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RH Emerson and T Potter
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The Use of the McKeever Metallic Hemiarthroplasty for Unicompartmental Arthritis*

BY ROGER H. EMERSON, JR., M.D.†, AND THEODORE POTTER, M.D.‡, BOSTON, MASSACHUSETTS

From the Department of Orthopaedic Surgery, Harvard Medical School, Massachusetts General Hospital, Boston

ABSTRACT: We reviewed the results of sixty-one McKeever unicompartmental arthroplasties performed by the senior one of us (T. P.) for osteoarthritis of the knee. The average follow-up was five years (range, two to thirteen years). Forty-four (72 per cent) of the arthroplasties were rated as good to excellent. The average postoperative range of motion in these knees was 110 degrees. Six knees were rated as fair and eleven knees, as poor. The poor results appeared to be caused by degenerative arthritis involving ipsilateral compartments that had not been resurfaced with an implant.

Osteoarthritis of the knee joint is not infrequently confined to one compartment, usually the medial one, with the lateral compartment being relatively free of disease[7,10,13]. The best treatment for this problem is controversial, and various methods have been proposed, including both tibial and femoral osteotomy[1-3,7,8,10,15], unicompartmental cemented prosthetic replacement[4,12], and total joint replacement[9,15].

With time, it has become clear that the cemented total joint prosthesis, particularly in the young or active patient, has an appreciable risk of failure, primarily because of loosening at the bone-cement interface[5,9]. Salvage of a failed cemented implant is a major surgical challenge[10]. The reported results of tibial osteotomy for medial compartment osteoarthritis with varus deformity have appeared to be generally satisfactory to date[1-3,7,8,10]. The reported results of tibial osteotomy for lateral compartment disease and valgus deformity have not been as satisfactory, however, and Shoji and Insall have stated that high tibial osteotomy is contraindicated in this situation. The alternatives that they have suggested are a supracondylar femoral osteotomy in the younger patient and a total knee replacement in the older patient. However, it has been reported that motion of the knee is frequently restricted following femoral osteotomy for arthritis[6]. Articular replacement of both joint compartments for unicompartmental arthritis seems excessive, and the results with cemented unicompartmental total joint replacements have been inconsistent[4,5,9,12].

A series of exclusively unicompartmental uncemented tibial-plateau arthroplasties for osteoarthritis has not been previously reported. Prior reports have combined unicompartmental and bicompartmental implants in both rheumatoid and osteoarthritic patients[11,14]. The senior one of us (T. P.), however, has used the McKeever prosthesis as a hemiarthroplasty in knees with unicompartmental osteoarthritis since 1971 (Figs. 1, 2, and 3).

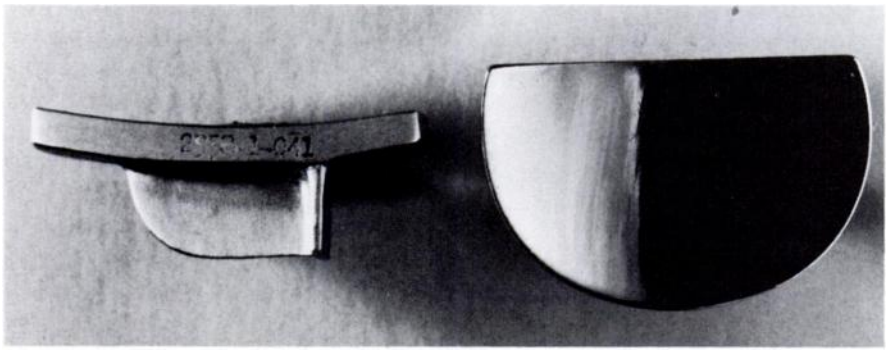

FIG. 1

Two views of the McKeever implant.

The purpose of this paper was to retrospectively study this experience in an attempt to determine the role of the McKeever prosthesis in the treatment of unicompartmental osteoarthritis.

Clinical Material

Seventy-two consecutive McKeever hemiarthroplasties for unicompartmental osteoarthritis were performed by the senior one of us in sixty-nine patients between 1971 and

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† Cambridge Hospital, 1439 Cambridge Street, Cambridge, Massachusetts 02139.

‡ New England Baptist Hospital, 91 Parker Hill Avenue, Boston, Massachusetts 02120.

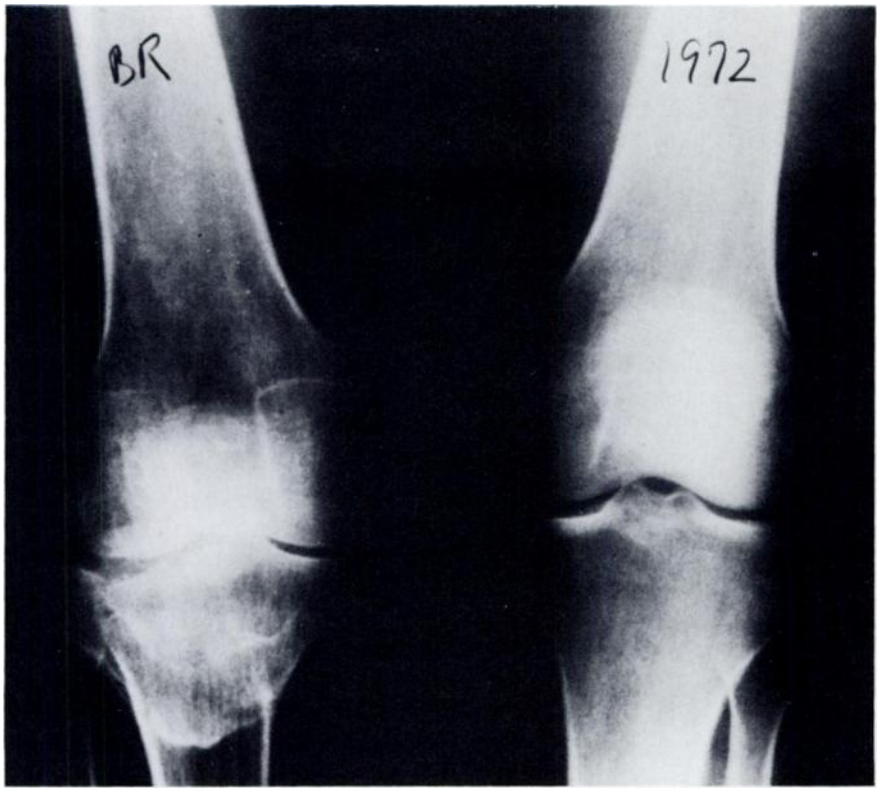

FIG. 2

Preoperative radiograph showing post-traumatic osteoarthritis of the lateral compartment.

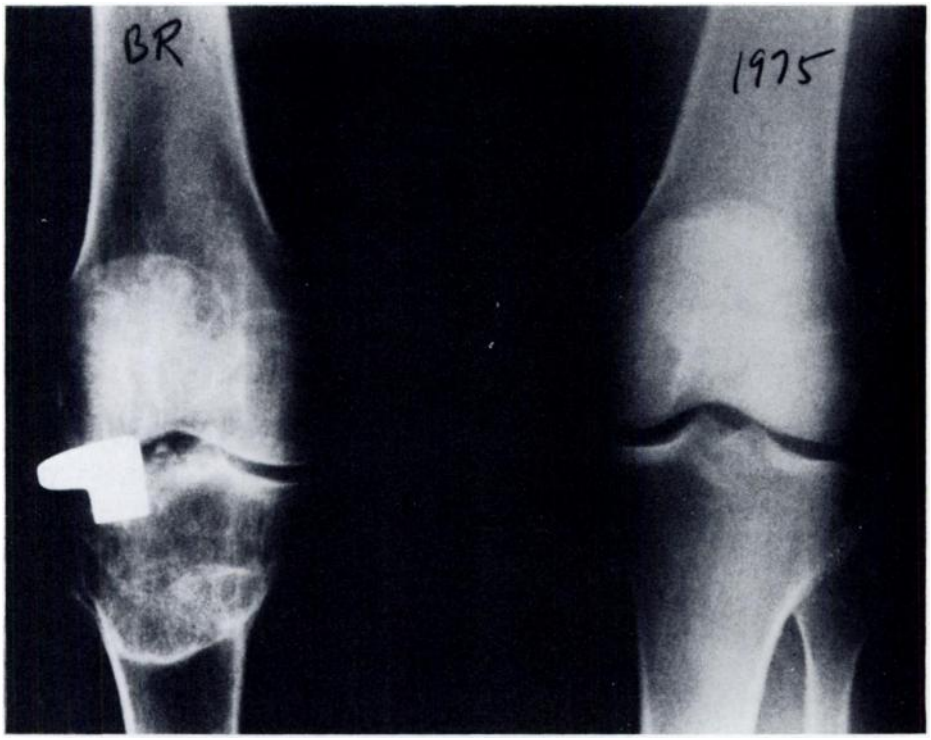

FIG. 3

Postoperative radiograph of the knees shown in Fig. 2, three years after insertion of a McKeever implant in the lateral compartment.

1978. These patients' hospital charts, radiographs, and postoperative office records were reviewed. The patients were interviewed by telephone when necessary to complete the follow-up. All of the patients were personally followed by the senior one of us. Of the seventy-two arthroplasties, sixty-one knees in sixty-one patients were available for follow-

up at two to thirteen years (average, five years) postoperatively.

The method of knee evaluation used in this study was reported previously by Potter et al. A grade of zero to 2 points is excellent; 3 to 6, good; 7 to 10, fair; and more than 11, poor.

The series consisted of thirty-three women and twenty-eight men, with thirty-five right and twenty-six left knee arthroplasties. The average age of the patients was sixty-one years (range, twenty-eight to eighty-one years).

Forty-eight implants were placed in the medial and thirteen, in the lateral tibial compartment. In the knees with replacement of the medial compartment, the preoperative varus deformity at the knee averaged 7 degrees (range, zero to 15 degrees). In the knees with replacement of the lateral compartment, the preoperative valgus deformity averaged 10 degrees (range, 2 to 20 degrees).

Twenty-four (39 per cent) of the knees had had previous surgery, of which a meniscectomy of the ipsilateral compartment was the most common. A total of forty previous operations had been done, with eight knees having had more than one procedure (Table I). The preoperative arc of motion for all knees averaged 84 degrees. Active flexion averaged 91 degrees (range, 60 to 120 degrees). There was an average flexion contracture of 7 degrees (range, zero to 25 degrees). Osteoarthritic involvement of the contralateral compartment

TABLE I

PREVIOUS SURGERY
(TWENTY-FOUR KNEES)

Procedure	No.
Meniscectomy	20
Débridement	3
MacIntosh implant	5
Intra-articular fracture	4
Synovectomy	2
Excision of a Baker's cyst	2
High tibial osteotomy	1
Ligament reconstruction	1

and of the patellofemoral articulation was frequent, fourteen knees (23 per cent) having significant involvement of the contralateral compartment and seventeen (28 per cent) having patellofemoral involvement. Thirteen of the former knees were rated as having mild and one, as having moderate involvement, and four of the latter were rated as having mild; ten, moderate; and three, severe involvement.

The McKeever implants (Howmedica) are available in two, three, four, and six-millimeter thicknesses. Larger sizes are available on special order. The most frequently used size in this study was four millimeters.

Surgical Technique

Proper surgical technique and careful attention to the postoperative program is necessary for a good result with this prosthesis. The surgical technique and postoperative regimen have been previously reported on by Potter et al., but some details of the technique used for unicompartmental prostheses must be emphasized.

The purpose of the unicompartmental prosthesis is primarily to resurface the arthritic tibial plateau and only secondarily to correct deformity. The least possible amount of bone should be removed, although the meniscus must be excised to accommodate the prosthesis. All osteophytes beneath the joint capsule should be removed to permit realignment of the leg. These osteophytes tent the capsule and produce a fixed deformity. Their removal permits the ligaments to return to their normal relationship with the joint surface. When this has been accomplished, the smallest implant that is stable should be used. The tendency to put in the largest implant to obtain better alignment of the leg should be resisted.

Postoperatively, in the operating room, a long cast is applied in one section from groin to toes to produce a stronger bivalved cast. As the patient must be observed carefully during the postoperative period for development of a flexion contracture, we prefer a bivalved long cast in extension rather than the usual prefabricated knee-immobilizer, which may produce a small flexion contracture. The cast is used in the hospital and, except during physical therapy sessions, is used at home at night for six to eight weeks.

The cast is bivalved in the recovery room about two hours after application to allow for swelling. Quadriceps-setting and gluteal-setting exercises are started on the first postoperative day. The bivalved cast is removed on the second or third day to allow the start of active, assisted range-of-motion exercises. The cast is lined and straps are applied for use as a night splint for the next eight to twelve weeks. Partial weight-bearing with crutches is allowed after 70 degrees of flexion has been attained, usually at about the third postoperative week.

If the patient does not attain 60 degrees of flexion by two weeks postoperatively, the knee is gently manipulated to 90 degrees under general anesthesia. The patient is instructed in a touch-down partial weight-bearing gait, which is used for a minimum of three months. If a residual knee-flexion contracture or excessive quadriceps weakness persists, the bivalved cast, holding the knee in maximum extension, is worn intermittently during the day. Several cast changes may be required to stretch out a residual flexion contracture. The importance of the postoperative regimen for the success of this procedure cannot be overemphasized.

Results

The average preoperative score of the sixty-one knees in this series was 9.5 points (range, 3 to 20 points) and the average postoperative score was 4.6 points (range, zero to 22 points). This was an average improvement of 4.9 points over the average preoperative score of 9.5 points (Table II). The results in knees with a medial compartment implant ranged from zero to 16 points (average, 3.7 points) and in knees with a lateral compartment implant they ranged from zero to 22 points (average, 6.8 points). Over-all, forty-four

TABLE II

CHANGE IN RATING AS RESULT OF ARTHROPLASTY

Ratings	No. of Knees
Poor to poor	7
Poor to fair	0
Poor to good	6
Poor to excellent	10
Fair to poor	3
Fair to fair	2
Fair to good	7
Fair to excellent	10
Good to poor	1
Good to fair	2
Good to good	3
Good to excellent	10

(72 per cent) of the knees were graded as good to excellent. Thirty-seven (77 per cent) of the knees with a medial compartment implant were rated as good to excellent and seven (54 per cent) of those with a lateral implant attained this rating. The twenty patients who were less than fifty-six years old had an average postoperative score of 4.0 points, which was better than the rating for the over-all series. It should be particularly noted that this was an active group of patients, most of whom worked regularly and engaged frequently in non-strenuous athletics. While some of the younger patients admitted to some aching in the knees that had been operated on, after an extremely active day, none had limitation of their normal activities.

The forty-eight knees with a varus deformity that received a medial implant were corrected to an average of 2 degrees of valgus angulation, and the thirteen knees with a valgus deformity that received a lateral implant were corrected to an average of 6 degrees of valgus angulation.

The average postoperative active flexion in the knees with excellent and good results was 110 degrees (range, 60 to 135 degrees). Only three knees had less than 90 degrees of flexion, and nine had more than 120 degrees. Fifteen patients required manipulation of the knee at two weeks postoperatively, including two who had to have manipulation twice. Three knees had a 5-degree flexion contracture; two, a 10-degree contracture; and one, a 30-degree contracture.

Six knees (9 per cent), all with a medial implant, were rated as having a fair result. None required revision surgery. Eleven knees (18 per cent) were rated as having a poor result at follow-up. Six had had a medial and five had had a lateral implant. Seven of these knees have since had revision to a total knee replacement. One first had revision to a unicompartmental cemented prosthesis, which in turn was revised to a total knee replacement and ultimately to a knee fusion. The average time from unicompartmental surgery to total joint replacement was 2.8 years (range, 1.5 to four years). The knees with a poor result were especially characterized by pain and the need to continue the use of crutches. The average arc of motion in this group was 98 degrees (range, 60 to 130 degrees). All lacked 5 degrees to full extension except for one knee with a 30-degree flexion contracture and only 60 degrees of flexion. The knees that subsequently required revision were those that had had the most severe arthritic involvement of the contralateral compartment and the patellofemoral joint.

Complications

Complications related to the implant were rare. One medial implant dislocated several years postoperatively while the patient was engaged in vigorous dancing. This was treated by revision to a larger prosthesis and the patient had continued good function. The other complications were few in number and were typical of any major joint operation. There were five deep-vein thromboses, five hemarthroses requiring aspiration, one superficial infection with *Staphylococcus epidermidis*, one reflex sympathetic dystrophy, and one postoperative cardiac arrhythmia.

Discussion

The alternative surgical procedures that are available today for the treatment of unicompartmental osteoarthritis include proximal tibial osteotomy, distal femoral osteotomy, and unicompartmental total joint replacement. The reported good to excellent results of high tibial osteotomy have ranged from 59 to 82 per cent[1-3,7,8,10]. The majority of these patients had varus deformity. The results of proximal tibial osteotomy for valgus deformity and lateral compartment osteoarthritis have generally been less satisfactory[15], although Jackson and Waugh[6] reported that eleven of their patients with valgus deformity experienced considerable relief of pain.

The results of unicompartmental total joint replacement have also been variable. Insall and Walker[4] reported 45 per cent good to excellent results and Laskin, 65 per cent relief at two years of follow-up. Marmor reported 75 per cent good to excellent results at two to four years of follow-up.

The results of unicompartmental tibial-plateau arthroplasty with a McKeever implant have not been previously reported. Only two small groups of patients who received a McKeever implant for bicompartmental osteoarthritis have been reported on. The first such report was published following McKeever's death, from material of his that was assembled by Robert Elliott[11]. Seventy-six implants in forty knees were described and there was only one failure due to infection. Potter et al. reported on nineteen patients with bicompartmental osteoarthritis. Seventeen (89 per cent) of them had good to excellent results with the same knee-evaluation scoring that we used in this series.

The results in our series were similar to the best results reported for the other techniques that have been used to address the problem of unicompartmental osteoarthritis[1-3,7,8,10]. There are, however, several advantages to the McKeever implant. Few complications are directly related to the prosthesis. The loosening problems that are inherent in cemented prostheses do not exist. The McKeever implant does have the capacity to correct some varus or valgus deformity by means of varying implant widths, but it is our opinion that overcorrection must be avoided. It can also be

used as an interpositional implant without changing the varus or valgus alignment of the joint in an arthritic knee without malalignment or in a knee with a depressed tibial-plateau fracture. A failed tibial osteotomy in a younger patient, in whom a cemented prosthesis could be a liability, can be easily converted to a McKeever hemiarthroplasty. There were two such patients in this series. One patient had an excellent result at the time of his death three years postoperatively, and the other, who has been followed for seven years to date, was working as an athletic coach with no significant pain or limitation of activity. Another significant advantage of the McKeever prosthesis is that its insertion does not require the removal of a significant amount of bone, thus making subsequent total joint-replacement surgery easier, and allowing the use of conventional total joint prostheses. The McKeever prosthesis has the capacity to function as a bicompartmental implant, although indications for this use are fewer in this era of total knee replacement. In special circumstances, however, such as in the younger patient, this use should be investigated.

The chief disadvantage of the McKeever implant is the prolonged rehabilitation that is required for a good result. Many older patients are not able to adhere to the regimen of strict partial weight-bearing. These patients, however, are probably better suited for a cemented joint arthroplasty than for the McKeever implant.

It is our opinion that the McKeever implant acts in a fashion similar to the cup arthroplasty of the hip. Observation of the established implant at surgery reveals a smooth glistening surface on both the tibial and femoral osseous surfaces, and while there is obviously motion on the femoral side, it is our opinion that there is micromotion on the tibial side which is important to the success of the implant. There is, therefore, a biological response of the tissues to the implant. The exacting and prolonged rehabilitation program is required to obtain this local tissue response. In addition, it is our clinical observation that this biological adaptation appears to be inhibited by too tight a fit between the implant and the joint surfaces.

The chief reason for failure in this series appeared to have been multicompartmental arthritis. As this was more common in the older patients, it may partially explain why the younger patients tended to do better. Also, the younger patients were better able to participate in the rehabilitation program, which is more demanding than that required for a cemented prosthesis. The patients in this series were operated on before the era of reliable total knee arthroplasty, and today many of the older patients would be treated with a total joint replacement. Bicompartmental arthritis or severe patellofemoral arthritis would now be considered a contraindication to the use of the McKeever prosthesis.

There continues to be, however, the occasional patient with limited osteoarthritis of the knee who is not a candidate for total joint replacement, due either to age or to the desire to engage in vigorous activities. Osteotomy continues to be the procedure of choice for this type of patient, in our opinion, since no artificial implant is required. In the patient with unicompartmental arthritis without significant deformity, however, in whom realignment of the limb has no rationale, the McKeever prosthesis offers a feasible alternative to the cemented prosthesis. Another indication for use of the McKeever prosthesis is a failed osteotomy, when avoidance of a cemented prosthesis is desirable. While one may not see a great number of patients who will require the McKeever prosthesis, in our opinion it is the best alternative for a small subset of patients, and if it is properly applied it can provide a reliable solution for the complaints of some patients.

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