We have compared the survival of 67 revision arthroplasties of the knee undertaken for aseptic loosening with and without the retention of a secure, cemented femoral component. All the patients had undergone a single primary procedure at a mean of nine years previously. In group I (25 knees) the original femoral component was secure and was retained. There were no abrasions or osteolysis. The knees were stable, normally aligned, with minimal bone loss. In group II 42 knees did not fulfil these criteria and underwent revision of both components. The mean follow-up was four years.

Re-revision for loosening was required in seven knees (28%) in group I and three (7%) in group II (p < 0.01). The remaining knees function well with Knee Society scores averaging 84/69 and no radiological evidence of osteolysis. When revising cemented implants, retention of a secure femoral component cannot be recommended even when conditions appear to be suitable.

Received 7 August 2002; Accepted 26 September 2002

Revision total knee arthroplasty is now a common and proven surgical procedure. Recent series report excellent or good clinical results of between 73% and 87% at four to eight years.1-3 Quoted survivorship figures range from 72% to 97% at five to ten years.3-7

Manufacturers market modular designs of implant which theoretically allow undamaged components to be retained at the time of revision, thereby minimising the surgical insult and damage to bone stock. There is little outcome evidence to assess the validity of this concept. When both the tibial and femoral components appear to be satisfactory, surgery may be limited to exchange of the polyethylene insert. In the 1990s Knight et al8 and Engh, Parkes and Ammeen9 reported good results with this technique in small series. In two recent large series, Babis, Trousdale and Morrey10 and Engh, Koralewicz and Pereles11 advised against the practice. Total knee arthroplasty commonly fails because of loosening of the tibial component, allowing the possibility of retaining a secure femoral component at revision. Cameron12 reported favourable results of revision limited to the tibial component but Siddique et al13 observed high rates of failure in uncemented arthroplasties of the knee using the technique. Our study compares the outcome of revision knee arthroplasty with and without the retention of a secure cemented femoral component.

Patients and Methods

Between 1992 and 1999, 67 arthroplasties of the knee required revision in 64 patients, 47 with osteoarthritis and 20 with rheumatoid arthritis (Table I). There were 40 women and 27 men with a mean age of 72 years (43 to 91).

All had undergone a single primary procedure at a mean of nine years previously (3 to 19). This included 25 Kinematic condylar and 42 Kinemax implants. Sixty-two implants had been cemented and five uncemented. The mean pre-revision Knee Society knee/functional score14 was 30/27.

Correlation of the preoperative clinical and radiological assessment with the intraoperative findings determined the cause of failure of the primary implant. There was wear of polyethylene sufficient to cause effusion and pain in nine patients. The tibial component was loose in 31, the femoral component in seven and in the 17 patients with both components loose, the tibial base plate had fractured in three cases. There was significant loss of bone from the femur in three knees and from the tibia in four; three revisions were for ligamentous instability.

We divided the arthroplasties into two groups. Group I comprised 25 knees (nine with polyethylene wear and 16 with a loose tibial component) in which the original femoral component was retained at revision surgery. To be included, the retained component had to be cemented and seen to be
Table I. Comparison of treatment groups; group I had the femoral component retained, while group II had both components revised

<table>
<thead>
<tr>
<th>Group</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of knees</td>
<td>25</td>
<td>42</td>
</tr>
<tr>
<td>Mean age in years (range)</td>
<td>73 (53 to 86)</td>
<td>72 (43 to 91)</td>
</tr>
<tr>
<td>Gender</td>
<td>F</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Pathology</td>
<td>Rheumatoid arthritis</td>
<td>Rheumatoid arthritis</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>19</td>
<td>28</td>
</tr>
<tr>
<td>Primary joint</td>
<td>Kinemax</td>
<td>Kinemax</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Number cemented</td>
<td>25</td>
<td>37</td>
</tr>
<tr>
<td>Mean time to revision (years)</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Mean Knee Society score (knee/function)</td>
<td>36/30</td>
<td>26/25</td>
</tr>
<tr>
<td>Prerevision</td>
<td>85/72</td>
<td>83/66</td>
</tr>
<tr>
<td>Postrevision</td>
<td>7 (28)</td>
<td>3 (7)</td>
</tr>
<tr>
<td>Mean time to failure (years)</td>
<td>3</td>
<td>3.5</td>
</tr>
</tbody>
</table>

solidly fixed with no macroscopic abrasion. The knee had to be stable, normally aligned and with no radiological evidence of osteolysis. Group II contained the remaining 42 knees (15 with a loose tibial component, seven a loose femoral component, 17 with both components loose and three with ligamentous laxity) which did not fulfil the above criteria. This group included the five uncemented primary implants requiring revision. We revised both components in these knees. The mechanical features of the new implants varied with the extent of bone loss and instability.

For all operations we used the previous mid-line skin incision and a medial parapatellar approach, undertaking synovectomy as required in order to remove all significant metallosis or polyethylene debris and assessing the existing components for damage and fixation.

In group I we removed the tibial component, recut the tibia and implanted a cemented Kinemax plus baseplate. In one a 40 mm stem was added. No augmentations or bone grafts were required. In all knees the polyethylene insert (≥8 mm thickness) matched the femoral kinematic or Kinemax component. In group II we removed all components and recut the bone surfaces. In 21 knees a cemented Kinemax plus prosthesis with a polyethylene insert of thickness ≥8 mm was used. A more constrained prosthesis was required in 21 revision operations. These included five Kinemax stabilisers, 11 superstabilisers and five rotating hinge implants. All had stemmed femoral and tibial components. Three 4 mm distal femoral augments and two 5 mm and one 10 mm tibial augments were inserted. One femoral condyle also required bone grafting.

The administration of intravenous antibiotics (cefuroxime) continued until tissue cultures were complete. One sample grew coagulase-negative staphylococcus on enriched culture. Antibiotics were continued for six weeks as a precaution, but there was no clinical evidence of infection. Drains were removed at 24 hours and physiotherapy began after a check radiograph. Compression stockings were worn for six weeks. Patients were discharged when they achieved 90° of flexion and full extension against gravity.

A research physiotherapist and arthroplasty nurse practitioner assessed the patients preoperatively, at three and six months after operation and yearly, thereafter, recording the American Knee Society clinical knee scores and radiological evaluation scores at each visit. No patient was lost to follow-up; six died during the study. In these patients the most recent review data were included. Chi-squared tests were used to test for significant differences between groups.

Results

At the final review the mean Knee Society functional scores for survival implants were 85/72 (66/60 to 100/80) for group I and 83/66 (55/40 to 95/85) for group II. This difference was not statistically significant. Overall, alignment of the implant was satisfactory in all knees and showed no significant difference between these groups. For groups I and II respectively, the mean anteroposterior (AP) femoral flexion angles were 98° and 96°, the AP tibial angles 89° and 88°, the total valgus angles 6° and 6°, the lateral femoral flexion angles 4° and 3°, and the lateral tibial angles 88° and 87°. The mean radiological lucency scores for surviving implants in group I were 1.3 (0 to 4) for the femoral and 0.7 (0 to 2) for the tibial component. In group II they were 0.8 (0 to 5) for the femoral and 0.6 (0 to 2) for the tibial component. Components with a score of 0 to 5 were considered to be secure; those of 5 to 10 required observation and those greater than 10 were defined as loose. No knee showed progression of these lucencies over time. The differences were not statistically significant.

Failed revision implants. In group I, seven of 25 knees (28%) failed at a mean of three years (2 to 5) after revision (Table I). In group II, three of 42 knees (7%) failed at a mean of 3.5 years (2 to 5) after revision. This difference was statistically significant (p < 0.01). In group I failure was because of loosening of both components in two knees, the femoral component in three and the tibial component in two. In group II loosening of both components occurred in one knee and of the tibial component in two knees. In no knee was there evidence of infection.

At the time of failure the mean Knee Society scores were 46/44 for those in group I and 46/32 for those in group II. The mean radiological lucency scores for the femoral and tibial components, respectively, were 11 and 15 in group I and 10 and 13 in group II.

In group I six of the seven knees have been re-revised to Kinemax Superstabiliser implants. The one patient with both components loose would benefit from further revision, but is judged to be too great an anaesthetic risk. In group II, one Kinemax knee has been re-revised to a Kinemax stabi-
Discussion

The group of knees in which we undertook revision of both components (group II) had a mean Knee Society knee and functional score of 83/66 with 93% of implants surviving at four years. These figures are comparable with the results for revision surgery quoted in the recent literature which document an excellent to good clinical outcome in 73% to 84% at between four and eight years and implant survival of 72% to 97% at between five and ten years. These figures are comparable with the results for revision surgery quoted in the recent literature which document an excellent to good clinical outcome in 73% to 84% at between four and eight years and implant survival of 72% to 97% at between five and ten years.

The four-year survival rate of 72% for the knees in which the original cemented femoral component (group I) was retained is poor. This group represented technically more simple revisions in which the implants were correctly aligned, showed no ligamentous instability and had no significant bone loss. Surgery entailed revising only the loose tibial component. The expected outcome should have been at least as good as the technically more difficult revisions in group II which included knees with significant bone loss or ligamentous instability. Most required the removal of at least one well-fixed component at surgery.

The modular concept is widely marketed as a means to limiting surgery to the exchange of loose or damaged components at the time of revision. Despite the current popularity there is little published evidence in the literature to support its validity. Four reports assess the results of replacing polyethylene inserts in knees in which the tibial and femoral components appear to be satisfactory. Knight et al reported survival of 93% at two years for 12 of 14 uncemented PCA knees undergoing exchange of the polyethylene insert. Engh et al reported the survival of nine of ten uncemented PCA knees at four years. Both reports concluded that as long as all wear debris is removed, well-fixed and aligned components may be retained. Babis et al reported survival of 63% at 5.5 years for a group of 56 knees undergoing exchange of the polyethylene insert without specifying the type of implant. Engh et al followed up a group of 48 uncemented arthroplasties of various types. The overall survival of the implant was 84% at 4.5 years. In those undergoing exchange of the polyethylene for rapid wear, only 73% survived five years. The authors advised against the practice of isolated exchange of the polyethylene insert. Based on our previous experience with PCA knees we agree with this conclusion. In the current study, we specifically avoided isolated exchange despite identifying wear of the polyethylene as being the indication for surgery in nine of the 25 knees in group I.

Other series have focused on the results of retention of the femoral component at the time of revision surgery. Cameron presented the outcome for a series of 98 Tricon M knees undergoing revision of an isolated tibial component. He concluded that well-fixed femoral components could be retained but the survival figure included two patients whose tibial components showed extensive radiolucencies. This combined with a loss to follow-up of 63% weakened the study. In a series of 14 revisions of uncemented PCA knees with the original femoral component retained, Siddique et al reported that six had failed within eight years. They concluded that both components should be changed at the time of revision. In the current series we retained only cemented femoral components. Uncemented primary implants formed only a small proportion (five of 67) of the study group of which four showed radiological loosening of the femoral component and the fifth proved to be loose at revision surgery.

Three mechanisms may explain the high rate of failure which we observed after retaining a secure femoral component. These are an accumulation of microscopic defects in the supporting cement mantle, the presence of significant amounts of polyethylene wear debris or mechanical factors in the form of malalignment of components and ligamentous instability. Review of the revision procedures which failed showed that there was malalignment in only one arthroplasty in group I, which was incompletely corrected when the tibial component was replaced. Although the femoral component is not radiologically loose, the loose tibial component will have generated particulate debris which may only satisfactorily be eliminated after removal of both components. Further studies are required to clarify whether the practice of retaining a secure component has any place in revision knee surgery. The balance of existing evidence suggests that such surgery yields poor results. Our findings suggest that even when conditions appear to be suitable, retention of a secure femoral component cannot be recommended.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References


