Meniscal Bearing Uncemented Total Knee Arthroplasty

Early Clinical Results at a Minimum 2-Year Review

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Abstract: A prospective study of early clinical and radiologic outcome of the Motus (Osteo, Selzach, Switzerland) meniscal bearing total knee arthroplasty was performed. We reviewed the first 75 consecutive prostheses in 62 patients, implanted over a 4-year period. The mean follow-up was 2.5 years. Average preoperative knee score was 97 out of 200 (Knee Society score, 43; functional score, 54) and at 2-year review was 179 out of 200 (Knee Society score, 87; functional score, 92). Average postoperative flexion at 2 years was 113°. No meniscal bearing subluxation, dislocation, or breakages occurred. Radiologically, there was no evidence of subsidence or osteolysis. Our results support the continued use of this meniscal bearing knee prosthesis. It is important to confirm, however, an equal flexion and extension gap without proximal joint line migration. **Key words:** meniscal bearing, uncemented, total knee arthroplasty (TKA).

The potential benefits of the meniscal bearing total knee prosthesis are good mobility, low contact stresses, and low shear stresses on the components, reducing polyethylene wear and implant failure [1–5]. Meniscal bearing prostheses are not suitable for all patients requiring total knee arthroplasty (TKA), however. This article discusses the rationale for intraoperative patient selection based on equal flexion-extension gaps and reports the early clinical and radiologic results of the Motus (Osteo, Selzach, Switzerland) meniscal bearing (sliding) prosthesis.

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Materials and Methods

A prospective study of clinical outcome of patients with the Motus meniscal bearing (sliding) uncemented TKA was conducted. The prosthesis was introduced in 1995, and a single surgeon (M.J.C.) performed all operations. Patient selection was done intraoperatively. Only patients with equal flexion-extension gaps after femoral and tibial resection were selected for implantation of the sliding meniscal prosthesis. Patients were placed on continuous passive motion machines postoperatively and were allowed to bear full weight immediately. All patients with a minimum 24-month follow-up were included. During the same period, 652 fixed bearing TKAs of a similar design were inserted.

Patients were assessed clinically and radiologically at 3, 6, 12, and 24 months postoperatively and annually thereafter. At each review, evaluation was done using a clinical knee score based on the Knee Society Score and the Hospital for Special Surgery

Table 1. Clinical Outcome

	Mean Knee Society Score	Mean Flexion (°)	Mean Knee Society Clinical Score†	Mean Functional Score†
Preoperative	97 (49–150)*	116 (60–140)*	43	54
2 years	179 (100–200)*	113 (90–135)*	86	93

*Values in parentheses indicate range.
†Clinical and functional scores have a maximum score of 100.

score. The clinical score and functional score have a maximum of 100 points and produce a total score of 200 [6]. Statistical analysis was done with SPSS software (version 10.0; SPSS Inc, Chicago, IL) using a 2-tailed Student *t*-test with the level of significance set at $P = .05$.

Prosthesis

The Motus meniscal bearing TKA is a posterior cruciate–retaining uncemented modular prosthesis. Sintered beads covered in hydroxyapatite coat the undersurface of the distal femur and the tibial plate. The femoral component (cobalt-chromium-molybdenum) is an anatomic shape and sized to reproduce the natural condylar dimensions and to minimize bone resection. The trochlea groove is chamfered into the femur to reproduce the line and depth of patellar tracking; this aids knee flexion and reduces the need for lateral release. The tibial component (cobalt-chromium-molybdenum) has a polished upper surface and 4 serrated pegs on the base to aid fixation. It is designed to achieve maximal cortical coverage. The polyethylene meniscal insert has a smooth undersurface for unconstrained movement over the tibial plate and a congruent femoral articulating surface.

Results

Over a 4-year period from 1995 through 1998, 75 prostheses were implanted in 62 patients. Mean follow-up was 2.5 years (range, 2 to 4 years). There were 16 women and 46 men with an average age of 66.8 years. There were13 bilateral and 49 unilateral TKAs; 43 were in right knees, and 32 were in left knees. Average tourniquet time was 45 minutes. Patella replacements were done in 19 patients in whom there was evidence of patella disease at operation. Most patients (71) had osteoarthritis. Of the remainder, 1 patient had psoriatic arthropathy, 1 had chondrocalcinosis, 1 had Ollier's disease, and the 1 had a postseptic arthritis. Five patients previously had had a high tibial osteotomy.

The average preoperative knee score was 97. Postoperatively the average knee score rose to 168 by 3 months and 179 by 2 years (Table 1). The average preoperative flexion was 116°. Postoperatively the average flexion was 106° at 3 months and 113° at 2 years (Figs. 1 and 2). Radiologic assessment revealed no component subsidence or osteolysis. There were no meniscal bearing dislocations, subluxations, or breakages.

To date, no patients have required revision surgery. One patient did require, however, a patella replacement for persistent anterior pain, which subsequently resolved. Two patients had significant arthrofibrosis flexing to 70°. Only 1 patient underwent arthrolysis and subsequently flexed to 95°, with the other patient flexing to 90° by 6 months. There was no posterior capsular impingement in

Fig. 1. Anteroposterior radiographs of the Motus meniscal bearing prosthesis *in situ*.

Fig. 2. Lateral radiograph shows flexion and rollback.

either of the cases. Other complications included 2 nonfatal pulmonary emboli, 2 deep venous thrombi, 2 superficial infections, and 2 hematomas.

A 2-tailed paired Student *t*-test comparing preoperative scores and 2-year postoperative scores revealed statistical significance ($P < .001$). The mean preoperative knee score was 97 (95% confidence interval 87 to 101). This improved significantly to a mean knee score at 2 years of 179 (95% confidence interval 172 to 187; $P < .001$). Comparison between preoperative and 2-year flexion did not show statistical significance ($P = .150$).

Discussion

The perceived advantage of congruent, meniscal bearing TKAs is the potential for reduced polyethylene wear, while allowing unrestrained tibiofemoral movement [4,7,8]. Meniscal bearing TKAs have reduced upper and lower surface stresses significantly compared with fixed bearing components [9]. The mean rate of polyethylene penetration of congruent meniscal bearings is less than that of fixed bearings and has been estimated *in vitro* to be 0.05 [10] to 0.01 mm [4] per year.

In addition, by allowing completely unconstrained motion of the mobile bearing (compared with central peg systems and systems in which the bearings are constrained by tracks), high shear stresses in the polyethylene and at the bone–component interface are avoided. Knees undergoing TKA are diseased, and the individual kinematics are impossible to forecast. As a result, we believe it is essential that the mobile bearing be allowed to find its own place and range of motion to suit the knee in which it has been implanted; that is, the bearing should be *self-centering*.

When using a meniscal bearing surface, it is essential to have equal flexion-extension gaps [11]. An equal flexion-extension gap maintains contact pressure on the bearing, helps maintain congruence, and avoids problems of subluxation and dislocation. To equalize the flexion-extension gap, the first cut in a TKA should be the anterior femoral cut to correct femoral rotation. The distal femoral resection should follow and is determined by the thickness of the femoral prosthesis to maintain the normal joint line. The posterior femoral resection is determined by the size of the femoral component selected, ideally to equal the distal resection. Femoral condyle profiles differ in anteroposterior height and radii of curvature. The posterior cuts cannot be equal in all cases. The flexion space also may vary medially and laterally.

The alternative, to move the joint line to ensure a relatively equal flexion-extension space, creates further problems. The extensor mechanism in particular may be compromised. Also, this enforced equality only applies at 0° and 90° without reference to greater or intervening flexion angles.

It has been suggested that in bicompartmental TKA, the movements of the meniscal bearing should be limited to the anteroposterior direction and that freely mobile bearings should not be used in the absence of a functioning anterior cruciate ligament [12]. This has not proved to be a problem with this sliding meniscus prosthesis, which sacrifices the anterior cruciate ligament and allows totally unconstrained meniscal movement.

The results of this series are comparable to outcomes achieved by other meniscal bearing prostheses [5,10,11,13]. The pain relief and restoration of function as assessed clinically and by the improvement in knee score are gratifying. A mean postoperative flexion of 113° compares favorably with other reports [13,14]. Further long-term follow-up still is required, however, to maintain the efficacy of this sliding meniscus prosthesis.

The early clinical and radiologic outcome achieved using the Motus meniscal bearing (sliding) TKA justifies its continued use. Appropriate intraoperative patient selection is crucial, however. Only patients in whom there are equal flexion-extension gaps present after completion of the femoral and tibial resections should be considered for implantation of a mobile bearing prosthesis.

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