howm. rotating hinge	22	6,2
Kotz	18	5,1
Mutars	14	3,9
Other	7	2,0
Total	355	100

Implants for primary UKA during 1999–2008

	Number	Percent
Link	3,690	42.1
MillerGalante	2,396	27.3
Oxford	1,507	17.2
Genesis	527	6.0
ZUK	161	1.8
Preservation	149	1.7
PFC	131	1.5
Duracon	97	1.1
Allegretto	51	0.6
EIUS	47	0.5
Marmor	3	0.0
Brigham	2	0.0
St.Georg	1	0.0
Total	8,762	100

Patello-femoral implants during 1999–2008

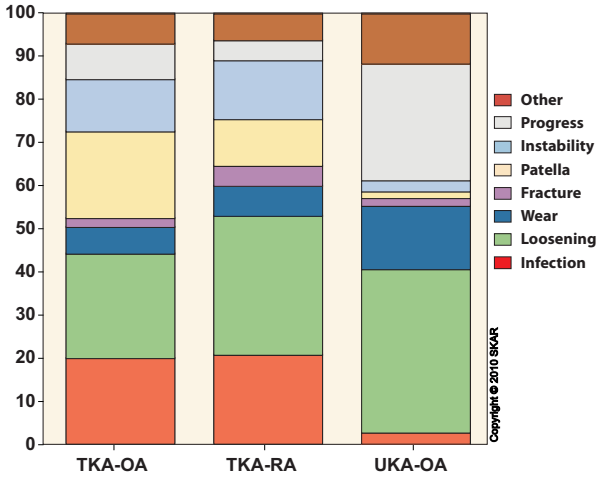
	Number	Percent
Lubinus/Link	50	35.2
Richard/Blazina	38	26.8
Avon	34	23.9
Zimmer P-F	6	4.2
LCS P-F	5	3.5
Journey P-F	3	2.1
Other	6	4.2
Total	142	100

Revisions during 1999–2008

During the 10-year period, 4,592 revisions were performed. 2,290 were revisions after TKA for OA, 313 after TKA for RA and 1,593 were revisions after UKA for OA. Note that some of the primary operations were performed before the accounted 10-year period, during which the revisions were performed. The indications for the revisions are shown in the diagram to the right.

Loosening remains the dominant reason for revision. ”Progress” in TKA mainly reflects revisions performed for femoropatellar arthrosis/arthritis. ”Patella” includes all kind of problems with the patella in patients who had their primaries inserted with or without a patellar button (excluding loosening and wear). Please note that the distribution of the indications may not reflect the risk for revision. The sharp increase in the number of primaries over the years leads to overrepresentation of early revisions.

Distribution (%) of indications for revision 1999-2008



Type of revision 1999–2008 in which the primary was a TKA/OA

	Number	Percent
Linked (rot. hinge)	196	8.6
TKA	599	26.2
Exchange of femur comp.	26	1.1
Exchange of tibia comp.	166	7.2
Exchange of disc/inlay	321	14.0
Patella addition	616	26.9
Patella exchange	35	1.5
Patella removal	8	0.3
Total implant removal	305	13.3
Arthrodesis	5	0.2
Amputation	13	0.6
Total	2,220	100

Type of revision 1999–2008 in which the primary was a TKA/RA

	Number	Percent
Linked (rot. hinge)	55	17.6
TKA	106	33.9
Exchange of femur comp.	5	1.6
Exchange of tibia comp.	14	4.5
Exchange of disc/inlay	27	8.6
Patella addition	45	14.4
Patella exchange	2	0.6
Patella removal	2	0.6
Total implant removal	51	16.3
Arthrodesis	0	0.0
Amputation	6	1.9
Total	313	100

Type of revision 1999–2008 in which the primary was a UKA/OA

	Number	Percent
Hinge	1	0.1
Linked (rot. hinge)	26	1.7
TKA	1,464	93.1
Medial UKA	17	1.1
Lateral UKA	2	0.1
Exchange of femur comp.	2	0.1
Exchange of tibia comp.	7	0.4
Exchange of meniscus/inlay	15	1.0
Patella addition	6	0.4
Total implant removal	31	2.0
Arthrodesis	0	0.0
Amputation	2	0.1
Total	1,573	100

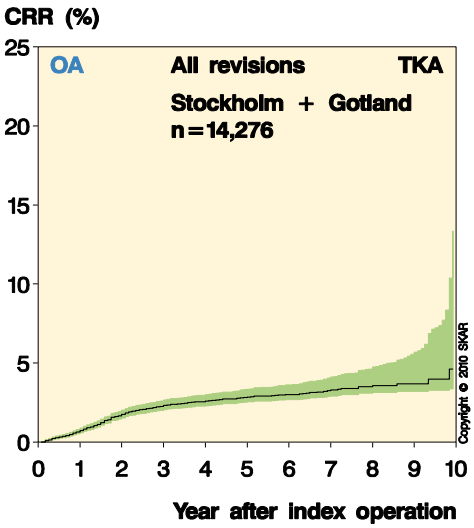
The tables show the different types of revisions (first) that were performed during 1999-2008. There are separate tables depending on the type of primary surgery (TKA/OA, TKA/ RA, UKA/OA). It should be noted that only one type is permitted for each revision. This implies that exclusive patellar surgery is listed, but not patellar surgery done in combination with exchange or addition of other components.

TKA revisions only affecting the patella are common (29% in OA and 15% in RA). Extensive revisions (linked implants, arthrodesis, amputations) seem more common in RA. It is satisfying to note that few UKA are revised to a new UKA as these type of revisions have been found to have a very high rate of re-revision.

Primary TKA implants for OA in the regions during 1999–2008

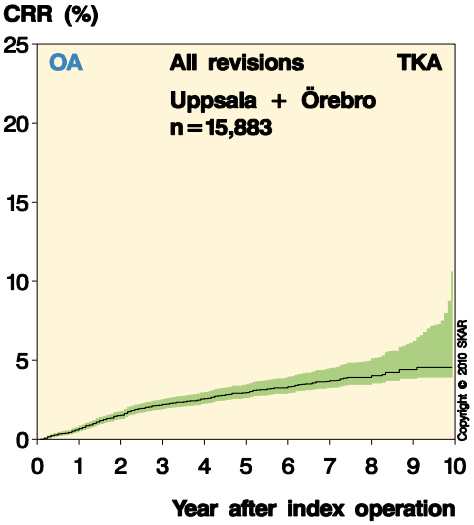
Stockholm + Gotland
Primary TKA implants for OA, 1999–2008

	Number	Percent
PFC Sigma	8,068	56.5
NexGen	1,860	13.0
Duracon	1,671	11.7
F/S MIII	1,361	9.5
Kinemax	407	2.9
AGC	360	2.5
PFC mobile bearing	132	0.9
Vanguard	78	0.5
Triathlon	76	0.5
Natural	72	0.5
AMK	62	0.4
Profix	33	0.2
Other	96	0.7
Total	14,276	100.0



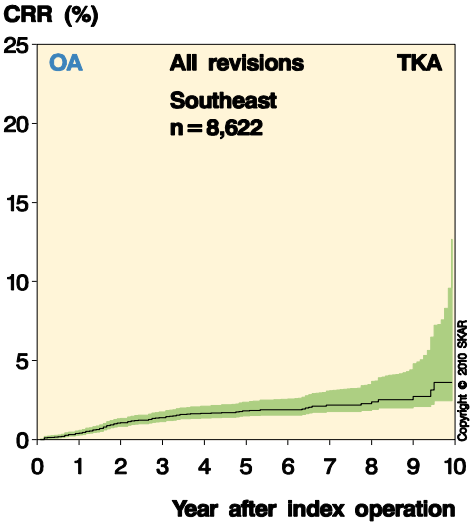
Uppsala+Örebro
Primary TKA implants for OA, 1999–2008

	Number	Percent
NexGen	4,899	30.8
AGC	4,010	25.2
F/S MIII	2,828	17.8
PFC Sigma	2,048	12.9
Kinemax	956	6.0
Duracon	490	3.1
Natural	268	1.7
AMK	108	0.7
MillerGalante2	64	0.4
PFC mobile bearing	59	0.4
NexGen mobile bearing	28	0.2
Scan	23	0.1
Vanguard	23	0.1
Profix	21	0.1
Other	58	0.4
Total	15,883	100



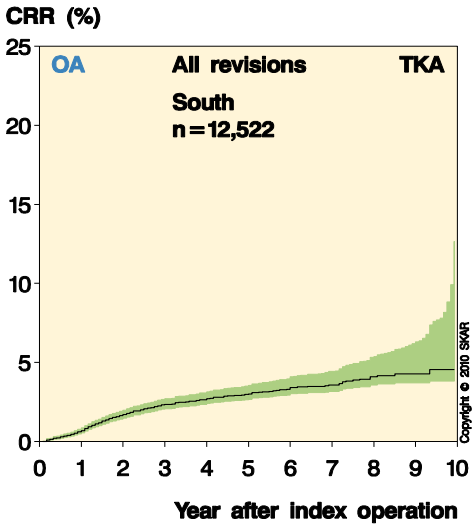
Southeast
Primary TKA implants for OA, 1999–2008

	Number	Percent
PFC Sigma	2,987	34.6
NexGen	2,876	33.4
AGC	2,332	27.0
Vanguard	161	1.9
Triathlon	74	0.9
Duracon	69	0.8
PFC mobile bearing	23	0.3
Profix	22	0.3
Evolution	11	0.1
Scan	10	0.1
Other	57	0.7
Total	8,622	100



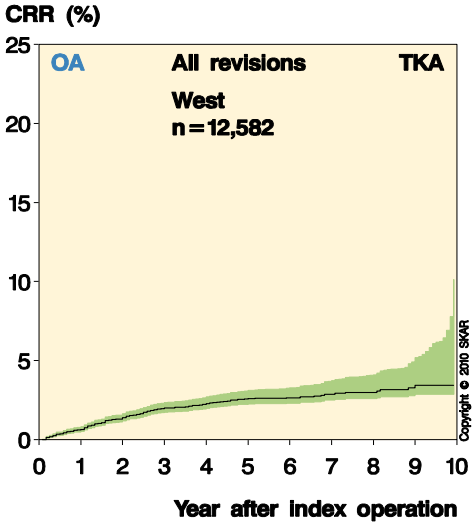
South
Primary TKA implants for OA, 1999–2008

	Number	Percent
PFC Sigma	4,458	35.6
Duracon	3,033	24.2
AGC	2,589	20.7
Triathlon	1,035	8.3
Scan	426	3.4
Vanguard	292	2.3
PFC mobile bearing	246	2.0
Profix	238	1.9
LCS	35	0.3
Oxford Rotating TKA	22	0.2
NexGen	8	0.1
Kinemax	8	0.1
Other	132	1.1
Total	12,522	100



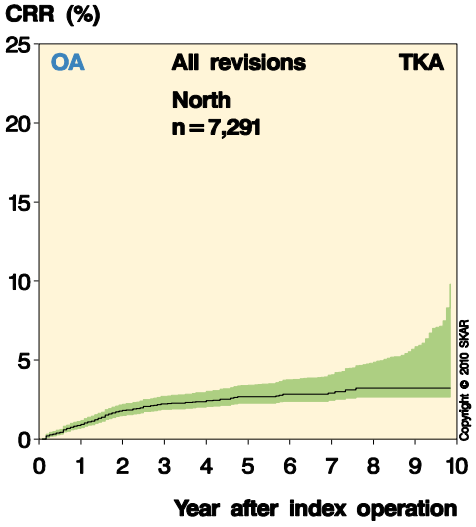
West
Primary TKA implants for OA, 1999–2008

	Number	Percent
AGC	3,421	27.2
NexGen	2,877	22.9
F/S MIII	2,279	18.1
PFC Sigma	1,660	13.2
Duracon	1,549	12.3
Vanguard	355	2.8
Scan	203	1.6
Natural	133	1.1
PFC mobile bearing	20	0.2
Profix	8	0.1
Other	77	0.6
Total	12,582	100



North
Primary TKA implants for OA, 1999–2008

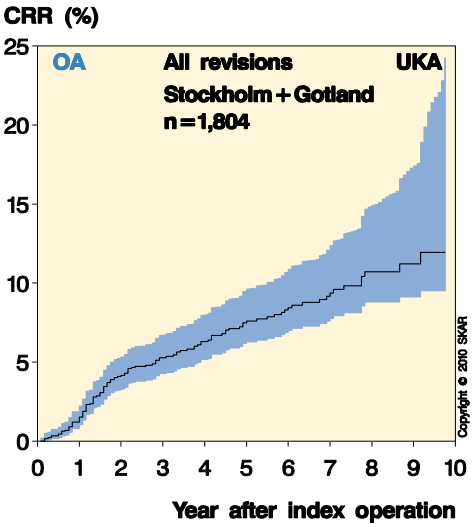
	Number	Percent
PFC Sigma	2,017	27.7
NexGen	1,920	26.3
AGC	1,680	23.0
Duracon	706	9.7
Profix	604	8.3
LCS	234	3.2
PFC mobile bearing	29	0.4
Vanguard	15	0.2
AMK	13	0.2
Performance	13	0.2
Triathlon	7	0.1
Other	53	0.7
Total	7,291	100



Primary UKA implants for OA in the regions during 1999–2008

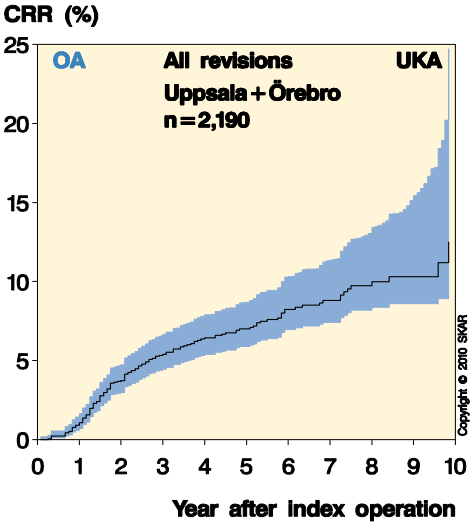
Stockholm + Gotland
Primary UKA implants for OA, 1999–2008

	Number	Percent
MillerGalante	1,153	63.9
Link	315	17.5
Oxford	238	13.2
Preservation	45	2.5
Allegretto	29	1.6
Genesis	14	0.8
ZUK	8	0.4
Brigham	2	0.1
Total	1,804	100



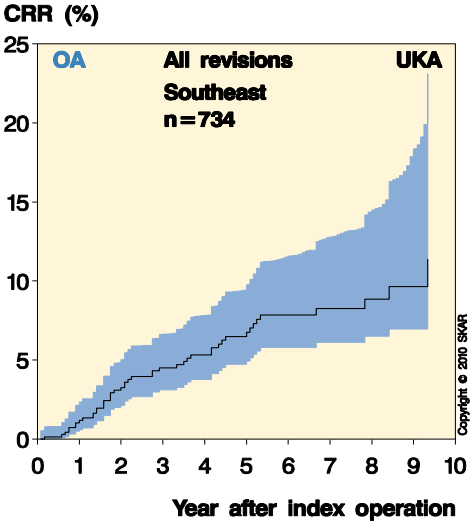
Uppsala+Örebro
Primary UKA implants for OA, 1999–2008

	Number	Percent
Link	1,618	73.9
Genesis	226	10.3
MillerGalante	151	6.9
Preservation	88	4.0
PFC	73	3.3
ZUK	21	1.0
EIUS	5	0.2
Allegretto	3	0.1
Marmor	3	0.1
Duracon	2	0.1
Total	2,190	100



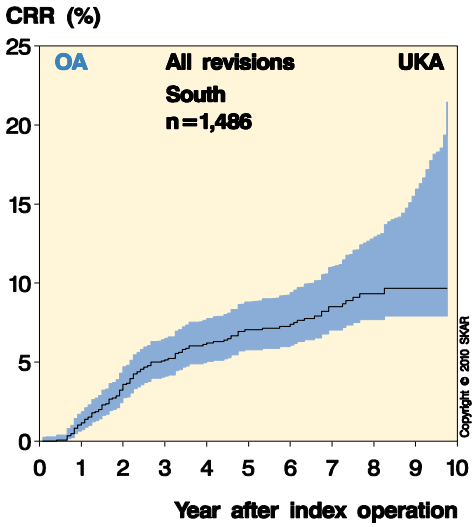
Southeast
Primary UKA implants for OA, 1999–2008

	Number	Percent
Link	251	34.2
Genesis	243	33.1
MillerGalante	127	17.3
Oxford	47	6.4
PFC	31	4.2
Duracon	23	3.1
Allegretto	7	1.0
Preservation	5	0.7
Total	734	100



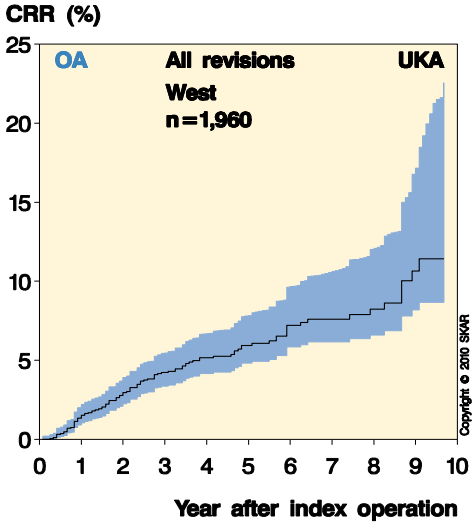
South
Primary UKA implants for OA, 1999–2008

	Number	Percent
Link	985	66.3
Oxford	216	14.5
MillerGalante	136	9.2
Duracon	52	3.5
EIUS	41	2.8
Genesis	22	1.5
PFC	19	1.3
Allegretto	8	0.5
Preservation	5	0.3
ZUK	2	0.1
Total	1,486	100



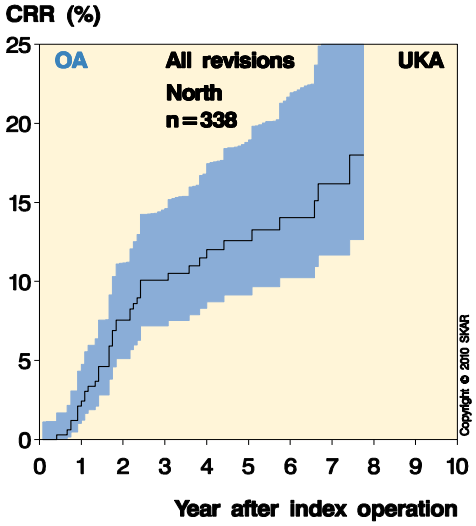
West
Primary UKA implants for OA, 1999–2008

	Number	Percent
Oxford	957	48.8
MillerGalante	671	34.2
Link	206	10.5
ZUK	108	5.5
Duracon	11	0.6
Genesis	5	0.3
Allegretto	2	0.1
Total	1,960	100



North
Primary UKA implants for OA, 1999–2008

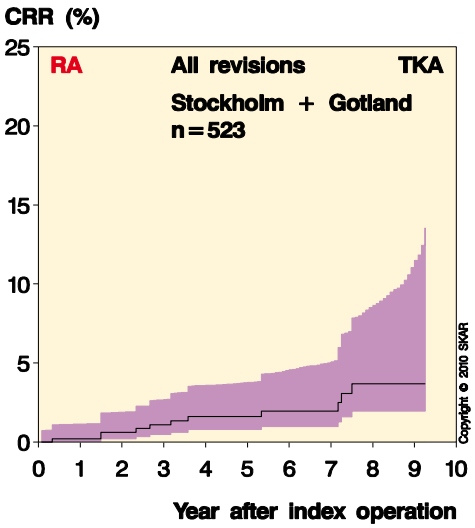
	Number	Percent
Link	225	66.6
MillerGalante	78	23.1
ZUK	19	5.6
Oxford	13	3.8
PFC	3	0.9
Total	338	100



Primary TKA implants for RA in the regions during 1999–2008

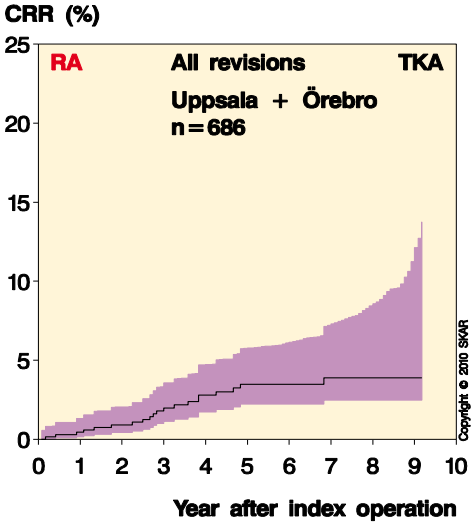
Stockholm + Gotland
Primary TKA implants for RA, 1999–2008

	Number	Percent
PFC Sigma	315	60.2
Duracon	98	18.7
NexGen	23	4.4
Kinemax	16	3.1
AGC	15	2.9
PFC Rotating Platform	10	1.9
F/S MIII	10	1.9
Natural	5	1.0
Triathlon TKA	5	1.0
Other	26	5.0
Total	523	100



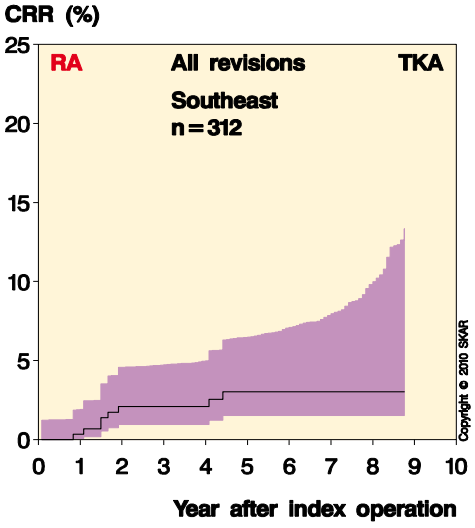
Uppsala+Örebro
Primary TKA implants for RA, 1999–2008

	Number	Percent
AGC	211	30.8
F/S MIII	186	27.1
NexGen	133	19.4
Kinemax	68	9.9
PFC Sigma	38	5.5
Natural	9	1.3
AMK	7	1.0
Duracon	7	1.0
MillerGalante2	6	0.9
Scan	5	0.7
Other	16	2.3
Total	686	100



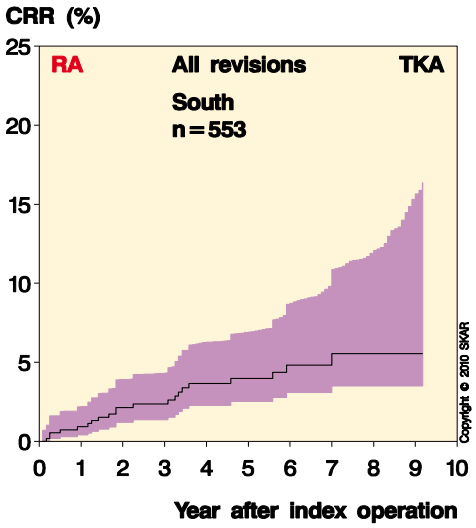
Southeast
Primary TKA implants for RA, 1999–2008

	Number	Percent
NexGen	114	36.5
PFC Sigma	88	28.2
AGC	84	26.9
Duracon	5	1.6
Other	21	6.7
Total	312	100



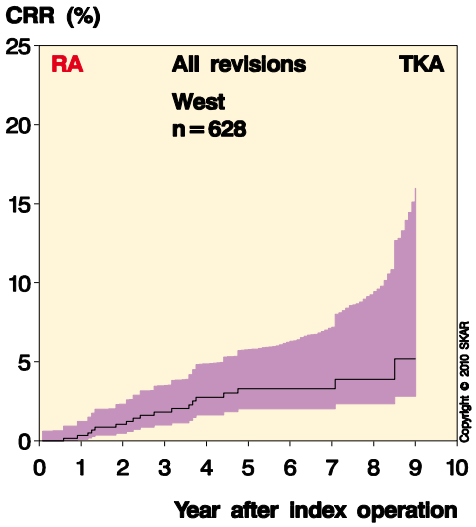
South
Primary TKA implants for RA, 1999–2008

	Number	Percent
PFC Sigma	161	29.1
Scan	109	19.7
AGC	100	18.1
Duracon	85	15.4
Vanguard	39	7.1
Profix	17	3.1
Triathlon TKA	11	2.0
Other	31	5.6
Total	553	100



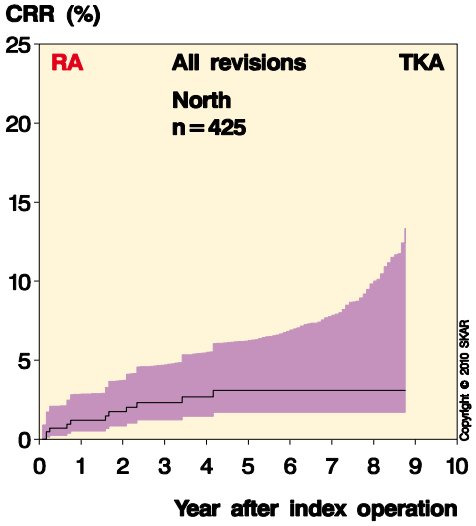
West
Primary TKA implants for RA, 1999–2008

	Number	Percent
AGC	229	36.5
F/S MIII	142	22.6
PFC Sigma	97	15.4
Duracon	60	9.6
NexGen	43	6.8
Scan	33	5.3
Vanguard	7	1.1
Other	17	2.7
Total	628	100



North
Primary TKA implants for RA, 1999–2008

	Number	Percent
PFC Sigma	123	28.9
AGC	78	18.4
Profix	70	16.5
Duracon	59	13.9
NexGen	45	10.6
LCS	20	4.7
Other	30	7.1
Total	425	100



The relative risk for implants used in primary arthroplasty during 1999–2008

In order to adequately summarize 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 there are reasonable numbers to be analyzed even if its use has ceased. Unfortunately, this implies that the number of implants analyzed may increase or decrease, depending on if the use of the brand is increasing or decreasing, which in turn may affect results.

The risk of revision is one of the many measures of outcome. Although not summarized here, the type of the revision should also be considered. Deliberately avoiding primary use of patellar button while preparing for a secondary resurfacing, when needed, increases the risk of revision. Therefore, we have decided to separately account for OA/TKA when used with and without a patellar button (see next page).

For the first time this year, we also display separate tables in which an isolated exchange of an inlay for infection is not considered to be a revision. The explanation for doing so is explained together with the tables on page 32-33.

Below you will find tables for the most common TKA and UKA models respectively.

The risk of revision (RR) with 95% confidence intervals. AGC is the reference in TKA and Link in UKA. The Cox regression adjusts for differences in gender, age and year of operation.

OA / TKA	n	p–value	RR	95% CI
AGC	14,392		ref.	
F/S MIII	6,472	0.07	0.84	0.70-1.01
PFC-Sigma	21,238	0.01	0.84	0.73-0.97
Scan	667	0.11	1.35	0.93-1.95
Kinemax	1,371	<0.01	1.77	1.39-2.26
Duracon	7,518	0.86	0.98	0.83-1.17
Profix	926	0.79	0.94	0.59-1.49
NexGen	14,440	<0.01	0.53	0.44-0.64
LCS	269	0.08	0.42	0.16-1.12
Natural II	473	0.83	0.94	0.53-1.67
PFC mob. bearing	509	0.72	1.11	0.63-1.93
Triathlon	1,198	0.16	0.6	0.30-1.22
Vanguard	924	0.06	1.63	0.98-2.71
Other	779	0.07	1.41	0.97-2.03
Gender (male is ref.)		0.97	1	0.90-1.11
Age (per year)		<0.01	0.96	0.96-0.97
Year of op. (per year)		0.59	1.01	0.98-1.03

RA / TKA	n	p–value	RR	95% CI
AGC	717		ref.	
F/S MIII	338	0.37	0.69	0.31-1.55
PFC-Sigma	822	0.29	0.71	0.38-1.32
Scan	147	0.17	1.72	0.79-3.74
Kinemax	84	0.09	2.17	0.88-5.37
Duracon	314	0.21	1.53	0.79-2.98
Profix	91	0.83	1.14	0.34-3.82
NexGen	361	0.03	0.2	0.05-0.87
LCS	*22*	*0.98*	*<0.01*	
Natural II	17	0.43	2.25	0.30-16.96
PFC mob. bearing	17	0.36	2.59	0.34-19.74
Triathlon	*17*	*0.99*	*<0.01*	
Vanguard	49	0.22	2.58	0.56-11.84
Other	131	0.86	0.9	0.27-2.98
Gender (male is ref.)		0.33	1.31	0.76-2.25
Age (per year)		0.86	1	0.98-1.02
Year of op. (per year)		0.55	1.03	0.93-1.15

Implants lacking sufficient numbers for analysis are shown in italics

OA / UKA	n	p–value	RR	95% CI
Link	3 600		ref.	
Oxford	1 471	0.48	1.1	0.85-1.42
MillerGalante	2 316	0.44	1.08	0.89-1.32
Duracon	88	<0.01	2.38	1.44-3.93
PFC	126	0.12	1.49	0.90-2.46
Genesis	510	0.42	1.17	0.80-1.71
Preservation	143	0.02	1.93	1.09-3.41
ZUK	158	0.3	0.47	0.12-1.92
Other	100	0.67	0.86	0.42-1.74
Gender (male is ref.)		0.42	0.93	0.79-1.10
Age (per year)		<0.01	0.96	0.95-0.97
Year of op. (per year)		0.91	1	0.96-1.04

For TKA´s inserted for OA, the PFC Sigma has significantly less risk of revision this year than the reference AGC. As of last year, the same is true for NexGen while Kinemax still has a higher risk. For the F/S MIII, which had significantly lower risk last year, the difference is no longer significant. If one does not consider a change of inlays in infected cases as being a revisions then the FS MIII maintains its advantage (see page 32).

For TKA´s inserted for RA, the NexGen still has a lower risk than the AGC while the PFC Sigma and Vanguard no longer are significantly different.

After UKA´s inserted for OA, Duracon still has a higher risk than the reference Link. This has also become true for the Preservation.

The risk of revision (RR) with 95% confidence intervals for TKA/OA inserted without and with a patella button respectively. In the lower right table, F/S MIII is used as reference instead of AGC.

Without patella button OA / TKA	n	p–value	RR	95% CI
AGC	12,607		ref.	
F/S MIII	3106	0.86	0.98	0.77-1.25
PFC-Sigma	20,110	<0.01	0.81	0.70-0.93
Scan	664	0.27	1.23	0.85-1.80
Kinemax	1024	<0.01	1.63	1.23-2.15
Duracon	6768	0.59	0.95	0.80-1.14
Profix	838	0.52	0.85	0.51-1.40
NexGen	14,238	<0.01	0.51	0.42-0.62
LCS	269	0.06	0.39	0.15-1.05
Natural II	445	0.95	0.98	0.55-1.75
PFC mob. bearing	383	0.71	1.12	0.62-2.00
Triathlon TKA	1,138	0.20	0.63	0.31-1.27
Vanguard	901	0.05	1.68	1.01-2.80
Other	698	0.19	1.30	0.88-1.92
Gender (male is ref.)		0.65	1.03	0.92-1.14
Age (per year)		<0.01	0.96	0.95-0.97
Year of op. (per year)		0.83	1.00	0.97-1.02

With patella button OA / TKA	n	p–value	RR	95% CI
AGC	1,784		ref.	
F/S MIII	3,364	0.60	1.12	0.74-1.70
PFC-Sigma	1,126	0.37	1.27	0.75-2.14
Scan	*3*			
Kinemax	346	<0.01	2.94	1.68-5.12
Duracon	749	0.38	1.32	0.72-2.42
Profix	88	0.16	2.37	0.72-7.79
NexGen	201	0.30	1.64	0.64-4.24
LCS				
Natural II	*28*	*0.98*	*<0.01*	
PFC mob. bearing	126	0.96	0.95	0.13-7.12
Triathlon TKA	*60*	*0.99*	*<0.01*	
Vanguard	*23*	*0.99*	*<0.01*	
Other	81	0.06	2.73	0.96-7.75
Gender (male is ref.)		0.17	0.81	0.61-1.09
Age (per year)		<0.01	0.98	0.96-0.99
Year of op. (per year)		0.26	1.04	0.97-1.11

Implants lacking sufficient numbers for analysis are shown in italics

As in previous reports, there are no differences that depend on gender and the risk of revision significantly decreases with increasing age in OA, but not RA.

Differentiating between TKA inserted with and without patellar button reduces the number of implants available for analysis, which can make it more difficult to demonstrate small differences.

Using AGC as a reference, when no patellar button is used (table above), PFC Sigma and Nexgen still have significantly lower risk while Kinemax and Vanguard have a higher risk. If revisions, in which an inlay has been exchanged because of infection, are excluded the difference for Vanguard no longer reaches a significant level (see page 33).

When a patellar component is used in TKA, only Kinemax with its significantly higher risk, differs from the reference implant.

With patella button using F/S MIII as a reference OA / TKA	n	p–value	RR	95% CI
F/S MIII	3,364		ref.	
AGC	1,784	0.60	0.89	0.59-1.36
PFC-Sigma	1,126	0.58	1.13	0.73-1.77
Scan	*3*			
Kinemax	346	<0.01	2.62	1.62-4.25
Duracon	749	0.57	1.18	0.68-2.04
Profix	88	0.21	2.12	0.66-6.77
NexGen	201	0.41	1.47	0.59-3.66
LCS				
Natural II	*28*	*0.98*	*<0.01*	
PFC mob. bearing	126	0.87	0.85	0.11-6.30
Triathlon TKA	*60*	*0.99*	*<0.01*	
Vanguard	*23*	*0.99*	*<0.01*	
Other	81	0.08	2.44	0.89-6.66
Gender (male is ref.)		0.17	0.81	0.61-1.09
Age (per year)		<0.01	0.98	0.96-0.99
Year of op. (per year)		0.26	1.04	0.97-1.11

Implants lacking sufficient numbers for analysis are shown in italics

Significant difference with higher risk ratio.
Significant difference with lower risk ratio.

The relative risk for implants used in primary arthroplasty during 1999–2008 if the exchange of an inlay, in case of infection, is not considered to be a revision

SKAR defines a revision being a second surgery (reoperation) of the knee in which implant components are exchanged, added or removed.

The reason for other types of surgeries not being considered is that shortly after start of the register, it was noted that many surgeons did not report 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 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 when the reason for revision is infection, this strict definition may treat certain implant brands unfairly. The reason is, that one fifth of all revisions for infection are synovectomies during which the inlay also is changed (which defines them as being revisions). However, a synovectomy in a knee with an implant in which the inlay is fixed (cannot be changed) is not counted as a revision, which in turn may favor that type. Thus, the argument has been made that a change of inlay in the case of an infection should not be considered a revision but a synovectomy.

The risk of revision (RR) with 95% confidence intervals. AGC is the reference in TKA and Link in UKA.
The exchange of inlay, in case of infection, is not considered a revision

OA / TKA	n	p-värde	RR	95% CI
AGC	14,392		ref.	
F/S MIII	6,472	0.01	0.79	0.65-0.95
PFC-Sigma	21,238	<0.01	0.79	0.69-0.91
Scan	667	0.27	1.24	0.85-1.80
Kinemax	1,371	<0.01	1.62	1.26-2.07
Duracon	7,518	0.24	0.90	0.75-1.07
Profix	926	0.31	0.77	0.46-1.28
NexGen	14,440	<0.01	0.46	0.38-0.57
LCS	269	0.07	0.40	0.15-1.07
Natural II	473	0.95	0.98	0.55-1.75
PFC mob. bearing	509	0.56	1.18	0.68-2.06
Triathlon TKA	1,198	0.21	0.61	0.29-1.31
Vanguard	924	0.38	1.31	0.72-2.41
Other	779	0.20	1.28	0.88-1.87
Gender (male is ref.)		0.25	1.07	0.96-1.19
Age (per year)		<0.01	0.96	0.95-0.97
Year of op. (per year)		0.16	0.98	0.96-1.01

RA / TKA	n	p–value	RR	95% CI
AGC	717		ref.	
F/S MIII	338	0.09	0.43	0.16-1.13
PFC-Sigma	822	0.22	0.67	0.36-1.26
Scan	147	0.18	1.70	0.78-3.70
Kinemax	84	0.23	1.81	0.68-4.79
Duracon	314	0.31	1.42	0.72-2.82
Profix	91	0.69	0.75	0.17-3.19
NexGen	361	0.03	0.20	0.05-0.87
LCS	*22*	*0.98*	*<0.01*	
Natural II	17	0.44	2.21	0.29-16.63
PFC mob. bearing	17	0.38	2.47	0.32-18.85
Triathlon TKA	*17*	*0.99*	*<0.01*	
Vanguard	49	0.24	2.51	0.55-11.59
Other	131	0.86	0.90	0.27-2.99
Gender (male is ref.)		0.39	1.28	0.73-2.24
Age (per year)		0.57	0.99	0.98-1.01
Year of op. (per year)		0.49	1.04	0.93-1.16

Implants lacking sufficient numbers for analysis are shown in italics

OA / UKA	n	p–value	RR	95% CI
Link	3,600		ref.	
Oxford	1,471	0.48	1.1	0.85-1.42
MillerGalante	2,316	0.44	1.08	0.89-1.32
Duracon	88	<0.01	2.38	1.44-3.93
PFC	126	0.12	1.49	0.90-2.46
Genesis	510	0.42	1.17	0.80-1.71
Preservation	143	0.02	1.93	1.09-3.41
ZUK	158	0.3	0.47	0.12-1.92
Other	100	0.67	0.86	0.42-1.74
Gender (male is ref.)		0.42	0.93	0.79-1.10
Age (per year)		<0.01	0.96	0.95-0.97
Year of op. (per year)		0.91	1	0.96-1.04

On the other hand it can be argued that infected TKA´s with fixed inlays are generally treated with a complete exchange of components, as a comprehensive synovectomy is not considered possible. This would result in a reversed bias if the exchange of an inlay is not considered as being a revision.

Without being able to give a definite answer regarding what is the most reasonable to do, we decided to do both, showing separate calculations in which the exchange of inlays (for infection) are not being considered revisions.

One has to realize that such exclusions reduce the number of revisions, which in turn reduces the sensitivity of the statistical analyses.

The risk of revision (RR) with 95% confidence intervals for TKA/OA inserted without and with a patella button respectively. In the lower right table, F/S MIII is used as reference instead of AGC.
The exchange of inlay, in case of infection, is not considered a revision

Without patella button OA / TKA	n	p–value	RR	95% CI
AGC	12,607		ref.	
F/S MIII	3,106	0.93	0.99	0.77-1.27
PFC-Sigma	20,110	<0.01	0.77	0.66-0.89
Scan	664	0.56	1.12	0.77-1.64
Kinemax	1,024	0.01	1.50	1.13-1.99
Duracon	6,768	0.15	0.87	0.72-1.05
Profix	838	0.34	0.77	0.45-1.32
NexGen	14,238	<0.01	0.44	0.36-0.54
LCS	269	0.05	0.37	0.14-1.00
Natural II	445	0.90	1.04	0.58-1.85
PFC mob. bearing	383	0.58	1.18	0.66-2.11
Triathlon TKA	1,138	0.26	0.65	0.30-1.37
Vanguard	901	0.32	1.36	0.74-2.51
Other	698	0.46	1.16	0.77-1.75
Gender (male is ref.)		0.12	1.09	0.98-1.23
Age (per year)		<0.01	0.96	0.95-0.96
Year of op. (per year)		0.03	0.97	0.95-1.00

With patella button OA / TKA	n	p–value	RR	95% CI
AGC	1,784		ref.	
F/S MIII	3,364	0.89	0.97	0.63-1.49
PFC-Sigma	1,126	0.62	1.14	0.67-1.95
Scan	*3*			
Kinemax	346	<0.01	2.59	1.46-4.58
Duracon	749	0.62	1.18	0.62-2.22
Profix	88	0.80	0.78	0.11-5.70
NexGen	201	0.29	1.67	0.65-4.30
LCS				
Natural II	*28*	*0.98*	*<0.01*	
PFC mob. bearing	126	0.88	1.16	0.15-8.77
Triathlon TKA	*60*	*0.98*	*<0.01*	
Vanguard	*23*	*0.99*	*<0.01*	
Other	81	0.07	2.63	0.93-7.49
Gender (male is ref.)		0.39	0.87	0.64-1.19
Age (per year)		<0.01	0.97	0.96-0.99
Year of op. (per year)		0.71	1.01	0.95-1.09

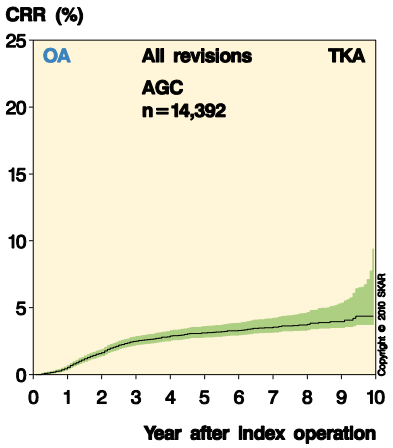
Implants lacking sufficient numbers for analysis are shown in italics

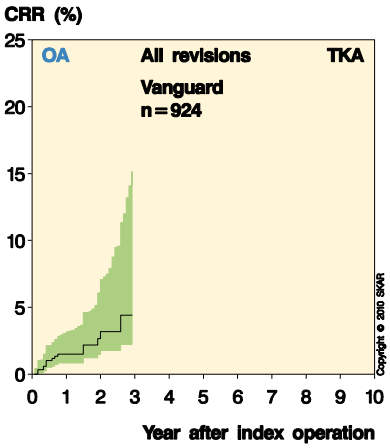
Significant difference with higher risk ratio.
Significant difference with lower risk ratio.

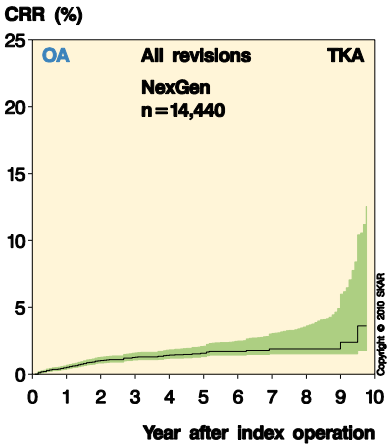
With patella button using F/S MIII as a reference OA / TKA	n	p–value	RR	95% CI
F/S MIII	3,364		ref.	
AGC	1,784	0.89	1.03	0.67-1.58
PFC-Sigma	1,126	0.49	1.18	0.74-1.88
Scan	*3*			
Kinemax	346	<0.01	2.67	1.61-4.43
Duracon	749	0.52	1.21	0.67-2.18
Profix	88	0.82	0.80	0.11-5.79
NexGen	201	0.25	1.72	0.69-4.29
LCS				
Natural II	28	0.98	<0.01	
PFC mob. bearing	126	0.86	1.20	0.16-8.97
Triathlon TKA	*60*	*0.98*	*<0.01*	
Vanguard	*23*	*0.99*	*<0.01*	
Other	81	0.05	2.72	0.99-7.45
Gender (male is ref.)		0.39	0.87	0.64-1.19
Age (per year)		<0.01	0.97	0.96-0.99
Year of op. (per year)		0.71	1.01	0.95-1.09

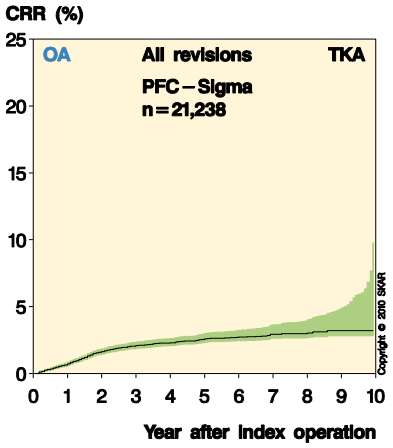
Implants lacking sufficient numbers for analysis are shown in italics

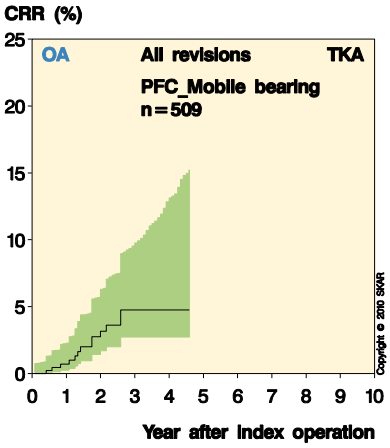
CRR for commonly used TKA implants for OA 1999–2008

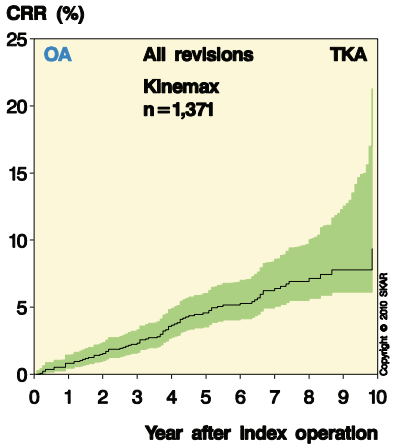


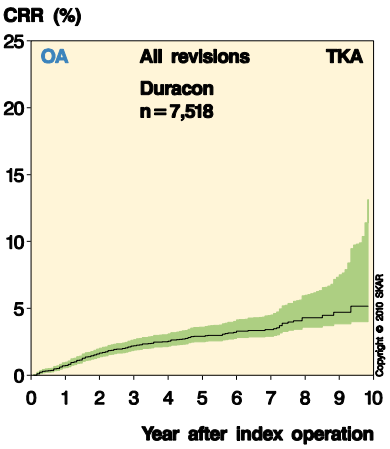


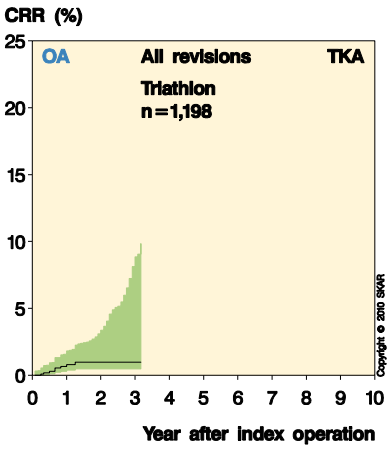


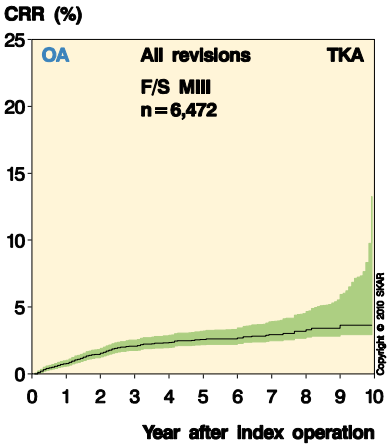











CRR (%)
OA
All revisions
TKA
F/S MIII
n=6,472
Year after index operation
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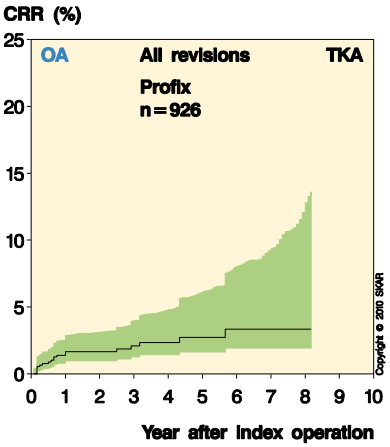
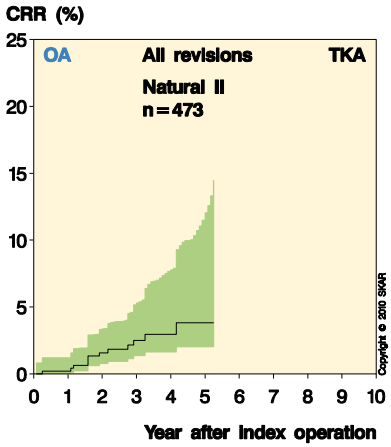
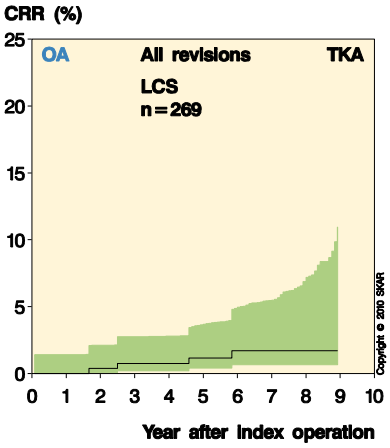
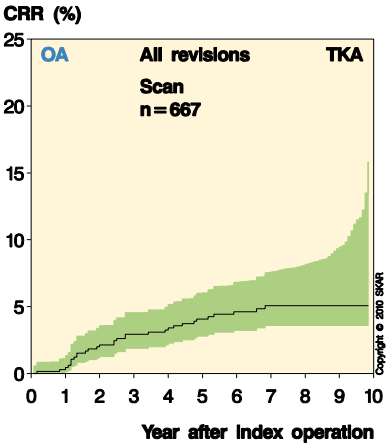
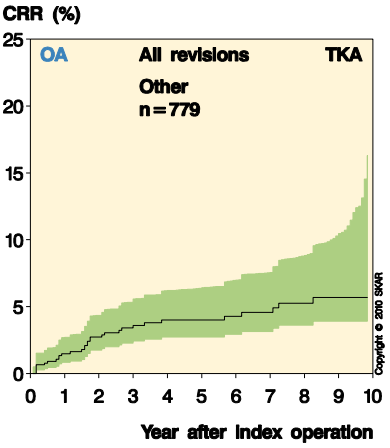
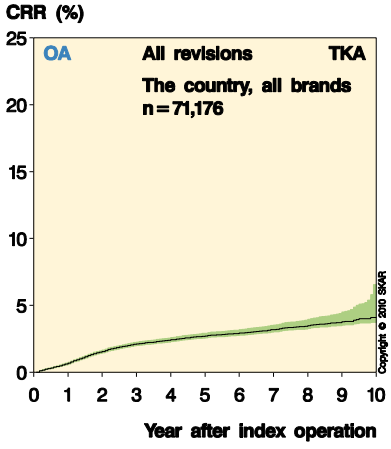

CRR (%)
OA
All revisions
TKA
Profix
n=926
Year after index operation
Copyright © 2010 SKAR


CRR (%)
OA
All revisions
TKA
Natural II
n=473
Year after index operation
Copyright © 2010 SKAR

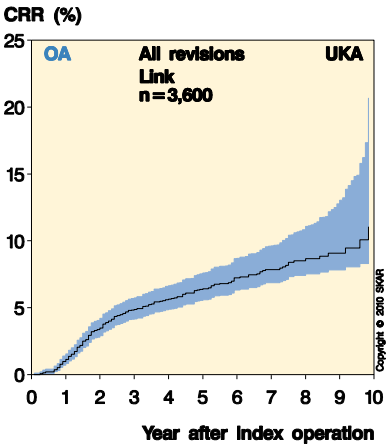

CRR (%)
OA
All revisions
TKA
LCS
n=269
Year after index operation
Copyright © 2010 SKAR

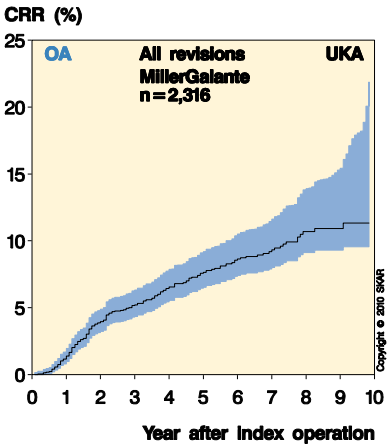

CRR (%)
OA
All revisions
TKA
Scan
n=667
Year after index operation
Copyright © 2010 SKAR

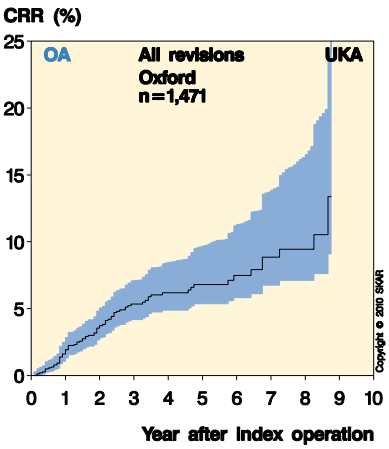

CRR (%)
OA
All revisions
TKA
Other
n=779
Year after index operation
Copyright © 2010 SKAR

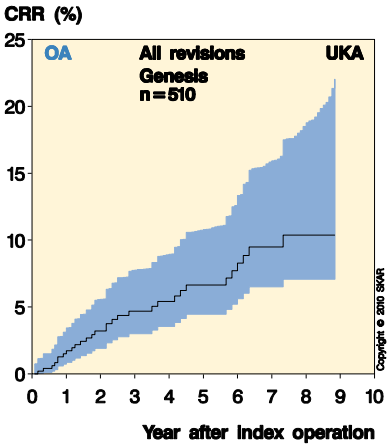

CRR (%)
OA
All revisions
TKA
The country, all brands
n=71,176
Year after index operation
Copyright © 2010 SKAR

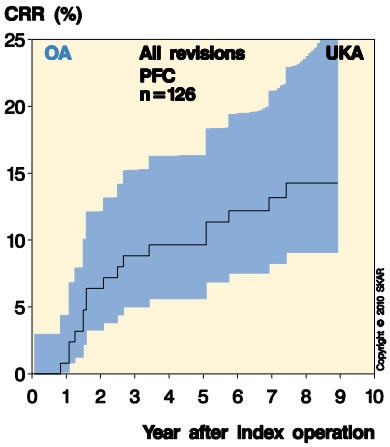
CRR for commonly used UKA implants for OA 1999–2008

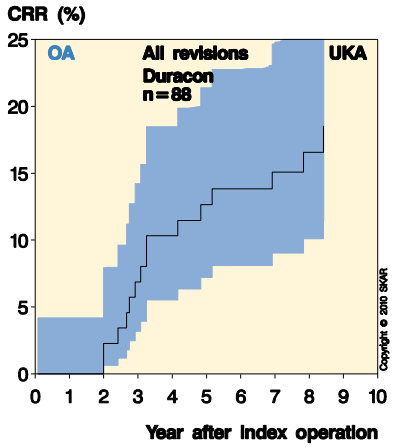


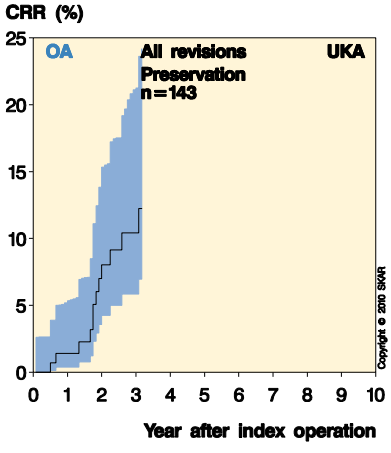


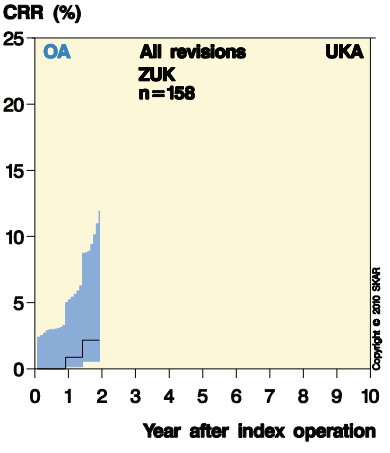


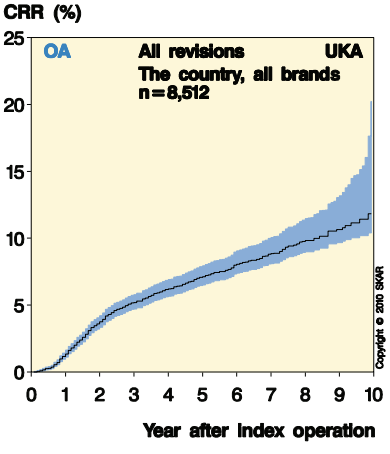












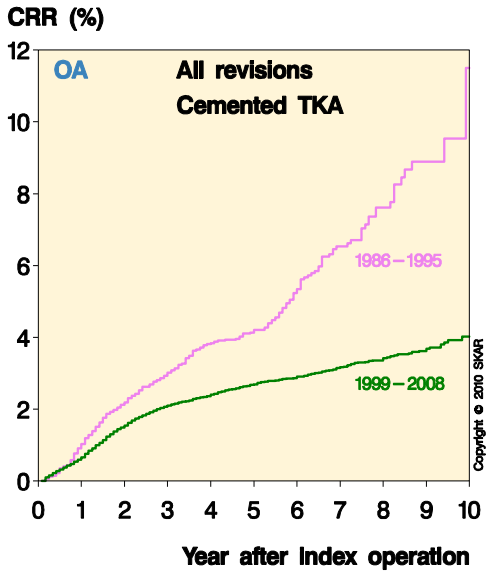
Changes in risk of revision over time (cemented TKA)

The figure below shows the overall risk of revision for the current 10-year period, 1999-2008, as compared to the period 1986-1995. It can be seen that the risk for the current period is considerably lower than for the earlier period.

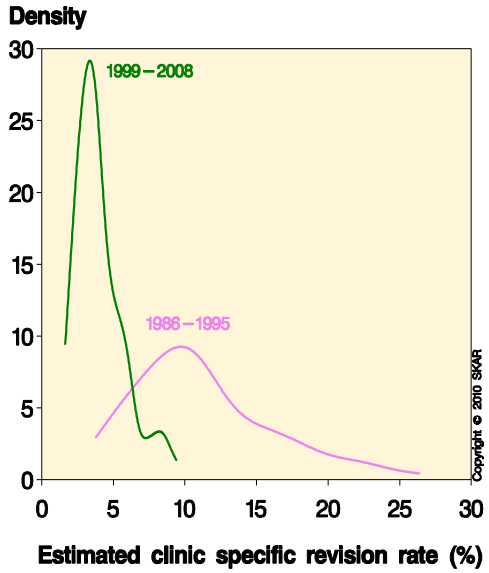
When the absolute specific risk of revision for the units is plotted for both periods (figure below left), it can be seen that the risk has become lower and the distribution has diminished. This implies that the results have improved overall and at the same time the results for the different units have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

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

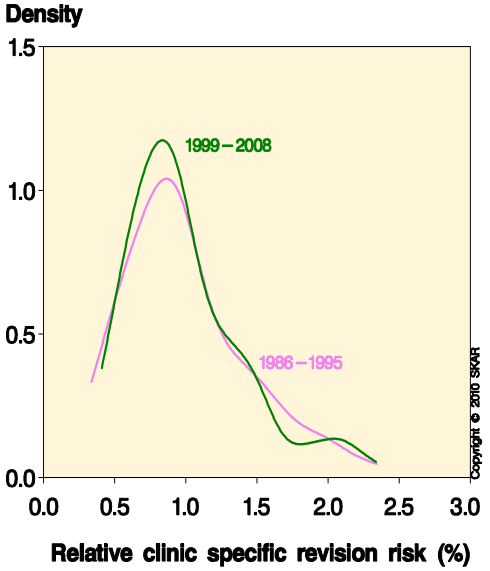
The register is requested to account for hospital specific results which can be found on the next pages. There were 10 hospitals having significantly better results than the average hospital and 12 with inferior results. One can only speculate on the causes for these differences. An unfortunate choice of implants, methods or surgeons may be the explanation, but also a selection of patients with 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 have to reflect the current risk for patients undergoing surgery.



Total CRR for cemented TKA in OA during the 2 periods 1986–1995 and 1999–2008 shows a considerable reduction in CRR over time.



Plotting the estimated absolute clinic specific risk of revision shows that the absolute distribution has diminished between 1986-1995 and 1999–2008 (x-axis = absolute risk of revision)



Plotting the relative clinic specific 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 1999–2008 (x-axis = relative risk).

Relative risk of revision for hospitals 1999–2008 (cemented TKA)

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 can't automatically be used to predict future results. The observed average result of a hospital treatment is not constant. Different selections of patients receiving 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 operations (cemented 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 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.

Only units performing more than 50 procedures during the 10-year period were evaluated in the analysis and only cemented TKA inserted for OA were included. The results are adjusted for differences in sex and gender as well as for differences with respect to if a patellar button had been used or not.

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	Unit	No. TKA	No. revised	RR	95% CI	rank	95% CI
56010	Västerås	565	2	0.41	0.19-0.91	1	1-42
10484	Sabbatsbergs närsjh	677	6	0.42	0.23-0.78	2	1-31
21001	Linköping	410	3	0.43	0.21-0.90	3	1-41
52012	Alingsås	1,000	7	0.47	0.26-0.85	4	1-37
21014	Motala	2,013	15	0.48	0.30-0.75	5	1-29
53011	Lidköping	779	6	0.50	0.27-0.92	6	1-44
64011	Lycksele	361	2	0.51	0.23-1.12	7	1-58
62011	Örnsköldsvik	952	10	0.54	0.32-0.92	8	2-43
12010	Enköping	1,160	10	0.55	0.32-0.92	9	2-45
65014	Kalix	164	1	0.57	0.24-1.35	10	1-68
42011	Varberg	1,183	14	0.58	0.37-0.93	11	3-44
56012	Köping	1,085	13	0.60	0.37-0.96	12	3-46
50010	Östra sjukhuset	926	11	0.62	0.37-1.03	13	3-51
53010	Falköping	848	10	0.64	0.38-1.07	14	3-54
22012	Värnamo	857	10	0.64	0.38-1.09	15	3-56
28013	Simrishamn	715	12	0.65	0.40-1.06	16	4-54
13012	Kullbergska sjukhuset	987	11	0.66	0.39-1.09	17	4-56
22010	Jönköping	913	12	0.66	0.40-1.07	18	4-54
23010	Växjö	714	9	0.67	0.39-1.16	19	4-60
11001	Karolinska	1,387	20	0.68	0.45-1.01	20	6-50
65012	Gällivare	549	7	0.68	0.38-1.22	21	3-62
13010	Eskilstuna	316	3	0.69	0.33-1.43	22	2-71
42015	Movement Halmstad	465	3	0.70	0.34-1.46	23	2-71
53013	Skövde	567	8	0.73	0.41-1.28	24	5-66
12481	Elisabethsjukhuset	404	4	0.74	0.37-1.47	25	3-73
50480	Carlanderska	79	0	0.75	0.29-1.97	26	1-81
52011	Borås	777	11	0.76	0.45-1.27	27	6-65
50080	Sergelkliniken Gbg	140	2	0.77	0.35-1.69	28	3-77

(forts.)

Relative risk of revision for units (continued)

Code	Unit	No. TKA	No. revised	RR	95% CI	rank	95% CI
27010	Karlskrona	145	3	0.78	0.37-1.61	29	3-75
54013	Säffle	285	5	0.78	0.40-1.50	30	4-73
50071	Frölunda Spec.Sjukhus	549	8	0.79	0.45-1.40	31	7-70
10011	S:t Göran	3,047	57	0.80	0.62-1.03	32	17-52
21013	Norrköping	525	10	0.80	0.47-1.35	33	8-68
41012	Helsingborg	401	8	0.81	0.46-1.42	34	7-71
30001	Malmö	239	4	0.83	0.42-1.65	35	5-76
50001	Sahlgrenska	361	7	0.84	0.47-1.52	36	7-74
25011	Oskarshamn	1,343	19	0.85	0.56-1.27	37	13-65
28011	Ängelholm	998	18	0.85	0.56-1.29	38	12-65
11002	Huddinge	709	12	0.85	0.52-1.39	39	11-70
62013	Sollefteå	731	13	0.87	0.54-1.39	40	12-70
65016	Sunderby sjukhus	302	7	0.88	0.49-1.59	41	8-75
55011	Karlskoga	707	13	0.88	0.55-1.42	42	13-70
57010	Falun	1,544	30	0.89	0.64-1.25	43	19-65
55012	Lindesberg	742	14	0.90	0.57-1.43	44	14-71
42010	Halmstad	1,142	22	0.93	0.62-1.39	45	18-70
13011	Nyköping	567	10	0.93	0.55-1.57	46	13-75
11011	Södertälje	862	17	0.93	0.61-1.43	47	17-71
25010	Kalmar	1,002	20	0.94	0.63-1.40	48	19-70
54010	Karlstad	1,210	21	0.94	0.63-1.40	49	18-69
11015	Nacka-Proxima	75	1	0.94	0.40-2.24	50	4-84
24010	Västervik	848	19	0.96	0.64-1.44	51	19-72
55010	Örebro	810	16	0.96	0.62-1.49	52	18-72
64001	Umeå	693	15	1.00	0.64-1.57	53	19-75
57011	Mora	919	21	1.01	0.68-1.49	54	23-73
64010	Skellefteå	602	14	1.01	0.64-1.61	55	20-75
63010	Östersund	725	16	1.02	0.65-1.57	56	21-75
27011	Karlshamn	1,228	27	1.02	0.72-1.46	57	26-72
10015	Sophiahemmet	869	23	1.04	0.71-1.51	58	24-73
10013	Södersjukhuset	1,425	27	1.04	0.73-1.49	59	26-73
11913	Stockholms Specialistvård	927	20	1.07	0.71-1.59	60	25-76
28012	Hässleholm	3,275	78	1.10	0.88-1.38	61	39-70
22011	Eksjö-Nässjö	706	18	1.11	0.73-1.69	62	27-77
11010	Danderyd	1,326	33	1.16	0.83-1.60	63	35-75
41010	Landskrona	510	18	1.18	0.78-1.80	64	31-79
42420	Spenshult	171	2	1.19	0.54-2.61	65	12-85
54014	Torsby	730	21	1.22	0.83-1.81	66	35-79
62010	Sundsvall	861	26	1.25	0.87-1.79	67	38-79
54012	Arvika	636	15	1.27	0.81-1.98	68	34-81
41001	Lund	139	6	1.29	0.69-2.38	69	23-85
41013	Ystad	280	11	1.29	0.78-2.13	70	30-83
52013	Skene	623	22	1.38	0.94-2.03	71	44-82
23011	Ljungby	574	21	1.42	0.96-2.11	72	46-83
51010	Uddevalla	1,139	35	1.43	1.04-1.97	73	52-81
50020	OrthoCenter IFK klin.	260	9	1.46	0.85-2.51	74	38-85
41011	Trelleborg	2,546	68	1.48	1.17-1.88	75	60-80
51011	Mölndal	504	17	1.48	0.97-2.27	76	46-84
10016	Ortopediska huset	1,786	55	1.53	1.18-1.98	77	60-82
26010	Visby	549	19	1.53	1.02-2.31	78	51-84
61010	Gävle	480	21	1.59	1.07-2.35	79	55-85
65013	Piteå	1,252	42	1.84	1.38-2.47	80	69-85
61011	Bollnäs / Söderhamn	1,239	48	1.87	1.42-2.46	81	70-85
54011	Kristinehamn	67	8	1.96	1.12-3.44	82	57-86
51012	Kungälv	1,038	52	2.11	1.62-2.76	83	76-86
11012	Norrtälje	585	30	2.14	1.51-3.02	84	73-86
61012	Hudiksvall	516	30	2.14	1.53-3.00	85	73-86
12001	Akademiska sjukhuset	840	50	2.37	1.80-3.11	86	79-86

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

Relative risk of revision for hospitals 1999–2008 (cemented TKA) if the exchange of an inlay, in case of infection, is not considered to be a revision

As described on page 32, the SKAR defines a revision as being a reoperation in which implant components are exchanged, added or removed.

The reason for this is shortly after the start of the register, it was noted that many surgeons did not report 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 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 for infected cases this strict definition may unfairly treat different implant brands and thus also those hospitals using these brands. The reason is that one fifth of all revisions for infection are synovectomies during which the inlay is exchanged (defining them as being revisions). However, a synovectomy in a knee with an implant in which the inlay is fixed to the baseplate, and thus cannot be exchanged, will not count as a revision, which in turn may favor that type of implant. Thus, the argument has been made that the change of inlay in the case of an infection should not be considered a revision, but a synovectomy.

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 synovectomy is not considered possible. This would result in a reversed bias when the exchange of an inlay is not considered being a revision.

Without being able to give a definite answer regarding what is the most reasonable thing to do, we decided to do both, showing separate calculations in which the exchange of inlays (for infection) are not being considered revisions.

If the table below is compared to the one on the previous page, it can be seen that although the rank has changed somewhat, the effect is relatively small with respect to what units are better and respectively worse than the national mean.

Excluding the exchange of liners in infected cases, Köping has no longer significantly lower risk than the national mean. At the other end, we find the same units as in the previous table with the exception of Ljungby, which no longer has a significantly higher risk than the national mean.

Relative risk of revision for units. The exchange of inlay, in case of infection, is not considered a revision

kod	klinik	antal TKA	reviderade	RR	95% CI	rang	95% CI
10484	Sabbatsbergs närsjh	677	6	0.44	0.24-0.81	1	1-34
56010	Västerås	565	2	0.45	0.21-0.97	2	1-47
21001	Linköping	410	3	0.46	0.22-0.94	3	1-44
52012	Alingsås	1,000	6	0.46	0.25-0.85	4	1-37
21014	Motala	2,013	14	0.49	0.31-0.77	5	1-31
62011	Örnsköldsvik	952	8	0.50	0.29-0.87	6	1-40
53011	Lidköping	779	6	0.53	0.29-0.98	7	1-48
64011	Lycksele	361	2	0.54	0.25-1.17	8	1-59
42011	Varberg	1,183	12	0.56	0.34-0.91	9	2-42
50010	Östra sjukhuset	926	9	0.58	0.34-0.98	10	2-48
12010	Enköping	1,160	10	0.59	0.35-0.98	11	2-49
65014	Kalix	164	1	0.60	0.26-1.38	12	1-70
56012	Köping	1,085	13	0.64	0.40-1.02	13	3-51
42015	Movement Halmstad	465	2	0.65	0.30-1.41	14	1-69
22010	Jönköping	913	11	0.65	0.40-1.08	15	4-54
13012	Kullbergska sjukhuset	987	10	0.66	0.39-1.11	16	3-56
53010	Falköping	848	10	0.68	0.40-1.13	17	4-58
28013	Simrishamn	715	12	0.68	0.42-1.11	18	4-56
22012	Värnamo	857	10	0.69	0.41-1.17	19	4-59
23010	Växjö	714	9	0.71	0.42-1.22	20	4-62
11001	Karolinska	1,387	20	0.72	0.48-1.07	21	7-54
65012	Gällivare	549	7	0.72	0.40-1.28	22	4-65
13010	Eskilstuna	316	3	0.73	0.35-1.49	23	2-72
50001	Sahlgrenska	361	5	0.73	0.39-1.38	24	3-69
53013	Skövde	567	8	0.77	0.44-1.33	25	5-67
50071	Frölunda Spec.Sjukhus	549	7	0.77	0.43-1.38	26	5-68
21013	Norrköping	525	9	0.78	0.46-1.33	27	6-68
64001	Umeå	693	10	0.78	0.47-1.31	28	7-65

(forts.)

Relative risk of revision for units (continued)

kod	klinik	antal TKA	reviderade	RR	95% CI	rang	95% CI
12481	Elisabethsjukhuset	404	4	0.78	0.40-1.54	29	4-73
50480	Carlanderska	79	0	0.78	0.31-1.98	30	2-81
25010	Kalmar	1,002	15	0.79	0.50-1.23	31	9-62
24010	Västervik	848	14	0.79	0.50-1.25	32	8-63
50080	Sergelkliniken Gbg	140	2	0.80	0.37-1.72	33	3-77
27010	Karlskrona	145	3	0.80	0.39-1.64	34	4-76
52011	Borås	777	11	0.81	0.49-1.35	35	8-67
54013	Säffle	285	5	0.82	0.43-1.56	36	5-74
25011	Oskarshamn	1,343	17	0.83	0.54-1.27	37	11-64
10011	S:t Göran	3,047	57	0.84	0.65-1.09	38	19-55
55012	Lindesberg	742	12	0.85	0.52-1.38	39	10-68
41012	Helsingborg	401	8	0.85	0.49-1.48	40	8-71
62013	Sollefteå	731	12	0.86	0.53-1.40	41	11-69
30001	Malmö	239	4	0.86	0.44-1.69	42	6-77
42010	Halmstad	1,142	19	0.88	0.58-1.35	43	13-68
57010	Falun	1,544	28	0.89	0.63-1.26	44	17-64
28011	Ängelholm	998	18	0.89	0.59-1.36	45	15-68
11002	Huddinge	709	12	0.90	0.55-1.46	46	12-72
65016	Sunderby sjukhus	302	7	0.92	0.51-1.64	47	9-76
55011	Karlskoga	707	13	0.93	0.58-1.49	48	14-72
11015	Nacka-Proxima	75	1	0.97	0.42-2.23	49	5-84
10013	Södersjukhuset	1,425	23	0.97	0.66-1.41	50	21-70
10015	Sophiahemmet	869	20	0.97	0.65-1.45	51	20-71
11011	Södertälje	862	17	0.98	0.64-1.51	52	19-73
13011	Nyköping	567	10	0.99	0.59-1.65	53	15-76
11010	Danderyd	1,326	26	1.00	0.69-1.43	54	23-70
54010	Karlstad	1,210	21	1.00	0.68-1.49	55	21-73
55010	Örebro	810	16	1.01	0.65-1.56	56	20-74
57011	Mora	919	20	1.02	0.68-1.52	57	22-73
42420	Spenshult	171	1	1.03	0.45-2.38	58	6-85
63010	Östersund	725	16	1.06	0.69-1.64	59	23-76
64010	Skellefteå	602	14	1.06	0.67-1.68	60	22-77
27011	Karlshamn	1,228	27	1.09	0.76-1.54	61	29-74
11913	Stockholms Specialistvård	927	20	1.13	0.76-1.68	62	29-77
22011	Eksjö-Nässjö	706	18	1.17	0.77-1.77	63	30-79
41010	Landskrona	510	17	1.17	0.76-1.79	64	30-79
28012	Hässleholm	3,275	78	1.17	0.94-1.47	65	44-72
54014	Torsby	730	21	1.28	0.87-1.90	66	38-81
41001	Lund	139	6	1.31	0.71-2.40	67	24-85
62010	Sundsvall	861	26	1.31	0.92-1.87	68	42-81
41013	Ystad	280	11	1.32	0.80-2.18	69	33-84
54012	Arvika	636	15	1.33	0.85-2.08	70	38-83
41011	Trelleborg	2,546	59	1.39	1.08-1.78	71	54-79
51011	Mölndal	504	15	1.40	0.90-2.18	72	41-84
52013	Skene	623	22	1.45	0.99-2.13	73	48-84
23011	Ljungby	574	21	1.48	1.00-2.19	74	49-84
50020	OrthoCenter IFK klin.	260	9	1.51	0.88-2.57	75	40-86
51010	Uddevalla	1,139	35	1.51	1.10-2.07	76	56-83
26010	Visby	549	19	1.61	1.07-2.42	77	54-85
10016	Ortopediska huset	1,786	55	1.62	1.25-2.10	78	63-84
61010	Gävle	480	21	1.65	1.11-2.43	79	56-85
51012	Kungälv	1,038	40	1.74	1.29-2.34	80	65-85
65013	Piteå	1,252	37	1.74	1.28-2.37	81	65-85
54011	Kristinehamn	67	8	1.94	1.12-3.39	82	57-86
61012	Hudiksvall	516	26	1.95	1.36-2.79	83	68-86
61011	Bollnäs / Söderhamn	1,239	48	1.98	1.50-2.60	84	72-86
11012	Norrtälje	585	28	2.11	1.48-3.01	85	72-86
12001	Akademiska sjukhuset	840	43	2.16	1.61-2.89	86	75-86

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

The new form – results for 2009

This is a general description of the new variables, reported from the units in 2009 for 12,707 primary knee arthroplasties.

Previous surgery

When reporting a previous surgery of the current knee, it is possible to mark more than one alternative on the form:

No previous surgery was reported in 73% of cases, 25.5% had one previous surgery before the primary arthroplasty and 2.5% more than one.

The table below shows the most common operations. It is not a comprehensive description of the previous surgery performed, but illustrates what the surgeon knew at the time when performing the primary arthroplasty.

Previous surgery in the index knee

Operation	Percent
None	73
Osteosynthesis	0.8
Osteotomy	2.1
Meniscal surgery	6.7
Cruciate ligement surgery	0.9
Arthroscopy	4.7
Other	2.1
Missing	9.7
Total	100

ASA

The American Society of Anesthesiologists classification is an estimate of the patient's health, and thus of the risk associated with the imminent anesthesia and surgery. As can be seen below, three quarters of the patients were considered healthy or only having a mild systemic disease (class I or II)

ASA klassification (simplified)

		Percent
ASA I	Healthy patient	18.5
ASA II	Mild systemic disease	58.3
ASA III	Severe systemic disease	13.5
ASA IV	Severe disease, constant threat to life	0.2
ASA V	Not expected to live 24 hours	-
Missing		9.5
Total		100

Body Mass Index (BMI)

One third of the patients had a BMI of 30 or more which is obisity according to the WHO classification. 2.1% had a BIMI over 49, i.e. morbid obesity. Women had a slightly higher BMI than men, but the difference was small.

Body Mass Index (kg/m2)

BMI group	Percent
<25	17,6
25-29.9	39.4
30-39.9	30.6
≥40	2.1
Missing	10.3
Total	100

Body Mass Index (kg/m2)

Gender	BMI (median)
Women	28.8
Men	28.0
All	28.4

Antithrombotic prophylaxis

Fragmin was the most commonly reported antithrombotic drug. With Fragmin, Inohep and Klexane, it was equally common that the treatment started pre- as postoperatively. During 2009 two new drugs, Pradaxa and Xarelto were taken into use by some units. These are per-oral drugs and the treatment is started 1-4 hours and 6-10 hours after surgery respectively.

Thromboprophylaxis

Type		Percent
No prophylaxis		0.3
Fragmin	started pre-op	24.5
Fragmin	started post-op	22.0
Inohep	started pre-op	12.1
Inohep	started post-op	14.7
Klexane	started pre-op	6.6
Klexane	started post-op	6.1
Xarelto		1.8
Pradaxa		1.1
Annat		0.1
Missing		10.7
Total		100

The planned length of antithrombotic treatment varies. For two thirds of the patients, it was 8-14 days, although that treatment for up to 42 days was reported. Not using any prophylactic medication is uncommon (see table below).

Thromboprophylaxis - length of treatment

Days	Percent
No prophylaxis	0.3
1-7	13.6
8-14	62.9
15-21	3.7
22-28	6.2
29-35	1.9
>35	0.5
Missing	10.9
Total	100

Type of antibiotic

Cloxacillin was the antibiotic reported by 80% of the units for 80% of the patients. Dalacin (klindamycin) was used in 5.9% of the surgeries which can be interpreted as this percentage of the patients being suspected of having penicillin allergy. Cephalosporin's are infrequently used in comparison to that which has been reported from other countries, e.g. Norway.

Antibiotic type

Substance	Percent
Cloxacillin	80.8
Dalacin	5.9
Zinazef	3.8
Cefotaxim	0.2
Vancomycin	<0.1
Other	<0.1
Missing	9.2
Total	100

Cloxacillin dose

	Dose	Percent
Cloxacillin	2gx3	51.5
Cloxacillin	2gx4	29.9
Cloxacillin	1gx3	3.9
Cloxacillin	1gx4	1.8
Cloxacillin	2g+1g+1g	9.0
Cloxacillin	annan dos	2.0
Missing		1.9
Total		100

Cloxacillin - dose

The most common cloxacillin dose, intended to use, was 2g x 3 (see table below, left). Most often, the 3 planned administrations were to be within the course of 24 hours. However, this varied from 8 hours to 48 hours.

Antibiotics - time of administration

The aim when using antibiotic prophylaxis is that the concentration in the tissues should be at its highest at the start of surgery. Antibiotics such as cloxacillin and cephalosporin have a short half-life and thus, it is commonly recommended to administrate the antibiotic approximately 30 minutes before start of surgery. When using a tourniquet, the antibiotic should not be injected to late if a reasonable concentration is to be reached in the tissues. For knee arthroplasty, most often performed using a tourniquet, it is therefore recommended that the antibiotic is administrated 15-45 minutes prior to turning the tourniquet on.

During 2009, three quarters of the units registering the time for injection (information was missing for 10%) reported staying within the 15-45 min. time interval (see table below). This is considerably better than what was found in a recently published study concerning the years 2007-2008 (Stefansdottir A et al. 2009). Hopefully this is a sign of a quality improvement obtained by the registration itself in combination with the preventive work done by the PRISS (prevention of implant related infections) and the introduction of the WHO checklist with a "time-out".

Still, we have observed some hospitals reporting the antibiotic being administrated exactly 30 min. prior to surgery in more than half of their cases. This can be interpreted as they reported the general hospital routine but not the exact time for the injection. We assume this is a run-in problem with the new form and that the real time for antibiotic administration will be reported in the future.

Antibiotic - time (minutes before surgery)

Minutes pre-op.	Percent
0-14	3.7
15-45	69.2
>45	14.8
Administrated after surgery	1.5
Missing	10.8
Total	100

The new form (cont.)

Anesthesia

Spinal anesthesia was the most common form of anesthesia, being used in 81% of the cases. General anesthesia was used in barely 10% of cases and epidural anesthesia only for 1%.

Type of anesthesia

Type	Percent
General	8.4
Epidural	1.1
Spinal	80.7
Other	0.3
Missing	9.5
Total	100

Tourniquet and drainage

Whether it is beneficial to use tourniquet or not is still being vividly debated. However, the Swedish orthopedic surgeons seem to rely on tourniquet as only 5% of the knee arthoplasties were reported as being performed without.

Drainage was only used in about 30% of cases. This may have to do with the recent popularity of LIA analgesia, after which a catheter often is left in the knee for later injection, resulting in surgeons avoiding use of drainage.

Tourniquet and drainage

Used	Tourniquet %	Drainage %
Yes	84.7	28.9
No	5.1	61.5
Missing	10.2	9.6
Total	100	100

Transplantation of bone

Bone transplantation is infrequently used in primary knee arthroplasty and if used, it is almost exclusively auto transplantation. Transplantation was reported in 1.7% of cases. 60% had the bone transplanted in the femur, 30% in the tibia and 10% in both femur and tibia. Information on bone transplantation was missing in 9.5% of the reports.

Computer aided surgery (CAS)

Only 1.2% of the cases were reported as having been operated on with CAS. Three quarters of the surgeries were performed at 4 hospitals (Hässleholm, Huddinge, Umeå och Visby) although the method was tested at 28 units. CAS was more often used for TKA than for UKA.

According to the annual report of the Norwegian arthroplasty register, 19% of the TKA and 1% of the UKA were performed using CAS in 2009.

Thus, use of CAS in Sweden is uncommon as compared to Norway.

LIA (local infiltration analgesia)

This type of anesthesia originates from Australia but was introduced in Sweden in approx.2003. The literature is sparse regarding other aspects of the method than pain relief, and it is really not known if it may affect the long term results. Anyway, as the table below shows, the method has spread quickly and was in 2009 used in 3/4 of the operations. In 40% of the cases (with or without LIA) a catheter was left in the knee for a later injection. In almost 10% of the cases, information was missing on whether LIA was used or not.

Local infiltration analgesia - LIA

Type	Percent
None	5.8
Only catheter	10.3
LIA	44.4
LIA and catheter	29.7
Missing	9.7
Total	100

Operating time

The median time for an operation was 130 min. for linked implants, 82 min. for TKA´s, 80 min. for UKA´s and 65 min. for femoro-patellar implants. It is somewhat surprising that the operating time for an UKA was almost as long as for a TKA, but this may be because TKA has become a routine operation and UKA an uncommon one.

Instructions for filling out the new form;

Patient ID:
12 digits (preferably stamp or stickers)

Hospital and hospital number:
Should be pre-printed upper left.
The hospital where 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 of more than one type of surgery being performed on 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 primary index knee:
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 for 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 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.

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

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

MIS (Minimal Invasive Surgery):
This implies a (small) arthrotomy is 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 katheter 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 and the dose (e.g. Ekvacillin 2g x 3). Regarding the time of administration in relation to the start of surgery, specify the number of minutes that the preoperative injection in fact was given (e.g. 25 min.). In case the injection was given after the operation started, then specify the time with a minus (-) sign. 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.

Hight 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:
Put the stickers on their intended spot:
The uppermost for the femoral components (e.g. stem, augments, ..)
The middle part for the tibia 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. +46-46-171345 Fax +46-46-177167

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 primary 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 name .....
(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

CAS: (computer aided surgery) ☐ 0 No ☐ 1 Yes
If yes, what system was used: .....

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
☐ 6 Suspected infection
☐ 7 Instability (not of the patella)
☐ 8 Femoropatellar problem
☐ 9 Suboptimal situs of the previous implant
☐ 8 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): .....

Antibiotic prophylaxis:
☐ 0 No
☐ 1 Yes: Name:..... dose:..... no. per day:.....
Start Preop. ☐ 0 No ☐ 1 Yes min. before surgery :.....
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 ....)

Kom ihåg klisterlapp(ar) för cementen

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

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

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Information on publications, dissertations and previous annual reports can be found on our Web-site: www.knee.se

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