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ORIGINAL ARTICLE

Computer-navigated minimally invasive total knee arthroplasty for patients with retained implants in the femur

Sung-Yen Lin [a,b], Chung-Hwan Chen [b,c], Peng-Ju Huang [b,c], Yin-Chih Fu [b,d], Hsuan-Ti Huang [a,b,*]

[a] Department of Orthopedics, Kaohsiung Municipal Ta-Tung Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan
[b] Department of Orthopedics, School of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan
[c] Division of Orthopedics, Department of Adult Reconstructive Surgery, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan
[d] Department of Orthopedics, Kaohsiung Municipal Hsiao-Kang Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan

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Abstract Total knee arthroplasty (TKA) in patients with knee arthritis and retained implants in the ipsilateral femur is a challenge for knee surgeons. Use of a conventional intramedullary femoral cutting guide is not practical because of the obstruction of the medullary canal by implants. Previous studies have shown that computer-assisted surgery (CAS) can help restore alignment in conventional TKA for patients with knee arthritis with retained femoral implants or extra-articular deformity, without the need for implant removal or osteotomy. However, little has been published regarding outcomes with the use of navigation in minimally invasive surgery (MIS)-TKA for patients with this complex knee arthritis. MIS has been proven to provide less postoperative pain and faster recovery than conventional TKA, but MIS-TKA in patients with retained femoral implants poses a greater risk in limb malalignment. The purpose of this study is to report the outcome of CAS-MIS-TKA in patients with knee arthritis and retained femoral implants. Between April 2006 and March 2008, eight patients with knee arthritis and retained femoral implants who underwent the CAS-MIS-TKA were retrospectively reviewed. Three of the eight patients had extra-articular deformity, including two femur bones and one tibia bone, in the preoperative examination. The anteroposterior, lateral, and long-leg weight-bearing radiographs carried out at 3-month follow-up was used to determine the mechanical axis of lower limb and the position of components. The mean preoperative femorotibial angle in patients without

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* Department of Orthopedics, Kaohsiung Municipal Ta-Tung Hospital, Kaohsiung Medical University, Number 68, ZhongHua 3rd road, Cianjin district, Kaohsiung, Taiwan.
E-mail address: hthuang@kmu.edu.tw (H.-T. Huang).

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extra-articular deformity was 3.8° of varus and was corrected to 4.6° of valgus. With the use of navigation in MIS-TKA, the two patients in this study with extra-articular femoral deformity also obtained an ideal postoperative mechanical axis within 2° of normal alignment. Overall, there was a good restoration of postoperative mechanical alignment in all cases, with a mean angle of 0.4° of varus. No limb malalignment or component malposition was found. In clinical assessments, there were also significant improvements in knee specific scores, functional scores, and motion arc. The results of this study suggest that navigation can help achieve accurate alignment and proper prosthesis positioning in MIS-TKA for patients with retained femoral implants and for whom intramedullary rod guidance is impractical.

Introduction

It is not uncommon for orthopedic surgeons to encounter patients with prior femoral fractures who have developed end-stage arthritis requiring total knee arthroplasty (TKA), although the incidence of arthritis is considerably lower than that after tibial plateau fractures [1]. However, TKA is difficult to perform in patients with knee arthritis and retained implants in the ipsilateral femur because the medullary canal obstruction by implants precludes the use of conventional intramedullary (IM) instrumentation [2,3]. Implant removal is usually suggested prior to TKA, but this may increase the risk of intraoperative fracture and result in an inferior outcome [4,5]. The use of an extramedullary (EM) guide and free-hand cutting are common options in these situations, but both options are less accurate than a conventional IM guide and mostly rely on the experience of the surgeons [6,7]. Therefore, there is a need to improve and optimize the outcomes of these patients.

Computer-assisted surgery (CAS) has been used in joint replacement surgery for years and has improved radiographic accuracy in both TKA [8,9] and minimally invasive surgery TKA (MIS-TKA) [10,11]. Moreover, obviating the need for IM guiding rod, navigation (NA) system has been reported to be suitable for application in some complex arthritic knee disorders. Previous studies have shown that NA can help restore alignment in TKA for patients with knee arthritis with retained femoral implants [2,3] or extra-articular (EA) deformity [12—16], without the need for implant removal or osteotomy, but most previous studies have reported on conventional TKA. By comparison, MIS-TKA has caused less soft tissue damage, with the advantages of less postoperative pain and rapid functional recovery [17,18]. However, little has been published regarding outcomes with the use of CAS in MIS-TKA for patients with retained implants or EA deformity. Therefore, in this study, we reported the results of CAS-MIS-TKA in patients with knee arthritis and retained implants in the ipsilateral femur.

Methods

Between April 2006 and March 2008, we performed MIS-TKA in eight patients with knee arthritis and implants in the ipsilateral femur. All surgeries were performed by the senior author in this study. Because the retained implants obstructed the medullary canal and precluded the use of a conventional IM femoral cutting jig, all the knees were operated on using the minimedial parapatellar approach with the assistance of a computed tomography-free Vector Vision knee NA system (BrainLAB, Munich, Germany). Posterior stabilized prostheses (NexGen, Legacy Knee LPS-Flex, Zimmer, Warsaw, IN, USA), were used in all of the patients and all components were fixed with bone cement.

The surgical procedure was started with a 12-cm medially curved skin incision extending from the superior pole of the patella to the top of the tibial tubercle. The joint was entered through the minimedial parapatellar arthrotomy from 1 inch above the superior pole of the patella to the tibial tubercle. The patella was then displaced laterally, but not everted. We used an image-free NA system with an optical tracking unit that detected reflecting marker spheres using an infrared camera. After arthrotomy, two reference arrays with passive marker spheres were fixed to the distal femur and proximal tibia. To avoid collision of femoral implants, a smaller guide pin (2-mm Kirschner wire) was used first. The guide pin was inserted into the anterior lateral cortex of the distal femur 10 cm proximal to the tibiofemoral joint line and plunged through the posterior cortex. After confirming that the pin did not violate the implants, we changed the pin to a 4-mm bicortical anchoring screw. Another 4-mm bicortical anchoring screw was placed into the tibia 10 cm distal to the tibial plateau for mounting the referencing trackers. The rotation center of the hip joint was first determined using a pivoting procedure. Then, the registration process was started and the special bony landmarks (the most prominent points of the medial and lateral epicondyles and the anterior sulcus) and the articular surface of the femoral condylar and tibial plateau were digitized using a NA pointer. After registration was completed, the system created an adapted bone model of the specific patient's anatomy based on these data, and offered a planning proposal for component orientation. MIS Multi-Reference 4-in-1 instrumentation (Zimmer) was used for bone cutting and the femur and tibia resections were then performed in sequence with the NA cutting guides. The ligamentous balance was checked using both the manual method and NA after the trail components were inserted, and final adjustments were made to ensure soft-tissue balance. Then, the patella was resurfaced to match the thickness of the patellar components. Finally, all components of the prosthesis were cemented into place.