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Anterolateral Ankle Pain: Comparison of Two Areas of Clinical Anterolateral Pain Using Imaging and Arthroscopic Findings

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Abstract

Background: Anterolateral ankle pain is a common symptom after ankle sprain in athletes. Although the pathologic conditions producing anterolateral ankle pain have been researched, we still do not know the exact relationship between structural abnormality and anterolateral ankle pain. The aim of this study was to assess two distinct areas of anterolateral ankle pain by comparing magnetic resonance imaging (MRI) and computed tomography (CT) findings with those of arthroscopic examination.

Methods: From 2011 to 2014, a total of 32 ankles were examined. Preoperative physical findings, MRI and CT findings, and systematic arthroscopic examination were retrospectively reviewed. Abnormalities of two anterolateral ankle regions, the lateral shoulder and anterior talofibular ligament (ATFL), were recorded.

Results: Tenderness over the lateral shoulder region was present in 20 patients (62.5%) and tenderness over the ATFL region was present in 17 patients (54.1%). CT abnormalities were found in 28 patients (87.5%). MRI abnormalities were found in 25 patients (78.1%). On arthroscopy, 32 patients (97.0%) showed abnormalities in the anterolateral area. Statistical analyses showed correlations between pathology on imaging and arthroscopic examinations, and clinical pain. In the lateral shoulder region, synovitis/scar tissue and accessory (Bassett's) ligament correlated with clinical pain. In the ATFL region, an abnormal ATFL and osteochondrial lesions correlated with clinical pain.

Conclusion: Various pathological findings were observed on arthroscopic examination. Although anterolateral impingent syndrome is considered to be due to soft tissue impingement, osteocartilaginous abnormalities were identified in these patients. Inadequate care resulting in scar tissue formation and the presence of microinstability are possibly etiologic factors associated with abnormal findings. In order to prevent these conditions, improvements in the initial treatment of ankle injuries is warranted.

Keywords: Anterolateral ankle pain; Ankle sprain; Ankle instability; CT findings; MRI findings; Arthroscopic findings; Scar tissue

Abbreviations:

MRI: Magnetic Resonance Imaging; CT: Computed Tomography; ATFL: Anterior Talofibular Ligament; SD: Standard Deviation

Introduction

Lateral ligament injuries of the ankle are common in athletes. The majority of these patients can be treated conservatively [1,2]. However, patients with continuous pain and instability affecting their ability to participate in sports can be treated surgically [3]. Chronic anterolateral ankle pain is a common complaint following ankle sprain in athletes [4].

Although the exact definition of the anterolateral aspect of the ankle is ambiguous, the area typically referred to as anterolateral is composed of the capsule and ligament anteriorly, fibula laterally, talus medially and inferiorly, and tibia medially and superiorly. To date, arthroscopic examination and imaging studies have demonstrated a variety of anterolateral ankle pathologies [4-13].

With respect to the anterolateral region of the ankle, several pathologic conditions reportedly cause "anterolateral ankle impingement", including osteophytes, synovitis, thickened scar tissue, an accessory anterior inferior tibiofibular (Bassett's) ligament, and loose bodies. Anterolateral impingement is defined by the presence of the interposition of abnormal soft tissue [4,7,11].

Currently, MRI is a validated, noninvasive diagnostic tool to detect anterolateral impingement that is strongly associated with abnormality at arthroscopy [8]. Although anterolateral ankle impingement is now better understood, the exact relationship between structural abnormality and physical anterolateral ankle pain remains unclear.

In the clinical setting, there are two primary areas of pain in the anterolateral region: the lateral edge of the plafond (lateral shoulder) and the area over the anterior talofibular ligament (ATFL). Only a few studies have described the relationship between findings on clinical

examination and the presence of physical pain in these specific regions [8,13].

Furthermore, there are no published studies assessing the anterolateral ankle region divided into these two separate areas. The aim of this study was to assess the relationship between imaging and arthroscopic intra-articular abnormalities in these two distinct areas of anterolateral ankle pain.

Materials and Method

Between 2011 and 2013, the electronic medical records of consecutive patients who underwent ankle joint arthroscopy were reviewed. The study was a retrospective review of the medical records and hence did not require review by the Local Research Ethics Committee.

Patients with chronic ankle pain or laxity of the ankle joint after two months of conservative treatment, consisting of anti-inflammatory medication and physical therapy, were included in this retrospective study. An ankle specialist (KA) assessed ankle laxity by performing the talar tilt test and anterior drawer test.

These tests were considered positive if there was soft end feel to the translation of the talus. Patients with septic ankle arthritis, crystal ankle arthritis, osteoarthritis of the subtalar joint, those who had undergone previous ankle surgery, and those with a history of a foot or ankle fracture were excluded.

A total of 32 patients (21 males, 11 females) with an average age of 36.5 (±15.9 standard deviation [14]) years were included in this analysis. The average duration between the onset of symptoms and the day of surgery was 9.3 (±7.2 SD) months and the average duration of follow-up was 25.1 (±11.7 SD) months.

Physical assessment

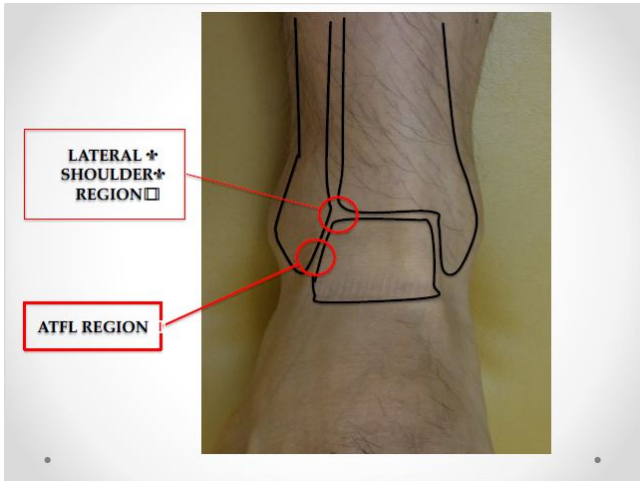

Figure 1: Two locations of tenderness over the anterolateral ankle area ATFL, anterior talofibular ligament.

The foot and ankle specialist (KA) assessed all patients preoperatively. Physical examination was performed for each ankle to determine if patients had tenderness over the anterolateral area.

To assess the point of tenderness precisely, we divided the anterolateral area into two regions: the lateral shoulder region and the ATFL region (Figure 1). The presence of tenderness was recorded in all patients. On clinical examination, there was no foot deformity or systemic hyperlaxity in any patient.

Imaging assessment

All patients were examined preoperatively by non-enhanced MRI and non-enhanced CT. CT studies were performed on a 16-slice CT (Bright Speed Elite, GE Healthcare, Milwaukee, USA) with a 0.625 × 16 mm detector or a 64-slice CT (Discovery CT750 HD, GE Healthcare, Milwaukee, USA) with a 0.625 × 64 mm detector.

CT findings, including osteophytes and osseous fragments in the lateral edge and ATFL regions, were evaluated. MRI studies were performed on a 3.0T-MRI unit (Verio, Siemens AG, Erlangen, Germany) or a 1.5T-MRI unit (Optima 450w, GE Healthcare, Milwaukee, USA). For the Verio, MR images included coronal and axial short tau inversion recovery (STIR) images (TR/TE/TI/FA = 5000/77/220/150) and T1WI images (TR/TE/FA = 600/10/150).

Each slice was 4 mm thick, and the slice gap was 0.5 mm. The field of view was 16 cm, and the matrix size was 320 × 256 mm in all images. With the Optima 450w, MR images included coronal and axial STIR images (TR/TE/TI/FA = 6000/52/150/160) and PDWI images (TR/TE/FA = 2500/22/160).

Each slice was 4 mm thick, and the slice gap, 0.5 mm. The field of view was 16 cm, and the matrix size was 320 × 224 mm in all images. MRI findings, including synovitis, scar tissue, and abnormal ATFL and osteochondral lesions in the lateral shoulder and ATFL regions, were evaluated.

A board-certified radiologist experienced in musculoskeletal radiology (13 years of experience) retrospectively reviewed MR and CT images while blinded to clinical and arthroscopic findings (Figures 2 and 3).

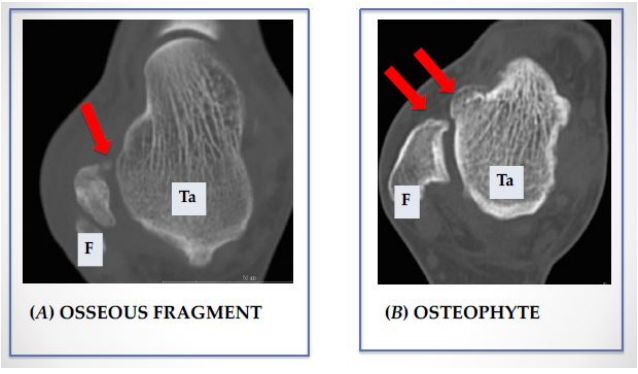

Figure 2: Abnormal CT findings: (A) Axial image showing an osseous fragment in the ATFL region, (B) Axial image showing an osteophyte in the ATFL region (F: fibula; Ta: talus).

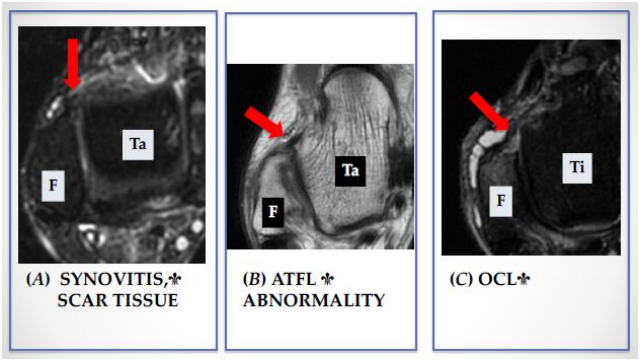

Figure 3: Abnormal MRI findings: (A) Axial T2 image showing synovitis and scar tissue in the lateral shoulder region (arrow), (B) Axial T1 image showing ATFL thickening (arrow), (C) Axial T2 image showing an osteochondral lesion in the lateral shoulder region (arrow)(F: fibula; Ta: talus; Ti: tibia; OCL: osteochondral lesion).

Arthroscopy method

Ankle arthroscopy was performed in all patients under general anesthesia by a single surgeon (KA). The limb was prepared in the usual fashion. Topographic landmarks of the anterior aspect of the ankle were identified. A non-invasive distraction device and an automated inflow pump system administering isotonic saline were used in all patients. A tourniquet was used only when scope visibility was impaired because of bleeding. A 2.7-mm 30-degree arthroscope, 2.9-mm shaver, and burr were used. Anteromedial and anterolateral portals were performed using blunt dissection with straight mosquito forceps to avoid injury to the superficial peroneal nerve, and penetration of the joint capsule was accomplished using a trocar with a rounded tip. Exploration of the ankle joint was performed in a systematic manner (Figure 4). All surgeries were recorded in DVD format from the beginning to the end of the procedure. The recordings were reviewed by the author (KA). The assessment of anterolateral lesions was made based on the presence of intra-articular pathologies including synovitis, scar tissue, Bassett's ligament, osseous fragment, abnormal ATFL, and osteochondral lesions in the lateral edge and ATFL regions. Appropriate postoperative care tailored to each patient was provided.

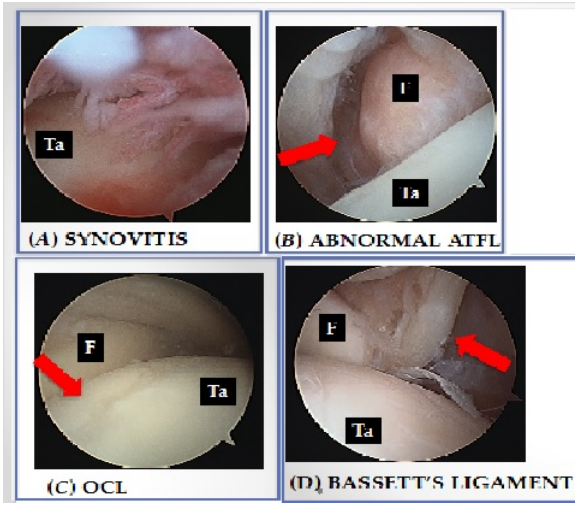

Figure 4: Abnormal arthroscopic findings: (A) Synovitis in the lateral shoulder region, (B) Torn ATFL in the ATFL region (arrow), (C) OCL in the lateral shoulder region (arrow), (D) Bassett's ligament in lateral shoulder region (arrow) (F, fibula; Ta, talus; Ti, tibia; OCL, osteochondral lesion).

Statistics analysis

Chi-squared tests were used to compare the results of CT and MRI versus arthroscopy. A level of $p<0.05$ was considered statistically significant; all statistical tests were two-tailed. Data were analyzed using IBM SPSS statistics software version 22.0 J (IBM, Tokyo, Japan).

Results

Individual patient findings are listed in Table 1. Almost all patients showed some abnormalities on both imaging and arthroscopy, regardless of physical tenderness.

No.	age	gender	tenderness (LS)	tenderness (ATFL)	CT (LS)	CT (ATFL)	MRI (LS)	MRI (ATFL)	arthroscopy (LS)	arthroscopy (ATFL)
1	53	male	1	0	1	2	1,2	1,2	2,4	1,4
2	28	female	0	0	0	2	0	0	1	4
3	30	male	0	0	1	0	4	0	3	1
4	30	male	1	1	1	1,2	1,2	1	1,2	1,3
5	32	male	1	0	1	1,2	1,2	1	1,2	1,3
6	27	male	1	1	1	1,2	1,2	1	1,2	1,3
7	19	male	1	1	1	1,2	1,2	1	1,2,4	1,3
8	19	male	0	1	0	0	1	0	1	1

9	44	female	0	1	0	0	0	0	0	0
10	49	male	1	0	1	1	1,2	1,2	1,4	1,4
11	21	male	1	1	1	2	0	0	1,2	1,3
12	29	male	0	0	1	0	2	1,2,3	0	0
13	20	male	1	1	1	0	0	0	1,2	0
14	24	female	0	1	1	2	0	0	1,3	0
15	44	male	0	1	0	2	0	0	1,4	1
16	30	female	1	0	1	1	1,2	0	1	1
17	49	male	1	1	1	1	1	1,2	1,2	3
18	40	male	0	1	1,2	1	1,2	1,2,3	1	1,3
19	29	male	1	1	2	1	0	1,2	1	1,3
20	64	female	1	1	1	1	1,2	1,2,3	1,4	1,2,3,4
21	21	male	1	1	2	0	1	1,2	1	1
22	21	male	0	0	0	0	1	0	2	1
23	27	female	1	1	0	0	1	1	1	3
24	18	female	0	0	0	1	1	1,2	1	3
25	36	female	1	0	0	0	0	1	1,2	3
26	40	male	1	0	1,2	1,2	1	1	1,3	1,2,4
27	64	male	1	0	1	1,2	1,2	1	1,3	2,4
28	57	female	1	0	0	0	1	1	2	1,4
29	67	female	0	0	1	1	1,2	1	1,3,4	1,2,4
30	73	male	1	0	1,2	1,2	1,2	1,3	1	1,3
31	20	female	1	1	0	0	1	0	1	0
32	43	male	0	0	1	0	0	0	1	1
LS: lateral shoulder; ATFL: anterior talofibular ligament; OCL: osteochondral lesion										

Table 1: Patient abnormalities on clinical, radiographic, and arthroscopic evaluation. TENDERNESS: 0: No pain 1: Pain
CT (LS): 0: Normal 1: Osteophyte 2: Osseous fragment
CT (ATFL): 0: Normal 1: Osteophyte 2: Osseous fragment
MRI (LS): 0: Normal 1: Synovitis, Scar tissue 2: Osteochondral lesion
MRI (ATFL): 0: Normal 1: Synovitis, Scar tissue 2: Abnormal ATFL 3: OCL
ARTHOSCOPIC FINDING (LS) 0: Normal 1: Synovitis, Scar tissue 2: Bassett's ligament
3: Osseous fragment 4: OCL
ARTHOSCOPIC FINDING (ATFL) 0: Normal 1: Synovitis, Scar tissue 2: Osseous fragment
3: Abnormal ATFL 4: OCL

Physical examination

Twenty-six patients (81.3%) showed tenderness over the anterolateral aspect: 20 (62.5%) had a lateral shoulder lesion, 17 (54.1%) had an ATFL lesion, and 11 (34.4%) had lesions in both regions.

Preoperative CT revealed bony abnormalities on the anterolateral aspect in 28 patients (87.5%). Concerning lateral shoulder lesions, 20 patients (62.5%) had bony spurs and 5 patients (15.6%) had osseous fragments. With regard to ATFL lesions, 15 patients (46.9%) had bony spurs and 12 patients (37.5%) had osseous fragments.

Preoperative MRI revealed abnormalities on the anterolateral aspect in a total of 25 patients (78.1%). Twenty-three patients (71.9%) had abnormalities of the lateral shoulder, including synovitis/scar tissue and osteochondral lesions, in descending order of frequency. Twenty patients (62.5%) had abnormalities of the ATFL region, including

synovitis/scar tissue, abnormal ATFL, and osteochondral lesions, in descending order of frequency.

On arthroscopy, 30 patients (97.0%) showed abnormalities of the entire anterolateral aspect. Thirty patients (97.0%) showed abnormalities of the lateral shoulder region, including synovitis/scar tissue, Bassett's ligament, osteochondral lesions, and osseous fragments, in descending order of frequency. Twenty-seven patients (84.4%) showed abnormalities of the ATFL region, including synovitis/scar tissue, abnormal ATFL, osteochondral lesions, and osseous fragments, in descending order of frequency.

Statistical analysis showed that abnormal radiographic and arthroscopic findings correlated with clinical pain. In the lateral shoulder region, synovitis, soft tissue scarring, and Bassett's ligament correlated with clinical pain. In the ATFL region, abnormal ATFL and osteochondral lesions correlated with clinical pain (Table 2).

Findings	LSpain (n=20)	ATFL pain (n=17)
CT osteophyte	0.29	0.63
CT ooseous fragment	0.37	0.54
MRI synovitis, scar tissue	0.03*	0.46
MRI abnormal ATFL	-	0.29
MRI OCL	0.15	0.65
A-S synovitis, scar tissue	0.12	0.31
A-S Bassett ligament	0.018*	-
A-S osseous fragment	0.261	0.25
A-S Abnormal ATFL	-	0.03*
A-S OCL	0.6	0.01*
*significance of p<0.05, Chi-squared test		
A-S: arthroscopy; ATFL: anterior talofibula ligament; OCL: osteochondral lesion		

Table 2: Correlation between clinical pain and abnormal findings.

Discussion

A number of studies have reported on anterolateral ankle pain [4-13]. Wolin [15] first described anterolateral soft tissue impingement as early as 1950. Bosien et al. [16] reported that one-third of acute ankle sprain patients develop chronic pain. To determine the exact cause of anterolateral ankle pain, various intra-articular abnormalities have been confirmed by imaging and arthroscopic examination [13]. Symptoms from the anterolateral area of the ankle occur when there is a build-up of scar tissue that is not physiologically present. Instability subsequent to a sprained ankle produces synovitis and a prominent soft tissue mass, ultimately resulting in anterolateral ankle impingement [4]. To date, anterolateral ankle impingement is thought to be the result of pathological soft tissue growth [4-6,13].

The current study shows that there are various abnormalities of the anterolateral ankle region. Six of our patients showed no tenderness over the anterolateral aspect, despite the presence of abnormalities on imaging and arthroscopy. In the lateral shoulder region, our findings showed that the presence of synovitis and scar tissue on MRI correlated with clinical anterolateral pain. In terms of scar tissue, the etiology and mechanism of its formation remains poorly understood. However, recent studies have revealed the mechanism of pathologic scarring [17,18]. Ishise et al. [17] concluded that repetitive mechanical stretching activates TRPC3 channels in fibroblasts, leading to increased production of fibronectin, a regulator of wound scarring. In the light of this data, the fact that a scar tissue mass can produce anterolateral ankle pain highlights the importance of immobilization and rest after ankle injury. Although early initiation of range of motion exercise is currently felt to improve outcomes, immobilization after ankle injury should be reconsidered in an effort to prevent scar tissue formation and subsequent disability. The same can be said regarding management following arthroscopic debridement procedures. Early range of motion training after arthroscopic debridement could lead to the formation of secondary scar tissue, as previously reported [19].

Bassett's ligament is another well-known finding associated with lateral ankle pain [20]. Despite arguments over its prevalence as a normal variant or its association with ankle instability, Bassett's ligament is an accepted possible cause of anterolateral pain [20,21]. Considering the lack of knowledge concerning functional alteration following surgical removal of Bassett's ligament, careful surgical procedures are needed in order to avoid producing damage to the main body of the anterior inferior tibiofibular ligament.

In the present study, we found that an abnormal ATFL and osteochondral lesions on arthroscopy correlated with clinical pain in the ATFL region. A previous study showed that, despite no demonstrable abnormal lateral laxity, morphologic ATFL abnormality can be observed on arthroscopic evaluation [13]. Morphologic ATFL abnormality causes microinstability that can lead to osteochondral lesions and soft tissue impingement in the ATFL region. In terms of osteochondral pathology, previous reports refer only to talar dome osteochondral lesions [22,23]. Other studies have shown that ATFL insufficiency leads to a significant increase in internal rotational instability in the transverse plane [24-26]. This instability results in microtrauma, causing osteochondral lesions of the lateral and medial ankle joint. It is important to realize that osteochondral lesions cause not only trauma but also instability. The locations of osteochondral lesions caused by instability were varied in the current study. Evaluation for osteochondral lesions requires careful inspection due to the potential to miss them at the tip of the lateral malleolus (within the ATFL region) because of narrowing, proliferative synovitis, and scar tissue.

There are several types of impingement that can occur in the ankle joint, including anterior, anterolateral, anteromedial, posterior, and posteromedial impingement [12]. Anterolateral ankle impingement is often considered to be a result of abnormal soft tissue. The current study revealed that osteocartilaginous tissues are potentially associated with clinical pain. As with anterior impingement, bony injury and cartilage damage result in anterolateral osteophytes with associated synovitis and scarring of the soft tissue. To better treat the underlying pathologic condition, anterolateral impingement should be considered a result of both soft tissue and osteocartilaginous growth. When evaluating these lesions, one must consider the fact that these soft tissue and osteochondral abnormalities may be old and asymptomatic. It is crucial to carefully assess ankle status by evaluating changes in physical activity and time course following acute injury.

This study has several limitations. All abnormal findings are poorly defined, and the best method of assessing these abnormalities remains controversial. In fact, in some cases, the same pathologic findings, such as an abnormal ATFL, showed no correlation with clinical pain when

diagnosed by MRI but did correlate when diagnosed arthroscopically. Another limitation is that only a small number of patients were reviewed, and this study was retrospective in design. Future prospective clinical trials enrolling a larger population, and taking into account the patient's duration of symptoms in relation to injury and activity level, are warranted.

Conclusion

In conclusion, patients affected by anterolateral ankle pain have intra-articular pathologic findings that may include both soft tissue and osteocartilaginous tissue abnormalities. In the anterolateral ankle, pain in the lateral shoulder region and the ATFL region showed different clinical findings. Although abnormal soft tissue was thought to be the cause of clinical pain in the lateral shoulder region, abnormal osteocartilaginous tissues were more common in the ATFL region. Inappropriate care resulting in scar tissue formation and the presence of microinstability are possible origins of abnormal findings. Future studies assessing the most beneficial treatment modalities for ankle injury are warranted.

Conflict of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this study.

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