Medial unicompartmental knee replacement in the under-50s

S. Parratte, J.-N. A. Argenson, O. Pearce, V. Pauly, P. Auquier, J.-M. Aubaniac

From Aix-Marseille University, Marseille, France

We retrospectively reviewed 35 cemented unicompartmental knee replacements performed for medial unicompartmental osteoarthritis of the knee in 31 patients ≤ 50 years old (mean 46, 31 to 49). Patients were assessed clinically and radiologically using the Knee Society scores at a mean follow-up of 9.7 years (5 to 16) and survival at 12 years was calculated. The mean Knee Society Function Score improved from 54 points (25 to 64) pre-operatively to 89 (80 to 100) post-operatively (p < 0.0001). Six knees required revision, four for polyethylene wear treated with an isolated exchange of the tibial insert, one for aseptic loosening and one for progression of osteoarthritis.

The 12-year survival according to Kaplan-Meier was 80.6% with revision for any reason as the endpoint. Despite encouraging clinical results, polyethylene wear remains a major concern affecting the survival of unicompartmental knee replacement in patients younger than 50.

Isolated medial unicompartmental arthritis of the knee in the young is a challenging problem.1,2 Non-operative treatment, including physiotherapy, modification of activity, anti-inflammatory medications and bracing, often provide only limited relief of pain and functional improvement.3,4 Surgical options include arthroscopic debridement,5 meniscal transplantation,6 high tibial osteotomy (HTO),7,8 unicompartmental knee replacement (UKR),9 or total knee replacement (TKR).2,10,11 In patients under 50 years of age functional recovery, the possibility of return to sporting activity and the finite lifespan of the implant are the three major concerns following these procedures.12-14 During the last decade enthusiasm for the use of HTO has declined.2,15 It remains an attractive procedure for avoiding a knee prosthesis in patients under the age of 50 with low-grade unicompartmental osteoarthritis and a varus deformity.2 However, the risk of failure of HTO increases dramatically for patients whose osteoarthritis is rated Ahlback16 grade 2 or higher.2 In these cases UKR or TKR should be considered. UKR, in a patient in whom only one compartment of the knee is affected, may provide better physiological function and quicker recovery than TKR and it also preserves bone stock.9,13,17-22

Previous studies have reported good clinical and radiological results in a large series of UKR's in patients over 60.17,23,24 Careful patient selection and newer instrumentation have reduced the incidence of loosening of the tibial component and the progression of arthritis in the other compartments, leaving polyethylene wear as the predominant failure mechanism.17,23-28 The indications for UKR in the younger patient have recently increased because of a shorter period of recovery resulting from minimally invasive surgery.18,21,29 In a recent survey30 by the American Association of Hip and Knee Surgeons concerning the treatment of medial compartment arthritis of the knee, surgeons were asked to identify their preferred procedure assuming a mechanical axis of 7° of varus with an intact cruciate and mild patellofemoral symptoms. UKR was the procedure recommended by 11.4% of the surgeons for a 45-year-old active man and by 29.5% of the surgeons for a 45-year-old active woman. Despite the clear interest of surgeons in UKR,30 this procedure remains controversial in the younger patient.1,9,17,23,31,32 The outcome following UKR in patients under the age of 50 has not previously been reported.

We have reviewed a series of patients under the age of 50 to assess (1) whether UKR is as effective at improving function as is UKR for published series in older patients; (2) the radiological results with UKR, and (3) whether UKR was as durable in this age group compared with older patients as measured by survival analysis at 12 years.
Patients and Methods

We retrospectively reviewed 31 consecutive patients (35 knees) under the age of 50 with isolated medial compartment arthritis of the knee who underwent UKR between December 1989 and December 2001. Approval of the local ethics committee was obtained. The indication for the procedure was medial compartment osteoarthritis associated with significant loss of joint space on the radiographs. The inclusion criteria included: age under 50 at the time of surgery; a minimum follow-up of five years; confirmed diagnosis of unicompartmental osteoarthritis of the knee grade 2 or more according to the Ahlback classification;16 pre-operative range of knee flexion > 100°; full knee extension; a stable knee in the anteroposterior (AP) and sagittal planes; no patellofemoral loss of joint space on skyline views at 30°, 60° and 90° of flexion; and the presence of full-thickness articular cartilage in the uninvolved compartment, with full correction of the deformity to neutral on stress radiographs performed with the patient supine using a dedicated knee stress system. The exclusion criteria included associated arthritis of the lateral or patellofemoral compartment; age over 50; revision arthroplasty and any neurological or musculoskeletal disorder that might interfere with gait or weight-bearing. Of the 560 UKRs performed during this period, 35 (6.25%) in 31 patients met the inclusion criteria.

Patient demographics. There were 21 women and 10 men and 19 right knees and 16 left. The mean age of the patients at the time of surgery was 46 years (41 to 49). Their mean body mass index was 26 kg/m² (19 to 34). The medial compartment was involved in all 31 patients, unilaterally in 27 and bilaterally in four. According to the Ahlback classification,16 three knees (9%) were grade 2 and 32 were grade 3 (91%). The aetiology included primary osteoarthritis in 25 knees (71%), post-traumatic arthritis in seven (20%), and avascular necrosis in three (9%). In the series, 29 patients were involved in manual jobs or sporting activities (Table I). No patients were lost to follow-up.

Surgical procedure. All the operations were performed by one or other of the two senior authors (JNA, JMA) using a cemented metal-backed prosthesis (Miller-Galante, Zimmer, Warsaw, Indiana) which has a cobalt-chrome alloy femoral component, a titanium alloy tibial tray and an ultra-high molecular-weight polyethylene insert sterilised by gamma-irradiation in an inert atmosphere. The tibial polyethylene articulating surface is flat and unconstrained. The femoral fixation is by means of two pegs, and that of the tibial component involves two pegs and a fin. All medial UKRs performed after 2000 (seven, 20%) were carried out through a mini-medial parapatellar approach using a previously described technique.33 Previously a standard medial parapatellar approach had been used (28.8%). Osteophytes anterior to the intercondylar notch were systematically removed during the procedure. The thickness of polyethylene ranged from 8 mm to 12 mm. An immediate fully weight-bearing rehabilitation protocol was used for all the patients. All patients also received routine thromboprophylaxis with low molecular weight heparin for three weeks post-operatively.

Post-operative evaluation. The clinical evaluation was performed by an independent observer (SP) using the Knee Society Knee Score,34 and function was assessed using the Knee Society Function Score.34 All the patients were evaluated clinically pre-operatively, three months post-operatively, and then at yearly intervals until the last follow-up. Patient satisfaction regarding the procedure was assessed using a four-level scale (enthusiastic, satisfied, no change, not satisfied) previously used for evaluation of outcomes after UKR.17 Return to or inability to return to previous levels of sporting activity were also documented.

Radiographic evaluation was performed by an independent observer (SP) on long-leg radiographs and on AP, lateral, and skyline radiographs of the knee and was assessed on long-leg radiographs, performed using a standardised protocol in which the patient stood with the patella facing anteriorly and was evaluated by measuring the pre- and post-operative hip-knee-ankle angles, and according to the classification described by Kennedy and White.35 In this lower-limb alignment is considered correct when the mechanical axis passes through either the medial part of the medial tibial plateau (zone 2) or the central part of the tibia (zone C).34 Alignment of the components was assessed on screened AP and lateral radiographs and the presence, extent, or progression of femoral or tibial radiolucencies according to the Knee Society roentgenographic score was recorded.34 Progression of osteoarthritis was evaluated in the uninvolved compartment on the AP radiographs and in the patellofemoral joint on skyline views according to Berger’s four-point scale.36 According to this grade 1 radiological change is defined as no measurable loss of joint space but with changes such as osteophyte formation. Grade 2 changes are defined as up to 25% loss of joint space, grade 3 up to 50%, and grade 4 as more than 50%.

Table I. The physical activities of the patients. Low-impact sport activities include swimming, gardening and cycling. Moderate-impact sport activities include golfing or hiking. High-impact activities include tennis, skiing and running.

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>No activity</th>
<th>Manual job</th>
<th>Sporting activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low impact</td>
<td>2</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Moderate impact</td>
<td>-</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>High impact</td>
<td>-</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>2/31</td>
<td>9/31</td>
<td>20/31</td>
</tr>
</tbody>
</table>
Statistical analysis. Statistical analysis was performed using the SPSS software (version 12; Chicago, Illinois). Patient demographics were described using means and SDs, or medians and ranges for continuous variables, and counts (percent) for categorical variables. Clinical improvement as described by the mean Knee Society knee and function score was analysed using a t-test for paired comparison in all patients. Then radiological outcomes in terms of restoration of lower-limb alignment and stability were analysed. Finally, survival analysis was performed using the Kaplan-Meier technique, with 95% confidence intervals, for all patients, first considering revision for any reason, or radiological loosening as the endpoint, and second considering implant removal as the endpoint.

Results

Clinical. The mean follow-up was for 9.7 years (5 to 16). The mean Knee Society knee score improved from 54 points (25 to 64) pre-operatively to 97 (85 to 100) (p < 0.0001, t-test). The mean Knee Society function score also improved from 43 to 75) pre-operatively to 97 (85 to 100) (p < 0.0001, t-test). The mean active flexion of the knee improved from 110° (95° to 125°) pre-operatively to 132° (120° to 150°). All but two patients returned to their pre-operative level of activity (Table II). At the time of the final follow-up, 20 patients (65%) were enthusiastic about the procedure; eight (26%) were satisfied; one patient (3%) reported no change; and two (6%) were not satisfied.

Radiological results. The mean pre-operative lower-limb mechanical axis was 173° (170° to 180°) and the mean post-operative alignment was 4° of varus (0° to 7°). Restoration of the mechanical axis was achieved in 32 (91%) knees. The mean AP axis of the tibial component was 89° (85° to 90°) and the mean tibial slope was 8° (0° to 8°). The mean AP femoral axis was 88° (82° to 92°). Progression to grade 1 osteoarthritis was seen in the uninvolved compartment in five knees (14%), to grade 2 in two (6%), and to grade 3 in one (3%). Progression of arthritis in the patellofemoral joint was seen in six knees, grade 1 in four (12%), grade 2 in one (3%) and grade 4 in one (3%). Three knees (9%) had progression of osteoarthritis, both in the uninvolved compartment and in the patellofemoral compartment. One of these had severe changes, grade 4 in the patellofemoral compartment and grade 3 in the lateral compartment, was symptomatic and required a revision, but none of the other patients with radiological progression of arthritis were symptomatic. Three (9%) showed radiolucencies < 1 mm at the tibial bone-cement interface without any sign of progression after five years of follow-up. No femoral radiolucencies were observed. There were no cases of radiological loosening.

Complications. There were no intra-operative complications. Two patients developed a deep-vein thrombosis and were treated with anticoagulants. Six knees required a revision. Four were revised for wear of the polyethylene insert at 76, 93, 112, and 145 months, respectively (Fig. 2) with exchange through a mini medial-parapatellar approach (Fig. 3). The Knee Society knee scores for these patients following revision were 95 points at 120 months, 94 at 140 months, 96 at 178 months, and 95 at 99 months. Component malalignment, abnormal mechanical axis or weight were not found to be a causative factor for these failures.

One knee was revised for aseptic loosening at 53 months to a standard cemented posteriorly stabilised, rotating plate, TKR. For this knee the indication for UKR had been post-traumatic arthritis. One knee was revised at 97 months for symptomatic progression of arthritis in the patellofemoral and lateral compartments using a standard cemented posteriorly stabilised, rotating platform TKR.

Discussion

The number of young patients presenting with symptomatic arthritis of the knee is increasing. In order to bridge the gap between high tibial osteotomy and TKR for unicompartmental arthritis in young patients with degenerative changes of Ahlback grade 3 or above UKR should be considered. The outcome following UKR in patients under 60 has been reported, but not in those under 50 years of age. Our results suggest that it is reliable in improving function in this age group, allows return to previous levels of activity and satisfactory radiological results can be achieved. We also found that survival, although acceptable, is lower than that previously reported for older patients. Revision for polyethylene wear remains the main concern.
One limitation of this study was the retrospective design and the absence of direct comparison with a matched series of UKRs for unicompartmental arthritis of the knee in an older population. However, we believe that this type of comparison would have been complicated by the increased comorbidities in the older group which would have adversely affected the outcomes. Furthermore, we did not perform any matched-pairs comparison based on age, gender and pathology to compare the results of HTO with UKR in younger patients, as previously reported by Weale and Newman. Based on previous reports, our indications for HTO and UKR are different, and we believe these two procedures, namely HTO for unicompartmental OA of Ahlback grade less than 3, and UKR for Ahlback 3 or more cannot be directly compared. Neither did we have, for comparison, a matched group of patients treated with TKR. Reliable function and good survival have been reported for TKR in younger patients, and this form of treatment has also been advocated for unicompartmental osteoarthritis. Recently, Morgan et al reported a 96% 12-year survival in a series of 63 young patients (mean age 50.7 years) treated with TKR for osteoarthritis. Mont et al also reported only one failure because of polyethylene wear in a series of 31 knees in patients under 50 treated with a TKR for osteoarthritis, with a mean follow-up of 86 months. According to Hanssen et al, despite the good clinical results, TKR should continue to be considered with caution for young patients because of the issues related to the eventual need for a revision.

Our experience showed that UKR may be a reliable option for middle-aged patients. However, wear after ten years remains a problem in this age group. In our series, four of the six revisions were related to polyethylene wear. We were unable to identify specific causes to account for this. In these four cases, a direct exchange of the worn polyethylene insert to a new one was easily performed through a minimally invasive approach, and the subsequent functional results were comparable with those obtained for the unrevised patients. One knee with progression of arthritis required revision to a standard posterior stabilised TKR.

Fig. 1
Kaplan-Meier analysis showing the 12-year survival rate to be 80.6% (95% confidence interval (CI) 0.65 to 0.96) and the 16-year survival to be 70.0% (95% CI 0.48 to 0.93), with revision for any reason as the endpoint.

Fig. 2a
(a) Long-leg weight-bearing anteroposterior radiograph 145 months after implantation of a metal-backed fixed-bearing unicompartmental knee replacement showing evidence of polyethylene wear. (b) Anteroposterior radiograph of the same patient showing evidence of wear with no osteolysis or implant loosening.

Fig. 2b
Fig. 3
Anteroposterior radiograph on the same patient at final follow-up, 33 months after isolated polyethylene insert exchange.
In a study by Pennington et al., nine of 45 knees (4.5%) were revised for polyethylene wear in patients under 60. Price et al., in a multicentre study of the Oxford UKR compared 512 patients, older than 60 and 53 patients under and showed that this implant functions well and is durable in patients younger than 60, although the survival was lower for this group (91% at ten years in the < 60 group versus 96% in the > 60 group). However, these results should be compared with ours with caution as only one patient was younger than 50 in the younger age group of this study. In another recent report, 93% of patients successfully returned to regular sporting and physical activities following a UKR, but the patients were older with a mean age of 64.44 In this series, three of the 66 patients required a revision.44 It has been demonstrated in a previous biomechanical study that running and jumping produce surface loads that exceed the limits of polyethylene resistance.12 To recommend specific activities after a UKR, factors such as wear, joint load and the type of prosthesis must be taken into account for each patient.20,23,24,45 Based on our results and previous reports, better wear seems to be the main factor in improving the long-term results of a UKR.9,23,31 Polyethylene exchange is only possible when there are no signs of osteolysis or component loosening.23 The diagnosis of polyethylene wear was made clinically and radiologically. Two major symptoms were observed when polyethylene wear occurred, medial knee pain without signs of inflammation and progressive non-traumatic frontal instability. There was no clinical or biological sign of infection. Physical examination is important to confirm the development of frontal instability in these patients. When these symptoms occurred, we performed weight-bearing and varus and valgus stress radiographs to confirm wear and look for osteolysis. When there was no evidence of infection, loosening or osteolysis exchange of the polyethylene insert was undertaken and the wear was mainly found on the posterior aspect. The anterior cruciate ligament was preserved in all the four patients. Even if direct insert exchange is possible, the best type of polyethylene for a UKR is still the subject of debate.23 Although mobile bearing congruent polyethylene may be an alternative,46 the risk of dislocation remains higher than in fixed-bearing UKRs in this age group.23,39,47,48

The advantages of UKR over TKR include retention of the cruciate ligaments, preservation of bone stock in the uninvolved compartments and better functional results.3,17,24,47 The good clinical results obtained in our series certainly support this statement. A modern UKR is a valid alternative to bridge the gap between a HTO and a TKR for young active patients with isolated unicompartmental tibiofemoral non-inflammatory disease of Ahlbach grade 3 or more. However, despite strict patient selection with regard to the status of the uninvolved compartments, and the anterior cruciate ligament, polyethylene wear remains a major concern following UKR in patients under the age of 50.

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