Case Report

Increased posterior slope and coronal inclination of the tibial joint line after opening wedge high tibial osteotomy may induce mucoid degeneration of the anterior cruciate ligament: A case report

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ABSTRACT

A mucoid degeneration of the anterior cruciate ligament (ACL) is regarded as a degenerative change in the ligament, which is clinically presented with pain on full extension or flexion. Regarding morphological factors, it has been reported that an increased posterior tibial slope can be a cause of ACL degeneration secondary to the repetitive overload. The increase in the tibial slope is among the potential problems after medial opening wedge high tibial osteotomy (OWHTO). Especially, a large wedge opening in the correction of severe varus deformity may lead to non-physiologic bony geometry including an increased posterior tibial slope and medial tibial coronal inclination.

We present a 69-year-old man had undergone OWHTO with a wedge correction angle of 12.4° for Kellgren–Lawrence grade 2, medial uni-compartmental osteoarthritis of the left knee. Evaluations of the postoperative radiographs revealed postoperative changes in radiological parameters with mechanical medial proximal tibial axis (mMPTA) from 81.3° to 94.3°, and posterior tibial slope (PTS) from 12.2° to 15.8°. Physical examination at 3 years after surgery revealed a knee extension of 0° and a limitation to knee flexion with maximum flexion of 110° and, and severe knee pain was elicited when the knee approached deep flexion. MRI revealed an increased signal intensity along the substance of the ACL and multiple cystic lesions indicative of a ganglion formation around the proximal ACL attachment site extending into the adjacent lateral femoral condyle. Microscopic examination of the resected tissues showed mucoid degeneration and mucous cysts indicative of ganglions formation within the ligament substance and the bone at the attachment site. The reported case illustrates the importance of being aware of this potential complication following OWHTO.

Lessons learnt

- A large wedge opening in the correction of severe varus deformity may lead to non-physiologic bony geometry including an increased posterior tibial slope and medial tibial coronal inclination
- The possibility of potential risk of ACL degeneration caused by joint line obliquity after OWHTO

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Introduction

Mucoid degeneration of the anterior cruciate ligament (ACL) is regarded as a degenerative change in the ligament, which is clinically presented with pain on full extension or flexion in the middle-aged population. Due to the lack of specific symptoms and signs, its diagnosis is often delayed or even misdiagnosed in clinical practice [1,2].

Although relationship between the mucoid degeneration of the ACL and degenerative joint condition has been shown in several studies [3–5], its pathogenesis remains unclear [1]. In regard to morphological factors, it has been reported that an increased posterior tibial slope can be a cause of ACL degeneration secondary to the repetitive overload [6,7]. The increase in the tibial slope is among the potential problems after medial opening wedge high tibial osteotomy (OWHTO). Especially, a large wedge opening in the correction of severe varus deformity may lead to non-physiologic bony geometry including an increased posterior tibial slope and medial tibial coronal inclination [8–10]. As a sequel to these geometric changes, concerns have been raised regarding the possibility of progressive degeneration of the ACL after OWHTO [11–13].

In this report, we present a cases of ACL mucoid degeneration occurring after OWHTO was performed for varus osteoarthritic knees. This case presented painful flexion loss requiring arthroscopic debridement. The reported case illustrates the importance of being aware of this potential complication following OWHTO.

Case presentation

A 69-year-old man had undergone OWHTO with a wedge correction angle of 12.4° for Kellegren–Lawrence grade 2, medial unicompartmental osteoarthritis of the left knee. He was able to return to his original activity level, jogging at least five times weekly, at 10 months after surgery. Evaluations of the pre- and postoperative radiographs revealed postoperative changes in radiological parameters with % mechanical axis (%MA) from 3.9% to 54.1%, mechanical medial proximal tibial axis (mMPTA) from 81.3° to 94.3°, and posterior tibial slope (PTS) from 12.2° to 15.8° (Fig. 1). Correction of the coronal knee alignment by the osteotomy achieved relief from the preoperative symptoms caused by varus osteoarthritis. Postoperative knee range of motion also was intact. As planned, the removal plate and second look arthroscopic examination were routinely performed at a year after the performing OWHTO, and the intact ACL was shown by second look arthroscopy at this point.

However, at 3 years after surgery, pain on flexion gradually developed without an episode of trauma following surgery. Physical examination revealed a limitation to knee flexion with maximum flexion of 110°, and severe knee pain was elicited when the knee approached deep flexion. No sign of ligamentous insufficiency was noted in manual stability tests. In terms of ACL on an initial MRI, there was a continuity of a ligament apparently was seen on T1-weighed sagittal image before undergoing OWHTO (Fig. 2A). However, MRI at 3 years after surgery revealed an increased signal intensity along the substance of the ACL on T1- and T2-weighed sagittal images (Fig. 2B and C). In addition, T2-weighed sagittal and axial images showed multiple cystic lesions indicative of a ganglion formation around the proximal ACL attachment site extending into the adjacent lateral femoral condyle (Fig. 2D and E). Based on these clinical and image findings, mucoid degeneration of the ACL was suspected as a pathology causing the patient’s symptoms. Since conservative treatment had failed to relieve the symptoms, arthroscopic examination/treatment was indicated.

In arthroscopic examination, the ACL appeared to be hypertrophied and loosened along its length without synovial coverage (Fig. 3A). When the yellowish crumbly tissues in the surface area were debrided using a shaver, ganglions were identified within the proximal ligament substance (Fig. 3B) and the neighboring bone at the ACL footprint (Fig. 3C). Even after removal of the superficial degenerative tissues, normal-looking longitudinal fibers of the ACL were not found in the deep region. Consequently, the whole ligament and the osseous tissues at its proximal insertion were resected (Fig. 3C and D). Microscopic examination of the resected tissues showed mucoid degeneration and mucous cysts.
indicative of ganglions formation within the ligament substance and the bone at the attachment site (Fig. 4A and B). In terms of the medial meniscus, the degenerative quality of meniscus tissue was seen, however it was not apparently changed in comparison with the previous arthroscopic examination. Therefore, the resection or the debridement were not performed for the meniscus in this case.

Fig. 2. The preoperative MRI images. A) Before undergoing OWHTO, a continuity of a ligament apparently on T1-weighed sagittal image. B) and C) Hypertrophic change exhibiting high signal intensity along the ligament on T1- and T2-weighed sagittal image. D) Multiple intraosseous cystic lesions around the femoral attachment site. E) A lobulated cystic lesion at the proximal end of the ACL.

Fig. 3. Arthroscopic views of the ACL. A) Hypertrophic and a loosened appearance (*) without synovial coverage (LFC: lateral femoral condyle). B) Yellowish crumbly tissues (white arrowhead) and ganglion cysts at the femoral attachment site (black arrow heads). C) The attachment site after removal of the substance. D) Inner wall of the lateral femoral condyle in the intercondylar notch after removal.

Fig. 4. Photomicrographs of the resected tissues (H & E staining, scale bar = 100 μm). A) Area of the focal myxoid degeneration in the ACL substance. B) A unilocular ganglion cyst identified in the resected osseous tissue at the ligament attachment.
The patient was allowed to bear full weight and range of motion exercise was initiated on the day following surgery. Resection of the pathological tissues by arthroscopic surgery resulted in satisfactory pain relief with improved flexion after surgery. In the follow-up evaluation at 2 years, preoperative symptoms were resolved, and no apparent instability was present without ACL reconstruction. As for the pre- and post-operative patient-reported outcome assessments using the Knee injury and Osteoarthritis Outcome Score (KOOS) system, the Pain section score improved from 53 to 83, the Symptoms section score improved from 57 to 71, the ADL section score improved from 74 to 90, the Sports activity section score improved from 10 to 25, and the QOL section score improved from 13 to 31.

Discussion

Since the first report made by Kumar et al. [14], there have been several articles describing the clinical features and management of mucoid degeneration of the ACL [15–19]; however, no article has reported its occurrence as a potential complication following OWHTO.

Mucoid degeneration of the ACL was regarded as a rare pathology in the past, while recent advancements in MRI imaging modality have revealed that its incidence is higher than previously thought. Based on the database search on 4221 knee MRIs, Bergin et al. reported that ACL ganglia and mucoid degeneration were identified in 74 examinations (1.8%) [20]. Regarding the clinical features, the predominant symptom is pain on maximum flexion/extension and limited range of motion due to pain, while the majority of the cases are asymptomatic. Therefore, its clinical diagnosis is often difficult. MRI is a useful tool for the diagnosis, and Bergin et al. proposed the diagnostic criteria as consisting poorly identified ACL fibers on T1-weighted image but seen on T2-weighted sequence [20]. Several authors have described the longitudinal layers of increased signal intensity on T2 weighted images with an adjacent well-defined intact rim having a “Celery stalk” appearance [1]. The case in this report was presented with knee pain on maximum flexion and limited flexion angles. MRI findings of these cases coincided with those reported in the previous relevant reports. In addition, the MRI examination showed multiple mucous cysts in the ligament substance associated with intraosseous extension at the femoral attachment site. In the database search conducted by Bergin et al., discrete intra-osseus ganglion were observed in 77% of the examined cases [20]. Therefore, a case reported here exhibited rather typical clinical and image features of ACL mucoid degeneration.

In consideration of its etiology, several theories have been proposed in previous literature, which include degenerative change of the ligament associated with degeneration of other intraarticular tissues, connective tissue degeneration after trauma, mucous deterioration of the connective tissue, synovial tissue herniation, and ectopia of the synovial tissue [1,3–5,17,18]. As for bony morphological factors, association with increased posterior tibial slope and ACL mucoid degeneration have been reported in previous studies [6,7]. From a biomechanical standpoint, an increased posterior tibial slope may induce excessive tension in the ACL leading to tissue degeneration [21,22]. An increased posterior tibial slope is regarded as a potential problem after OWHTO, and association between postoperative degeneration of the ACL and an increased tibial slope has also been reported [11–13]. OWHTO has become a commonly performed and well-established surgical procedure for patients with uni-compartmental osteoarthritic knees [23,24]; however, several reports have raised concerns about non-physiologic joint line obliquity following OWHTO, especially in cases requiring a large wedge opening for correction of severe varus deformity [8–10]. In this situation, joint line obliquity may give rise to anterior tibial translation on the sagittal plane and medial subluxation of the proximal tibia on the coronal plane, and both of these alignment changes may lead to increased tension of the ACL [11,21,22,25]. This case report illustrates the possibility of potential risk of ACL degeneration caused by joint line obliquity after OWHTO. Considering the possibility of degeneration existing in the ACL of osteoarthritic knees [3,4], careful consideration should be given to avoid non-physiologic joint line obliquity in determining surgical option and procedure of the osteotomy.

In regard to surgical management of the symptomatic ACL myxoid degeneration, previous relevant articles have reported satisfactory outcomes following arthroscopic treatment without subsequent instability [14–19,26,27]. In the case reported in this article, arthroscopic debridement succeeding in alleviating the preoperative symptoms leading to functional improvement; however, further follow-up evaluations should be continued to examine the long-term consequences of the ACL excision on these knees. In case of a subjective instability occurred, undergoing ACL reconstruction might be considered.

Conclusion

We present a case of ACL mucoid degeneration occurring after OWHTO with a 12-mm wedge opening was performed for varus osteoarthritic knees. The reported case illustrates the importance of being aware of this potential complication by non-physiologic bony geometry following OWHTO.

Statement of informed consent

Patient were informed that their data would be submitted for publication and provided consent.

Ethics

Patient were informed that their data would be submitted for publication and provided consent.

Declaration of competing interest

No funds have been received in support of this work. No benefits in any form have been or will be received from a commercial party related to, directly or indirectly, to the subject of this article.

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