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Outcomes of total knee arthroplasty in degenerative osteoarthritic knee with genu recurvatum

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ABSTRACT

Background: This study aimed to assess the incidence of genu recurvatum without neuromuscular disorders in knees that underwent navigation-assisted total knee arthroplasty (TKA), to evaluate short-term radiologic and clinical results of navigation-assisted TKA in genu recurvatum, and to evaluate differences in results according to the degree of pre-operative hyperextension and type of implant and insert.

Methods: This study retrospectively reviewed 510 knees that underwent navigation-assisted TKA from January 2005 to December 2011. The incidence of knees that showed hyperextension of ≥5° (genu recurvatum) on navigation, and the accompanying alignment were evaluated. It assessed radiologic, intraoperative, and clinical results in recurvatum and control groups by using propensity score matching.

Results: A total of 465 knees underwent navigation-assisted TKA for degenerative osteoarthritis. Genu recurvatum was observed in 55 knees (11.8%). Of these, 41 knees (74.5%) had degree of hyperextension between five degrees and 10°, and 47 (85.4%) had varus alignment. The thickness of the resected distal femur in the recurvatum group (7.6 ± 1.6 mm) was less than that in the control group (8.4 ± 1.4 mm, $P = 0.001$). The thickness of the insert in the recurvatum group (12.5 ± 2.3 mm) was greater than in the control group (10.8 ± 1.5 mm, $P < 0.001$). The sagittal alignment at the final follow-up was 1.3 ± 3.4° in the control group and −0.1 ± 0.7° in the recurvatum group ($P = 0.003$). Subgroup analyses in the recurvatum group showed no significant difference in sagittal alignment and patient-related outcomes by degree of pre-operative hyperextension and implant/insert type ($P > 0.05$ for all parameters).

Conclusions: Genu recurvatum was not uncommon among patients undergoing primary TKA. This review obtained satisfactory short-term clinical and radiologic results, with a smaller distal femoral resection and thicker insert.

1. Introduction

Genu recurvatum is related to neuromuscular disorders such as poliomyelitis [1–3]. In cases where limbs have been affected by a neuromuscular disorder, total knee arthroplasty (TKA) can result in pain relief. However, concerns have been raised about recurrence of knee instability and functional deterioration in patients with poor pre-operative quadriceps function. Hence, TKA is contraindicated in knees with severe muscle weakness. It has been reported that in knees without neuromuscular disorder, a recurvatum deformity can develop in conditions such as genu valgum and rheumatoid arthritis [4,5]. Genu recurvatum has been reported as being uncommon among patients who have undergone TKA. Some studies (before the early 2000s) have reported a <1% incidence of

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genu recurvatum in knees that required TKA [6–8]. However, these studies were limited by lower diagnostic accuracy, as they either used a goniometer to identify genu recurvatum or did not clearly describe the hyperextension measurement method. In 2012, Mullaji et al. objectively confirmed genu recurvatum using navigation and reported an incidence rate of 3.9% [9]. It is interesting that the incidence increased when genu recurvatum was checked by navigation. The difference in reported genu recurvatum incidence rates between previous literature and Mullaji et al. may be attributable to anesthesia, diagnosis method, and racial differences [9]. A few studies have investigated the incidence of genu recurvatum so far, and more research on this topic is required.

Satisfactory clinical and radiologic results have been reported for TKA on knees with genu recurvatum [6–9]. However, existing literature is limited by small numbers of cases or a follow-up period <2 years. Moreover, when evaluating TKA results in knees with genu recurvatum, factors likely to affect the results should be considered such as the degree of pre-operative hyperextension and type of implant and insert. However, it is believed that there is no available literature on these factors.

Considering the lack of literature related to genu recurvatum in TKA and the methodological problems of previous studies, there is a need for more research on genu recurvatum in knees undergoing TKA. Therefore, the current authors developed the following specific research questions: (1) Is the incidence of genu recurvatum in knees having undergone TKA as rare as reported in previous studies? (2) Are short-term radiologic and clinical results good? (3) Do clinical results differ according to the degree of pre-operative hyperextension and implant and insert type?

The current study aimed to (1) assess the incidence of genu recurvatum without neuromuscular disorders in knees that underwent navigation-assisted TKA, (2) evaluate short-term radiologic and clinical results of navigation-assisted TKA in genu recurvatum, and (3) evaluate differences in results by the degree of pre-operative hyperextension and type of implant and insert. It was assumed that the incidence of genu recurvatum would be higher in knees undergoing TKA than those previously reported, and that TKA results would be good, regardless of the degree of pre-operative hyperextension and implant or insert type.

2. Materials and methods

This study was approved by the Institutional Review Board. From January 2005 to December 2011; 612 primary TKAs were implemented by one surgeon at the current institution. Among them, 510 cases of TKA were implemented by using navigation. Inclusion criteria for the genu recurvatum group in the current study were (1) degenerative osteoarthritis and (2) hyperextension ≥5° under spinal or general anesthesia on navigation. Patients excluded were those with a follow-up period <2 years; with history of fracture or ligament injury in the ipsilateral knee; and with inflammatory arthritis, neuropathic arthropathy, or neuromuscular disorders. The study attempted to compare the results between the recurvatum group and the control group. To minimize selection bias, the control group was selected from patients who had received TKA due to degenerative osteoarthritis during the same period without pre-operative genu recurvatum ≥5°, according to the propensity score matching (1:2, nearest neighbor matching without replacement). Matching variables included age, sex, body mass index, and pre-operative femorotibial angle. Navigation-assisted TKA was performed in almost all cases during the study period.

The navigation used in the included cases was the OrthoPilot computer-aided surgery system (B. Braun, Aesculap, Tuttlingen, Germany), with OrthoPilot Tibia First with Soft Tissue Management TKA v4.0, v4.2, and v4.4 software (the different versions of the software used corresponded to software updates). The minimal detectable angular and length change of the navigation system were one degree and one millimeter, respectively. The surgical technique for navigation-assisted TKA is described in detail elsewhere [10,11]. In brief, patients were placed in a supine position on the surgery table under general or spinal anesthesia. The knee was exposed by medial parapatellar arthrotomy. The navigation tracker was located on the distal femur approximately six centimeters above the articular surface and on the proximal tibia six centimeters below the articular surface. After registering the knee, hip, and ankle joints in the navigation system, anatomical landmarks were registered, including the intercondylar notch and medial and lateral epicondyles. Next, the alignment of the lower extremity was evaluated on coronal and sagittal planes. Bone resection was performed on the proximal tibia, distal femur, anterior and posterior femur (in that order). The proximal tibia was resected to be 0° to the mechanical axis of the tibia on the coronal plane, with a three-degree posterior slope on the sagittal plane. Flexion and extension gaps were checked after resection of the proximal tibia. Bone resection of the distal femur was targeted so that the distal transverse plane cut was 0° to the mechanical axis of the femur. In cases of a large extension gap, resection of the distal femur was reduced by one to two millimeters [12]. Soft tissue release was performed with the knee in full extension such that the difference in the medial and lateral gaps was <3 mm. Next, the medial and lateral gaps were measured with the knee at 90° flexion. The medial and lateral flexion gaps were evaluated using navigation when the femoral component was rotated within the range of external rotation from 0 to five degrees, with the knee at 90° flexion. Rotation of the femoral component was determined such that the difference in the medial and lateral flexion gaps was <3 mm.

After anterior and posterior bone resection of the distal femur, a trial implant was inserted and the alignment and soft tissue balance checked. A tension device was used to evaluate the gap size and stability during surgery. Both medial and lateral gaps were measured using navigation after applying tension, and only cases with a difference of <3 mm were accepted. The thickness of the insert was chosen such that on navigation, when the knee was extended after inserting a trial insert, the sagittal alignment remained within the flexion contracture from 0 to three degrees. A thicker insert was chosen if genu recurvatum was confirmed, and a thinner insert was chosen when flexion contracture was >3°. Implantation was executed in one stage in the tibia, femur, and patella. Coronal and sagittal alignment was re-measured after implantation. The type of implant used depended on the following. Initially, the procedure was performed without sacrificing the posterior cruciate ligament (PCL) (i.e., the posterior cruciate-retaining (CR) type). The PCL was sacrificed if it was over-released during soft tissue balancing or if there was a mismatch in the flexion-extension gap after soft tissue release (i.e., the posterior cruciate-stabilizing (PS) type). The implant

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