Polyethylene wear of the PCA unicompartmental knee

Prospective 5 (4–8) year study of 120 arthrosis knees

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In Lund, 120 arthrosis knees had the PCA unicompartmental endoprosthesis during 1983–1987 and were followed prospectively for 5 (4–8) years. 17 knees were excluded from the final clinical follow-up because of the development of rheumatoid arthritis (2), severe neurologic disease (3), or death (12). Subjectively, 68 knees were much improved, 26 improved and 9 had failed. First-steps problems were only present in the uncemented group of 49 knees. Of the 9 failures (7 cemented and 2 uncemented) 6 were revised. The main reason for revision was loosening of the femoral component (2), tibial component (2), or both components (1), and polyethylene wear (1). However, all revised tibial components showed polyethylene wear, in 4 quite pronounced. Weight-bearing radiographs (61 knees) revealed major polyethylene wear in an additional 14 knees; not only in thin tibial components.

There may be an increasing clinical problem due to polyethylene wear. With the presented findings the PCA unicompartmental knee endoprosthesis cannot be recommended.

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The early clinical results of the more anatomic PCA (Howmedica) unicompartmental endoprosthesis were satisfactory (Lindstrand et al. 1988, Gacon et al. 1990, Magnusson and Bartlett 1990, Hasegawa et al. 1991), except for a few reports of early loosening in smaller series of uncemented arthroplasties (Bernasek et al. 1988, Wanivenhaus et al. 1990). The uncemented arthroplasties also had a higher proportion of first-steps pain (Lindstrand et al. 1988).

We now report our further clinical and radiographic results concerning the PCA unicompartmental knee in a follow-up extended to 4–8 years.

Patients and methods

During the period December 1983–October 1987, 120 primary PCA unicompartmental knee arthroplasties were performed in our unit as a consecutive series. The mean age at the time of surgery was 73 (53–90) years; 3 patients were under the age of 60 and 4 patients over 85. The patients had femoro-tibial arthrosis Stages I–III (Ahlbäck 1968) of the medial (103) or lateral (17) compartment, respectively. They had disabling pain on weight bearing, and one in four had also pronounced pain at rest. 17 knees were excluded from the final clinical follow-up because of the development of rheumatoid arthtritis (2 knees), severe neurological disease (3 knees), or death (12 knees). The clinical follow-up included 97 knees (75 female and 22 male knees). 4 patients had to be examined in their home/institution. The mean observation time was 5 (4–8) years.

Operative technique

The operation was performed as described by Lindstrand et al. (1988), usually in a "greenhouse", and with prophylactic antibiotics. In the cemented cases, cement with gentamycin (Palacos) was used. After removal of osteophytes from the condyles and patella the guide instruments were used. In cases 31–100 the use of cement was randomized at surgery in cases with good bone quality, flush position of the trial prosthesis on the bone, and stability during the whole range of motion. If these criteria were not met, cement was used. The cement was applied in the low viscosity state for improved penetration of the porous surfaces of the components. Furthermore, the cement was injected into the porous coating and into the cancellous bone after flushing with saline. For better anchorage multiple holes in different directions were drilled when the underlying bone was sclerotic.

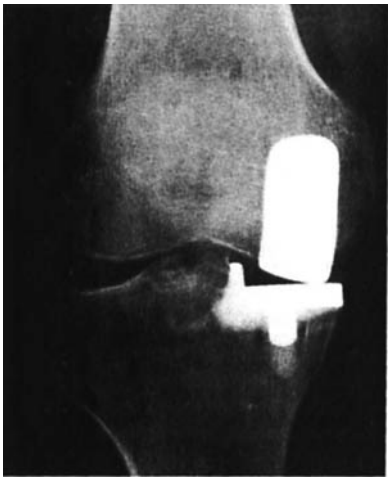

Figure 1. Weight-bearing radiograph at follow-up of a PCA uniarthroplasty. There is definite lowering of the polyethylene indicating wear.

Results

By subjective assessment, 68 knees were much improved, 26 improved and 3 had failed. The painfree walking distance was increased; 3 out of 4 could walk more than 500 meters. In 90 knees there was no pain at rest and in 7 pain at rest after physical activity. The range of motion showed either zero degrees (32 knees), 5 degrees (59 knees) or at most 10 degrees (6 knees) of extension defect. The mean flexion was 124 (70–140) degrees. The medio-lateral instability was improved, all but 13 knees being stable at walking. There were 6 knees with first-steps pain; all in the uncemented group.

In 61 of the 97 clinically examined knees, standing radiographs were performed; the remaining patients were not examined standing as this procedure was introduced during the follow-up period. The examined patients did not differ clinically from the whole patient material. In standing radiographs, we found major polyethylene wear in 14 knees (Figure 1), minor wear in 15 knees, and no wear detectable in 32 knees. Among the 14 knees with major wear there were 5 7-mm high tibial components, 4 9-mm and 5 11-mm high. The deviation of the mechanical axis for medial gonarthrosis before surgery was 11 degrees in varus and after surgery 4 degrees in varus. The deviation of the mechanical axis for lateral gonarthrosis before surgery was 12 degrees in valgus and after surgery 3 degrees in valgus.

There were 9 failures (7 cemented and 2 uncemented arthroplasties) and, among those, 6 revisions were performed. The main reason for revision was loosening of the femoral component (2), tibial component (2), or both components (1), and polyethylene wear (1). All revised tibial components showed some polyethylene wear; in 4 it was pronounced.

Discussion

Our present 4–8 year clinical results are inferior to those in our previous report (Lindstrand et al. 1988) as we now had 9 failures in 120 cases but still better than our results with the Marmor prosthesis, reported in the early 1980s (Jonsson 1981). Bernasek et al. (1988) reported 6 revisions in 28 PCA unicompartmental arthroplasties, which is similar to the small series by Wanivenhaus et al. (1990). Both groups used the uncemented principle, and their failures were due to loosening of one of the components. On the other hand, Magnusson and Bartlett (1990) had only one revision in 51 cementless PCA uniknees reviewed at a minimum of 2 years after surgery, Gacon et al. (1990) had 3 revisions in 100 uncemented PCA uniknees followed at least 1 year, and Hasegawa et al. (1991) had one revision in 67 knees followed 2–4 years. These findings are similar to those in our own early report (Lindstrand et al. 1988) concerning 93 knees followed for 1–4 years where at that time no revisions had been performed. Today, in a somewhat extended series, we have revised 6 out of 120 knees.

The differences in revision frequency in these reports may reflect differences in many aspects, such as patient selection, notably patient age and activity level, surgical technique, and also the surgeon's attitude to postoperative patient complaints. However, a recent report (Lindstrand et al. 1992) deals with the revision frequency of unicompartmental knee arthroplasties in the Swedish national knee arthroplasty study. There was a significant difference in the cumulative revision rate with 15 percent for the PCA prostheses compared with 5–7 percent for the two other types. The main reason was loosening of the PCA femoral component.

Even if it is possible to achieve early good results with the PCA unicompartmental arthroplasty without femoral loosening, the procedure seems, however, to be demanding. An arthroplasty has to be reliable in the hands of a large group of orthopedic surgeons, and the results achieved by them at least equal to the standard, notably the traditionally cemented unicompartmental prosthesis. However, training and familarity with a procedure have an influence, as was found regarding the revision frequency for the Marmor knee in the Swedish Knee arthroplasty study (Lewold et al. 1991).

Even if it were possible to avoid femoral loosening, the PCA uniknee seems to have a serious polyethylene wear problem: 4 of our 6 revisions had major wear of delamination type; we have earlier reported two of these cases (Lindstrand et al. 1990). More alarming, 14 of our 61 radiographically examined knees showed major polyethylene wear on weight-bearing radiographs.

The ultra-high molecular weight polyethylene in the PCA knee is not machined but heat-pressed (moulded) which means that the superficial surface design is finally achieved by a heating process. The manufacturing process and the exact composition of the polyethylene can have an influence (Bloebaum et al. 1991). However, metal backing, with a different modulus of elasticity from that in bone and cement, in combination with a small contact area, as is the situation for most unicompartmental knees, may contribute to increased wear as well. The thickness of the component is also relevant as the 7 mm tibial component has a polyethylene thickness of only 4 mm in the thinnest part while the 9 mm component has a 6 mm plastic thickness. Even 6 mm thick all-polyethylene components have been shown to be too thin (Knutson et al. 1981). Tibial components of any type, metal-backed or not, do need to be thicker (Bartel et al. 1985, 1986). Other previously suggested factors, like weight and activity level of the patient, position of a prosthesis as well as the mechanical axis achieved, may also influence the degree of wear. The tension-compression-tension cycles of the knee make more demands on the polyethylene in the knee than on the hip (Bartel et al. 1986).

Even if the majority of the patients have good clinical results we anticipate an increasing polyethylene wear problem, especially in units using this arthroplasty also for relatively young and active patients. As unicompartmental arthroplasties usually are intentionally undercorrected we also believe that metal-backed unicompartmental endoprostheses of any design, especially when the polyethylene is thin, will face an increasing wear problem.

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