

A comparison between arthroscopic and open surgery for treatment outcomes of chronic lateral ankle instability accompanied by osteochondral lesions of the talus

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Abstract

Background : The present study aimed to examine the efficacy and safety of concurrent arthroscopic treatment of osteochondral lesion of talus (OLT) and lateral ankle instability. It was hypothesized that the outcome of all arthroscopic surgery was no worse than that of the combined open and arthroscopic surgery for treating chronic lateral ankle instability accompanied by OLT. **Methods :** All the patients diagnosed of chronic lateral ankle instability accompanied by OLT who were surgically treated between May 2015 and May 2017 were targeted for inclusion. A total of 32 patients received concurrent arthroscopic treatment of OLT and lateral ankle instability, and 35 patients received arthroscopic treatment of OLT and open lateral ankle stabilization. All these patients were followed up using Karlsson Ankle Functional Score, visual analog scale (VAS) scores, Tegner activity score, and American Orthopaedic Foot and Ankle Society Score (AOFAS). The satisfaction and complication rate was evaluated and compared. **Results :** At 24-month follow-up, the Karlsson score, VAS score, Tegner score and AOFAS score were significantly improved in both groups in relation to the pre-operative condition. The two groups did not differ significantly from each other in terms of functional outcomes, satisfaction and complication rate. **Conclusion :** In comparison with the open lateral ankle stabilization and arthroscopic treatment of OLT, the all arthroscopic procedure showed no difference in clinical outcome at 24-month follow-up for treating chronic lateral ankle instability accompanied by OLT. With the benefits of minimal invasive arthroscopic procedure and an aggressive rehabilitation protocol, the treatment efficacy for the patients with chronic lateral ankle instability accompanied by OLT was still inferior to that for the patients with chronic ankle instability. **Trial registration :** The present study was carried out with the retrospectively registered data starting from May 28, 2015

Background

Osteochondral lesions of the talus (OLT) are commonly-seen injuries that are often resulted from acute ankle sprains or chronic ankle instability. It is reported that up to 16%-54% of patients diagnosed of chronic lateral ankle instability are suffering OLT[1-5]. Prolonged instability of the ankle is a potential contributing factor to the development of osteochondral lesions, which can ultimately result in osteoarthritis[6]. Therefore, concomitant treatment of OLT and lateral ankle instability has been indicated[7-9].

Previous studies suggested that the concurrent arthroscopic treatment of OLT and open lateral ankle stabilization was a reliable procedure[10, 11]. The arthroscopic bone marrow stimulation has been regarded as a preferred technique for treating OLT, which provides fibrocartilage infill to the defect site. However, with respect to the treatment of chronic lateral ankle instability, an additional curved 4-cm incision was required after the arthroscopic treatment of OLT. Although the open modified Brostrom procedure has been proved effective for chronic lateral ankle instability, the benefits of minimal invasive arthroscopic procedure no longer exist when a lateral open incision is made.

In recent years, an arthroscopic assisted Brostrom technique has become increasingly popular[8]. Several comparative studies have demonstrated similar clinical results between the arthroscopic procedure and the open modified Brostrom procedure[12-15]. For patients accompanied by OLT, the arthroscopic assisted Brostrom technique makes the concurrent arthroscopic treatment possible. However, there are few reports that compared the all arthroscopic technique with the combined arthroscopic and open treatment in terms of efficacy and safety. In view of this, the present study aimed to test the following hypothesis: The outcome of all arthroscopic surgery is no worse than that of the combined open and arthroscopic surgery for treating chronic lateral ankle instability accompanied by OLT at 24-month postoperatively.

Methods

The patients diagnosed of chronic lateral ankle instability and OLT, who were considered surgical candidates for surgery by our Foot and Ankle Orthopaedic Clinic after comprehensive assessment from May 2015 to May 2017 were invited to take part in this research. The inclusion criteria are as follows: (1) recurrent instability of the ankle secondary to an injury to the lateral ligament complex and showing no response to conservative therapy including restriction of activities and administration of non-steroidal anti-inflammatory medicines for at least 3 months; (2) giving way; (3) persistent pain; and (4) OLT being detected on magnetic resonance imaging (MRI) images. The exclusion criteria are : (1) previous surgery for lateral ankle instability, (2) previous fracture(s) of the affected ankle, (3) hyperlaxity, (4) neuromuscular disorder , (5) large OLT (with an area more than 150 mm² or with an depth more than 8 mm on the MRI image), and (6) showing syndesmosis widening in ankle arthroscopic evaluation.

A total of 87 patients who were qualified for the inclusion criteria and surgically treated at Xiangya Hospital by the same surgeon (Liu Hua) were included. Of these 87 patients, 8 were excluded because of large OLTs and syndesmosis widening, 5 withdrew after the surgery (2 arthroscopic and 3 open patients) and 7 were lost to follow-up (5 arthroscopic and 2 open patients). Eventually, the number of patients that completed the study for the arthroscopic and open group is 32 and 35, respectively. No significant difference in basic characteristics was observed between the two groups in terms of age, gender, body mass index, symptom duration, and preoperative clinical score (Table 1). The patients were followed up during outpatient service for >2 years after surgery. This study had been approved by the ethics committee of the Xiangya Hospital of Central South University (China), and the written consent had been acquired from all participants prior to implementation.

The chronic lateral ankle instability was confirmed based on manual anterior drawer stress test (ADT) and the patients' complaints of continuous ankle instability lasting for >3months. The ADT was performed with the lower leg hanging free and the knee maintaining flexed. The ankle was positioned at 10° to 20° of plantar flexion. The tibia and the heel were stabilized by one hand each. The ADT was assessed bilaterally. A side-to-side difference above 5 mm in tibiotalar translation was regarded as positive[16].

OLTs were evaluated by MRI. All patients received MRI examination on the affected ankle using a 3.0-T MRI scanner before operation. During the MRI examination, the ankle was placed in the neutral position. Coronal and sagittal imaging was performed using short time inversion recovery (STIR). The area of OLT was calculated based on the following equation: $OLT\ area = coronal\ length \times sagittal\ length \times 0.79$ [17]. The patients with large OLTs who needed to undertake additional procedures rather than debridement or microfracture were excluded.

Clinical evaluation methods

The patients were examined both preoperatively and at 24 months postoperatively. Clinical evaluation, including subjective functional examination and ADT, was conducted by a professional orthopaedic surgeon (Xu Can) based on the pain visual analog scale (VAS), Karlsson ankle functional score (Karlsson score), Tegner activity score, and American Orthopaedic Foot & Ankle Society (AOFAS). A 10-point VAS (i.e., “0” indicates no pain and “10” indicates the highest level of pain imaginable) was used to assess the ankle pain during walking. The Karlsson scoring scale was developed and used to evaluate the ankle function after the treatment for lateral ligament injuries of the ankle joint[18]. The Tegner activity scale is a numerical scale (0-10) with each value representing a specific activity[19]. The AOFAS ankle-hindfoot rating score is defined as a 100-point physician-based scale containing 3 components: function (45 points), pain (40 points), and alignment (15 points). All the patients were requested to grade their satisfaction about the overall outcome at 24 months follow-up as “good”, “fair”, or “unsatisfactory”. It is noteworthy that they were not required to elaborate what influenced their specific sense of satisfaction.

Surgical technique

All the procedures were implemented in a standardized way by Liu Hua, a senior orthopedic surgeon with 10 years of working experience specialized in foot and ankle surgery. The patient was positioned in a supine pose under general anesthesia. With the inflation of pneumatic tourniquet and noninvasive traction, a 2.7-mm, 30°arthroscope was utilized to ensure the best visualization with the lowest risk of iatrogenic injury to intra-articular structures. Standard anterolateral, anteromedial, and posterolateral portals were used. All the patients had undergone ankle arthroscopic evaluation of intra-articular pathology before performing lateral ankle stabilization. The patients accompanied by syndesmosis widening were excluded from our study because it was a strong risk indicator leading patients to dissatisfaction[20], which may affect the overall assessment outcome of efficacy. Debridement (including soft tissue impingement, synovitis, ossicle, osteophyte, and loose body) was performed if necessary under arthroscopic observation. The intra-articular lesions are recorded in Table 2. As it can be seen, there is no significant difference between the two groups with respect to accompanying abnormalities.

When OLT was identified, the stage and size of the lesion would be carefully evaluated with a marked probe. The OLTs can be classified into 6 stages in accordance with the Ferkel and Cheng[21] classification system as follows, Stage A: smooth, intact, but soft or ballotable; Stage B: rough surface; Stage C: fibrillation/fissuring; Stage D: flap present or bone exposed; Stage E: loose, undisplaced fragment; and Stage F: displaced fragment. For a cartilage with a rough surface or fibrillation (stage B-C),

debridement would be implemented using a mechanical shaver (Dyonics Power Shaver System; Smith & Nephew, Andover, MA). For a lesion with a visible cartilage defect (stage D-F), microfracture would also be performed besides the debridement of the flapped cartilage and subchondral cyst to facilitate the revascularization of the lesion. The OLT size, location and Ferkel stage are shown in Table 3. No significant difference was observed between the two groups.

Then, the anterior talofibular ligament(ATFL) was evaluated. If the fibers of the ATFL were adequate and in satisfactory condition based on the arthroscopic view, the arthroscopic assisted Brostrom surgery would be performed[22]. If it appeared impossible to perform arthroscopic repair, the open modified Brostrom procedure would be conducted after arthroscopy.

For the arthroscopic assisted Brostrom procedure, two initial anterior arthroscopy portals were utilized. The anterior lateral ankle joint was completely debrided to avoid potential postoperative impingement as far as possible. The anterior distal face of the fibula was then debrided with a shaver to create raw bone for promoting the adherence of soft tissues. Then, an accessory anterolateral (acAL) portal was created at a site of 1.5 cm anterior to the tip of the fibula, going through just proximal to the site of the raw bone prepared before. A drill/anchor guide was placed through the acAL portal and positioned in the raw bone prepared in the fibula. The fibula was drilled with the purpose to insert one or two suture anchors (2.8-mm, Arthrex, US) inside. Then, a tissue-penetrating instrument was used to penetrate the ATFL remnant. Thereafter, the sutures would be grasped to pass through the ATFL and then be pulled to tighten the ATFL.

The open modified Brostrom procedure would be conducted if arthroscopic repair could not be performed. A curvilinear incision was created over the lateral malleolus. The ATFL remnant was identified and exposed, and one or two suture anchors were inserted into the fibula. The ATFL was tensioned under the eversion of the ankle and fixed to the fibula. Then, the proximal extensor retinaculum was exposed and moved from the attachment to the distal fibula to make sure that the repair of ATFL could be reinforced.

Postoperative Rehabilitation

The postoperative rehabilitation protocol was developed under the guidance of a physical therapist. The affected ankle was immobilized by an ankle brace (A60; DJO Global) for 6 weeks. Isometric contraction of muscle groups around the ankle joint was allowed from the day after surgery. Passive and active range of motion (ROM) was allowed 6 days after surgery under the protection of the ankle brace. Then, the patients were advanced to partial weight bearing 4 weeks after surgery, and to full weight bearing 6 weeks after surgery over a period of 1 to 2 weeks. Generally, the patient could return to high-impact physical activities 6 months after surgery.

Statistical analysis

Although the present study was retrospective, sample size calculation was done based on a non-inferiority design during accumulation of cases. The primary outcome used to determine the sample size was Karlsson score at 24-month follow-up. The 95% confidence interval (CI) was applied to decide whether the difference in Karlsson score at 24-month postoperatively was within the pre-specified margin of non-inferiority, which was set to be -6 points as previous studies suggested[14]. A power analysis was carried out a priori to compute the minimum sample size required for detecting the 95% effect size at a 1-sided significance level ($P < .05$) ($N = 30$). Assuming the dropout rate is 10% (i.e., patients lost to follow-up and patients withdrew after surgery), 34 patients were needed for each surgery group in our study. The secondary outcomes include improvements in pain (VAS), AOFAS score, Tegner activity score and satisfaction rate from baseline to 24-month follow-up. In addition, the safety parameters including superficial peroneal nerve injuries and wound infection were also evaluated.

Statistical analyses were carried out with SPSS software (Version 24.0 for Windows, IBM Corporation, Armonk, NY, USA). The continuous variables were expressed as mean \pm standard deviation, while the categorical data were presented as counts and percentages. Wilcoxon's signed-rank test was employed to compare the preoperative and postoperative functional outcome scores. Student's t-test, chi-square test, and Fisher's exact test were performed to make necessary comparisons between the two groups. A 95% CI was used for analysis, and $P < .05$ was taken as statistically significant.

Results

The ADT of all the ankles in both groups appeared normal at 24-month postoperatively. The Karlsson score, VAS score, Tegner score, and AOFAS score were significantly improved for both groups against the pre-operative level. All the patients managed to resume their pre-injury works after recovery from the surgery. Table 4 shows the statistical results of the Karlsson score, VAS score, Tegner score, AOFAS score, and satisfaction rate at 24-month for both groups. As it can be seen, the clinical outcome at 24-month follow-up was comparable between the two groups, and no significant difference in satisfaction rate was found.

3 and 2 patients experienced superficial peroneal nerve injury in the all arthroscopic group and the open group, respectively. In addition, 2 patients suffered knot pain in the all arthroscopic group and 2 patients suffered wound infection in the open group. No statistically-significant difference in total complication rate was observed between the two groups.

Discussions

Lateral ankle instability frequently coexists with intra-articular pathologic conditions, such as OLT, synovitis, impingement, osteophyte and loose body. It was reported that OLT occurred in half of the acute lateral ankle sprains[23] and in 16%-54% of the patients diagnosed of chronic lateral ankle instability[1-5]. In recent years, alongside the advancement of all-inside arthroscopic Brostrom operation, the concurrent arthroscopic treatment for these concomitant conditions has become possible. In this study, we

compared the efficacy and safety between the all arthroscopic and the combined open and arthroscopic surgery for treating chronic lateral ankle instability accompanied by OLT. Our most important finding is that concurrent arthroscopic treatment of OLT and lateral ankle instability is not inferior to the open lateral ankle stabilization and arthroscopic treatment at 24-month postoperatively.

In the existing literature, the arthroscopic surgery of OLT and the open modified Brostrom procedure of lateral ankle instability are the common treatments for these two concomitant disorders. After evaluating 31 patients who received concomitant arthroscopic treatment for OLT and lateral ankle stabilization with the open Brostrom procedure, Gregush et al.[10] concluded that the concurrent arthroscopic treatment of OLT and open lateral ankle stabilization was proved to be safe and effective. Lee et al.[24] compared the outcomes of OLTs with and without chronic lateral instability. In their study, the lateral ligament reconstruction was conducted with the modified Brostrom procedure. Kazuya et al.[25] examined whether chronic lateral ankle instability was associated with the size and staging of OLT. In their study, the lateral ligaments were treated by open direct repair. Yasui et al.[9] published the outcome of concurrent surgery for lateral ankle instability accompanied by OLT and suggested that the concurrent surgery of lateral ankle stabilization and retrograde drilling guided by arthroscope and fluoroscope was a reliable treatment technique. In their study, the lateral ankle instability was treated by the open Brostrom procedure. Jiang et al.[11] evaluated the effect of concurrent arthroscopic OLT treatment and lateral ankle ligament repair on the clinical results of chronic lateral ankle instability, and reported that the concurrent arthroscopic treatment of OLT exhibited no significant adverse effect on the overall outcome in patients diagnosed of chronic lateral ankle instability. In their study, the lateral ankle ligaments were also treated by the modified Brostrom procedure. To the authors' best knowledge, this is the first study that reported the results of concurrent arthroscopic surgery for both OLT and lateral ankle instability. The clinical outcome suggested that the all arthroscopic treatment was no worse than the combined open and arthroscopic procedure. On the contrary, the all arthroscopic treatment seemed to deliver an even better outcome. In view of that non-inferiority had been achieved and our sample size was slightly more than we needed, we conducted some additional tests on the superiority. However, the results did not support all arthroscopic surgery as a better treatment (not shown in the results).

The specific effect of OLT on the clinical results of chronic lateral ankle instability is still unclear. Choi et al.[20] attempted to associate the type and number of intra-articular lesions with the outcome of ligament reconstruction for chronic lateral ankle instability, and found that patients with OLT had an risk of dissatisfaction 8.5-fold higher compared to those without OLT. Nery et al.[26] examined 38 patients who underwent arthroscopic Brostrom-Gould repair for managing lateral ankle instability. No significant difference in terms of outcome was found in patients who had received microfracture for the management of cartilage lesions in comparison with those without cartilage lesion at an average follow-up of 9.8 years. Li et al.[16] compared the lateral ankle instability with and without OLT, and found that the functional outcome of the two did not differ significantly from each other. Hua et al.[27] assessed the clinical outcome of patients with chronic lateral ankle instability accompanied by intra-articular symptoms. They reported that the modified Brostrom procedure in combination with ankle arthroscopy delivered satisfactory results, but the accompanying chondral injuries were found

to be associated with worse outcome. In our study, all the ankles with chronic lateral ankle instability were accompanied by OLT. We compared the results of our patients with previous studies in terms of the chronic ankle instability and found that the functional scores of our patients were inferior to those with chronic ankle instability. Li et al.[12] compared the arthroscopic repair procedure with the open repair procedure in terms of clinical outcome, and reported that the mean AOFAS score of the arthroscopic group was 93.3 postoperatively at an average follow-up of 40 months. Rigby et al.[15] examined the patients who received the treatment of lateral ankle stabilization either by the open Brostrom or the arthroscopic Brostrom procedure with the purpose to compare and detect any discrepancy in the functional outcome between the two. The mean postoperative VAS and Karlsson scores for the arthroscopic Brostrom were equal to 1.5 and 91.80 respectively, at an average follow-up of 1.3 years. Yeo et al.[14] compared the clinical outcome between the arthroscopic and open Brostrom operation. According to their results, the mean VAS and AOFAS score of the arthroscopic group was 1.7 and 90.3 respectively, at 12-month follow-up. The patients included in these studies had several different intra-articular pathologies such as synovitis, anterior tibial spur and loose body, not just OLTs. It can be noticed that the functional outcomes in these studies were better than the outcomes of the patients in our study. It seems that OLT indeed exerted a negative effect on the clinical outcome, which is consistent with previous studies. Gregush et al.[10] compared the AOFAS score among 3 study populations at their institution: lateral stabilization alone, lateral stabilization with OLT, and OLT alone. They reported that the group with lateral stabilization alone had achieved the best results. Jiang et al.[11] compared the effect of concurrent arthroscopic OLT treatment and open lateral ankle ligament repair on the clinical outcome of chronic lateral ankle instability, and found that ROM restriction was observed in 23.5% of patients with chronic lateral ankle instability accompanied by OLT.

Previous studies suggested that the reason attributed to the inferior outcome might be associated with the lengthened period of immobilization[11]. For OLT patients, ankle motion should start as soon as it is tolerable to promote fibrocartilage healing[28]. However, for the patients diagnosed of chronic lateral ankle instability, a relatively long period of immobilization without weight bearing is necessary for improving the strength of the repair[29]¹. Nevertheless, some latest studies advocated early ROM exercises after lateral ankle stabilization and early weight-bearing for OLT patients after receiving the treatment of microfracture[30-32]. In our study, passive and active ROM under the protection of A60 ankle brace was allowed 6 days after surgery, while partial weight bearing was allowed 4 weeks after surgery. This is a relatively aggressive rehabilitation protocol, but the outcomes were still inferior to the patients with chronic ankle instability. With the benefits of minimal invasive arthroscopic procedure, early ROM exercise and weight bearing, the efficacy has yet been improved. Therefore, further studies are needed to improve the clinical results of the patients with chronic lateral ankle instability accompanied by OLT.

Our study has several limitations. First, the patients were not randomly allocated into 2 groups. The arthroscopic Brostrom procedure was performed for patients with sufficient ATFL remnant. However, no significant difference in terms of basic characteristics was observed between the 2 groups (Table 2). The lesion size, location and Ferkel stage of the OLTs also showed no significant differences (Table 3).

Second, the ADT was evaluated manually without taking stress radiographic images, which however are considered more accurate for evaluating the stability of the ankle. Third, MRI examination was not performed for evaluating OLT repair in the follow-up visit. Despite these limitations, the present study found no difference in terms of efficacy and safety between the all arthroscopic and combined surgery for the treatment of chronic lateral ankle instability accompanied by OLT at 24-month postoperatively.

Conclusions

In comparison with the open lateral ankle stabilization and arthroscopic treatment of OLT, the all arthroscopic procedure showed no difference in clinical results at 24-month follow-up for treating chronic lateral ankle instability accompanied by OLT. With the benefits of minimal invasive arthroscopic procedure and an aggressive rehabilitation protocol, the treatment efficacy for the patients with chronic lateral ankle instability accompanied by OLT was still inferior to that for the patients with chronic ankle instability.

List Of Abbreviations

OLT: osteochondral lesion of talus; VAS: visual analog scale; AOFAS: American Orthopaedic Foot and Ankle Society Score; MRI: magnetic resonance imaging; ADT: anterior drawer stress test; ROM: range of motion; ATFL: anterior talofibular ligament

Declarations

Availability of data and materials

The datasets referred to and/or analyzed in the present study can be retrieved from the corresponding authors upon reasonable request.

Ethics approval and consent from participants

This study had been approved by the ethics committee of Xiangya hospital of Central south University. Written consent had been acquired from each participant prior to the implementation of the corresponding research work.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

LH contributed to the conception of the study. XC performed the follow-up experiments and drafted the manuscript. LMQ performed the data analyses. WCG supported with the analysis work and provided constructive discussions. All authors read and approved the final manuscript.

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Tables

Table 1: Preoperative data of demographics of the study groups

	All arthroscopic group (n=32)	Combined arthroscopic and open group (n=35)	<i>P</i> -value
Age, y	33.7±7.0	35.8±8.5	n.s
Gender, n	24males/8females	25males/10females	n.s
Body mass index, kg/m ²	23.3±2.3	24.1±2.1	n.s
Symptom duration, mo	30.1±15.3	28.7±13.7	n.s
Karlsson score	56.5±11.5	59.3±10.4	n.s
VAS score	8.0±1.5	8.2±1.5	n.s
AOFAS score	52.5±11.5	53.3±13.4	n.s
Tegner score	3±1-5	3±1-5	n.s

“n.s”: stand for “no significant difference” between study groups.

Table 2: Comparison of accompanying abnormalities between the arthroscopic and open group

	All arthroscopic group	Combined group	<i>P</i> -value
Soft tissue impingement	25	24	n.s
Ossicle at lateral malleolus	4	3	n.s
Synovitis	6	6	n.s
Osteophyte	7	6	n.s
Loose body	6	5	n.s

“n.s”: stand for “no significant difference” between study groups.

Table 3: The OLT size, location and Ferkel stage in terms of arthroscopic classification

	All arthroscopic group	Combined group	<i>P</i> -value
OLT size(on MRI images)			
Length	8.16±3.3	9.2±4.0	n.s
Width	5.0±1.67	6.23±1.72	n.s
Depth	4.7±1.31	5.13±1.4	n.s
Location			
Lateral	21	24	n.s
Medial	11	11	n.s
Ferkel and Cheng stage			
B-C	10	13	n.s
D-F	22	22	n.s

“n.s”: stand for “no significant difference” between study groups.

Table 4: Comparison of clinical outcomes between the arthroscopic group and open group

	Mean±SD	95%CI	<i>P</i> -value
Karlsson score, mean±SD			
All arthroscopic group	83.1±8.2	80.7, 85.3	0.89
Combined group	81.7±9.1	79.9, 85.0	
VAS, mean±SD			
All arthroscopic group	1.8±1.6	1.5, 2.2	0.73
Combined group	2.1±1.7	1.7, 2.5	
AOFAS score, mean±SD			
All arthroscopic group	87.7±7.6	86.0, 89.4	0.77
Combined group	86.9±7.3	85.6, 88.7	
Tegner score			
All arthroscopic group	5.5±2.3[1-8]	5.0, 7.3	0.72
Combined group	5±2.1[1-7]	4.5, 6.5	
Satisfaction rate, n(%)			
All arthroscopic group	27(84.3%)	82.7%, 85.9%	0.69
Combined group	29(82.8%)	81.2%, 84.4%	