Revision of unicompartmental knee arthroplasty

Outcome in 1,135 cases from the Swedish Knee Arthroplasty study

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From 1975 through 1995, 45,025 knee arthroplasties were recorded in the prospective Swedish Knee Arthroplasty study. By the end of 1995, 1,135 of 14,772 primary unicompartmental knee arthroplasties (UKA) for localized, mainly medial arthrosis had been revised. The Marmor/Richards and St. Georg sledge/Endo-Link prostheses were used in 65%. Mean age at revision was 72 (71) years. 232 revisions were performed as an exchange UKA (partial in 97) and 750 as a total knee arthroplasty (TKA). 153 were revised by other modes. In medial UKA, the indication for revision was component loosening in 45% and joint degeneration in 25% and in lateral UKA, the corresponding figures were 31% and 35%, respectively. In 94 cases, unicompartmental components were added to the initially untreated compartment, in 14 with partial exchange of a component. The CRRR was estimated using survival statistics.

After only 5 years, the risk of having a second revision was more than three times higher for failed UKAs revised to a new UKA (cumulative rerevision rate (CRRR 26%) than for those revised to a TKA (CRRR 7%). This difference remained, even if those revised before 1985, when modern operating technique was introduced, were excluded (CRRR 31% and 5%, respectively).

UKA is a safe primary procedure, when performed with well-designed components and modern surgical technique. It gives documented good patient satisfaction, range of motion, pain relief and relatively few serious complications. However, once failed, the knee should be revised to a TKA. This applies to most modes of failure. Not even joint degeneration of the unoperated compartment can be safely treated by adding contralateral components; CRRR after this procedure was 17%, while it was 7% when converted to a TKA.

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Revision rates after primary unicompartmental knee arthroplasty (UKA) for arthrosis vary from 5% to 30% in mid-term follow-up reports (Insall and Walker 1976, Heck et al. 1993, Callahan et al. 1995). It is commonly stated to be just over 10% at 10 years, which is in accordance with the findings in the Swedish Knee Arthroplasty study (Knutson et al. 1994).

The revision rate of UKA is often compared with that of modern tricompartmental knee arthroplasty (TKA), which is reported to be between 3% and 10% at 10 years (Knutson et al. 1994). Although a direct comparison of these two procedures as regards revision rate is not completely justified, the overlap in indication is large enough to warrant further analysis.

The two procedures have been clinically compared in patients who have a UKA on one side and a TKA on the opposite in two recent studies (Laurencin et al. 1991, Rougraff et al. 1991). Both concluded that, with proper selection of patients, the UKA gave better patient satisfaction. Thus it would be possible to accept a slightly higher revision rate for the UKA. However, to justify such a policy, the prognosis of revised UKAs has to be considered. Only a few reports, with small numbers and short observation time (Padgett et al. 1991, Lai and Rand 1993, Lahm and Reichelt 1996, Levine et al. 1996) deal with this aspect. Therefore, we analyzed the long-term prognosis in the framework of the Swedish Knee Arthroplasty study. A large number of patients was available, since orthopedic surgeons in Sweden have performed UKA more than in most other countries.

Patients and methods

Primary arthroplasties

By December 31st 1995, 45,025 primary knee arthroplasties had been reported from 80 centers to the prospective nationwide Swedish Knee Arthroplasty Register, which was initiated by the Swedish Orthopedic Society in 1975 (Bauer et al. 1980).

Three-fourths (34,518) of the arthroplasties were performed for arthrosis and, of these, 14,772 were UKAs (13,436 medial and 1,336 lateral). 64% were

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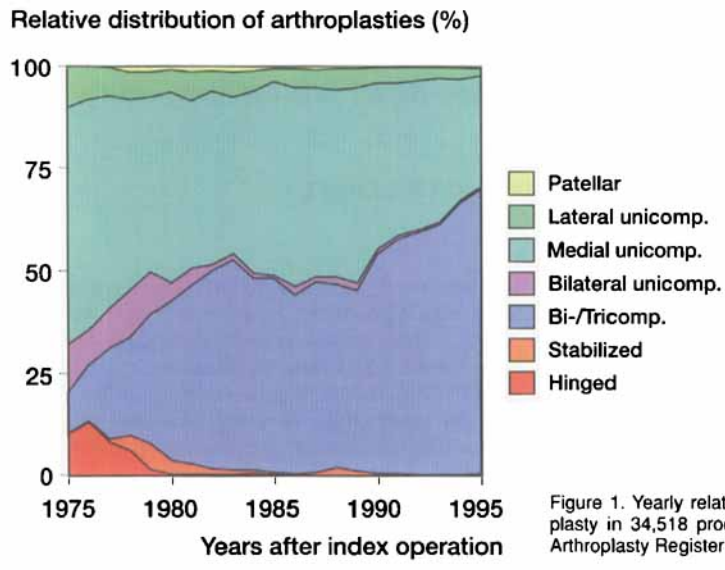

Figure 1. Yearly relative distribution between types of arthroplasty in 34,518 procedures recorded in the Swedish Knee Arthroplasty Register 1975–1995.

Table 1. Type of revision in 1,135 revised UKAs in Sweden 1975–1996, related to prosthesis

			Exchanged comp.		Added comp.		Added + exchanged	Conversion			
Type	Primary	Revision	Fem/Tib[a]	Menisc.	Patella.	Contr.[b]	Med.+Lat.[b]	TKA[c]	Constrained	Removal	Arthrodesis
Marmor	4602	367	87		6	44	7	206	16		1
St. Georg	2600	234	57		2	21	2	140	7	2	3
Link uni	2368	73	7			5		61			
PCA uni	1089	179	39			3		137			
Oxford	983	84	8	12		1		63			
Brigham	870	29	8			1	1	19			
Gunston-Hult	507	104	20		1	3	4	72	3		1
Various	1753	65	6			2		52	2	1	2
Total	14772	1135	232	12	9	80	14	750	28	3	7

[a] Revision unicompartmental arthroplasty (UKA). Fem/Tib femoral and/ tibial components exchanged.
[b] Revision bicompartmental arthroplasty with unicompartmental components (BKA). Contr contralateral compartment
[c] Revision total knee arthroplasty (TKA)

women and they had an average age of 71 (29–91) years at the primary operation. Men had an average age of 70 (33–92) years.

During most of the 1980s, the proportion of UKA to TKA was equal. However, since the late 1980s, the use of UKA has decreased continuously to 30% in 1995. The proportion of lateral to medial UKAs has also gradually diminished. Nowadays, bicompartmentally implanted unicompartmental prostheses (BKA) are scarcely used (Figure 1). The proportion of UKA to TKA at different centers has shown a wide variation.

The Marmor/Richards and St. Georg sledge/Endo-Link prostheses were the unicompartmental prostheses most often used during the study period (Table 1).

First revisions

1,135 (7.7%) of the UKAs were revised, i.e., components were added, exchanged or removed. 67% were women with an average age of 72 years at revision. Revised men had an average age of 71 years. The crude revision rate varied between 3% and 21%, depending on the prosthesis used (Table 1). The revision was performed as a change to a new UKA in 232 (revision UKA) and conversion to a TKA in 750 (revision TKA). In 3 cases, the prosthetic components were removed. 1 was eventually fused and 2 were left permanently with a resection arthroplasty. 10 cases had a two-stage revision. In 97 of the 232 revised UKAs, a partial revision was done, i.e., exchange of a femoral (28), a tibial (57) or a meniscal (12) component. Contralateral components were added in 94 (re-

Table 2. Type of revision in 1,135 revised UKAs in Sweden 1975–1996, related to compartment

			Exchanged comp.		Added comp.		Added + exchanged	Conversion			
Type	Primary	Revision	Fem/Tib[a]	Menisc.	Patella.	Contr.[b]	Med.+Lat.[b]	TKA[c]	Constrained	Removal	Arthrodes
Med	13436	995	217	9	7	62	12	655	23	3	7
Lat	1336	140	15	3	2	18	2	95	5	0	0
Total	14772	1135	232	12	9	80	14	750	28	3	7

[a–c] See Table 1.

Table 3. Indication for revision in 1,135 revised UKAs in Sweden 1975–1996

Indication	Medial UKA		Lateral UKA		Total	
	n	%	n	%	n	%
Infection	42	4.2	0	0	42	3.7
Loosening	449	45.1	43	31	492	43.3
Other mechan.	142	14.3	25	18	167	14.7
Patellar	26	2.6	3	2	29	2.6
Instability	27	2.7	10	7	37	3.3
Progress of OA	251	25.2	48	34	299	26.3
Various	58	5.8	11	8	69	6.1
Total	995	100	140	100	1135	100

Table 4. Mechanical problems other than loosening as indication for UKA revision in Sweden 1975–1996

Indication	Medial UKA	Lateral UKA
Wear	51	8
Settling/subsidence	32	3
Technical error/malposition	21	5
Fracture of the prosthesis	21	3
Luxation of a meniscal bearing	15	5
Fracture of the plastic component	2	1
Total	142	25

vision BKA) and 14 of these also had exchange of components. Patellar replacement was performed in 9 cases. 28 were revised with a constrained type of prosthesis and 7 were primarily or as a two-stage procedure fused (Table 2).

The main indications for revision were component loosening in 492 (43%), progression of arthrosis in 299 (26%), and other mechanical problems in 167 (15%) (Table 3). The commonest mechanical problem besides loosening was wear (Table 4).

Mechanical loosening was a commoner indication for revision in medial (45%) than in lateral (31%) UKAs ($p < 0.001$), whereas other mechanical problems, such as wear, inadequate positioning of the prostheses, subsidence, etc., did not differ in this respect (14% vs. 18% of the revisions in medial and lateral UKAs) ($p = 0.3$) (Tables 3 and 4). Progression of arthrosis was the indication for revision in 25% and 34% in medial and lateral UKAs, respectively ($p = 0.02$). The proportion of revisions for infection, patellar problems and instability was not significantly different when comparing medial with lateral UKAs.

Statistics

The database is annually updated against national census registers of deceased patients. The cumulative revision rates (CRR) and rerevision rates (CRRR) have been calculated using Kaplan-Meier survival statistics (SPSS software). The log rank test was used to compare curves with a significance level of 0.05. Graphs were plotted with a one-month time-base and confidence intervals were calculated using Wilson Quadratic equation, with Greenwood and Peto effective sample size estimates (Dorey et al. 1993). Only UKA and TKA were analyzed and the cut-off point was 40 remaining knees. For differences between groups, the chi-square test was used and a probability level of < 0.05 was considered significant.

Results

Rerevision

58 of the 232 revision UKAs and 42 of the 750 revision TKAs were further revised and the main indication for rerevision was loosening (Table 5).

The cumulative rerevision rate 5 years after the first revision (5-year CRRR) of the 232 revision UKAs was three times higher than that of the 750 revision TKAs (26% vs. 6.7%; $p < 0.001$; Figure 2a). When the comparison was limited to first revisions done before 1986 (64 revision UKAs and 99 revision TKAs), no significant difference was found in terms of 5-year CRRR ($p = 0.8$). However, when the first revision was done in 1986 or later, the 5-year CRRR was 31% in 168 revision UKAs and 4.9% in 651 revision TKAs ($p < 0.001$; Figure 2b). When the comparison was limited to first revisions done in 1986–1995, because

Table 5. Indication for 117 rerevisions in 1,135 revised UKAs in Sweden 1975–1996

Indication	Revision UKA [a]	Revision BKA [b]	Revision TKA [c]
Infection	2	0	7
Loosening	37	5	14
Other mechanical	6	3	6
Patellar	1	1	5
Instability	1	2	5
Progress of arthrosis	8	4	2
Various	3	2	3
Total	58	17	42

[a–c] See Table 1.

of loosening, the difference remained (5-year CRRR 33% in 113 revision UKAs vs. 4.0% in 288 revision TKAs).

In 94 revision BKAs, i.e., UKAs revised for progression of arthrosis in the remaining compartment by addition of components, with or without exchange of original components, the 5-year CRRR was 17% (Table 5). UKAs converted to TKA for progression of arthrosis had a 5-year CRRR of 8.3% (p = 0.04, Figure 3).

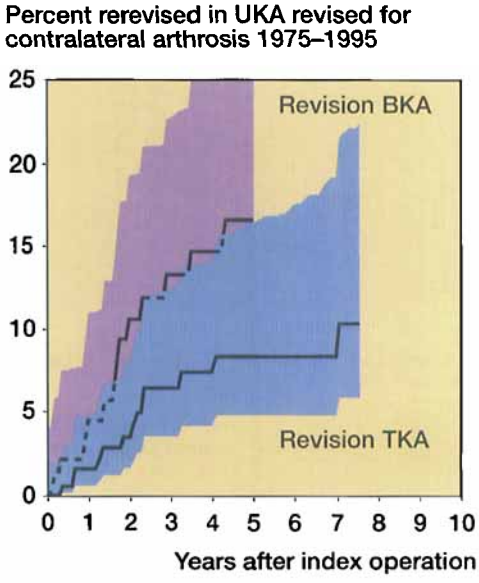

Figure 3. Cumulative rerevision rate and corresponding 95% confidence interval for unicompartmental knee arthroplasties (UKA) for OA revised for contralateral progression by addition of contralateral components to a bicompartmental knee arthroplasty (revision BKA; n 94) or conversion to a total knee arthroplasty (revision TKA ; n 209; p = 0.04).

Further revisions

A third revision was recorded in 25 knees, including 12 TKAs, 4 partial TKAs, 1 partial UKA, 1 constrained prosthesis, 1 patella resurfacing and 6 arthrodeses. A fourth revision was recorded in 6 knees, including 2 TKAs, 1 constrained prosthesis, 1 removal of the implant and 2 arthrodeses. A fifth revision was recorded in 2, including 1 constrained prosthesis and 1 partial TKA. The only sixth revision was an arthrodesis.

Of 14,772 primary UKAs for arthrosis, 23 eventually were given arthrodeses, hence the crude risk of

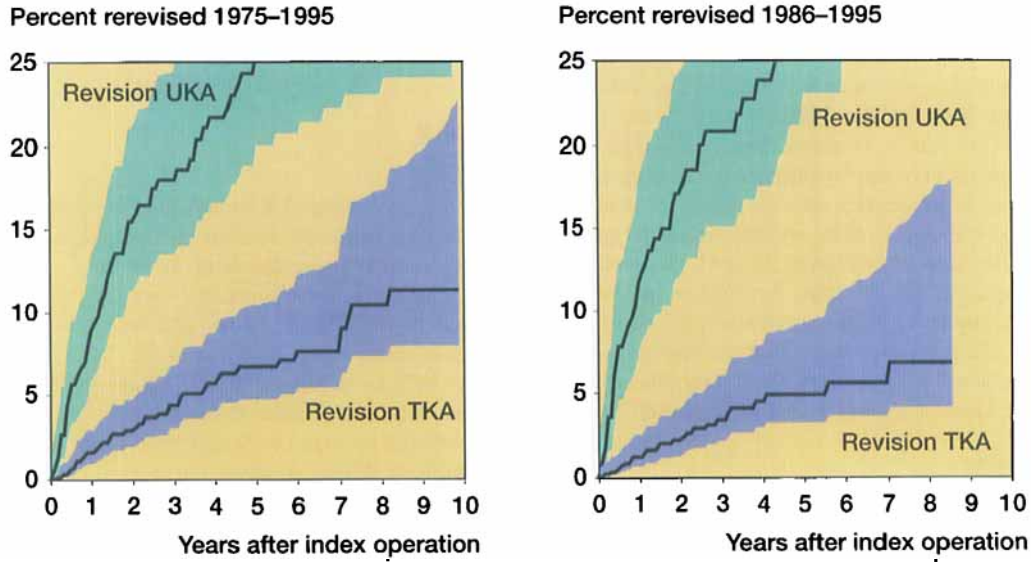

Figure 2. Cumulative rerevision rate and corresponding 95% confidence interval for unicompartmental knee arthroplasties (UKA) for arthrosis revised to a new UKA (revision UKA; n 232) or converted to a total knee arthroplasty (revision TKA; n 750) in 1975–1995 (p < 0.0001) and 1986–1995 (revision UKA, n 168; revision TKA, n 651; p < 0.0001).

arthrodesis was 0.16%, compared to 0.33% for primary TKA (59 of 17,886) (p = 0.003). Subsequently, 2 of the 232 revision UKAs and 8 of the 750 revision TKAs had an arthrodesis.

Discussion

The introduction of guide instruments for precise surgical technique, stricter indications and avoidance of thin components, have gradually improved the survival of UKAs (Jonsson 1981, Lewold et al. 1993). Further attempts to improve the unicompartmental prosthesis with other anatomic designs, metal backing and moving meniscal bearings, all have produced inferior results when used by the average surgeon (Lindstrand and Stenström 1992, Lindstrand et al. 1992, Bartley et al. 1994, Lewold et al. 1995).

The good long-term results with tricompartmental prostheses have proved to be consistent not only in a few specialized centers (Stern and Insall 1992), but also in larger multicenter studies with a 10-year CRR of 7% (Knutson et al. 1994). This has usually not been possible with unicompartmental knees, not even with a good design, when used in multicenter studies (Lewold et al.1993). Commonly, the 10-year CRR is reported to be around 12% (Lewold et al. 1993, Knutson et al. 1994). This has caused a gradual decrease in the use of unicompartmental knees, not only in Scandinavian countries (Figure 1) but also in USA. The proponents of UKA state that the outcome is often better. In two recent studies on patients with a UKA on one side and a TKA on the other, the patient judged the UKA to be the "better knee", with better range of motion and pain relief (Laurencin et al. 1991, Rougraff et al. 1991).

Another argument for UKA is that if a revision is needed it is often straightforward (Marmor 1988). This notion may also be one reason for the high revision rate in UKA. It is easier for the surgeon to take the decision to revise, when this can be done with standard implants and techniques. This has, however, been questioned by Padgett et al. (1991), who reported that 16 of 21 revised UKA had a major osseous defect at revision, making the operation difficult. On the other hand, Levine et al. (1996) reported that, although 13 of 31 failed, unicompartmental knees required bone transplantation that could be managed with simple wedges or a cancellous graft.

The total cost of an arthroplasty has been highlighted recently (Rissanen et al. 1996). UKA with minimally invasive surgery and even shorter ward time (Möller et al. 1997) has been introduced. A recent study showed the cost effectiveness of UKA compared to TKA, taking subsequent revisions into account (Robertsson et al. 1997). This may explain the renewed interest in the uniconcept in Sweden.

A slightly higher revision rate after primary UKA may be acceptable, provided that the final outcome is not jeopardized. In this respect, more serious complications, such as infection and others causing permanent loss of knee function—i.e., amputation, arthrodeses, and resection arthroplasty—deserve special attention.

A concern is the decreasing use of UKA in Sweden. Today, at some centers very few such knees are implanted per surgeon. This, combined with the introduction of more demanding designs, may lead to an increased failure rate, which has, in fact, been noted in a few centers already (Kolstad K, Uppsala and Nilsson KG, Umeå, personal communication).

We found that patients with UKA ran a lower risk of permanently losing their knee function than those with TKA. We also found that a failed UKA should be revised to TKA. Not even the addition of components in the contralateral compartment was safe. By doing this, the rerevision rate would have been considerably reduced. However, it is noteworthy that the failure rate was low when revising UKA to TKA, although data were collected from a number of centers in Sweden not specialized in revision surgery. The CRRR was 7%, compared to a CRR of 4% in primary TKA for arthrosis. Therefore, we could not agree that revision of unicompartmental knees was a challenge, at least not in terms of prosthesis survival.

In Sweden, the range in preferences for UKA vs. TKA in treatment of arthrosis also focus on another problem: Do we apply strict indications? Would a narrowing of indications to patients older than 70 with arthrosis (Ahlbäck 1968) stage I and II lead to lower revision rates? Can we avoid the need for secondary contralateral replacement by avoiding both unicompartmental arthroplasty in sagittally unstable knees and overcorrection of alignment? It seems that the latter is being avoided, since revision because of progression of arthrosis in the contralateral compartment has diminished over the years.

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