Multicenter study of unicompartmental knee revision

PCA, Marmor, and St Georg compared in 3,777 cases of arthrosis

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The prospective Swedish Knee Arthroplasty Project contained 772 PCA, 1564 Marmor and 1441 St Georg unicompartment prostheses, implanted for gonarthrosis during the period December 1983–July 1990. Follow-up was performed in September 1991. There was a significant difference in the cumulative revision rate after only 2 years, increasing to 15 percent for the PCA, compared with 5–7 percent for the two other types.

The difference between PCA and Marmor/St Georg was loosening of the femoral component. Major polyethylene wear was noted in a quarter of the revised PCA tibial components. The wear pattern of Marmor/St Georg was not analyzed in this study.

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In Sweden, unicompartmental gonarthrosis, Stages 2 and 3 (Ahlbäck 1968), has preferably been treated with a unicompartment arthroplasty in elderly patients. Results from the Swedish nationwide multicenter investigation have been reported with survival data for 8000 knees during the first 8 years; the probability of a prosthesis remaining in situ was 90 percent for a unicompartmental prosthesis (Knutson et al. 1986). The prostheses used during that period were mainly the Marmor and St Georg prostheses with all-plastic tibial components. A frequent reason for failure was the use of a thin tibial component (Knutson et al. 1981).

The PCA prosthetic concept, an anatomic design and a porous surface for bone ingrowth, was adapted for unicompartmental components in 1983. The early results were satisfactory (Lindstrand et al. 1988, Gacon et al. 1990, Magnusson and Bartlett 1990), but other smaller series with a short follow-up have indicated a high revision rate (Bernasek et al. 1988, Wanivenhaus et al. 1990). For this reason all patients operated on in Sweden with primary PCA unicompartmental prostheses were identified, and the cumulative revision rate was compared with an age, sex and time-matched group of Marmor and St Georg prostheses.

Material and methods

In October 1975, the Swedish Orthopedic Society started a nationwide survey known as The Swedish Knee Arthroplasty Project (Knutson et al. 1986). Subsequent knee arthroplasties were reported for computer filing. The entry form contains information on the condition of the knee, the type of replacement, and any complication during the hospital stay. The project has no authority over participants, who apply their own indications for arthroplasty, choice of prostheses, and indications for revision. Each patient has been followed up at 3, 6, and 10 years by means of enquiries, complications or revisions being noted. At present, each hospital reports the complication/revision frequency annually. By September 1, 1991, 22 157 primary knee arthroplasties had been reported to the Center. Two thirds of the patients had arthrosis (14 986) and one third rheumatoid arthritis (6 134).

All primary PCA unicompartmental prostheses inserted for arthrosis from December 1983 through June 1990 (Table 1) were identified at the Center, and requests for any missing primary procedures or missing revisions were sent out to the departments using or having used the prosthesis (20 departments). Time-matched groups of Marmor prostheses (23 departments) and St Georg prostheses (11 departments) were identified, and requests were sent to these groups as well which increased the number of primary operations by one fourth. There was an equal age and sex distribution in the three series. The mean age when the primary surgery was performed was 68 (53–85) years.

There were 772 PCA unicompartmental prostheses with 65 revisions reported by September 1, 1991; 1564 Marmor prostheses with 50 revisions; and 1441 St Georg prostheses with 56 revisions.

Table 1. Operations for arthrosis with uniknee prostheses 1983–1990

	PCA	Marmor	St Georg
Dec. 1983–1984	31	267	130
1985	40	304	165
1986	75	248	189
1987	152	220	260
1988	203	208	299
1989	222	220	277
–June 1990	49	97	121
Total	772	1562	1441

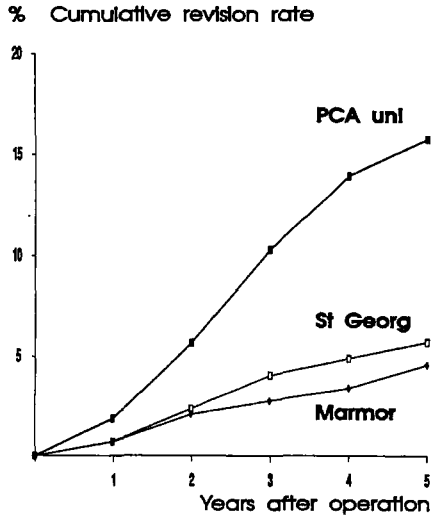

Figure 1. The cumulative revision rate for PCA, Marmor, and St Georg uniprostheses for gonarthrosis.

20 departments had performed on average 65 PCA arthroplasties, with 8 percent revisions. The corresponding data for the Marmor and St Georg prostheses were 23 and 11 departments, 54 and 111 operations, and 3 and 4 percent revisions, respectively.

Using an *actuarial* method, the cumulative revision frequency for the 3 various prostheses was calculated. Further, the *crude* revision incidence in each prosthesis group was calculated for expert and average ortopedic surgeons separately. For statistical analysis the Wilcoxon test was used.

PCA revisions

The medical records of the revised PCA uniknees were requested for analysis of the failure patterns.

Table 2. Cumulative revision rate (CRR) for PCA, Marmor, and St Georg uniprostheses for gonarthrosis

Year	N entering	Revised	CRR (percent)
PCA			
0–1	772	14	1.9
1–2	700	23	5.7
2–3	459	18	10.3
3–4	262	8	13.9
4–5	124	2	15.8
5–6	61	0	15.8
Marmor			
0–1	1562	12	0.8
1–2	1426	20	2.3
2–3	1179	7	3.0
3–4	961	6	3.6
4–5	736	7	4.7
5–6	502	0	4.7
St Georg			
0–1	1441	10	0.7
1–2	1292	19	2.4
2–3	1008	15	4.1
3–4	697	5	4.9
4–5	441	3	5.7
5–6	255	3	7.3

All but 3 of the 65 revisions performed in the PCA group were medial. The main reason for revision was loosening of the femoral component (35), loosening of the tibial component (3), loosening of both components (7), polyethylene wear (9), infection (1), and technical failure (3). No obvious reason for revision was found in the medical reports of 7 cases. In one case both infection and femoral loosening was present. In half of the revised knees the thickness of the tibial component was 7 mm. 53 of the femoral components and 55 of the tibial components were cemented at the time of the primary arthroplasty. Intact polyethylene at the time of revision was found in 4 knees, minor wear in 7, major wear in 18 components, and in 36 knees there was no information in the files on polyethylene wear. 27 knees were revised to a new uniknee and 38 to a total knee.

Results

There was no difference between the Marmor and St Georg groups regarding the *cumulative* revision rate ($P > 0.13$). The PCA uniknee had a higher cumulative revision rate already at 2 years ($P < 0.001$), and this trend was confirmed year after year (Table 2, Figure 1). After 6 years the PCA revision rate was three times that of the Marmor/St Georg. 15 of the 20 units using or having used the PCA uniknee did not differ from the Marmor/St Georg.

3 PCA departments had each performed more than twice the average number of operations, with a *crude* revision rate of 3 percent in 355 cases vs 12 percent ($P < 0.001$) in 417 cases operated in the other 17 departments. The corresponding revision rates in the Marmor and St Georg departments were 2 and 4 percent ($P > 0.5$), and 5 and 3 percent($P > 0.5$), respectively.

Discussion

When the difference between PCA uniknee and the other two types of similar arthroplasties was found the users in Sweden as well as the manufacturer was informed.

Half of the PCA revisions were due to femoral prosthetic loosening, which was a major difference compared with earlier series with unicompartmental prostheses (Jónsson 1981, Knutson 1986, Marmor 1988). There are several explanations, for example, too little femoral resection where the distal femoral surface was hard and sclerotic. If no anchorage holes were made or too little cement was used, this could result in loosening. The cement had to be in a low viscous state in order to penetrate into the cancellous bone and the porous coating. This could be one explanation as the majority of the reported loosenings were cemented femoral components. At the same time the prosthesis has to be positioned correctly; there is not much room for technical errors. The revision rate in the Swedish Multicenter Study shows that this operative procedure is somewhat demanding. The arthroplasty has to be reliable when used by a large group of orthopedic surgeons and the results should be at least equal to earlier reported cemented uniprostheses. Having made this point, we also mean that these early femoral loosenings could be mastered by familarity with the procedure. Indeed, the introduction of any prosthesis may, in a national perspective, include a learning curve.

However, the PCA knee also has a polyethylene wear problem as one fourth of the revised knees showed substantial wear according to the medical file reports, confirming case reports by Lindstrand et al. (1990) and Maagard Christensen et al. (1990). Lindstrand and Stenström (1992) in a 4–8-year follow-up of consecutive series of 120 PCA uniarthroplasties found so many polyethylene wear problems that the authors do not recommend continued use of this prosthesis.

The high density polyethylene component in the PCA prosthesis is not machined but heat moulded which means that the surface is finally achieved by a heat pressing process. This may have an implication on the wear pattern (Bloebaum et al. 1991). However, also metal backing, with a different modulus of elasticity than bone and cement in combination with a small contact area, as in most unicompartmental prostheses, may contribute to the wear. Other suggested factors like weight, activity level of the patient, height of the component, position of the prosthesis as well as the achieved mechanical axis can also influence the amount of wear. It is not possible to study any of these parameters in a national study or to draw any conclusions regarding the occurrence and severity of the wear as there was frequent missing data. A prospective retrieval analysis should be necessary in order to penetrate these findings more in detail.

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