Total Knee Arthroplasty for Patellofemoral Arthritis

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Background: Multiple treatment methods have been advocated for patellofemoral arthritis. The purpose of the present study was to report on our experience with the use of total joint replacement for the treatment of primarily severe patellofemoral arthritis of the knee in patients more than fifty-five years of age.

Methods: Between January 1980 and December 1994, thirty knee replacements were performed in twenty-seven patients for the treatment of arthritis that primarily involved the patellofemoral joint. The Ahlbäck radiographic evaluation scale was used to grade the severity of arthritis; the mean score was 4.83 points (range, 4 to 5 points) for the patellofemoral compartment and 0.6 point (range, 0 to 1 point) for both the medial and lateral compartments. The patients included eighteen women and nine men who had a mean age of seventy-three years (range, fifty-nine to eighty-eight years). None of the patients had had any prior procedures on the knee, but all had been treated for a minimum of six months with nonoperative measures. The mean preoperative Knee Society score was 50 points (range, 20 to 64 points).

Results: At a mean duration of follow-up of eighty-one months (range, forty-eight to 133 months), there were twenty-eight excellent, one good, and one poor result. The mean Knee Society objective score was 93 points (range, 67 to 100 points). The poor result was in a patient who sustained a rupture of the patellar tendon postoperatively as the result of a fall, which necessitated a tendon reconstruction.

Conclusion: Total knee arthroplasty was found to be a viable treatment option in patients more than fifty-five years of age with primarily severe patellofemoral disease.

Multiple treatment methods have been advocated for patellofemoral arthritis[1-5]. While many patients can be managed with activity modification and nonoperative therapy, some patients have more severe and disabling symptoms and may need surgery.

Proximal and distal soft-tissue procedures, osseous realignment procedures, and patellectomy have been advocated for younger patients[1-3,5]. The problem becomes more complex in less active, older patients with severe patellofemoral disease. Patellofemoral arthroplasties have not had optimal results[1], and for many patients the only alternative has been a total joint arthroplasty[4]. To the best of our knowledge, there has been only one report in the English-language literature on total knee arthroplasty for patients with arthritis confined to the patellofemoral joint[4]. The purpose of the present study was to report on our experience with total joint replacement for the treatment of primarily severe patellofemoral arthritis of the knee.

Materials and Methods

Thirty total knee replacements that had been performed in twenty-seven patients between January 1980 and December 1994 for the treatment of arthritis that primarily involved the patellofemoral joint were identified from the databases of two institutions. Twenty-seven (2.6%) of 1054 knees that had been treated at one institution and three (1.5%) of 202 knees that had been treated at the other institution were selected for inclusion in the study. To be included in the study, a patient had to meet the strict radiographic criterion of having primarily severe patellofemoral arthritis before the knee arthroplasty. All of the patients who met this criterion were followed for a minimum of four years, and none were lost to follow-up. All patients were evaluated with an interview, an examination, and radiographs, and all filled out a standardized questionnaire that allowed for the evaluation of activity levels, satisfaction, and the objective and functional scores of the Knee Society[6].

All radiographic evaluations included standing anteroposterior, lateral, and Merchant patellofemoral views of the knee[7]. The Ahlbäck radiographic evaluation scale was used to grade the severity of arthritis to determine whether the knee should be included in the study (Appendix)[8]. This scale rates the severity of arthritis in each knee compartment with a score from 0 to 5 points (with 5 points indicating the greatest severity) on the basis of sclerosis, joint-space narrowing, the presence of osteophytes, and subluxation. Knees that had a medial or lateral compartment score of >1 point were excluded. The knees that were studied had a mean score of 4.83 points (range, 4 to 5 points) for the patellofemoral compartment, 0.6 point (range, 0 to 1 point) for the medial compartment, and

0.6 point (range, 0 to 1 point) for the lateral compartment.

The study group included eighteen women and nine men who had a mean age of seventy-three years (range, fifty-nine to eighty-eight years) at the time of the arthroplasty. No patient had had any prior procedure involving the knee but all patients had been treated for a minimum of six months with a variety of nonoperative modalities (e.g., analgesics, anti-inflammatory medications, corticosteroid knee-joint injections, physical therapy, and activity modification). The mean preoperative Knee Society objective score was 50 points (range, 20 to 64 points). All patients had pain, including anterior knee pain, after prolonged walking. In addition, all patients had increased pain when rising from a sitting to a standing position as well as when ascending or descending stairs. Other symptoms included giving-way or instability during walking (sixteen patients), weakness (eight patients), and pain at night (seven patients).

Prostheses

Nine knees were treated with the Porous Coated Anatomic prosthesis (Howmedica, Rutherford, New Jersey); eighteen, with the Duracon prosthesis (Stryker-Howmedica-Osteonics, Allendale, New Jersey); and three, with the Insall-Burstein II prosthesis (Zimmer, Warsaw, Indiana). Ten femoral components had cementless fixation, and twenty were cemented. Four tibial components had cementless fixation, and twenty-six were cemented. Six patellar components were metal-backed dome-shaped components that had cementless fixation, and twenty-four were all-polyethylene dome-shaped components that were cemented. Twenty-four knees received a posterior cruciate-retaining prosthesis, and six received a cruciate-substituting design. The types of components, the method of fixation, and the prosthetic design (posterior cruciate-retaining or posterior cruciate-substituting) were chosen according to the preference of the surgeon.

Patellar Preparation

The goals of the technique of patellar replacement in these patients were (1) to cut the uneven articular surface of the arthritic patella parallel to the nonarticular surface in order to allow for an even recession of patellar bone, (2) to maintain the joint line, (3) to balance the soft tissues in order to allow more normal tracking of the patella[9], and (4) to achieve medial placement of the patellar implant in order to allow more normal tracking of the patella. All patellae had grade-IV chondromalacia according to the system of Outerbridge[10].

In four knees, severe patellar erosion necessitated the use of a small cemented patellar component; the native patellar thickness in these knees ranged from 10 to 14 mm. In all other knees, there was sufficient native patellar bone to allow for resection to a thickness of >15 mm. No specific instruments were used to prepare the patella for resurfacing. The patellar resection was performed with the knee flexed and the patella everted. The goal was to resect the minimum amount of bone needed to create a flat surface for the seating of the component. The patellar component was positioned in a manner to avoid medial-lateral tilt and was placed in line with the medial border of the remaining portion of the patella. Patellar tracking was ascertained during trial reduction of the components by checking the lateral or medial migration of the patella throughout the entire range of motion. The goal was for the patellar component to stay within the trochlear groove without any excess finger pressure (the so-called no thumbs technique)[11]. Twelve knees (40%) had a lateral release because of a persistent tendency for subluxation or dislocation of the patella. Lateral releases were performed with use of an inside-out approach with an attempt made to preserve the superior lateral geniculate artery. Tourniquets were deflated after all lateral releases to check for hemostasis.

Rehabilitation

Patients were allowed to walk with 50% weight-bearing for the first six weeks with the aid of a cane, crutches, or a walker. They were then advanced to full weight-bearing without walking aids as tolerated. Range-of-motion exercises were begun on the second postoperative day. A continuous-passive-motion machine was not utilized.

Clinical Evaluation

The final follow-up evaluation involved either a clinical visit (twenty-five patients) or telephone contact with both the patient and his or her present orthopaedic surgeon (two patients). All patients were evaluated with use of the Knee Society objective and functional rating scales[6]. A score of ≥90 points was considered an excellent outcome, a score of 80 to 89 points was considered a good outcome, a score of 70 to 79 points was considered a fair outcome, and a score of <70 points was considered a poor outcome. All patients with a score of <80 points and all knees that required a revision procedure were considered to have an unsuccessful clinical outcome. Scores of ≥80 points were considered to indicate a successful clinical outcome.

The severity of anterior knee pain was evaluated preoperatively and at the time of the most recent follow-up with use of a five-tier grading system as described by Fern et al.[12]. Pain was graded as absent (grade 0), minor (grade 1), mild (grade 2), moderate (grade 3), or severe (grade 4). The degree of support needed when ascending and descending stairs was also evaluated preoperatively and at the final follow-up assessment.

Activity level was determined preoperatively and at the time of the final follow-up by determining two grades: one for distance and one for impact[13]. Distance was denoted by three grades: grade 1 indicated that the patient was housebound, grade 2 indicated that the patient was able to go shopping and to walk approximately three to five miles (4.8 to 8.0 km) per week (normal activity), and grade 3 indicated that the patient was able to walk one mile or more (≥1.6 km) per day (high activity). Impact was also denoted by three grades: grade 1 indicated that the patient was housebound or was able to take short walks; grade 2 indicated that the patient was able to participate in low-level activities such as golf, long walks, and occasional biking; and grade 3 indicated that the patient was able

to participate in high-level activities such as running, tennis, and aerobics.

Radiographic Analysis

Each patient was evaluated preoperatively, postoperatively, and at the time of the final follow-up with full-length standing anteroposterior, standard lateral, and Merchant radiographs as well as with anteroposterior and lateral fluoroscopic views.

Axial alignment was measured on full-length standing anteroposterior radiographs[10,14,15]. Preoperative alignment was measured on the most recent radiograph that had been made before the operation. Postoperative alignment usually was measured on the radiograph that was made at six weeks after the operation. Alignment of the knee was described in terms of the tibiofemoral angle. The axis of the femoral shaft was defined as a line drawn between the center of the proximal part of the femoral shaft and the center of the knee. The mechanical axis of the leg was defined as the line between the center of the knee and the center of the ankle. The tibiofemoral angle was defined as the angle formed at the knee by the intersection of the axis of the femoral shaft and the mechanical axis of the leg. Any deviation of the line from neutral was considered a varus or valgus deformity. Zonal analysis of all components was used to evaluate progressive radiolucent lines and bead-shedding (in patients with cementless prostheses).

Merchant radiographs were made with the knee flexed 45° and the x-ray beam projected in a caudad direction at an angle of 30° from the plane of the femur. Lateral radiographs were made with the knee in 30° of flexion.

On Merchant radiographs, the patella was considered to be in the normal position if it was in the center of the trochlear groove. If the patella was overriding the condyle, it was considered to be subluxed. Dislocation was defined as complete displacement from the groove. Asymmetric resurfacing of the patella was defined as a discrepancy of >2 mm of thickness between the medial and lateral facets of the patella. Patellar tilt was considered to be absent if there was symmetrical patellar contact and present if there was a lack of contact on one side of the patella and the trochlear groove of the femur. If patellar tilt was present, the degree of tilt was measured on Merchant radiographs with use of the trochlear portion of the femoral component as a guide[16,17].

The preoperative and postoperative positions of the patella were evaluated. Changes in patellar height (the perpendicular distance from the inferior margin of the tibial articular surface), changes in patellar tendon length, and the distance from the distal pole of the patella to the distal part of the tibial tubercle were measured. Changes in patellar thickness were not evaluated because the relatively radiolucent patellar component was difficult to visualize, making postoperative radiographic measurements unreliable for this assessment.

The cement-bone interface (or the metal-bone interface in patients with cementless fixation) around the patellar component was examined for the presence of radiolucencies.

The data were analyzed with the assistance of a clinical biostatistician. Preoperative and postoperative Knee Society scores and activity levels were compared with use of the Wilcoxon signed-rank test. Comparisons of other preoperative and postoperative variables (degree of arthrosis, patellar height, patellar displacement, and patellar tendon length) were performed with use of the Student t test, with the level of significance set at $p < 0.05$.

Results

At a mean duration of follow-up of eighty-one months (range, forty-eight to 133 months), there were twenty-eight excellent results, one good result, and one poor clinical result. The mean Knee Society objective score was 93 points (range, 67 to 100 points), which was an improvement from the mean preoperative score of 50 points (range, 20 to 64 points) ($p < 0.0001$). The Knee Society total function score improved from a mean of 49 points (range, 20 to 80 points) preoperatively to a mean of 86 points (range, 60 to 100 points) at the time of the final follow-up ($p < 0.001$). The mean range of flexion improved from 102° (range, 65° to 125°) preoperatively to 118° (range, 91° to 128°) at the time of the final follow-up.

Twenty-five patients (twenty-eight knees) did not report pain during normal walking. Except for the patient with a poor result, no patient complained of weakness, instability, or night pain. The patient with a poor result had a rupture of the patellar tendon postoperatively after a fall, which necessitated a tendon reconstruction. At 102 months follow-up, she had minimum pain in the knee and had an extension lag of 25°. There were no clinical findings of patellar subluxation or dislocation. No patient reported anterior knee pain that was sufficient to require any treatment other than analgesics on an occasional basis. Only two patients (two knees) reported anterior discomfort at times.

Twenty-two patients (81%) (twenty-four knees) could ascend and descend stairs without support, three patients (four knees) used assistive devices for stability while descending stairs, and two patients (two knees) required support for both ascending and descending stairs.

The mean distance grade improved from 1.2 preoperatively to 2.1 at the time of the most recent follow-up ($p < 0.05$). At the time of follow-up, two patients had a distance grade of 1, twenty-one patients had a grade of 2, and four patients had a grade of 3. The mean impact grade improved from 1.1 preoperatively to 1.5 at the time of the most recent follow-up. At the time of follow-up, seventeen patients (nineteen knees) had an impact grade of 1, eight patients (eight knees) had a grade of 2, and two patients (three knees) had a grade of 3 ($p > 0.05$).

The twelve knees that required a lateral release all had an excellent Knee Society objective score (>90 points). These twelve knees did not differ significantly from the remaining knees in terms of postoperative lateral patellar tilt (mean, 3.8° for this subgroup compared with 3.7° for the entire group) or patellar displacement (observed in two of the twelve knees in this subgroup compared with four of the thirty knees in the entire group) ($p > 0.05$).

The four knees with the most severe patellar erosion all required a lateral release during surgery, although they all had

an excellent clinical result (mean Knee Society objective score, 96 points; range, 91 to 100 points).

Radiographic Results

Radiographs of the patellofemoral articulation revealed no instances of dislocation. Preoperatively, two knees had a medial patellar tilt (mean, 3.2°) and twenty-two knees had a lateral patellar tilt (mean, 4.0°). Postoperatively, one knee had a medial tilt of 4° and eight knees had a lateral tilt (mean, 3.7°). There was a decrease in lateral patellar displacement postoperatively; twenty-six patellae were laterally displaced preoperatively (mean displacement, 5.5 mm; range, 0.5 to 9 mm), whereas only four were laterally displaced postoperatively (mean displacement, 2.1 mm; range, 0.5 to 4 mm) ($p < 0.05$).

Compared with the preoperative radiographs, the mean postoperative change in patellar height was −3 mm (range, 2 to −4 mm) ($p > 0.05$). The mean change in patellar tendon length was −1.5 mm (range, 3 to −4 mm) ($p > 0.05$).

On the basis of the numbers available, there was no significant relationship between the preoperative degree of arthrosis, subluxation, or patellar tilt and the postoperative clinical outcomes (Knee Society scores and anterior knee pain) or the postoperative radiographic indices (medial tilt, patellar displacement, patellar height, and patellar tendon length) ($p > 0.05$ for all comparisons).

Nonprogressive patellar radiolucent lines measuring <2 mm in width were found on the Merchant radiographs of two knees (7%). No progressive lines or radiolucencies measuring >2 mm in width were found in any knee.

No progressive radiolucent lines or changes in position or alignment were noted around any of the tibial or femoral components. At the time of the final follow-up, femoral anteroposterior alignment averaged 98.2° (range, 95° to 102°; goal, 99°). In only one patient did the alignment vary from the goal by ±3°. The lateral femoral angle averaged 0.44° (goal, 0°), with all measurements being within ±3° of the goal. The anteroposterior tibial angle averaged 88° (goal, 87°), with only one patient having an angle that varied from the goal by ±3°. The lateral tibial angle averaged 88° (goal, 89°), with all measurements being within ±3° of the goal.

Discussion

Multiple procedures are aimed at preserving the patellofemoral articulation in young patients with patellofemoral arthrosis. Various soft-tissue and osseous realignment procedures have been advocated, depending on the underlying deformity or pathology[2,3,5]. Isolated patellar resurfacing has been associated with almost universally poor results when used for the treatment of severe patellofemoral arthrosis[18-20]. Because of these poor results, some authors have advocated patellectomy[1,5]. Patellectomy is usually utilized in younger patients, with the patients in most studies having a mean age in the early forties. We agree that knee arthroplasty should be avoided in young patients. In the present study of older patients, attempts to save the knee joint were not made because of the severe patellofemoral joint degeneration (mean Ahlbäck score, 4.83 of 5 points).

Laskin and van Steijn[4] recently reported on forty-two patients who were managed with total knee replacement for the treatment of primary patellofemoral arthritis. After a mean duration of follow-up of 4.2 years, these patients had superior knee scores (mean, 96 points) than did a matched group of patients with tricompartmental arthritis (mean, 88 points). The authors concluded that the results of total knee replacement in the patellofemoral disease subgroup were as good as or superior to those in the group of patients with tricompartmental arthritis. The results of that study are in agreement with those of present study, in which an excellent or good clinical result was obtained in twenty-nine (97%) of thirty knees.

The majority (twenty-one) of the thirty knees in the present study received prostheses aimed at improving the kinematics of the patellofemoral articulation. The Duracon prosthesis has a trochlear flange on the femoral component that is designed to improve patellofemoral tracking[10]. Likewise, the Insall-Burstein II prosthesis was also an improvement over the first version and was designed to aid patellar tracking and to avoid the patellar clunk syndrome[15].

In summary, patients more than fifty-five years of age with primarily patellofemoral joint disease can be treated successfully with a total knee arthroplasty. Proximal and distal soft-tissue realignment procedures and other osseous procedures such as patellectomy can be avoided.

Appendix

The medial, lateral, and patellofemoral compartments were evaluated separately and were assigned a score on the basis of the various Ahlbäck[8] parameters as follows.

The scores for the medial and lateral compartments were determined on the basis of the presence of joint-space narrowing (1 point) or obliteration (2 points), tibial and/or femoral sclerosis (0.5 point each), osteophytes measuring <1 cm (0.5 point) or >1 cm (1 point), and joint subluxation (1 point), for a maximum total of 5 points. The score for the patellofemoral compartment was determined on the basis of the presence of narrowing (1 point) or obliteration (2 points), osteophytes measuring <1 cm (0.5 point) or >1 cm (1 point), translation of the patella (1 point), and attrition (1 point), also for a maximum total of 5 points.

The Ahlbäck scale was then modified by assigning the highest score of the three compartments to be the determinant of the arthritic severity grade. Knees with a score of ≤2 points in all three compartments were classified as having "mild radiographic arthritis." Knees with a score of >2 and <4 points in at least one compartment were graded as having "moderate radiographic arthritis." Knees with a score of ≥4 points in at least one compartment were graded as having "severe radiographic arthritis." ■

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In support of their research or preparation of this manuscript, one or more of the authors received grants or outside funding from Stryker-Howmedica-Osteonics. In addition, one or more of the authors received payments or other benefits or a commitment or agreement to provide such benefits from a commercial entity (Stryker-Howmedica-Osteonics). No commercial entity paid or directed, or agreed to pay or direct, any benefits to any research fund, foundation, educational institution, or other charitable or nonprofit organization with which the authors are affiliated or associated.

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