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Original article

Increase of patellofemoral height has decreased maximum knee flexion after total knee arthroplasty of posterior cruciate-substituting prosthesis in a clinical series

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ABSTRACT

Background: Biomechanical studies in vitro suggested that patellofemoral (PF) stuffing would cause knee flexion restriction after total knee arthroplasty (TKA). We investigated the effect of anterior PF stuffing on the postoperative knee flexion after cemented TKA of posterior cruciate-substituting (PS) design.
Methods: A retrospective review of 140 primary TKAs for osteoarthritis with an average age of 68.5 was conducted. The patella was resurfaced. The height of PF joint and the patella thickness were evaluated radiographically, preoperatively and 2-year postoperatively.
Results: The maximum flexion angle was 129.7° (standard deviation: SD 16.9) pre-operatively and 129.3° (SD 11.9) 2-year postoperatively. The increase in height was associated with the differences in maximum flexion angle between preoperatively and postoperatively ($R = 0.254$ $P < 0.01$). The patella thickness change did not show any significant influences.
Conclusion: The increase in patellofemoral volume has decreased range of motion after total knee arthroplasty of posterior cruciate-substituting prosthesis.

1. Introduction

Total knee arthroplasty (TKA) is an effective treatment for advanced osteoarthritis of the knee. Patients' satisfaction after TKA is influenced by multiple factors [1]. Some studies suggested that function after a TKA correlates with patient's satisfaction [2]. Other studies pointed out more psychological factors and emphasize the importance of preoperative education [3,4]. The range of motion of the knee (knee ROM) obtained after TKA is important for daily performance of the patient and for postoperative satisfaction [5,6]. However, knee ROM is sometimes more limited than expected. It can be determined by several factors, including preoperative ROM, surgical technique, postoperative physiotherapy and the design of the prosthesis [7,8]. However, factors affecting knee ROM after TKA are not fully understood and the reasons for limited ROM have yet to be investigated.

A previous cadaveric knee study has speculated that anterior patellofemoral overstuff causes reduced range of motion [9]. Anterior patellofemoral overstuff is caused by the design and size chosen for the prosthesis, and by the operative technique comprised of cutting the femur and patella. The effect of anterior patellofemoral stuffing on postoperative knee ROM has not been thoroughly studied in a clinical setting.

The purpose of the present study was to investigate the effect of patellofemoral stuffing on postoperative knee flexion after total knee arthroplasty of PS design for patients with osteoarthritis. Since we invested anterior patellofemoral stuffing in detail, we assessed the thickness of the patella and anterior patellofemoral height (PF height) that was the distance from the anterior cortex of the patella to the anterior cortex of the femoral shaft.

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2. Patients and methods

2.1. Patients

We conducted a retrospective review of 140 primary TKAs that had been performed in 2001 and 2007. This study was carried out in the same hospital. Demographic data, including age, gender and diagnosis, were noted pre-operatively. This study included 57 patients of bilateral TKA and 26 patients of unilateral TKA. There were 11 men and 72 women. The mean age of the study patients at the time of the index arthroplasty was 69.6 years. The diagnosis was primary osteoarthritis (OA) in 83 patients.

Exclusion criteria included refusal of consent, a history of knee infection, augmentation with wedges, structural bone grafting at the time of operation and knees that underwent less than 2 year follow-up. 2 patients of rheumatoid arthritis, and 5 knees that had severe extension limitation of 30° or more preoperatively were excluded.

This study was approved by Ethical committee Approval Number 1145 on January, 2012.

2.2. Operative technique

All operations were performed by 2 senior doctors (TM and KY). Surgeries were performed with an identical technique of incision, approach and soft tissue balancing. In short, the procedure was done based on a femoral first cut technique using an intramedullary instrumentation for the femoral cut and an extramedullary instrumentation for the tibial cut. Ligament balancing in extension and flexion and in medial and lateral sides was performed [10]. For a knee with medial type OA, releases of the medial side of the knee and resection of medial osteophytes were performed until good balancing was achieved, with a difference of 5 mm or less in extension and flexion and in medial and lateral. Releases of the medial side of the knee was undergone step by step as follows: the tibial attachment of the medial joint capsule from anterior to posterior, the medial osteophyte, and then the collateral ligament and the attachment of the semimembranosus tendon at the posteromedial corner, if necessary. A PS prosthesis (Nexgen/LPS FLEX Knee; Zimmer, Warsaw, Indiana) was used in all knees. All prostheses were cemented. The patella was resurfaced in all of the knees with an all-polyethylene component.

2.3. Postoperative rehabilitation

Post-operative rehabilitation followed standard protocol and postoperative management. The same procedure was used for all patients as follows. Postoperatively, the operated knee was not immobilized. Knee range of motion exercise, weight bearing and walking exercises were instructed at the physical therapy department. Weight bearing was not restricted and weight-bearing was permitted as tolerated at 1 day after surgery. Knee range of exercise was started 2 days after surgery on a bed and in the rehabilitation room. Continuous passive motion exercise was not applied. The majority of patients were discharged with T-cane walking around 3 weeks postoperatively. The patients were seen at the outpatient office 3, 6, and 12 months after surgery with daily instruction for maintaining exercises at home. After 1 year of visits, the patients were evaluated on an annual basis.

2.4. Evaluation methods

Preoperative and postoperative radiographic measurements of anterior patellofemoral height (PF height) and the thickness of the patella were taken. All radiographic evaluations were performed by the principal author (H.K). The radiographic evaluation was done blindly with regard to the clinical outcome. Measurement reproducibility was assessed by the intra-observer ICC and the inter-observer ICC. Observers (H.K and K.N) were blinded for the previous results of each other's test.

Radiographic techniques were standardized for each radiographic view. Only true lateral radiographs were used for the assessment. We chose true lateral radiographs of knee from all preoperative and postoperative lateral radiographs. True lateral radiographs of the knee without rotation demonstrated the posterior borders of the femoral condyles directly superimposed. PF height was assessed by the distance from the anterior cortex of the patella to the tangent of the anterior cortex of the femoral shaft (PF height), and the thickness of the patella was assessed by the maximum antero-posterior thickness of the patella in the vertical direction that was normal to the horizontal direction decided by the posterior cortex of patella (Figs. 1 and 2).

Postoperative data on range of motion was retrieved electronically from the patient database, which reflects data collected by the operating surgeon at the time of office follow-up visits. Passive maximum flexion angle was measured using a standard goniometer while the patient was supine.

2.5. Statistical analysis

Test–retest reliability was determined with the ICC, which measures the correlation by the same observer on 2 separate occasions (intra-observer ICC). ICCs ranged from 0 to 1. The reliability was considered to be excellent if the ICC was greater than 0.81, substantial between 0.61 and 0.80, and moderate between 0.41 and 0.60 [11].

The StatView 5.0 program (SAS Institute, Cary, NC) was used for statistical analyses. Test of normality was analyzed by chi-square goodness-of-fit test. Comparisons between 2 groups were analyzed using the Mann–Whitney U test. A P-value of <0.05 was considered statistically significant. The relationship between the

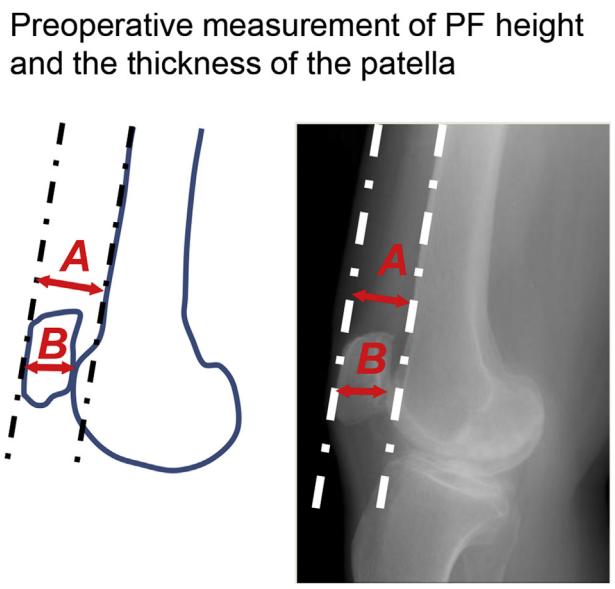

Fig. 1. Line drawing (left) and preoperative true lateral radiograph showing (right). The preoperative PF height was defined as the distance from the anterior cortex of the patella to the tangent of the anterior cortex of the femoral shaft (measurement *A*). The thickness of the patella was defined as the maximum antero-posterior thickness of the patella in the vertical direction that was normal to the horizontal direction decided by the posterior cortex of patella (measurement B).

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