McKeever Hemiarthroplasty of the Knee in Patients Less Than Sixty Years Old

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McKeever Hemiarthroplasty of the Knee in Patients Less Than Sixty Years Old

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Background: Knee arthritis in the young patient is a challenging problem that may necessitate surgical treatment. We continue to perform hemiarthroplasty with a metallic tibial implant in selected young patients who, for various reasons, are not candidates for osteotomy, unicompartmental arthroplasty, or total knee arthroplasty. The purpose of the present study was to determine the minimum twelve-year results of this procedure in young patients.

Methods: The original study group consisted of a consecutive series of twenty-four patients (twenty-six knees) who were managed with McKeever tibial hemiarthroplasty for the treatment of unicompartmental osteoarthritis of the knee. All patients were younger than sixty years of age at the time of the index procedure (average age, 44.6 years). During the study period, two patients died and one was lost to follow-up, leaving twenty-one patients (twenty-three knees) available for review. All patients were followed clinically for a minimum of twelve years or until revision. Knee Society knee and functional scores and Tegner scores were determined, and seven of the ten implants were evaluated radiographically.

Results: Thirteen knees were revised at an average of eight years after the index procedures. All thirteen knees had an uncomplicated revision to either a unicompartmental arthroplasty or total knee arthroplasty. Ten retained implants were available for clinical review after an average duration of follow-up of 16.8 years. The mean Knee Society knee scores, functional scores, and Tegner scores, available for nine of these ten knees, were 80, 97, and 4.2, respectively.

Conclusions: We believe that the McKeever tibial hemiarthroplasty continues to be a reasonable surgical option for patients who are not candidates for osteotomy and are too young or too active for a unicompartmental or total knee arthroplasty.

Level of Evidence: Therapeutic Level IV. See Instructions to Authors for a complete description of levels of evidence.

Knee arthritis in the young patient can be a challenging problem. The disease ultimately will progress and may require surgical intervention. Surgical options include osteotomy, unicompartmental arthroplasty, or conventional total knee arthroplasty. These procedures, however, have a finite lifespan in the young patient, and often the initial procedure may compromise the results of future surgical procedures.

There remains a subgroup of patients who are not ideal candidates for the procedures mentioned above. This subgroup includes patients who are potential candidates for osteotomy, such as obese patients or those who are unwilling to accept the cosmetic deformity; patients with early disease in the opposite compartment who are candidates for unicompartmental arthroplasty; and patients who are considered to be too young or too active for a total knee arthroplasty.

Some of these patients, however, may be candidates for a unicompartmental tibial hemiarthroplasty. The senior author (R.D.S.) has continued to perform the McKeever hemiarthroplasty for these highly selected patients over the past three decades. We estimate that approximately 1% of patients with osteoarthritis of the knee may be candidates for this procedure. It requires minimal to no bone resection, and the implant later may be converted to a unicompartmental or total knee replacement. We report the minimum twelve-year results of hemiarthroplasty with use of the McKeever metallic implants in a consecutive series of patients who were less than sixty years of age at the time of the index procedure.

Materials and Methods

Hemiarthroplasty with use of a metallic tibial implant (McKeever and MacIntosh prosthesis; Howmedica, Rutherford, New Jersey) was first introduced in the 1950s. The McKeever prosthesis that was used in the present study is a Vitallium metal prosthesis (Howmedica) that roughly simulates the shape of the tibial plateau. The inferior surface of the implant has a T-shaped keel that allows for fixation to the tibia

either with or without cement (Fig. 1). The prosthesis is designed in right and left mirror images and varying thicknesses ranging from 2 to 15 mm.

In general, the McKeever hemiarthroplasty is indicated for patients who are not considered to be candidates for osteotomy and are too young, heavy, or active for total knee arthroplasty. Relative contraindications to osteotomy include knee flexion to <90°, a flexion contracture of >15°, intercondylar osteophyte impingement, and early disease in the opposite compartment. An advantage of the McKeever hemiarthroplasty as compared with tibial osteotomy is that meniscal fragments and osteophytes can be removed and it is possible to gain both flexion and extension, thus overcoming these contraindications to osteotomy. Additional criteria for surgery included unicompartmental disease due to osteoarthritis with an intact anterior cruciate ligament, minimal disease in the opposite compartment or the patellofemoral compartment, minimal tibiofemoral subluxation, and stable collateral ligaments without notable deformity in the sagittal or coronal plane. Patients are counseled preoperatively that they should not expect a normal knee but rather that the goal should be an appreciable improvement in terms of pain and activity levels without compromising future arthroplasty options.

The operative technique has been described previously[1]. The procedure initially was performed through a standard midline incision with a medial parapatellar arthrotomy. For medial placement of the prosthesis, the patella generally does not need to be everted. Lateral compartment placement often requires eversion of the patella for adequate exposure. We begin by removing the remnant of the meniscus. All peripheral osteophytes as well as any intercondylar osteophytes that may be causing impingement are removed. The status of the anterior cruciate ligament is evaluated by direct inspection. It is not necessary to remove all of the articular cartilage, but only what is needed to properly shape the tibial and femoral condyles. An oscillating saw is then used to shape the tibial plateau to mate with the undersurface of the prosthesis. Approximately 3 mm of the posterior aspect of the femoral condyle must be resected to create room in flexion for the thickness of the prosthesis that corrects and stabilizes the knee in extension. An oscillating saw is used to recontour the junction of this resection with the distal aspect of the condyle. A series of templates is available for appropriate sizing. As a general principle, the curved peripheral aspect of the implant should not overhang the tibial plateau. An osteotome or reciprocating saw can form a buttress along the tibial spine for the straight inner edge of the component. A T-shaped slot to accommodate the keel of the prosthesis can then be made with either a small oscillating saw or a burr. The correct thickness of the prosthesis is selected so that it fills the joint space and allows it to be opened approximately 1 mm with a valgus stress for the medial compartment or a varus stress for the lateral compartment. The prosthesis should not overstuff the joint and cause subluxation of the tibia on the femur or excessive pressure on the contralateral compartment. The prosthesis also should be checked with the knee in flexion. If it is excessively tight, a little more bone can be resected from the posterior aspect of the femoral condyle. The prosthesis can then be inserted either with or without cement onto the tibial plateau. In the present study, all prostheses were inserted without cement, partly because of the young age of the patients, and a firm press-fit was achieved with the fixation keel.

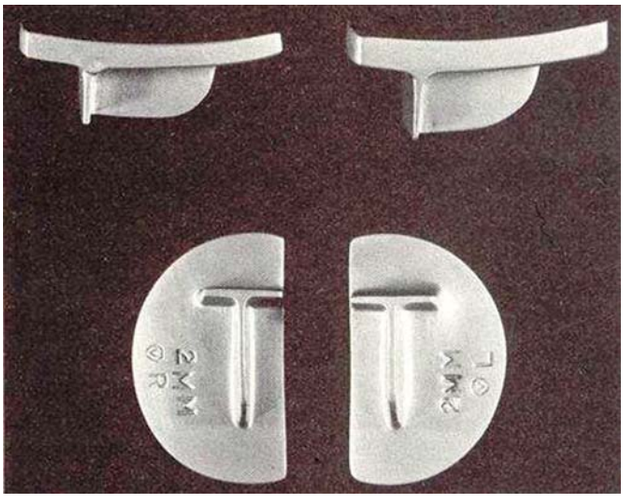

Fig. 1

The McKeever metallic hemiarthroplasty implant (Howmedica) is a Vitallium metal prosthesis that roughly simulates the shape of the tibial plateau. The inferior surface has a T-shaped keel that allows for fixation to the tibia either with or without cement.

Between December 1975 and December 1990, the senior author (R.D.S.) performed twenty-six consecutive McKeever tibial hemiarthroplasties on twenty-four patients who were less than sixty years of age with use of the technique described above. Two patients died, and one was lost to follow-up. We report the outcome for the remaining twenty-three knees (twenty-one patients) at a minimum of twelve years (range, twelve to twenty-nine years) after the index procedure (see Appendix).

The original group included fourteen men and ten women. The average age at the time of the index procedure was 44.6 years (range, twenty-two to fifty-eight years). Fifteen knees were on the right side, and eleven were on the left. Eight knees had involvement of the medial compartment, and eighteen had involvement of the lateral compartment. Twelve knees had had a previous meniscectomy of the affected compartment. Three knees had posttraumatic osteoarthritis following a fracture of the tibial plateau, and one knee had had a previous proximal tibial osteotomy and meniscectomy. One knee had had previous arthroscopic débridement, one had had anterior cruciate ligament reconstruction, and the remaining eight had had no previous surgery.

Case records were examined to determine the status of the McKeever implant. Operative charts were reviewed on all knees that had already been revised. The mode of failure was determined, and details regarding the technical difficulty of the total knee arthroplasty were recorded. All patients who

had not had a revision were contacted, and their records were reviewed. Clinical assessment was performed by means of either a telephone interview or an examination in the clinic. We used the Knee Society clinical rating system[2] and the Tegner activity score[3]. Data were analyzed with use of the Fisher exact test for simple proportions and with use of Kaplan-Meier survivorship analysis, and the log-rank test was used to detect any significant differences in terms of implant survival. The level of significance was set at $p < 0.05$. The study was approved by the internal review board at the New England Baptist Hospital in Boston, Massachusetts.

Results

Two patients died during the study period. One patient died eleven years after surgery with the McKeever implant still in situ. This patient was evaluated in the clinic ten years after surgery and had minimal knee pain at that time. The findings on plain radiographs were unchanged, and revision surgery was not planned. No information was available on the outcome for the second patient. The patient had not been seen since the early postoperative period and died seventeen years after surgery. Attempts to contact living relatives were not successful.

One patient who underwent surgery in 1988 relocated. At the time of the latest clinical follow-up, ten years postoperatively, clinical records indicated no pain and a well functioning knee.

Surviving Implants

At the time of the latest follow-up, at an average of 16.8 years (range, twelve to twenty-nine years) after surgery, ten knees in nine patients had a surviving implant. Preoperative Knee Society knee scores, functional scores, and Tegner scores were calculated for nine of the ten knees. The mean preoperative knee score was 38.1 (range, 13 to 70), the mean preoperative functional score was 27.8 (range, 0 to 60), and the mean preoperative Tegner score was 0.7 (range, 0 to 1).

At the time of the latest follow-up, the mean postoperative knee score for the same nine knees was 80 (range, 45 to 100), the mean postoperative functional score was 97 (range, 80 to 100), and the mean postoperative Tegner score was 4.2 (range, 2 to 7). Subjectively, all eight patients (nine knees) indicated that they were extremely satisfied with the surgical

Fig. 2-A

Fig. 2-B

Figs. 2-A through 2-D Anteroposterior radiographs of the knee of an active woman with lateral compartment osteoarthritis who underwent a lateral McKeever tibial hemiarthroplasty at the age of fifty-three years. **Fig. 2-A** Preoperative radiograph. **Fig. 2-B** Postoperative radiograph.

procedure and the status of knee function at the time of the latest follow-up. Likewise, all patients indicated that they would choose to have the procedure again in order to delay the need for a unicompartmental or total knee arthroplasty.

Radiographs

Serial radiographs were available for seven of the ten knees with a surviving McKeever tibial implant. The average duration of radiographic follow-up was 15.9 years (range, twelve to twenty-nine years). All knees had laterally placed implants. Radiographs were assessed on the basis of four parameters: tibiofemoral alignment, degeneration in the unresurfaced compartment or the patellofemoral compartment, subsidence of the implant, and radiolucencies around the tibial keel on the lateral projection.

The overall tibiofemoral anatomic alignment averaged 2.6° of valgus (range, 0° to 5° of valgus). Five of the seven knees had radiographic evidence of degenerative changes in either the opposite tibiofemoral compartment (four knees) or the patellofemoral compartment (one knee). One knee had radiographic evidence of progressive degenerative changes of the femur in the involved compartment. No knee had evidence of radiolucency around the keel of the tibial component or radiographic evidence of subsidence of the component.

Revisions

Thirteen knees (in twelve patients) were revised at an average of eight years (range, 0.5 to seventeen years) after the index procedure. Information regarding the revision procedures was available for all patients. Five of the eight original implants in the medial compartment and eight of the eighteen original implants in the lateral compartment required revision. With the numbers available, no significant difference was found between medial and lateral implants with regard to the proportion of revisions ($p = 0.38$) or the survival rate ($p = 0.20$).

The reasons for revision included progression of femoral arthritis in the involved compartment (four knees), progression of disease to the other compartment or the patellofemoral joint (seven knees), and loosening of the component (two knees). The revision procedures that were performed included one unicompartmental knee arthroplasty in a patient with pro-

Fig. 2-C

Fig. 2-D

Fig. 2-C Ten years postoperatively, the patient had development of symptoms of progressive disease and radiographic evidence of progression of the osteoarthritis in the lateral compartment. **Fig. 2-D** The patient underwent conversion to a standard cruciate-retaining total knee arthroplasty without technical difficulty.

gression of unicompartmental femoral disease and eleven revisions to a cruciate-retaining total knee arthroplasty.

The remaining knee, which had radiographic evidence of a loose implant without progression of disease in the other compartments, had a revision McKeever tibial hemiarthroplasty six months after the index procedure. The patient was a thirty-nine-year-old woman with isolated lateral compartment disease who had undergone a previous lateral meniscectomy. At the time of the index procedure, an uncemented McKeever hemiarthroplasty was performed in the lateral compartment. Postoperatively, the patient continued to complain of pain and serial radiographs showed migration of the component. At the time of revision, the component was grossly loose and yet the bone stock remained well preserved. The decision was made to insert a new McKeever component with cement. The patient subsequently did well postoperatively with no additional complications.

Of the twelve knees that were revised to either a unicompartmental arthroplasty or a total knee arthroplasty, only two required minor particulate bone-grafting of the tibia after removal of the component. In both instances, the graft was placed into the areas of the tibia where the original fins of the McKeever prosthesis had been. No revisions required the use of augmentation or stems, and all were performed with a primary cruciate-retaining system (Figs. 2-A through 2-D). The tibial cut was made in a standard fashion in all knees, and all knees received a tibial polyethylene insert that ranged in thickness from 8 to 12.5 mm.

Discussion

McKeever hemiarthroplasty of the knee was introduced in the late 1950s. This procedure is indicated for patients who are not considered to be candidates for osteotomy and are too young, heavy, or active for total knee arthroplasty. Despite encouraging early reports, the procedure did not gain widespread acceptance. Emerson and Potter reported the results of sixty-one McKeever unicompartmental hemiarthroplasties after an average duration of follow-up of five years[4]. The average age of the patients was sixty-one years. Seventy-two percent of the knees were rated as good or excellent.

Scott et al. reported on forty-four knees, none of which are included in the current study, that were treated with a McKeever prosthesis[1]. The average age of the patients at the time of the procedure was sixty-seven years (range, thirty-two to eighty-two years). They similarly reported a 70% rate of good or excellent results after an average duration of follow-up of eight years. Six knees required revision to either a unicompartmental or total knee arthroplasty.

In both of those studies, younger patients had better overall results, satisfaction, function, and implant survival. In the current study, the patients in whom the implant was retained were an average of nine years younger than those who required revision. In addition, the patients in the former group retained the implant for approximately twice as long as those in the latter group did (seventeen compared with eight years).

Osteotomy has been advocated for patients who are deemed too young or active for a total or unicompartmental knee arthroplasty[5,6]. Recovery can be prolonged, pain relief can be unpredictable, and there is often deterioration of satisfaction with this procedure over time. Most reports have indicated that osteotomy is associated with early initial success and satisfaction, which tend to diminish by ten years[7,8]. Conversion to total knee arthroplasty after osteotomy has been associated with a higher complication rate, and the results generally are not similar to those of primary total knee arthroplasty[9,10].

Unicompartmental arthroplasty may be an attractive option for middle-aged patients as it addresses only the diseased compartment and also can be a relatively bone-preserving procedure[11]. It does, however, introduce a bearing surface and thus can be associated with all of the problems inherent with a total knee arthroplasty, including wear, osteolysis, loosening, and bone loss.

Engh and McAuley reported a 28% revision rate at seven years in a study of forty-nine patients with a failed unicompartmental knee arthroplasty who were forty to sixty years old at the time of the index arthroplasty[12]. Schai et al. assessed twenty-eight unicompartmental knee arthroplasties in patients who were less than sixty years old[13]. Ninety percent of the knees had a good or excellent result, and two required revision because of femoral component loosening. The authors concluded that unicompartmental arthroplasty was inferior to total knee arthroplasty in young patients. Pennington et al. recently reported on forty-five unicompartmental knee arthroplasties in patients who were less than sixty years old[14]. After an average duration of follow-up of eleven years, three knees had been revised and 93% of those with a retained implant had an excellent result.

The early to intermediate-term results of total knee arthroplasty in young patients have been encouraging, yet long-term reports of more than ten to fifteen years are not yet available for these patients, to our knowledge[15,16]. Most long-term reports have included patients with severe posttraumatic arthritis or rheumatoid arthritis and often have not included young active or heavy patients with isolated unicompartmental disease[17,18].

Recently, a unicompartmental spacer device designed to treat isolated medial compartment disease was introduced[19,20]. This device can be thought of as a mobile McKeever hemiarthroplasty device. Instead of being fixed to the tibial plateau by means of a keel, it is designed to translate freely on the tibial plateau as determined by the conforming articulation of its top surface with the femoral condyle. This mobility makes it inappropriate for use in the lateral compartment, where femoral roll-back could cause dislocation of the implant and/or soft-tissue impingement[21].

In the only published report of which we are aware, seventy-one knees in sixty-seven patients were reviewed after a minimum duration of follow-up of one year[22]. Five knees (7%) had been revised to a total knee arthroplasty, and an additional ten knees (14%) had had an exchange of the implant because of either dislocation (six) or pain (four). The overall one-year revision rate was 21%. In addition, seventeen knees

(24%) had arthrofibrosis requiring manipulation with the patient under anesthesia. The advantage of this device (UniSpacer; Centerpulse, Austin, Texas), however, is the surgeon's ability to insert it through a minimally invasive approach, whereas the McKeever implant requires a larger exposure for contouring of the femur and tibia. The early results of the UniSpacer make its continued use uncertain.

The most common reason for revision in the present study was the progression of ipsilateral femoral disease or the development of disease in another compartment of the knee. Only two patients had a revision because of a failure that was directly related to implant loosening.

Among the patients who had a failure and ultimately required revision, no difficulties were encountered during conversion to a unicompartmental or total knee arthroplasty. This finding is most likely related to the relatively bone-sparing nature of the implantation technique. For the patients who required revision, the implants survived for an average of eight years. This is an important point to remember, considering that they were an average of forty-eight years old at the time of implantation of the McKeever unicompartmental hemiarthroplasty device.

Over the past three decades, the senior author (R.D.S.) has continued to perform hemiarthroplasty with the McKeever metallic implant. While the indications for this procedure are limited, with perhaps only 1% of patients qualifying, it remains a viable option for patients who for various reasons (such as obesity) are not candidates for osteotomy and are too young and active for joint arthroplasty. Its bone-sparing nature makes it an attractive option as a temporizing procedure for select patients with unicompartmental disease.

Appendix

eA Tables showing clinical data for all patients are available with the electronic versions of this article, on our web site at jbjs.org (go to the article citation and click on "Supplementary Material") and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM). ■

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