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Chronic Lateral Ankle Instability

The Effect of Intra-Articular Lesions on Clinical Outcome

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Background: There has been no attempt to correlate the type and number of intra-articular lesions with the results of ligament reconstruction for chronic lateral ankle instability.

Hypothesis: Certain intra-articular lesions affect the clinical outcome of ligament reconstruction.

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

Methods: Sixty-five ankles from 64 patients underwent a modified Broström operation for chronic lateral ankle instability with a mean follow-up of 28.7 months (range, 12-67). The results were assessed according to the Karlsson-Peterson Ankle Score. The type of intra-articular lesions and the association of clinical outcome were investigated using Pearson's correlation coefficient and multivariate logistic regression analysis.

Results: The average Karlsson-Peterson Ankle Score was improved from 53 ± 14.63 preoperatively to 85.21 ± 11.97 at final follow-up ($P < .001$). Five different intra-articular lesions were described in 63 ankles (96.9%), and the ankle score negatively correlated with the number of lesions ($r = -.604$; $P < .001$). Multivariate logistic regression showed that syndesmosis widening (odds ratio, 11.1; 95% confidence interval: 2.2-55.4; $P = .003$), osteochondral lesions of the talus (odds ratio, 8.5; 95% confidence interval: 1.7-42.3; $P = .008$), and ossicles (odds ratio, 4.5; 95% confidence interval: 1.0-20.2; $P = .046$) are significant predictors of unsatisfactory results after ligament reconstruction.

Conclusion: Arthroscopic diagnosis and treatment of intra-articular lesions associated with chronic lateral ankle instability is a safe and effective method. The presence of any combination of associated intra-articular lesions can result in a poor outcome.

Keywords: ankle; arthroscopy; instability; intra-articular lesions

Chronic lateral ankle instability may be a sequela in 10% to 20% of patients with acute sprain injury and is commonly associated with other lesions, such as osteochondral lesions, soft tissue impingement syndrome, loose body, and peroneal tendon disorder.[7,15,21,28]

Currently, there are many surgical treatment modalities for chronic lateral ankle instability, including a modified Broström technique that is relatively simple and requires only a small incision to anatomically reconstruct the ligaments with minimal injury to the peroneal tendon and nerve.[1,3,11,19] However, a review of the literature shows that 13% to 35% of patients report symptoms such as pain after a successful ligament reconstruction.[8,18,25,27,30] Intra-articular lesions have been suggested as the cause for these persistent symptoms, and although many authors have reported arthroscopic findings in patients with chronic lateral ankle instability, there has been no attempt to correlate the type and number of intra-articular lesions with the patient outcome.

We performed an arthroscopic examination of the ankle immediately before reconstruction of the lateral ligament to treat chronic lateral ankle instability. We analyzed the intra-articular lesions associated with chronic lateral ankle instability and determined the relationship between the type and number of lesions and the clinical outcome of ligament reconstruction.

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MATERIALS AND METHODS

We analyzed 64 patients (65 ankles) with diagnosed chronic lateral ankle instability who had received reconstruction of the lateral ligament using a modified Broström technique between January 2001 and September 2006. The study group was composed of 44 male and 20 female patients, with a mean age of 27 years (range, 15-57) at the time of operation. Twenty-six cases involved the left ankle, and 39 involved the right. The average time from initial episode of ankle sprain to operation was 19 months (range, 6-84), and the average follow-up period was 28.7 months (range, 12-67). Twenty cases had less than 2 years' follow-up. Surgery was performed on patients who had repetitive ankle sprain injury or instability with pain greater than grade 2 on an anterior drawer test, despite 6 months of conservative treatment.

Clinical assessment included the physical examination of swelling, tenderness, range of motion, and strength. We used the Karlsson-Peterson Ankle Score[15] to evaluate postoperative outcomes, and functional assessments at final follow-up were graded according to the criteria of Okuda et al[24] (good, 90-100; fair, 75-89; poor, <75) (Table 1). We considered good (more than 90 points) as satisfactory improvement and fair and poor (less than 90) as unsatisfactory improvement.

At the preoperative and final follow-up examinations, we obtained anteroposterior and lateral weightbearing radiographs to assess the ankle for degenerative arthritis. Lateral mechanical instability was diagnosed using the TELOS device (TELOS, Weiterstadt, Germany), as described by Karlsson and Lansinger.[20] The criterion for diagnosing instability of the lateral side of the ankle was a side-to-side difference for talar tilt of 10° or more compared with the contralateral side. Anterior displacement of the talus was diagnosed when the tibiotalar distance was 4 mm or more. We excluded patients who showed diastasis of the ankle mortise, including an abnormal range of the tibiofibular overlap, a widened tibiofibular clear space, or medial clear space. We performed magnetic resonance imaging (MRI), including contrast-enhanced fat-suppressed 3D fast spoiled gradient-recalled acquisition in the steady state (CE 3D-FSPGR) images, to evaluate any associated injuries and ligament damage before the operation. This MRI technique was recently reported to have high sensitivity and specificity in diagnosing soft tissue impingement and syndesmosis injury in the ankle joint.[13,16,17,22]

The clinical results were analyzed using the paired sample t test. Bivariate associations between the number of intra-articular lesions and the clinical scores were examined using Pearson's correlation coefficient. Multivariate logistic regression analyses were used to assess intra-articular lesions independently associated with postoperative patient satisfaction. Odds ratios (ORs) were calculated with 95% confidence intervals (CI). Differences were considered significant at $P < .05$. These were performed by a statistician using SPSS statistical software (version 12.0.1; SPSS Inc, Chicago, Illinois).

TABLE 1
The Karlsson Scoring System (100 Points)

Characteristic	Points
Instability	
No instability	25
1 or 2 sprains each year (during exercise)	20
1 or 2 sprains each month (during exercise)	15
Walking on uneven ground	10
Walking on even ground	5
Constant (severe), using ankle support	0
Pain	
None	20
During exercise	15
Walking on uneven surface	10
Walking on even surface	5
Constant (severe)	0
Swelling	
None	10
After exercise	5
Constant	0
Stiffness	
None	5
Moderate	2
Marked (constant, severe)	0
Work, sports activities, and activities of daily living	
Same as preinjury	15
Same work, less sports, normal leisure activities	10
Light work, less sports, normal leisure activities	5
Severe impaired working capacity, decreased leisure activities	0
Stair climbing	
No problems	10
Impaired (instability)	5
Impossible	0
Running	
No problems	10
Impaired	5
Impossible	0
Support	
None	5
Ankle support during exercise	2
Ankle support during daily activities	0

Surgical Technique

The patient was positioned supine with a pneumatic tourniquet applied to the upper thigh. Noninvasive ankle distraction (15 pounds) was applied using an ankle harness, and intra-articular lesions were inspected with a 2.7-mm, 30°-angled arthroscope. During arthroscopy, soft tissue impingement was characterized by hypertrophic synovial and fibrotic scar tissue obliterating the joint space within the capsular reflection that corresponded to the injured and painful site of the ankle.[16,22] Syndesmotic instability was defined as the ability to displace the fibula laterally more than 2 mm with the shoulder of the probe while placed in the syndesmotic joint (Figure 1).[13,23] This criterion was based on the study by Close,[5] who reported that the maximum

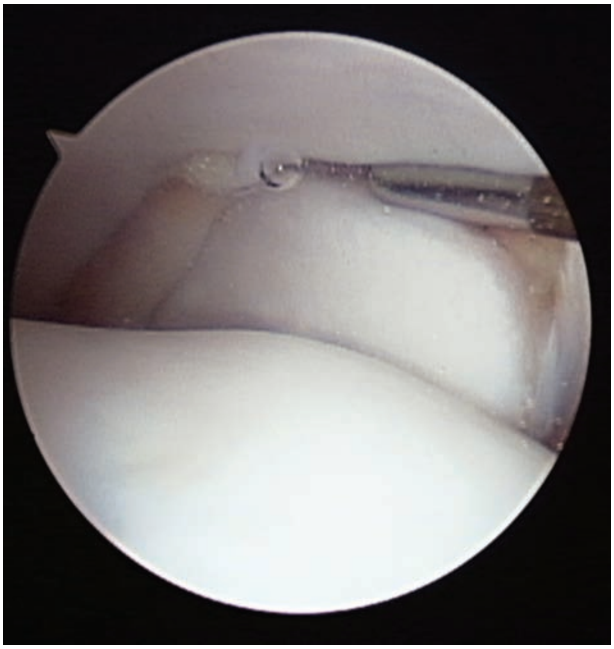

Figure 1. Arthroscopic view of syndesmosis widening in chronic lateral ankle instability.

widening of the intra-articular distal tibiofibular syndesmosis was approximately 1.5 mm in a normal ankle. Osteochondral lesions of the talus were debrided, and bone marrow stimulation, such as microfracture or abrasion arthroplasty, was performed. After arthroscopic inspection, anatomical reconstruction of the lateral ligament was performed using the modified Broström technique. The anterior talofibular ligament and calcaneofibular ligament were approached using a curved incision at the lateral malleolus area, avoiding injury of the sural nerve. In most cases, the anterior talofibular ligament presented with severe adhesion to the synovial membrane due to its anatomically thin, plate-like structure, while the calcaneofibular ligament was accurately identified with a moderate degree of adhesion. Each ligament was dissected and sutured to the anteroinferior area of the fibula using the transosseous suture technique. In addition, the inferior extensor retinaculum was augmented to the fibular periosteum. A 4-week postoperative short leg cast immobilization with partial weightbearing was followed by joint motion and muscle-strengthening exercises.[12,14]

TABLE 2
Clinical and Radiologic Results

	Preoperative	Postoperative	*P* Value[a]
Karlsson-Peterson Ankle Score			
Pain	6.76 ± 5.11	14.69 ± 6.17	<.001
Instability	6.61 ± 4.60	21.15 ± 5.64	<.001
Total	53 ± 14.63	85.21 ± 11.97	<.001
Stress radiograph			
Talar tilt angle, °	13.42 ± 7.57	5.45 ± 4.64	<.001
Anterior displacement, mm	7.87 ± 2.89	4.63 ± 2.66	<.001

[a]Paired sample *t* test.

RESULTS

Sixty-three of 65 ankles (96.9%) showed intra-articular lesions on arthroscopic evaluation, while 2 ankles demonstrated no lesions. Arthroscopic findings included soft tissue impingement (81.5%), ossicles at the lateral malleolus (38.5%), syndesmosis widening (29.2%), osteochondral lesion of the talus (23.1%), and osteophyte formation (10.8%). Debridement was performed for all intra-articular lesions, and removal of loose bodies and excision of osteophytes and microfractures were performed for specific lesions. The average preoperative Karlsson-Peterson Ankle Score was 53 ± 14.63, and this score improved to 85.21 ± 11.97 at the last follow-up ($P < .001$). The pain score (total 20 points) significantly improved from 6.76 ± 5.11 to 14.69 ± 6.17 ($P < .001$), and the instability score (total 25 points) also significantly improved from 6.61 ± 4.60 to 21.15 ± 5.64 ($P < .001$) (Table 2).

When considering a score more than 90 points as satisfactory and less than 90 points as unsatisfactory, syndesmosis widening was the strongest risk indicator for patients' lack of satisfaction, with the OR being 11.1 (95% CI: 2.2-55.4) compared with patients without syndesmosis widening. Patients with an osteochondral lesion of the talus and ossicles at the lateral malleolus had an 8.5-fold

TABLE 3
Associations Between Patient Satisfaction and Intra-Articular Lesions

	Satisfactory[a] (n = 46)	Unsatisfactory[b] (n = 73)	Odds Ratio (95% CI)[c]	*P* Value
Syndesmosis widening (n = 19)	5	14	11.1 (2.2-55.4)	.003
Osteochondral lesion (n = 15)	4	11	8.5 (1.7-42.3)	.008
Ossicles at lateral malleolus (n = 25)	10	15	4.5 (1.0-20.2)	.046
Soft tissue impingement (n = 53)	25	28	4.6 (0.7-28.8)	.095
Osteophyte formation (n = 7)	2	5	5.7 (0.5-59.5)	.141

[a]Karlsson-Peterson ankle score ≥90.
[b]Karlsson-Peterson ankle score <90.
[c]CI, confidence interval.

TABLE 4
Association Between Number of Intra-Articular Lesions and Clinical Results

Number of Intra-Articular Lesions	Mean Postoperative Karlsson Score[a]	Mean Improvement Between Preoperative and Postoperative Scores[b]
0	99.50 ± 0.70	48.50 ± 19.09
1	93.10 ± 4.37	45.57 ± 15.04
2	84.18 ± 9.81	27.62 ± 13.45
3	73.08 ± 14.92	20.58 ± 9.88

[a]Pearson's correlation coefficient (r) = –.604; P < .001.
[b]Pearson's correlation coefficient (r) = –.571; P < .001.

(95% CI: 1.7-42.3) and 4.5-fold (95% CI: 1.0-20.2) higher risk of dissatisfaction, respectively, compared to patients without these lesions. No association was found between patient satisfaction and soft tissue impingement or osteophyte formation (Table 3).

We classified the 65 ankles into 4 groups based on the number of intra-articular lesions. Two ankles showed no lesions, 19 ankles showed 1 lesion, 32 ankles showed 2 lesions, and 12 ankles showed 3 or more lesions. The best results were achieved in the no lesions group, followed by the 1-lesion group. Patients in the 2-, 3-, or more lesions groups scored lower. Pearson's correlation coefficient analysis showed a significant inverse relationship between the number of intra-articular lesions and Karlsson-Peterson Ankle Score (r = –.604; P < .001) (Table 4). Although there were no differences in the distribution of age or gender among the 4 groups (P = .369, P = .715, respectively), the duration of symptoms showed a significant positive relation with the number of intra-articular lesions (r = .541; P < .001).

The talar tilt angle based on stress radiographs was 13.42° ± 7.57° at the preoperative exam and was reduced to 5.45° ± 4.64° at the last follow-up examination (P < .001). Anterior displacement of the talus also significantly decreased from 7.87 ± 2.89 mm to 4.63 ± 2.66 mm (P < .001) (Table 2). The measurements of mechanical stability in the presence of intra-articular lesions also showed a significant improvement at follow-up compared with the preoperative values (P < .05) (Table 5). However, both the talar tilt and anterior displacement of the talus on stress radiographs had no statistically significant correlation with either the number of intra-articular lesions (P = .555, P = .264, respectively) or Karlsson-Peterson Ankle Score (P = .948, P = .847, respectively).

In the current study, there were no complications, including nerve injury, infection, or delayed wound healing. Three patients had residual instability of the involved ankle and grade 1 instability on physical examination at the last follow-up, but this did not affect their daily activities. Six patients had pain during activity, and 4 of these had 3 intra-articular lesions. Five patients lost slight range of motion compared to preoperative values, with an average loss of 5° of inversion and eversion. One patient showed slight weakness on eversion compared with the contralateral side. All were successfully treated with conservative measures and went back to their previous activity levels.

DISCUSSION

Inversion sprain is the most common type of injury to the ankle joint, and the majority of lateral ligamentous injuries of the ankle can be treated successfully with conservative treatment. If such measures fail, surgical repair or reconstruction of the injured lateral ligamentous structures should be considered.[1,10]

There are many nonanatomical reconstruction techniques for chronic lateral ankle instability, but since Gould et al[11] introduced the modified Broström technique for anatomical reconstruction, many authors have reported good results for augmentation of the extensor retinaculum to the fibula. Hamilton et al[12] reported good results in all but 1 in 28 cases treated using the modified Broström technique. They obtained good results in ballet dancers and stated that the procedure was suitable when normal ankle motion and preservation of peroneal tendon function were necessary. They also stated that osteochondral lesions of the talus, soft tissue impingement syndrome, loose body, peroneal tendon disorder, and other associated injuries could be other sources of postoperative pain in chronic ankle instability patients. Finally, they suggested that all intra-articular lesions must be diagnosed via thorough physical examination, radiographic imaging studies, and arthroscopic examination. To date, there have been few reports on surgical results with regard to intra-articular lesions in patients with chronic lateral ankle instability. In a study of 61 patients with chronic lateral ankle instability,

TABLE 5
Improvement of Mechanical Stability in Presence of Intra-Articular Lesions[a]

	Talar Tilt Angle, °		Anterior Displacement, mm	
	Preoperative	Postoperative	Preoperative	Postoperative
Syndesmosis widening	12.63 ± 6.14	4.57 ± 3.99	8.84 ± 2.30	5.83 ± 2.74
Osteochondral lesion	15.46 ± 8.34	7.77 ± 4.86	7.31 ± 3.08	5.67 ± 2.84
Ossicles	13.38 ± 5.60	6.04 ± 4.06	7.31 ± 3.23	4.61 ± 2.14
Soft tissue impingement	12.57 ± 7.72	4.72 ± 4.25	7.84 ± 3.00	4.44 ± 2.56
Osteophyte formation	19.14 ± 6.22	8.94 ± 4.90	8.50 ± 2.27	5.15 ± 2.87

[a]Results of the Wilcoxon signed rank test were all significant (P < .05).

DiGiovanni et al[7] reported 47 cases with peroneal tenosynovitis, 41 cases with anterolateral soft tissue impingement, 30 cases with synovitis, 16 cases with loose bodies, and 14 cases with osteochondral lesions of the talus. They also reported that the diagnosis and treatment of associated lesions can affect patient outcomes. Scranton et al[28] reported the relationship between bony spur and chronic ankle instability in a series of 35 cases and stated that 57% had an anterior bony spur or loose body, and there was no difference in the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale after removal of the bony spur. On the other hand, Cannon and Hackney[3] reported good results after removal of bony spurs in patients who had anterior impingement syndrome with chronic ankle instability. Komenda and Ferkel[21] found intra-articular lesions in 93% of 55 cases with ankle instability by arthroscopic examination. They did not identify a particular intra-articular injury that was associated with a poor prognosis. Okuda et al[24] reported chondral lesions in 63% of 30 ankles with instability. They found no correlation between focal chondral lesions and postoperative pain and concluded that persistent postoperative ankle pain after successful reconstruction of the lateral ligament may be caused by other intra-articular pathologic conditions, including synovitis, hypertrophic synovial thickening, soft tissue impingement, or deltoid ligament injuries. Hintermann et al[15] found arthroscopic evidence of cartilage injury in 66% of cases with chronic lateral ankle instability. They suggested that arthroscopic examination was a useful diagnostic tool in confirming associated intra-articular lesions in patients with chronic ankle instability. Taga et al[30] reported cartilage lesions in 95% of a chronic injury group and concluded that the longer the duration from the initial injury to surgery, the more severe the associated chondral lesions became. In the present study, the number of lesions was greater in the chronic group, which was related to a poor clinical outcome. For this reason, we predict that more chronic cases are associated with more severe intra-articular lesions and poor surgical outcomes.

Out of 65 cases in our study, 63 (96.9%) had intra-articular lesions, of which 53 cases (81.5%) showed soft tissue impingement as the most common associated lesion. Other associated intra-articular lesions included ossicles at the lateral malleolus (38.5%), syndesmosis widening (29.2%), and osteochondral lesion of the talus (23.1%). One of the notable features of this study is that we analyzed the clinical outcome relative to the presence of intra-articular lesions and have shown that the strongest risk indicators for patients' dissatisfaction were syndesmosis widening, osteochondral lesions of the talus, and ossicles. Syndesmosis widening has been recognized as one of the causes of prolonged ankle pain. Injury to the syndesmotic ligaments occurs as a result of external rotation forces, which often accompany inversion sprains. Teramoto et al[32] and Taylor et al[31] reported that a possible explanation for the increased incidence of recurrent sprains in patients with syndesmosis widening is decreased fibular mobility and altered ankle biomechanics. Disrupted distal fibular migration and fibular axial motion can alter normal ankle function. The resultant alteration in ankle function may predispose the ankle to inversion sprains. Therefore, after the distal tibiofibular syndesmosis is ruptured, healing is protracted, prognosis is guarded, and functional disability is not uncommon. Some controversy exists regarding the treatment method and the merits of screw fixation.[2,4,23] Han et al,[13] in accordance with Ogilvie-Harris and Reed,[23] suggested that soft tissue hypertrophy and its impaction inside the ankle joint might be the cause of pain and disability in chronic tibiofibular syndesmosis injury. They recommended arthroscopic marginal resection alone if it has been determined that there is no rupture of the medial deltoid ligament and, thus, no effect on the contact surface and maximal pressure of the ankle joint. In this study, there were no patients with medial deltoid ligament injury, so we did not perform reduction and screw fixation of the distal tibiofibular joint. Our proposed hypothesis is that poor functional outcome might be the result of residual instability of the distal tibiofibular joint after lateral ligament reconstruction, and we believe anatomical reconstruction of syndesmosis will be needed to restore syndesmosis stability. Several studies have shown that chronic lateral ankle instability is often associated with chondral lesions in the ankle.[15,21,24,34] Although it is clear that high contact pressure and shear stress adjacent to cartilage defects may interfere with normal cartilage function,[29,35] the relationship between osteochondral lesions and postoperative patient satisfaction after ligament reconstruction for chronic lateral ankle instability has not been well documented. In the present study, we performed marrow stimulation techniques, such as microfracture or abrasion arthroplasty, because previous clinical results indicate the relative success of these procedures.[14,26] It is our assertion that the marrow stimulation technique reduces weight stress on the area of cartilage repair, and the stress increment from weightbearing redistribution can produce damage in some healthy cartilage. Such a deleterious effect may explain the worse clinical outcome with osteochondral lesions in spite of a successful ligament reconstruction.

The associations between soft tissue impingement, osteophyte formation, and clinical results were weak. Soft tissue impingement is known to be strongly associated with osteochondral lesions due to the self-regeneration mechanism of synovial osteoprogenitor cells that migrate to the lesion site. However, there is disagreement about whether this would affect the clinical outcome.[6,9,33] Lee et al[22] described the diagnosis and arthroscopic treatment of soft tissue impingement in 38 patients with chronic ankle pain after trauma. The term "soft tissue impingement" included hypertrophic synovial and fibrotic scar tissue obliterating the joint space that corresponded to localized tenderness. In the current study, soft tissue impingement was noted at the time of arthroscopy in 53 of 65 (81.5%) cases; this high rate may be a response to coexisting intra-articular lesion or repetitive inversion stress to the ankle. The large number of soft tissue impingement cases indicates that this lesion may coexist with chronic lateral ankle instability more frequently than previously reported and may not be suitable for discrimination of prognosis. Moreover, we classified the patients into 4 groups according to the number of lesions, and the ankle score showed a significant decrease as the number of intra-articular lesions increased.

On stress radiographs, the talar tilt angle and anterior displacement of the talus showed significant postoperative improvement, but there was no significant difference in outcome among the 4 groups with different numbers of lesions.

Our study was limited because it was retrospective instead of prospective, and the patient groups were classified according to the number of lesions regardless of the type of lesion. Because the intra-articular lesions coexisted with other lesions, it is difficult to determine the exact effect of any specific lesion on the outcome. Using a multivariate logistic regression analysis limits the effect of this bias on the outcome of this study. We used a conservative cutoff of 90 points in the Karlsson-Peterson Ankle Score to define patient satisfaction, and this may have overestimated the number of dissatisfied patients. However, in our outpatient clinic, many patients with scores between 80 and 90 were not satisfied with their results at final follow-up. We would like to include in the "good" results only the patients who are really satisfied with their outcomes. The most noteworthy point of this study is the attempt to correlate the type and number of intra-articular lesions with patient outcome. Studies with a longer follow-up are necessary to assess the longevity of the correlation seen in this study and the effect of other factors on clinical outcomes after lateral reconstruction for chronic lateral ankle instability.

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