TOTAL KNEE ARTHROPLASTY WITH A MOBILE TIBIAL BEARING. MEDIUM-TERM FOLLOW-UP RESULTS

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ABSTRACT

Objective: Evaluation of mid-term follow up results of the application of a total knee replacement with a mobile tibial bearing design. Methods: Ninety six patients (107 knees) were submitted to total knee Arthroplasty, performed with a model of prosthesis with rotating mobility in the tibial component. The patients were evaluated after a mean follow-up of 52.7 months – standard deviation 21.94 (minimum 24 months and maximum 120 months) through the Knee Society Clinical Rating System (KSCRS), with a mean outcome of 78.22 points. Results: The complications that occurred immediately after or during the surgery included: one wound dehiscence with spontaneous healing, two patellar fractures, one fracture of the medial condyle of the femur, three peroneal nerve impairments, and one sympathetic reflex nervous distrophy. Subsequent complications were: one patellar fracture, one distal fracture of the femur, four aseptic loosenings and four deep joint infections, which required arthroplastic revisions. Conclusion: With the exception of the cases requiring arthroplastic revision due to septic or aseptic loosening, the authors conclude that the clinical and functional results obtained with Total Knee Replacement with a mobile bearing component, in a mid-term follow-up, were good.

Keywords: Knee arthroplasty, knee replacement. Knee prosthesis. Treatment outcome. Outcome assessment (health care). Postoperative complications.

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INTRODUCTION

Knee prostheses should offer high durability, if possible above 20 years, avoiding their loosening or excessive wear of the polyethylene, by means of a design that respects details of the anatomy, the kinematics and the joint physiology. This condition will enable the expansion of their indications, including younger patients, particularly if the risk of premature failure and all the adversities that may arise in arthroplasty reviews are decreased.[1]

The concept of knee arthroplasties with mobile tibial bearing was introduced in 1978 by Goodfellow and O'Connor[2]. This innovation was based on the need for adaptation of the prosthesis components to the different situations during flexion-extension movements.[3]

Some authors advocate that total knee replacements with rotating bearing have the advantage of standardizing the contact pressures among components, thus reducing the formation of polyethylene particles and, consequently, osteolysis, besides promoting better adaptation of the extensor mechanism to possible imperfections in the rotational positioning of the tibial component.[4] Tibial component fixation in inadequate rotation increases incongruity, causing an increase in the patellofemoral contact pressure due to poor alignment; if the polyethylene component is mobile it will adapt to the condyles, promoting automatic rotation of the tibia, imitating the movements of the normal knee.[5,6]

Several studies have exhibited good results on the long terms with the use of these implants, both those that use two isolated tibial components connected to the metallic base (meniscal prostheses) and those of a single mobile plastic component.[7-10] However, some authors indicate the need for studies with a long follow-up, proving clinical advantages and survival, in comparison to implants with fixed tibial bearing.[11,12] Another factor is the possibility of platform displacement, a complication that frequently requires review arthroplasty.[10,12,13]

The analysis of the results of international studies showing the durability and good function of mobile bearing total knee replacements stimulated their use in our field.

All the authors declare that there is no potential conflict of interest referring to this article.

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The aim of this article is to present the medium-term results of total knee replacements with mobile tibial bearing in patients from the Knee Surgery Group of the Department of Orthopedics and Traumatology of Santa Casa de Sao Paulo, Brazil.

CASUISTRY

Between January 2000 and July 2007, 162 patients underwent total knee arthroplasties using implants with all-polyethylene tibial component with rotating movements. Of these 96 responded to the summons, and 11 had bilateral prostheses, totaling 107 knees. There were 14 men and 82 women, with age ranging between 44 and 85 years (mean age 73.2 years). The mean follow-up time was 4 years and 4 months, ranging between 2 and 10 years.

METHODS

After an analysis of the semiological data obtained and of panoramic frontal with load, lateral and axial radiographs for patellofemoral joint, and following the diagnosis of osteoarthrosis, the patients were submitted to a preoperative evaluation to perform the procedure with minimum risks. Diaphyseal deformities that would not allow correction by arthroplasty, major bone loss due to osteolysis, ligament laxity that would require implants with stabilizer mechanisms (non-existent in the model to be used), and osteoarticular infections were considered exclusion factors.

CHARACTERISTICS OF THE IMPLANTS

All the cases were operated with implants coming from the same manufacturer. The tibial metallic component has a smooth upper surface and a central axis in which an orifice is fitted in the lower part of the polyethylene, inside the post that substitutes the resected posterior cruciate ligament. This set permits rotating movements of the polyethylene, which is congruent to the curvatures of the femoral implant in the sagittal and coronal planes and accompanies it during flexion-extension, enabling physiological rotating adjustments. The femoral component presents a central slot to receive the posterior polyethylene stabilizer post, and the patella has cupuliform shape being slotted into a recess, with a central pin. (Figures 1 and 2)

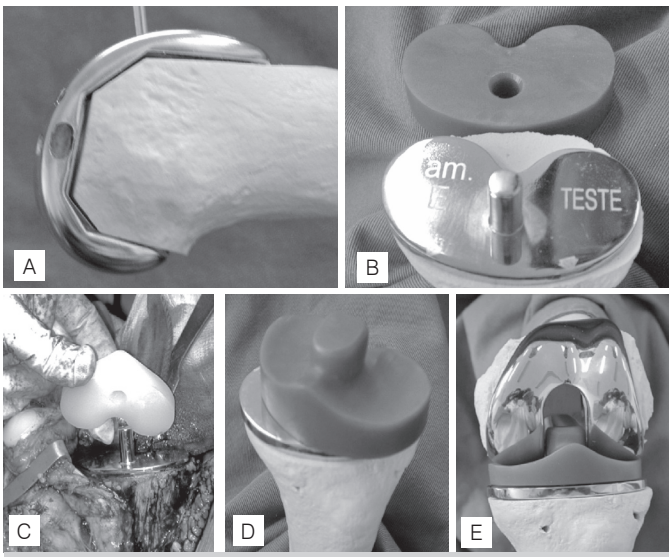

Figure 1 – *A) Profile of the femoral implant; B) metallic base of the mobile tibial component and central axis for rotation; C) polyethylene groove orifice; D) free rotating movement, which will be limited by the peripheral structures; E) congruence among the components of the tibiofemoral joint.*

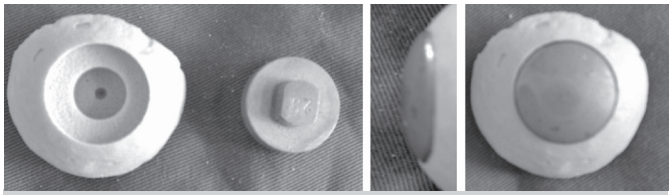

Figure 2 – *The cupuliform patellar implant, fitted into a milled circular recess, with a depth of 5mm, with a groove at the center for a 5mm deep fixation pin.*

TECHNIQUE USED

The operations were performed through the medial parapatellar approach (transquadricipital) following the use of cutting guides, gauges, correction of capsuloligamentary tension, tests and permanent fixation of the implants with polymethylmethacrylate (PMMA). An aspiration drain tube was left for a period of 24 to 48hrs, finishing with suturing by plans of the incised structures and use of inguino-malleolar compression wrap. (Figure 3)

All the patients received 2g of intravenous cefazolin 30 minutes before anesthetic induction as prophylaxis, continuing with 1g every 8/8hrs until the third postoperative day. Functional recovery started on the second postoperative day with passive movement, active movement on the second and walking with full load and use of a walking frame on the third postoperative day. This was followed by dressings and removal of stitches on the 14th day, continuing onto gait without the help of crutches or a walking frame.

The patients were examined and x-rayed for evaluation according to the objective criteria established by the Knee Society Clinical Rating System (KSCRS).[14] In this system, the final score varies between 0 and 100. A score above 84 is considered an excellent result, between 70 and 84 good, between 60 and 69 fair and below 60, poor.

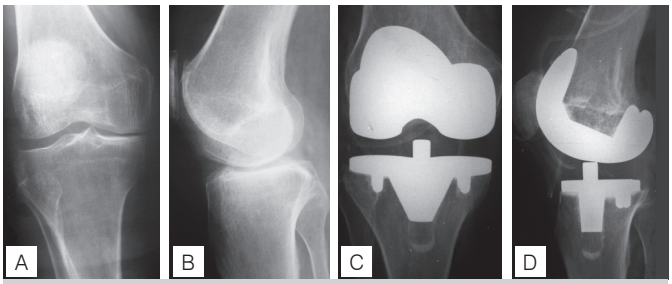

Figure 3 – *69-year-old female patient, bilateral primary arthrosis with predominant pain on the right. Immediate postoperative radiographies, showing the fitting post of the mobile tibial polyethylene.*

The data obtained were submitted to statistical evaluation, with the chi-squared test applied for quantitative variables and Fisher's exact test for multiple variables, with use of the "EPI Info" program (www.cdc.gov), following the guidelines of the statistics of the Núcleo de Apoio a Publicações da Faculdade de Ciências Médicas da Santa Casa de São Paulo (Center for Support to Publications of the Faculty of Medical Sciences).

RESULTS

Of the 162 patients, 96 responded to the call, of which 11 were operated bilaterally. With a mean follow-up period of 4 years and 4 months, 107 knees were evaluated.

The arthroplasties that required revision received a score of "zero". In the other cases the final count was the sum of the scores collected in the objective and subjective evaluations and the deductions of points due to the presence of load axis misalignment, flexion contracture and extension deficit. The minimum postoperative score was zero and the maximum score was 100, with a mean score of 78.22 points.

In the medical record data we collected eight knees with transoperative or immediate postoperative (up to 2 months later) complications. There were nine with late-onset complications, occurring from the third postoperative month onwards. (Table 1)

The relationship between the occurrence of complications and the performance of unilateral or bilateral (never simultaneous) arthroplasty was evaluated. There was no statistically significant difference in the incidence of complications (Fisher's exact test, p=0.45). There was no statistically significant difference between the sexes either, in relation to the incidence of complications (Fisher's exact test, p=0.61).

The etiology of the patients' arthrosis is presented in Table 2.

In evaluating the occurrence of complications in the patients with secondary arthrosis, a 50% higher risk was verified in these patients in comparison with those with primary arthrosis (RR 1.497 - Confidence Interval of 95%), with p=0.022 (Fisher's exact test), as demonstrated by Table 3.

Table 1 – *Complications N=107.*

Trans-operative and immediate complications	Incidence	Score (KSRS)
Patellar fracture	2 (1.8%)	95.83
Femoral condylar fracture	1 (0.9%)	0
Fibular neuropraxia	3 (2.7%)	93. 64. 91
Reflex nervous dystrophy	1 (0.9%)	45
Dehiscence of cutaneous suture	1 (0.9%)	95
Late complications		
Patellar fracture	1 (0.9%)	68
Aseptic loosening	4 (3.6%)	0
Infection	4 (3.6%)	0

Table 2 – *Etiology of osteoarthrosis.*

Etiology	knees
Primary	95
Secondary	
osteonecrosis	5
fracture	5
pyoarthritis	1
Reumathoid Arthritis	1
Total	107

The patients were split into two age groups, for evaluation of fracture occurrence. In the first group patients under 60 years of age at the time of surgery, and in the second, those 60 years of age or over. No statistical difference was found in the incidence of fractures between the groups, p=0.22 (Fisher's exact test). Neither was there any statistical difference in these two groups when compared in relation to the results, Mann-Whitney test p=0.85. The results were equivalent when compared between male and female sex (Mann-Whitney's test p=0.71).

Table 3 – *Relation between the etiology of arthrosis and the occurrence of complications*

Etiology	knees	complications	%
primary	95	12	13
secondary	12	5	42
Total	107	17	16

DISCUSSION

Total knee arthroplasty started to be used on a large scale from the 60s and, since then, has been undergoing refinements to offer a functional and durable knee, broadcast through a considerable number of reports, both international and from our field.

Mobile bearing replacements appeared in 1979 through Goodfellow and O'Connor[2] (Oxford unicompartmental replacements). Right from the start, people defended the concept that the mobile tibial component, solidary to the femoral condyle, allowed a congruent prosthesis without flexion-extension restrictions, with high durability, movements similar to the normal knee, respecting the kinematics, and having its indication extended to younger patients.[1,3,4,7-9,15,16]

Its use progressively increased, and as of the year 2000, we began to adopt the present model, with the objective of eliminating pain (the main complaint of patients) and conserving the results obtained with the previous models, to allow physiologic rotating movements, producing a joint functionally compatible with daily life activities.

The anatomical configuration of the femoral condyles, which are different from each other, and the concave shape of the medial tibial condyle and convex shape of the lateral condyle, are underlying factors of the rotating movements that occur in the knee, with greater displacement in the lateral compartment and fixity in the medial compartment. This is proved by the greater mobility of the lateral meniscus that, during flexion-extension, shifts in anterior posterior direction, accompanying the lateral femoral condyle, while the medial meniscus accompanies the tibia. The sliding and rolling phases of the condyles during flexion-extension, the mediation of the cruciate and collateral ligaments and condylar asymmetry provoke the adaptive rotating movements, with the observation, in the last degrees of extension, of the event denominated screw home mechanism, which stresses the static stabilizers by lateral rotation of the tibia under the femur, creating a stable knee in any plane. This knowledge of anatomy and physiology stimulated the creation of the so-called meniscal replacements, and, finally those with tibial platform with a rotating polyethylene base.[4]

The reduction in the femorotibial contact pressures and consequent decrease in the formation of polyethylene debris in the total knee replacements with rotating bearing was well demonstrated through an in vitro biomechanical test.[16] An in vivo videofluoroscopic study followed by three-dimensional reconstruction of the images obtained, comparing fixed and mobile base total knee replacements, with the same origin and design, demonstrated that the femorotibial contact surface is twice as large in knee replacements with rotating bearing than in those with fixed bearing.[5] In this study it was noticed that the good results were similar in both models, but, both objectively and subjectively, the mobile bearing was considered the closest to the normal knee.

The rotational alignment in which the implants will be fixed, to obtain a space in symmetrical flexion and centralization of the extensor apparatus, is facilitated when the tibial bearing is mobile.[17,18]
The high durability of mobile tibial bearing total replacements is well evidenced in the literature consulted, reaching over 20 years of survival in 97.7% of cases.[7,9,15,19,20]
In spite of these publications, other authors do not see advantages of one model over the other, as they found similar results in terms of patient satisfaction and durability of the implant. There was an analysis of the results of simultaneous bilateral arthroplasties in which a fixed bearing prosthesis was implanted in one knee and a rotating bearing prosthesis in the other, with no significant differences having been found between the two implants after a mean follow-up of 6 years.[1,11,13,21]
As regards the casuistry, of the 162 arthroplasties, only 96 patients (107 knees) responded to our call. The non-response to calls for revaluations also occurred in the literature consulted,[22] and may be caused by variable factors; besides difficulties in access due to changes of address, death or socioeconomic obstacles, we can assume that the absence may be due to disregard, in view of good results, whereas a return visit to the Service was not considered important. We can also assume that this behavior may be the cause of our recording a higher number of complications in the group evaluated, 96 (59.3%) of the 162 patients operated.
Immediate or trans-operative (up to 30 days after surgery) complications were rare and did not compromise the final evaluation of the group; such a result was similar to that obtained in a study comprised of 141 cases treated with a mobile bearing replacement, with statistics similar to that presented, with a follow-up of 5.6 years, 4 infections, 3 patellar fractures, 1 femoral supracondylar fracture, and 94% of good results.[23]
Two fractures (1 of the patella and 1 of the femoral condyle) occurred during the execution of the incisions. The patellar fracture was marginal, occurring after the cementation of the patellar implant. The medial condylar fracture was temporarily fixed with Steinmann wires until cementation. There were no functional sequelae in the two cases, yet the patient with femoral condylar fracture was submitted to a review due to late aseptic loosening. The other patellar fracture, which was comminuted, occurred thirty days after surgery, due to direct trauma, with the performance of total resection, obtaining a good result (KSCRS 83).
The patellar and medial condylar fractures called for a delay in the start of walking, but presented good evolution, without anatomo-functional changes. Such fractures can be caused by motorized cutting instruments, spacers, or intramedullary guides, and, if protected until consolidation, do not influence the outcome.[24]
Except for the marginal patellar fracture when milling was executed, the others occurred after fall and direct trauma to the knee. The first case was a comminuted fracture described previously. The second patient suffered a late transversal fracture, without deviation, which received non-surgical treatment; however, after six months without signs of consolidation, this patient underwent removal of the implant and partial patelectomy, obtaining functional recovery without pain (KSCRS 68). The radiological aspect evidenced an osteolysis, mentioned as being one of the most frequent causes of patellar fractures after arthroplasties.[25]
The implantation of patellar prostheses fitted into circular recesses can weaken the remaining bone and create conditions for more frequent than those with fixation assisted by groove orifices for the pins existing in the implant[26]; this data can explain the occurrence of the fractures described.
One of the controversies still present these days is the need for covering of the patellar surface or not, with authors concluding that there are no differences in the two groups.[27] One hundred knees had the patellar surface replaced; in the remaining seven, the patellar thickness was deemed insufficient (smaller than 20 mm) whereas joint replacement was not performed without deterioration in the functional result or local pain.
Paralysis of the fibular nerve are more frequent in knees with valgus deviation, as upon correction of the axis, by section of capsular, tendon and ligament structures, the nerve can be under tension and neuropraxia may appear.[28] Three fibular nerve lesions were detected, two of which presented valgus deformity. The treatment was conservative in two of them; neurolysis was performed on the third case in the second postoperative month and there was total recovery in all of them.
One patient exhibited intense pain since the first postoperative days, without clinical and laboratorial signs of infection. The clinical and radiological evolution suggested reflex sympathetic dystrophy, having been treated by the team specialized in pain, with partial improvement after the 4th postoperative month and a KSCRS score of 45, which is a poor result.
Dehiscence of suture of the skin and subcutaneous tissue over the patella occurred soon after the removal of the stiches, without areas of necrosis or infection; the patient was hospitalized for treatment with dressings, and healing occurred by second intention.
Eight revision arthroplasties were performed up to the time of reevaluation, with 4 due to aseptic loosening and 4 to deep infection.
Three of the cases of aseptic loosening were diagnosed at 30 months, 56 months and 60 months. The cause of the arthrosis that led to the arthroplasty was primary in the first case, due to osteonecrosis and sequela of tibial plateau fracture, in the other two cases. They were submitted to review operations, with satisfactory evolution. The other case of loosening, described previously, presented trans-operative femoral condyle fracture, and was successfully submitted to review.
Among the factors that lead to aseptic loosening, special emphasis is placed on inadequate positioning of the tibial or femoral component in the sagittal plane, in an inexact lateral rotation that provokes lateralization of the extensor apparatus, angular deviations that favor the formation of polyethylene debris[26,28]: or asymmetries in the articular space in flexion, causing abnormal laxity and tensions in the compartment in which the space is more narrow and the polyethylene with thickness compatible with the slacker side.[29] In an abnormal situation such as the one described, if bone resection is minimal, there will be exacerbation of the situation, due to attempts to use implants of reduced thickness, which are subject to earlier wear and tear, whereas the minimum thickness compatible with a good durability is 8 mm.[30] There were four cases of aseptic loosening. In none of these patients was there any poor alignment of the axis in the postoperative period that could have accelerated the loosening process; this phenomenon is probably caused by the formation of polyethylene debris. They were submitted to review operations and evolved satisfactorily.
Another factor that may cause an increase in pressures is the presence of an intact and retracted posterior cruciate ligament, particularly in cases in which the knee presents a limitation of its extension of 20^{o} or more. Total knee replacements with mobile tibial bearing have been performed with preservation or substitution of the posterior cruciate ligament with similar results.[31] In all our

cases there was substitution of the posterior cruciate ligament, with the objective of avoiding asymmetries in tension and the possibility of a rotating luxation of the mobile platform.[12]

One disadvantage of total knee replacements with mobile tibial bearing is the possibility of luxation of the rotating component (spin out), having been reported more frequently (3.2%) in prostheses with two independent mobile tibial bearings, that is, in the so-called meniscal total knee replacements, and more rarely in single platforms (0.7%), when the posterior cruciate ligament is preserved and the tension of the soft parts is irregular, with one side slack in relation to the other.[4,10,12,13,32] In order to avoid this complication it is essential to obtain equalized flexion and extension spaces through an adequate balance of soft parts. In our study such a complication never occurred. In addition to the abovementioned precautions, it is emphasized that the replacement of the posterior cruciate ligament by the central post of the polyethylene platform hinders the occurrence of spin-out".

Infections (3.6%) occurred in a late phase, and were submitted to review surgery at two times; initially, all the components were removed and a PMMA spacer impregnated in antibiotic (1 gram of vancomycin), antibiotic therapy established by the Infectology Group, was instituted until the regression of the flogistic signs and normalization of values in the blood count, erythrocyte sedimentation rate and of the protein C reactive levels. Review components were deployed afterwards. Two of them evolved in a satisfactory manner; another two presented relapse of the infectious process, with removal of the implants and execution of arthrodesis.

This percentage of cases with infection is equivalent to the mean value encountered in national literature (~3.8%), and the successful review, in only half of the cases, is much lower than the values reached at other centers.[33] We assume that these patients with infection could present immunosuppression (not investigated) as a consequence of poor alimentary conditions, inattention to personal care or systemic infectious diseases, inherent to the high age group, particularly in groups of socially unprotected elderly individuals.

The obtainment of 74 (69%) excellent and 17 (15.9%) good results, indicates that the implants with the mobile tibial base will continue to be used; a long-term evaluation will evidence the persistence of such results, their advantages and disadvantages compared with those of the fixed tibial platform.

CONCLUSION

On the medium term, the total knee replacement with mobile tibial bearing submitted to the Knee Society Clinical Rating System obtained good results, reaching the mean score of 78.22 points.

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