Surgical Management of Complex Ankle Bony Impingement Combined With Chronic Ankle Instability

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Background: Anterior ankle bony impingement, which can cause pain and dysfunction of the ankle, is commonly seen in sports injuries. Its primary cause is repeated injury due to chronic ankle instability. An excellent clinical result has been reported by surgically removing osteophytes and ankle stabilization. However, reports of complex anterior impingement combined with lateral ankle instability are rare, which remains challenging in clinical practice.

Purpose/Hypothesis: The purpose of this study was to evaluate the clinical outcomes of anterior ankle bony impingement combined with lateral ankle instability with surgical dissection of osteophytes and stabilization. It was hypothesized that complex ankle osteophytes with instability would achieve optimal clinical outcomes through surgical management.

Study Design: Case series; Level of evidence, 4.

Methods: A total of 57 patients with complex ankle bony impingement combined with lateral instability treated with surgical dissection of complex osteophytes between September 2013 and January 2019 were enrolled in the study. The clinical outcomes were evaluated by visual analog scale (VAS) for pain score, American Orthopedic Foot and Ankle Society (AOFAS) score, Karlsson score, and radiographic examination with a mean follow-up time of 39.6 months. Postoperative ankle function and complications were compared using the *t* test and post hoc Tukey significant difference test.

Results: The mean AOFAS score significantly increased at the 3-month, 1-year, and 2-year follow-ups compared with the preoperative condition ($t = 10.57$, $P = .0001$). The mean Karlsson score after surgery also significantly improved at each follow-up time compared with the preoperative score ($t = 12.93$, $P = .0001$). The preoperative VAS score significantly decreased at 3 months, 1 year, and 2 years postoperatively ($t = 8.73$, $P = .001$). A significant improvement of mean dorsiflexion difference was observed at 3 months and 1 year compared with the preoperative condition, but it seemed to have regressed at the 2-year follow-up ($t = 2.11$, $P = .01$). Tibial side recurrence was found in 9 cases, including 7 Scranton type 1 and 2 Scranton type 2. Talar side recurrence was also found in 3 of those cases.

Conclusion: Our retrospective study demonstrated that complex ankle bony impingement combined with lateral instability can yield good clinical results when treated surgically with both ankle stabilization and osteophyte removal.

Keywords: Ankle impingement; osteophyte; lateral instability; clinical outcomes

Anterior ankle bony impingement (AABI) is characterized by anterior ankle bony osteophytes with pain and restricted dorsiflexion of the affected ankle. The primary cause of AABI is repeated injury due to chronic ankle instability (CAI).[8,20,22] Anterior osteophyte formation was commonly seen during arthroscopic examinations of CAI, as reported in several studies.[3,7]

The mechanism of osteophyte formation on the anterior ankle is still not clear. D'Hooghe et al and van Dijk et al believe that repeated excessive metatarsal flexion of the foot leads to increased tension at the attachment of the anterior joint capsule, thus causing local osteophyte formation. In a study of football players, Tol et al[18] found that in the process of foot impact under test conditions, 39% of cases have increased local tension caused by excessive metatarsal flexion of the ankle. However, most bone spurs

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found under arthroscopy are located at the anterior edge of the tibial and talar neck between 5 mm and 8 mm from the attachment of the ankle capsule.[21] Therefore, other scholars believe that the impact of the front ankle is due to the repeated action of the pressure generated by the metatarsal flexion of the ankle on the nonbearing edge of the anterior ankle joint, resulting in local cartilage injury, bone trabecular fracture, and periosteal bleeding.[12,14] These traumatic injuries eventually heal in the form of osteophytes.

Parma et al[14] reported a classification to describe the severity of osteophytes: focal lesions are less than one-third of the anterior articular margin (tibial anteromedial, central, anterolateral, or talar); wide lesions are from one-third to two-thirds of the anterior articular margin (with eventual talar hyperostosis, no kissing lesion); and complex lesions are more than two-thirds of the anterior articular margin (kissing lesion, whole tibial, multiple tibial, or talar lesions). It has previously been reported that a better prognosis can be achieved by surgically removing osteophytes[4,16,17] with or without ligament repair.[4,8,20] However, very few clinical cases were reported that describe the necessity of osteophyte removal for patients with chronic ankle instability and complex osteophyte impingement. Therefore, we hypothesized that complex ankle osteophytes with instability would achieve optimal clinical outcomes through surgical management.

METHODS

Study Sample

Between September 2013 and January 2019, 66 patients diagnosed with ankle bony impingement and chronic ankle instability were surgically treated in our hospital. The inclusion criteria were (1) diagnosis as AABI and fitting Parma standards[14] (lesion >two-thirds of the anterior articular margin); (2) anterior talofibular ligament injury confirmed by magnetic resonance scans; and (3) positive anterior drawer test. Patients with previous ankle surgery, trauma, malalignment, infection, and talus cartilage injury were excluded from the study. The study was approved by the ethical committee of the Peking University Shenzhen Hospital (No. 201400211).

Surgical Procedure

All the procedures were performed by 1 senior surgeon (a qualified foot and ankle/sports medicine surgeon with >10 years of experience who performs more than 300 cases of ankle arthroscopy per year). The patients were in the supine position. Standard anterior and posterior portals were adopted, and a 4.0 mm 30° arthroscope was used without traction. The location of the osteophyte and the continuity of the anterior talofibular ligament (ATFL) were evaluated first. The osteophytes from both the distal tibial and talar neck were then removed with a burr under arthroscopy. After removing all the bony impingements, fluoroscopy of the lateral ankle was performed to confirm that osteophytes had been completely removed. We did not use any biological materials in the resected bed to prevent the recurrence of osteophytes. The classic Broström technique[12] was used in 30 cases: ATFL was repaired with 2 suture anchors placed in the ATFL footprint in the distal fibula (lupine 3.0 mm; Depuy Mitek). In 27 cases, all-inside the ATFL repair was completed, as described by Vega et al.[23] A typical case is shown in Figure 1

Rehabilitation

All patients were treated with a standard antithrombotic prophylaxis procedure (10 mg daily for 12 days, Rivaroxaban; Bayer Germany). A neutral position "U shape" splint was used to immobilize the ankle for 2 weeks. The patient could wear sports shoes with an ankle support to walk with partial weightbearing. During this period, physical therapy, including proprioceptive training, active ankle extension, and eversion exercises, was used to restore the range of motion. Six weeks after the operation, the patient could walk with full weightbearing and begin stationary cycling. Running and swimming were introduced at 3 months, and the patients returned to high-contact sports at 6 months.

Postoperative Follow-up

The patients were regularly followed up at 3 months, 1 year, and 2 years postoperatively. The ankle function was scored using the American Orthopedic Foot and Ankle Society (AOFAS) and Karlsson scores.[9,10] The pain around the ankle was assessed using the visual analog scale (VAS). The difference in bilateral ankle dorsiflexion was checked with a protractor in the supine position, and the difference was calculated bilaterally to compare with the preoperative condition. The recurrence of osteophytes was checked by radiograph and computed tomography scan. The Scranton classification was used to evaluate the condition of recurrent osteophyte[15]: type 1, tibial spur <3 mm; type 2, tibial spur >3 mm; type 3, significant tibial exostosis

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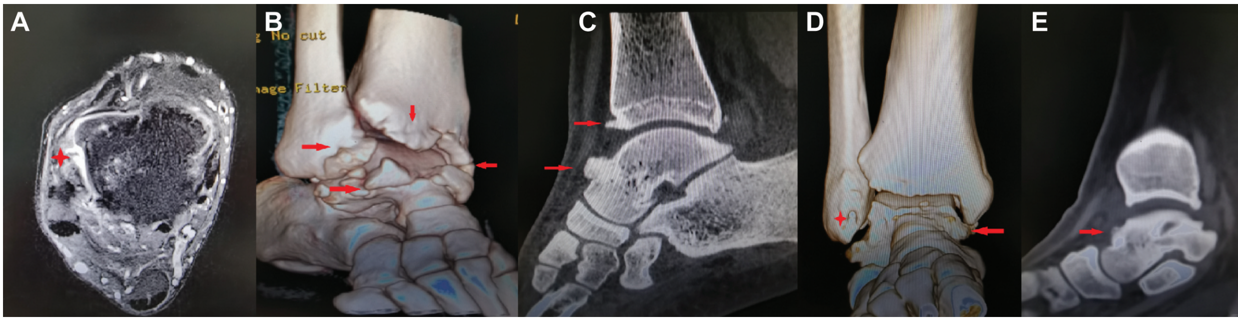

Figure 1. (A) Anterior tibiofibular ligament injury in magnetic resonance T2 axial scan (red star). (B) Three-dimensional computed tomography (CT) scan and (C) sagittal CT scan showing complex osteophyte formation in the anterior ankle joint (red arrows). (D) Three-dimensional CT scan and (E) sagittal CT showing talus side recurrence at 2-year follow-up (red arrow). The suture anchor canal can also be seen in panel D (red star).

with a secondary spur on the neck of the talus, with eventual fragmentation of the osteophytes; and type 4, osteophytes associated with arthritic joint destruction.

Statistical Analysis

SPSS Version 25.0 (IBM Corp) was used for statistical analysis, and the Shapiro–Wilk test was used to verify the normal distribution. The results were expressed as mean ± standard deviation. The adopt independent samples t test and post hoc Tukey significant difference test were carried out for statistical analyses, and $P < .05$ was considered statistically significant.

RESULTS

Among the included patients, 5 patients were lost to follow-up and 4 sustained lower limb injuries in the follow-up period and were therefore excluded. As a result, 57 (86.3%) patients (34 men, 23 women; mean age, 34.2 ± 6.2 years) were included in the study. The mean follow-up time was 39.6 ± 2.3 months (range, 28-91 months). The mean preoperative AOFAS score was 75.4 ± 4.0, and the score significantly increased 3 months (80.6 ± 3.3), 1 year (82.9 ± 10.6), and 2 years (89.2 ± 3.4) compared with postoperatively (t = 10.57, P = .0001). The AOFAS score remained stable during the 1- and 2-year follow-up periods (t = 0.161, P = .109). The mean preoperative VAS score was 2.6 ± 0.5, and the score decreased 3 months (1.1 ± 0.91), 1 year (0.21 ± 0.36), and 2 years (0.26 ± 0.52) compared with postoperatively (t = 8.73, P = .001). No significant difference occurred between 1 and 2 years postoperatively (t = 0.81, P = .419). The mean postoperative Karlsson score was 79.5 ± 2.9 (at 3 months), 90.3 ± 4.5 (at 1 year), and 94.2 ± 3.5 (at 2 years). There was a significant improvement in each follow-up time compared with the mean preoperative score (75.1 ± 3.9), and the difference was statistically significant (t = 12.93, P = .0001). The mean dorsiflexion difference was 10.7° ± 2.3° before surgery. A significant improvement (t = 13.24, P = .0001) at each follow-up was observed at 3 months (8.2° ± 1.4°), 1 year (4.3° ± 1.3°), and 2 years (5.2° ± 1.5°) compared with postoperatively. However, dorsiflexion seemed to have regressed at the 2-year follow-up (t = 2.11, P = .01) (Figure 2). Tibial side osteophyte recurrence was found in 9 cases, including 7 Scranton type 1 and 2 Scranton type 2. Talar side osteophyte recurrence was found in 3 of those cases.

DISCUSSION

The major finding of our study demonstrated that even with complex anterior bony impingement and ankle instability, surgical osteophyte removal and ankle stabilization may yield favorable clinical results. Follow-up results showed significant improvement in the clinical scale (AOFAS, Karlsson) in 2 different 2-year follow-ups ($P <$ .05), even if some patients could not fully recover the dorsiflexion of the ankle. The osteophyte recurrence rate was approximately 15%.

The relationship between ankle instability, anterior impingement, and osteophyte formation is poorly understood.[11,15] However, some patients with chronic ATFL injuries resulting in mechanical instability of the ankle joint have shown a high occurrence of anterior ankle impingement. Odak et al[13] investigated 100 cases of ankle instability and reported 12% combined bony impingement. They also found a high incidence of anterior/anterolateral synovitis in patients with chronic ankle instability. However, there was a relatively low incidence of anterior bony impingement lesions or osteochondral lesions in other studies.[5,26] Lee et al[12] also confirmed a similar rate under arthroscopic examination.

Several studies have indicated that secondary intra-articular pathologies,[4,5,14] particularly bony impingement, is linked with ankle instability caused by lateral ligament damage. One retrospective study revealed 334 (31%) osteophytes among 1169 patients diagnosed with ankle instability.[25] The risk factors for osteophyte formation include male sex, older age, postinjury duration of 5 years or longer, and calcaneofibular ligament injury. Patients with concomitant ATFL and calcaneofibular ligament injuries were significantly more likely to have osteophytes than those with single-ligament injuries.[22]

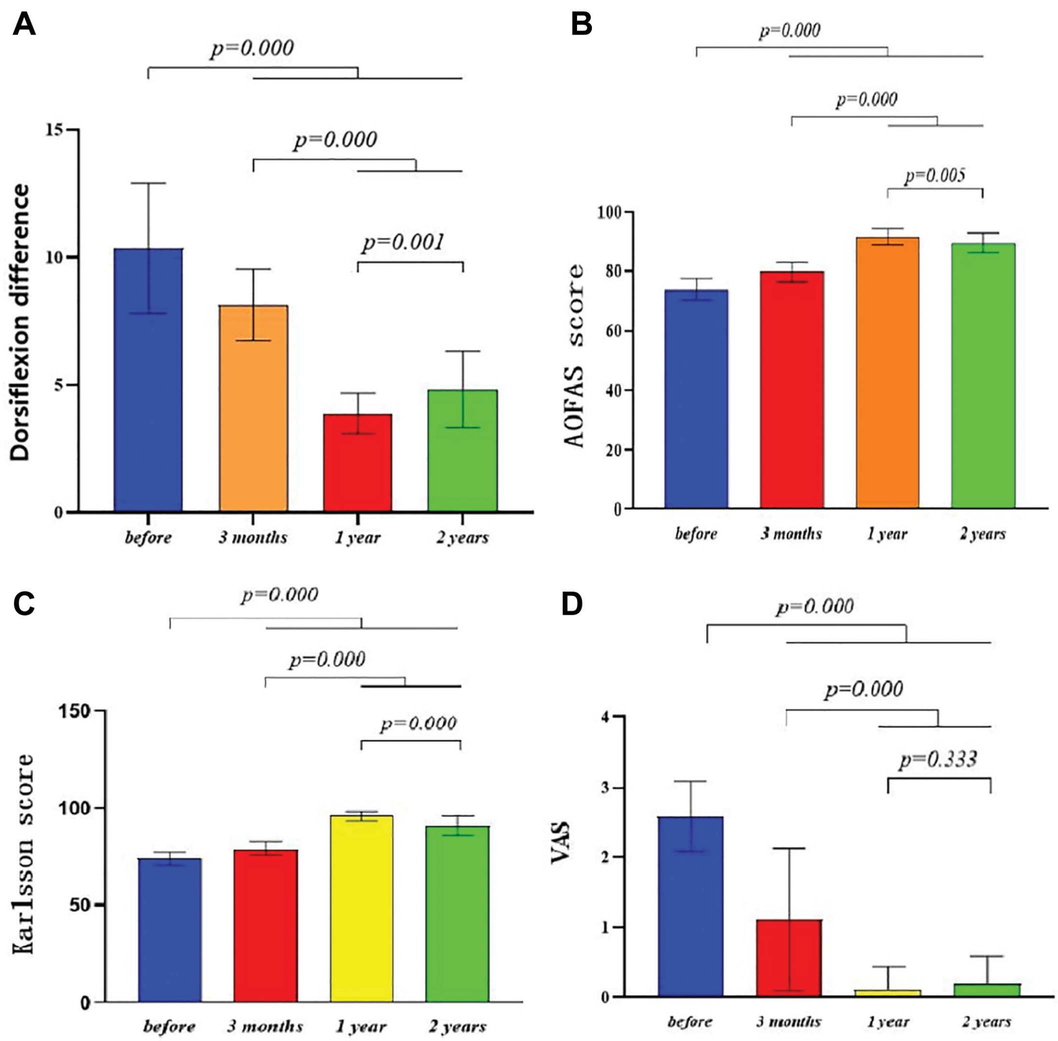

Figure 2. Bar chart of the statistical result of (A) dorsiflexion difference, (B) AOFAS score, (C) Karlsson score, and (D) VAS. AOFAS, American Orthopedic Foot and Ankle Society; VAS, visual analog scale.

Scranton et al[15] classified AABI according to the size and location of the spurs. They inferred that osteophyte formation is related to the mechanical instability of the ankle. Bonnel et al[1] reviewed the biomechanical mechanism between chronic ankle instability and associated lesions. They pointed out that the broader talus at the front may cause restricted ankle dorsal flexion.[6] This suggests that anterior osteophytes (impingement exostosis) aggravate instability and, thus, osteophytes. Therefore, osteophyte removal and ankle stabilization should relieve pain and instability and minimize recurrence.

Symptoms caused by anterior osteophytes can be achieved with good clinical results by open or arthroscopic bone spur dissection.[1,6,12] AFTL repair or reconstructive surgery can also achieve acute ankle stability satisfactorily.[16,19] However, patients with chronic ankle instability may have a combination of cartilage lesions, synovitis, and soft tissue injuries. These conditions should also be treated along with ankle stabilization surgery. Wang et al[25] performed osteotomy and lateral ligament repair on 60 patients. There was a significant improvement in functional outcome scores and dorsiflexion after surgery. Combined treatment of CAI and anterior ankle impingement produced satisfactory surgical results in patients with CAI with symptoms of anterior ankle impingement. The mean AOFAS score (62.9 ± 11.7 vs 72.9 ± 11.1; P = .002) indicated complete clearance of the osteophytes in all patients. Chen et al[2] compared 2 groups of patients with ankle instability alone or with a combined anterior bony impingement. Patients with combined femoroacetabular impingement and AAI had relatively poorer outcomes than those with femoroacetabular impingement alone. Scranton et al[15] compared 35 patients with 100 healthy controls regarding ankle function. It was found that patients who underwent Brostrom surgery did not show a significant difference in terms of AOFAS hindfoot.[20] Patients who underwent Brostrom surgery had 3.37 times the incidence of bone spurs compared to normal adults. This also implies that residual ankle instability may cause osteophyte formation. On the other hand, bony impingement may result in limited dorsiflexion of the ankle joint. When the osteophyte is removed, ankle motion may improve. However, dorsiflexion function is not fully restored in most cases. This may be related to contracture of the Achilles tendon or joint capsule. However, we do not have additional clinical evidence to support this.

During the first 2 years of follow-up, 9 (15.7%) cases of recurrence of osteophyte were detected by radiological examination. Tibial side recurrence was found in all 9 cases, including 7 cases of Scranton type 1 and 2 cases of Scranton type 2. Talar side recurrence was found in 3 of those cases. Walsh et al[24] reported that anterior osteophytes recurred and were commonly seen postoperatively. This may compromise postoperative improvement in ankle motion seen at midterm follow-up. The present study found no significant correlations between recurrence and ankle motion loss. The recurrence of osteophytes on the tibial side is consistent with the matching of the radius of the joint surface, so it is also indicated that the osteophytes on the talar side may be more related to the symptoms.

Limitations

There are some limitations to our study. First, the elasticity of the Achilles tendon or ankle capsule was not examined preoperatively, so we cannot tell the difference in ankle motion after the surgical removal of the osteophytes. Second, we did not use Telos or other devices to quantify the stability of the ankle joint during follow-up. Only the anterior drawer test was used, which is a subjective physical examination varying from surgeon to surgeon. Third, the magnetic resonance scan was used to assess ATFL repair rather than biomechanical testing. In this way, some subtle instability in the ankle joint may have been missed during follow-up, which may explain the recurrence of osteophytes.

CONCLUSION

Osteophyte removal and ankle stabilization may well treat ankle instability with complex anterior bony impingement. The clinical outcomes showed significant improvement postoperatively.

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