



Medium term results of the Miller-Galante unicompartmental knee arthroplasty with 10 year survivorship

Rajesh RACHHA, Karunakar VERAVALLI, Manoj SOOD

From Bedford Hospital, U.K.

Seventy-four Miller-Galante unicompartmental knee arthroplasty procedures were performed in 69 patients between 1990 and 2003. All patients underwent regular prospective clinical and radiological follow-up. Their average age at the time of surgery was 63.9 years (range : 47-80 years). Seventeen patients died during the period of follow-up.

At a mean of 10.7 years follow-up the average Knee Society Score was 79.9 (range : 51-95) and the average functional score was 75.5 (range : 45-90). On the basis of clinical knee scoring, 48 knees (85.7%) were graded as excellent or good. The average amount of flexion at final follow-up was 115.9° (range : 90-140°). Arthritic progression in the opposite compartment was seen in 13 knees (23.2%). Two such knees underwent revision to total knee replacement (TKR) and 3 other knees were revised to TKR for persistent pain or infection.

Ten-year survivorship with "revision due to progression of arthritis in the opposite compartment" as the end point was 97.3% and with "revision due to any cause" as the end point was 94.6%.

Keywords : unicompartmental knee replacement ; Miller-Galante ; unicompartmental knee arthritis.

INTRODUCTION

There is no universally accepted treatment for isolated medial or lateral compartment arthritis of the knee. High tibial osteotomy (HTO), Unicompartmental Knee Arthroplasty (UKA) and Total knee re-

placement (TKR) have all been recommended. The results of UKA in its evolutionary stages were not encouraging (7,12,14,25) but with improved instrumentation and operative technique and adherence to the strict inclusion criteria advocated by Kozzin and Scott (11) for patient selection, the intermediate and long-term results of UKA have been satisfactory (25).

UKA has several advantages as a technique, there is no ligament sacrifice, it is a more bone preserving operation, and post-operative rehabilitation is relatively rapid with range of movement usually regained rapidly. It is theoretically easier to revise and the results of revision of failed UKA to TKA are superior to those of failed TKA and failed high tibial osteotomy (13).

There have been few series reporting more than 10 year survivorship of fixed-bearing unicompartmental knee replacements (3,16,19,23,24).

The purpose of our study was to present the results at 5 to 18 years follow-up and 10-year

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- Rajesh Rachha, Senior Clinical Fellow.
 - Karunakar Veravalli, Senior House Officer.
 - Manoj Sood, Consultant Orthopaedic Surgeon.

Orthopaedic Department, Bedford Hospital, Bedford, U.K.

Correspondence : Rajesh Rachha, Department of Orthopaedics, Bedford Hospital NHS Trust, Bedford, MK41 7JW, U.K.
E-mail : drrachha@gmail.com

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survivorship of the Miller Galante UKA. This appears to be the largest series of Miller Galante UKA reported in the British literature.

PATIENTS AND METHODS

Between 1990 and 2003, 74 consecutive unicompartmental knee replacements were performed in 69 patients by two senior surgeons, with the use of the cemented metal backed fixed bearing Miller-Galante prostheses. By the time of final follow-up in the year 2008, 17 patients had died, leaving 56 knees in 52 patients for clinical and radiological examination. The mean duration of follow-up was 10.7 years (range : 5 to 18 years). The indication for the operation was single compartment osteoarthritis (OA) in 67 patients (97.1%). Two patients (2.8%) had single compartment rheumatoid arthritis (RA) and these cases were the only ones where the surgical indications fell outside the Kozzin and Scott Criteria.

UKA was deemed contraindicated in patients with more than 5 degrees of flexion contracture, a range of motion less than 90 degrees, coronal plane deformity of more than 10 degrees of varus and more than 15 degrees of valgus, grade III and IV chondromalacia of the patella, and in those with an anterior cruciate deficient knee. All patients were regularly reviewed in the clinic.

A thorough chart review was completed on all patients using a standard proforma for preoperative demographics, previous surgeries, intraoperative findings and component sizing. A Modified Insall's Knee Society-scoring system (8) was used at the final follow-up to evaluate the knee score and the functional score, and the radiographs taken at the last follow-up were compared with initial pre-operative films. Arthritic progression in the opposite compartment was classified according to the system of Berger *et al* (4,23): Grade 1 (evidence of osteophytes, but with no measurable loss of joint space), Grade 2 ($\leq 25\%$ loss of joint space), Grade 3 ($\leq 50\%$ loss of joint space), or Grade 4 ($> 50\%$ loss of joint space).

The patient population consisted of 32 men (46.3%) and 37 women (53.6%). Amongst them 67 (97.1%) had OA and 2 (2.8%) had RA. The average age was 63.9 years (range : 47-80 years) with an average weight of 80.8 kg (range : 53-115 kg), BMI data for all patients was not available. Thirty-four knees (59.6%) had undergone previous arthroscopy and 2 knees had undergone previous high tibial osteotomy for medial unicompartmental OA. There were 25 (48.1%) right knees, 23 (44.2%) left and 4 (7.6%) bilateral knees. Fifty-two (91.2%) were medial compartmental arthroplasties and 5 (8.8%) were lateral compartmental arthroplasties.

The operative technique in all the knees was a conventional midline incision with a medial parapatellar arthrotomy. Minimal medial release was performed if needed for access and removal of osteophytes. Alignment was reproducible by strict adherence to the operative technique using an intramedullary jig for the femoral alignment and an extramedullary jig for tibial alignment. We aimed for neutral alignment of the limb. As well as instrumented alignment orientation, alignment was checked visually and by using a diathermy cord to assess the mechanical axis from the centre of the femoral head to the centre of the ankle with the trial implants in place. Care was also taken not to "overstuff" the knee with too thick a polyethylene insert. A Miller-Galante® (Zimmer, Warsaw, IN, USA) cemented femoral component (ZIMALOY, cobalt-chromium-molybdenum alloy) and metal backed modular cemented tibial component (TIVANIUM, Ti-6Al-4V alloy) with ultra-high molecular weight (UHMW) polyethylene insert, which was sterilised in inert gas was used in all the knees. The thickness of the tibial polyethylene insert ranged from 8 mm to 14 mm, the size of the tibial component ranged from 27 mm to 35 mm and the size of the femoral component ranged from 47 mm to 60 mm. Neither the operative technique, nor the generation of components used changed over the study period.

RESULTS

Clinical results

At a mean of 10.7 years follow-up, the average Knee Society Score was 80 (range : 51-95) and the average functional score was 75.5 (range : 45-90). During the follow-up period there was only minimal variation in the mean knee and functional score of the group of patients (Fig. 1).

On the basis of clinical knee scoring, 33 knees (58.9%) were graded as excellent (85-100 points), 15 (26.8%) were graded as good (70-84 points), 4 (7.1%) were graded as fair (60-69 points) and 4 (7.1%) were graded as poor (< 60 points).

At the time of final follow-up 28 patients (53.8%) had no pain, 14 (26.9%) had mild or occasional pain, 6 (11.5%) had moderate pain and 4 (7.7%) had severe pain. The average range of motion at final follow-up was 115.9 degrees (range : 90-140 degrees).

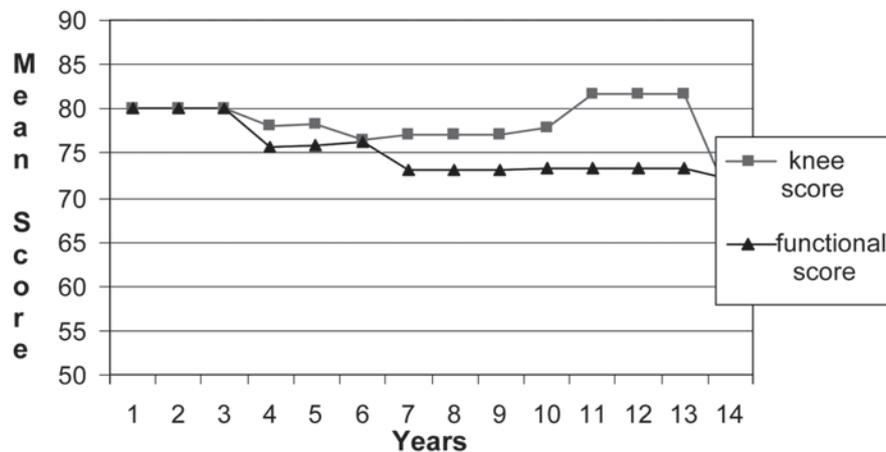


Fig. 1. — Modified Insall's knee scoring system showing knee and functional scores

Radiological results

As in many other institutions, because of radiation exposure and additional costs, it has not been routine practice for us to perform long leg HKA radiographs for patients prior to unicompartmental or total knee replacement unless there were significant deformities or malalignment of the femur, tibia or the knee joint (including mal-unions of previous fractures) or a history of previous surgery around the knee. Such patients, in any case, do not usually fulfil the criteria for unicompartment replacement. Short standard standing radiographs were obtained for radiological evaluation. We measured the tibio-femoral angle with the use of mid diaphyseal lines to determine anatomical knee alignment. We compared the preoperative and postoperative anatomical axis to assess correction of knee alignment. Knees in which a medial unicompartmental replacement had been performed (52 knees) had an average preoperative femorotibial angle of 6.8° of varus (range: 0° to 10° of varus). Following medial compartment replacement, the average femorotibial angle was 4.4° valgus (range: 1° varus to 10° valgus). The average correction was 10.4° (range: 5° to 14°).

In knees in which a lateral unicompartment replacement had been performed (5 knees), the average preoperative femorotibial angle was 11.4° valgus (range: 10° to 13° valgus) and following re-

placement it was 5.8° valgus (range 2° to 8° valgus). The average correction was 5.6° (range: 4° to 9°).

At the time of final follow-up 2 knees had component subsidence/loosening (change in position of > 2 mm or an angular change of $> 3^\circ$ relative to surrounding bone). Three knees had incomplete tibial bone cement radiolucent lines. No knee had femoral radiolucencies. No osteolysis was seen around the components. With regard to tibial component alignment, 2 knees had 4° varus tilt of the prostheses with respect to the longitudinal tibial axis, 2 knees had 5° and 1 knee had 3° varus tilt.

Arthritic progression in the opposite compartment was classified according to the system of Berger *et al* (4). In 12 knees (21.42%) there was no progression of arthritis in the opposite compartment. Evidence of osteophytes with no measurable loss of joint space (grade 1) was seen in 31 knees (55.3%), $\leq 25\%$ loss of joint space (grade 2) was seen in 9 knees (16.1%) and in 4 knees (7.1%) there was $\leq 50\%$ loss of joint space (grade -3). When we looked at all knees with medial UKA which developed arthritis in the opposite compartment, we found that all had some degree of valgus alignment. Progression to grade 2 or 3 arthritis was seen in all cases in which excessive valgus correction (greater than 7°) occurred.

Grade 2 and grade 3 progression of arthritis was seen only in 13 patients who had significant over-

correction into valgus (with postoperative tibio-femoral angles ranging from 7°-10° of valgus). Two of these 13 patients needed revision to a TKR and 2 required revision of the tibial insert due to polyethylene wear.

We looked at the results of UKA in patients who were overweight. We did not have BMI data on all the patients at the time of the index procedure, but the weight of the patients was available. We looked more closely at the sub-group of patients with a weight of over 85kg. This group comprised 16 patients with weights ranging between 85-110 kg (average 95 kg). At a mean of 7 years follow-up in this group the average knee score was 76.4 (range : 51-90). Subsidence was noted in one knee in a patient weighing 90 kg and who underwent lateral UKA. One amongst these patients who weighed 89 kg (BMI-30) underwent change of tibial insert at 13 years. As the number of obese patients was relatively small, we could not come to any statistically significant conclusions, but overall the results in this group were satisfactory.

Taking age at the time of surgery into consideration, we had 18 patients below the age of 60 years (range : 47-60) and rest of the 38 patients were above 60 years of age (range : 61-80). There was a better functional outcome in patients above 60 years of age with the mean knee score being 80.6 and functional score 76.1. In patients below 60 years of age the knee score was 69.35 and in this group there were 2 knees with subsidence and 2 knees with incomplete tibial bone cement radiolucent lines.

Complications

One patient had a tibial spine fracture (Fig. 2) which was recognised intraoperatively and stabilised successfully using a single cancellous screw (functional score at final 5-year follow-up : 90). One patient had an undisplaced medial tibial condyle fracture (Fig. 3) which was recognised on the immediate postoperative radiograph. This was treated conservatively in an above-knee cast (functional score at final 7 year follow-up : 46). An intraoperative MCL injury occurred in one patient and this was recognised and primarily repaired (functional score at final 8-year follow-up : 90). One knee de-



Fig. 2. — Tibial spine fracture fixed with cancellous screw

veloped a deep infection and required a two-stage revision procedure with conversion to a total knee replacement at the second stage.

Revisions (Table I)

In our total series of 74 knees (including deceased patients), 5 underwent revision to TKR. Two knees among these underwent conversions of a lateral unicompartmental knee arthroplasty at 2 & 3 years respectively for persistent pain and stiffness. Two of the medial compartmental knee arthroplasties underwent revision at 12 and 13 years respectively for progression of arthritis in the lateral and patellofemoral compartments (Table I). One knee underwent 2-stage revision to TKR for infection.

Two knees underwent change of the tibial insert at 8 years and 13 years respectively.

Lateral Unicompartmental knee replacements

Of the 5 lateral unicompartmental knee arthroplasties, 2 underwent conversion to TKR at 2 & 3 years respectively due to stiffness and persistent pain and the other 3 had follow-up of 12, 13 & 5 years respectively with functional scores of 65, 60 and 85 at the final follow-up.

Table I. — Reasons for revision

Type of knee replacement	Number of knees	Reason for revision to Total knee Replacement	Time to revision
Medial compartment	1	Progression of arthritis in opposite compartment	12 years
Medial compartment	1	Progression of arthritis in opposite compartment	13 years
Medial compartment	1	2-stage revision for infection	2 years
Lateral compartment	1	Persistent pain and stiffness	2 years
Lateral compartment	1	Persistent pain and stiffness	3 years



Fig. 3. — Medial tibial condyle fracture (AP view after healing)

Survivorship

Kaplan Meier Survivorship analysis (9) of the prosthesis at 10 years for “revision due to aseptic loosening and progression of arthritis in the opposite compartment” as an end point was 97.3% (Fig. 4) and for “revision due to any cause” as an end point was 94.6% (Fig. 5).

DISCUSSION

Our results using the Miller-Galante unicompartmental knee arthroplasty are satisfactory and are comparable to reported intermediate and long-term survival rates using the same prosthesis in the literature (1,4,5,17,27).

In our series, patients in the age group above 60 years at the time of surgery had better functional and knee scores than patients below 60 years of age. Subsidence and radiolucent lines around the tibial bone cement interface was seen in patients below 60 years of age. However the series included only 18 patients below 60 years of age and therefore we could not derive any statistically significant conclusions. Several reports (11,13,21) have shown that age above 60 years is the best positive predictive criterion for good to excellent results. A retrospective study of UKA by Pennington *et al* (20) in active patients below 60 years of age showed good pain relief and excellent function at an average follow-up of eleven years.

Body weight had no influence on the overall functional outcome. The clinical and functional results in the overweight or obese patients were satisfactory, however as there were relatively few obese patients, we could not derive any statistically significant conclusions.

Critical analysis of our revisions and progression of arthritis in the opposite compartment revealed that the postoperative knee alignment was crucial. Kennedy and White (10) developed tibial zones through which the mechanical axis passes to assess postoperative alignment and its influence on overall results of unicompartmental knee arthroplasty. We have used short standard standing radiographs and observed that progression of arthritis to grade 2 and grade 3 in the opposite compartment was seen in those patients where the post operative knee alignment was overcorrected (7°-10° valgus). Two out of 13 knees that fell in to this group required revision to TKR and 2 required tibial inserts revision. It has been well documented that intermediate and long term results are better if the knee axis is slightly un-

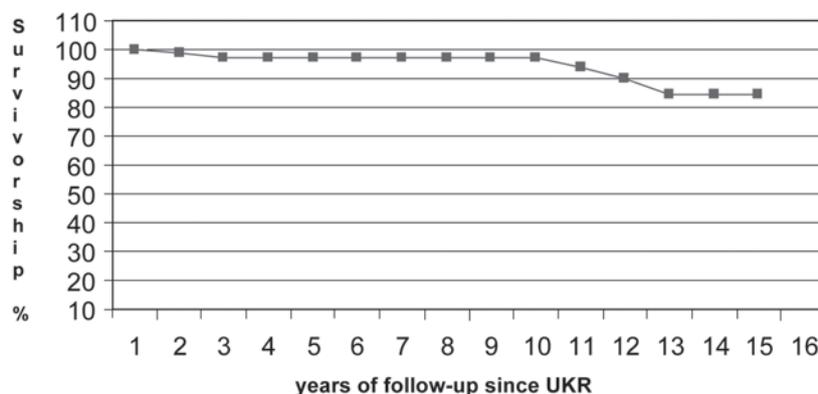


Fig. 4. — Survivorship curve for “revision due to progression of arthritis” as end point

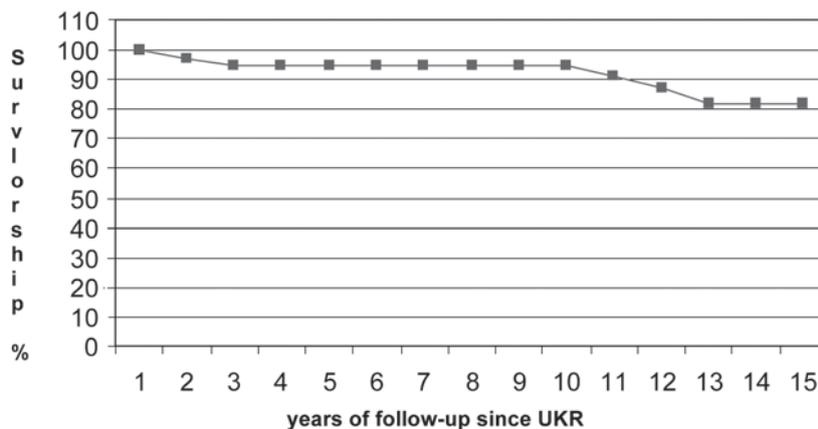


Fig. 5. — Survivorship curve for “revision due to any cause” as end point

dercorrected (4,17,21) in unicondylar knee arthroplasty (0° - 6° valgus).

The complication rate with the use of this prosthesis was low. In our series we had two fractures (2.6% incidence) – a rare complication of one tibial spine fracture and one undisplaced medial tibial condyle fracture. Voss *et al* (27) in their series using the same prosthesis have reported a 5% incidence of intra and perioperative tibial plateau fractures, which they attributed to the placement of fixation pins for the tibial cutting guide and to the fixation peg.

Our experience with lateral compartmental knee arthroplasty was less favourable. Two out of 5 underwent conversion to TKR at 2 and 3 years respectively due to stiffness and persistent pain and the other 3 had follow up of 12,13 & 5 years respec-

tively with functional scores of 65, 60 and 85 at the final follow-up. We could not derive any statistically significant conclusions due to the small number of lateral UKA'S. There are only a few studies reporting clinical results of lateral unicompartmental knee replacement, with variable results (4,18,23). Marmor (15) described excellent results in 11 of 14 knees at 7 year follow-up. Ashraf *et al* (2) reported the largest series of lateral unicompartmental knee replacement using the “St George sled” implant in 88 patients with 2 to 22 years follow-up ; they reported overall satisfactory results but their results were not as satisfactory as those for medial compartment replacement. Lateral unicompartmental knee replacements are technically more demanding, performed less frequently with an approximate

ratio of medial to lateral arthroplasties being 10 : 1 and have several differences in technique compared to medial compartment arthroplasties (22).

Post operative knee alignment is the most important parameter for the long term survivorship of this implant and we recommend careful intraoperative technique to achieve neutral alignment and avoid “overstuffing” the compartment through inadequate bone resection or through the use of too thick an insert.

Our short term and intermediate results of the Miller Galante UKA were encouraging : 84.4% of patients had excellent or good results based on clinical scoring. We achieved excellent survivorship and our results are as good as those with other fixed and mobile bearing unicompartmental replacements reported in the literature. The study was of adequate power with 74 knees available for analysis and survivorship. We have used standard short leg radiographs for radiological assessment of knee alignment which is one drawback of this study. The alignment of the knee is best assessed using long leg films as proposed by Kennedy *et al* (10). However standardised standing short knee radiographs can be used to measure knee alignment and may be comparable to HKA radiographs (6,26) if inter-observer error is minimised. All the measurements were made by single observer in this study to reduce the inter-observer variability.

We need longer term follow-up to compare the results of fixed bearing metal backed UKA with mobile bearing UKA. We suspect from our series that fixed-bearing UKA devices are capable of yielding results that are as good, and perhaps better, than contemporary mobile-bearing devices. It must be noted that the excellent results documented in this study were achieved using a device that utilised an earlier generation of polyethylene and that the devices were implanted through a conventional “total knee” type incision. Newer generation polyethylene inserts may prove even more durable.

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