Open-wedge high tibial osteotomy in patients with discoid lateral meniscus

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Abstract

Background: There are concerns about the progression of the lateral osteoarthritis (OA) should be taken into account when high tibial osteotomy (HTO) is performed in patients with discoid lateral meniscus (LM). This study evaluated the clinical results of HTO in patients with discoid LM and elucidated factors affecting the results. Methods: This study evaluated 32 female patients with varus deformity and medial OA. Patients with discoid LM (8 patients) or without discoid LM (24 patients) underwent open-wedge HTO. The mean age was 53.5 years and the mean follow-up period was 35 months. Clinical results, including the Hospital for Special Surgery (HSS) score, Knee Society knee score (KS) and function score (FS), were evaluated. The progression of OA in the lateral compartment was also evaluated. Finally, we evaluated the factors affecting the clinical results and OA progression in the lateral compartment. Results: Between two groups, all clinical scores were not different (p = 0.964, 0.963, and 0.559, respectively). Three of eight patients (37.5%) in the discoid group developed OA in the lateral compartment, whereas 2 of 24 patients (8.3%) in the control group developed such; however, this was not significantly different (p = 0.085). In discoid group, patients with undercorrection has higher KS relative to patients with acceptable correction (p = 0.044). Other clinical results and OA change in the lateral compartment were not affected by evaluated factors. Conclusions: Patients who underwent open-wedge HTO showed the satisfactory clinical results and lateral OA progression regardless of the presence or absence discoid LM. However, when discoid LM was present, patients with undercorrection showed higher KS in comparison with patients with acceptable correction.

Keywords
discoid lateral meniscus, high tibial osteotomy, lateral compartment, varus deformity

Introduction

High tibial osteotomy (HTO) is an effective treatment method to manage young patients with varus deformity paired with osteoarthritis (OA) of the medial compartment.1-3 In this context, the weight-bearing axis can be shifted laterally after surgery and, as a result, the unloading of the medial compartment could mitigate the medial OA.4-6 However, valgus alignment after HTO reversely increases the loading of the lateral compartment, potentially provoking the degeneration of the lateral compartment to progress.7 Therefore, arthrosis of the lateral compartment is a contraindication of HTO and the clinical results in affected patients are expected to be unsatisfactory due to lateral OA progression.8,9

Discoid lateral meniscus (LM) can increase the pressure load on the lateral compartment of the knee joint.10 Especially, after HTO, shifting the weight-bearing axis to the...
lateral compartment can increase the loading of the lateral compartment, enhancing the risk of tear of the LM. Therefore, concerns about the progression of the lateral OA should be taken into account when HTO is performed in patients with discoid LM.

We hypothesized that inferior clinical results would result after HTO in patients with discoid LM relative to among patients without discoid LM. Further, the degree of correction may also affect the clinical results. As such, the purpose of this study was to evaluate the clinical results of HTO in patients with discoid LM and to elucidate factors affecting the results.

Material and methods
This study retrospectively evaluated 32 female patients with varus deformity and medial OA. From February 2010 to July 2018, patients with discoid LM (n = 8 patients) or without discoid LM (n = 24 patients) underwent open-wedge HTO. Matching was performed for age, sex, body mass index, varus alignment, and Kellgren–Lawrence grade. Patients without discoid LM were included in the control group at a ratio of three (discoid group) to one (control group).

The mean age of the study population was 53.5 years (range: 44–61 years) and the mean follow-up period was 35 months (range: 12–82 months). Among the eight patients with discoid LM, two had undergone partial meniscectomy previously. All patients in this study underwent open-wedge HTO with locking plates. Tomofix locking plates (Synthes GmbH, Solothurn, Switzerland) were adopted in 20 cases and OhtoFix locking plates (Ohtomedical Co., Ltd., Goyang, Korea) were chosen for 12 patients.

This research has been approved by the IRB of the authors’ affiliated institutions (No. 2019-10-039-001).

Surgical technique
All surgeries were performed by a single surgeon. All patients underwent diagnostic knee arthroscopy prior to osteotomy to assess the condition of the articular surface and meniscus, which was followed by debridement or meniscectomy if needed. The arthrosis in the lateral compartment was not revealed by radiography, magnetic resonance imaging, and arthroscopic evaluation during HTO operation in all patients. Among four patients with discoid LM who underwent partial meniscectomy, two underwent additional partial meniscectomy due to the presence of meniscal tear. During surgery, after the pes anserinus was completely separated and the superficial medial collateral ligament was elevated from the peristeum, each patient underwent biplanar osteotomy proximally behind the tibial tuberosity. Thereafter, the posteromedial tibial osteotomy site was opened using a chisel and bone spreader, the osteotomy site was spread, and locking plate fixation was performed. Allogeneic bone chips mixed with autologous bone marrow were harvested from the ipsilateral anterior superior iliac spine and grafted into the osteotomy gap. The osteotomy site was covered with the superficial medial collateral ligament and the pes anserinus was resutured to the periosteal membrane. The target point was determined to be the mechanical axis of the limb located at the 60.0% point from the medial border along the longest medial-to-lateral width of the tibial plateau (Figure 1).

Assessment
Clinical results, including the Hospital for Special Surgery (HSS) score, Knee Society knee score (KS) and function score (FS), were evaluated at the time of surgery and at the final follow-up. The progression of OA in the lateral compartment was also evaluated by radiography. Additionally, we evaluated the factors affecting the clinical results and OA progression in the lateral compartment, including age, previous meniscectomy, meniscus tear at the discoid LM, and correction degree. Among these, the postoperative correction degree was stratified into three groups, where acceptable correction was determined to be a degree within 5% of the target point (55.0–65.0%), undercorrection was determined to be a degree of 5% or greater under the target point (55.0%), and overcorrection was determined to be a degree of 5% or greater over the target point (65.0%).

Statistical analysis
Fisher’s exact test, the Mann–Whitney U test, and the chi-squared test were used for comparing values between the two groups, while the paired t-test was used to compare preoperative and postoperative values. Separately, the Kruskal–Wallis test, Mann–Whitney U test, and Fisher’s exact test were adopted for the evaluation of each factor affecting the postoperative results.

Statistical significance was assumed at a p-value of less than 0.05. All statistical analyses were performed using the SPSS Statistics version 21.0 software program (IBM Corp., Armonk, NY, USA).

Results
The demographics, preoperative alignment, and clinical scores between the two groups were not significantly different (Table 1).

After medial open-wedge HTO, the mean mechanical axis changed from 10.8% preoperatively to 57.8% (p < 0.001), while the mechanical femoro-tibial angle (mFTA) was corrected from varus 8.8° to valgus 2.1° postoperatively (p < 0.001). All clinical scores, including HSS score, KS, and FS, increased, with the HSS improving from 70.6 to 88.7 points (p < 0.001), the KS improving from 70.6 to 88.7 points (p < 0.001), and the FS improving from 50.8 to 89.8 points (p < 0.001). In both study groups, the
alignment and clinical scores were also all improved significantly.

Between the two groups, the mFTA and mechanical axis were not different postoperatively ($p = 0.396$ and 0.862, respectively). All clinical scores including the HSS score, KS, and FS were also not different ($p = 0.964, 0.963$, and 0.559, respectively). Three of eight patients (37.5%) in the discoid group developed arthritis in the lateral compartment, whereas 2 of 24 patients (8.3%) in the control group did so; however, this result was not significantly statistically different ($p = 0.085$) (Table 2).

In discoid group, the KS was only affected by correction degree postoperatively. Especially, patients with undercorrection has higher KS than did patients with acceptable correction ($p = 0.044$). Other clinical results and arthritic change in the lateral compartment were not affected by evaluated factors, including age, previous meniscectomy, meniscus tear at the discoid LM, and correction degree. In

Figure 1. (A). A full-length, anteroposterior lower limb weight-bearing radiograph in a 56-year-old woman with medial left knee pain. The mechanical axis was on a line 27.7% from the medial border along the medial-to-lateral width of the tibial plateau. (B). Radiograph and magnetic resonance imaging of left knee showed the osteoarthritis in medial compartment and the complete type of discoid lateral meniscus. (C) Arthroscopic finding showed the complete type of discoid lateral meniscus without tear. The meniscectomy was not performed. (D). After high tibial osteotomy, the mechanical axis was on the line 56.7% from the medial border along the medial-to-lateral width of the tibial plateau. (E). Anteroposterior radiograph at 30 months showed without arthritic change on lateral compartment.
Table 1. Preoperative demographics, alignment, and clinical scores.

|                  | Discoid group | Control group | p-value |
|------------------|---------------|---------------|---------|
| Age (years)      | 53.3          | 53.6          | 0.948   |
| Sex (male:female)| 0.8           | 0.24          | 0.797   |
| Body mass index  | 26.6          | 26.4          | 0.835   |
| (kg/m²)          |               |               |         |
| Right:left       | 1.7           | 13.11         | 0.053   |
| Mechanical femoro-tibial angle (°) | Varus 9.0 | Varus 8.3 | 0.744 |
| Mechanical axis (%) | 10.5       | 15.6          | 0.632   |
| Kellgren-Lawrens grade |       |               |         |
| Grade 0          | 0             | 0             |         |
| Grade 1          | 0             | 0             |         |
| Grade 2          | 6             | 16            | 0.659   |
| Grade 3          | 2             | 8             |         |
| Grade 4          | 0             | 0             |         |
| Hospital for Special Surgery score | 70.5   | 70.6          | 0.615   |
| Knee Society knee score | 57.5     | 59.0          | 0.744   |
| Knee Society function score | 48.8     | 55.6          | 0.313   |

Table 2. Postoperative results.

|                  | Discoid group | Control group | p-value |
|------------------|---------------|---------------|---------|
| Mechanical femoro-tibial angle (°) | Valgus 2.2 | Valgus 2.1 | 0.862   |
| Mechanical axis (%) | 55.6       | 58.5          | 0.396   |
| Hospital for Special Surgery score | 89.5     | 88.5          | 0.964   |
| Knee Society knee score | 86.3     | 86.7          | 0.963   |
| Knee Society function score | 88.8     | 90.2          | 0.559   |
| Arthritic change of lateral compartment | 3/8 (37.5%) | 2/24 (8.3%) | 0.085   |

The limitations of this study include its small number of patients, retrospective design, and conduct of postoperative cartilage evaluation without involving magnetic resonance imaging or other methods. Moreover, the wide range of follow-up period (range: 12–82 months) could be the limitation of this study. A further prospective study with a
larger sample and the involvement of various methods for evaluating the cartilage condition should be performed.

**Conclusion**

Patients who underwent open-wedge HTO showed satisfactory clinical results and lateral OA progression regardless of the presence or absence of discoid LM. However, when patients have discoid LM, those with undercorrection showed higher KS in comparison with patients with acceptable correction.

**Declaration of conflicting interests**

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