Accuracy of clinical and radiological assessment of lateral ankle instability

Samer Ali[1], MD and Moheib Ahmed[2], MD

1- Lecturer of Orthopedic Surgery, Mansoura University, Egypt
2- Associate professor of Orthopaedic surgery, Mansoura University, Egypt

Corresponding Author: Samer Ali, MD, EBOT
Department of orthopaedic and trauma surgery, Mansoura University Hospital, *Egypt*
E-mail:drsamer200@gmail.com
Tel: 00201005705951

The Egyptian Orthopedic Journal; 2022 supplement, December, 57: 44-49

ABSTRACT:

Background:
Ankle instability is a major cause of symptoms following an ankle sprain and is considered one of the most prevalent disabling diseases. With a thorough history and examination, appropriate additional investigations including cross-sectional imaging, and thoughtful interpretation of the information, one should rarely be caught out by misdiagnosis, multiple diagnoses or unusual underlying causes. Radiological modalities which include ultrasound, MRI, Stress radiography and arthroscopy play a role in the diagnosis of chronic ankle instability. However, their sensitivities and specificities differ among each other's and also among various researches. The aim of the current study was to asses different imaging modalities in diagnosis of chronic lateral ankle instability.
Patients and Methods:
This study was conducted at Mansoura University Hospital, Foot and Ankle Unit from 2018 to 2021 on 20 patients diagnosed as chronic lateral ankle instability with persistence of the symptoms 12 months after the initial trauma.
Results:
MRI demonstrated higher efficacy in terms of the diagnosis of Lateral Ligament instability of the ankle joint compared to Ultrasound and stress radiography.
Conclusion:
The current study demonstrated that, MRI and stress radiography had significant agreement with arthroscopy in terms of the diagnosis of lateral ankle instability. MRI had high sensitivity but low specificity; however stress radiograph and ultrasound proved to be very specific.
Keywords:
Chronic ankle instability, ATFL, CFL, anterior drawer test, stress radiography, ankle arthroscopy.

INTRODUCTION:

Ankle sprain is one of the most common sport injuries. The lateral ankle ligaments may be injured by a foot plantar flexion movement that combines inversion and adduction [1-3]. Around 85% of ankle sprain cases lead to lateral ligamentous complex injury [4, 5], which is composed of anterior talofibular ligament (ATFL), calcaneofibular ligament (CFL), and posterior talofibular ligament (PTFL) [6].

The most frequently injured structure is the ATFL (in about 65% of cases), which is particularly prone to strain and injury while the ankle joint is plantar flexed [7]. Combination injuries to both the CFL and ATFL are the second most frequent type of injury representing about 20% of cases. Rarely does the CFL show a single rupture [8]. Unless there is a major ankle joint dislocation, the PTFL is rarely affected [9, 10]. Ankle joint laxity may result in mechanical limitations once the lateral ligaments are initially injured. Recurrent periods of instability and weakness of the lateral ligamentous complex may result from these abnormalities. Additionally, sensory deficits that cause ongoing discomfort, a sense of instability, and a dread of further harm can appear. This changed kinematics; weakness, poor reflexes, and diminished neuromuscular control are caused by these mechanical and sensory deficits. Finally, this results in a vicious cycle of mechanical, sensory, and motor deficits, which fuel persistent instability of lateral ankle [11]. In addition to being disabling, lateral ligament instability can cause post-traumatic arthritis, a disease that is even more serious. Understanding the ligamentous complex, which stabilizes the lateral ankle and mechanism of failure for each individual component is necessary for accurate diagnosis and treatment of this problem [9, 12, 13].

There are several classifications for lateral ligament instability, yet the optimal classification scheme is still point of debate. According to a widely used classification system, grade I injury is defined as damage to the ATFL and/or CFL but not a complete rupture of either component. The ATFL completely ruptures with a grade II injury, although the CFL exists. The ATFL and CFL are often completely torn apart in a grade III injury. Injury to the PTFL may or may not occur in Grade III injuries [7].

Clinically, Patients frequently report ankle twisting injuries experienced during athletic activity like running, cutting, or jumping, often associated with crackling or popping sound. This is commonly followed by ankle pain, swelling, and ecchymosis. Patients with severe wounds won't be able to put weight on the injured extremity [9].

A useful method for assessing lateral ligamentous injury is a physical examination. Routine physical examination includes assessment of oedema, ecchymosis, deformities, open wounds, tenderness, and range of motion in addition to point palpation of anterior talofibular and calcaneofibular ligaments, tendons of peroneal muscles, fifth metatarsal base, and lateral malleolus. The diagnosis of lateral ligament instability may be aided by stress tests, such as anterior drawer as well as talar tilt. It is equally important to assess the risk conditions such as pes cavus, and generalized laxity of the ligaments [9].

Importantly, diagnostic radiological tools such as Magnetic resonance imaging, ultrasonography, stress radiography, and arthrography are frequently implicated as diagnostic tools for the lateral ankle ligamentous injury [14]. However, the accuracy of clinical assessment and the radiological tools in the diagnosis of lateral ankle instability is still controversial. Thus, we aimed to compare the accuracy of clinical physical assessment and radiological imaging techniques in the lateral ankle ligamentous injury and instability.

PATIENTS AND METHODS

This study was conducted at Mansoura University Hospital, Foot and Ankle Unit from 2018 to 2021 on 20 patients diagnosed as chronic lateral ankle instability. The inclusion criteria were positive history recurrent ankle sprains, chronic lateral ankle pain persisting more than one year or repeated ankle giving way. Patients with history of previous ankle fractures, previous ankle surgery or patients with neuropsychiatric disorders were excluded from this study.

All the patients were evaluated by careful history taking which includes the mode of the 1st traumatic event, frequency of ankle sprains and time of the last sprain.

Clinical assessment was done for all patients using stress clinical tests. Anterior drawer testing was done to investigate the strength of the ATFL (Fig 1A). An aberrant translation of 5 mm or more was considered as a sign of ATFL injury. Talar tilt test was done to for asses the integrity of the ATFL and the CFL (Fig 1B). Increased talar tilt more than 5 degrees in comparison to the contralateral side was considered to be positive.

Ultrasound assessment was done for all patients by a specialized radiologist with 15 years' experience. Ultrasound (US) was performed in the resting position (US resting) and in the maximal anterior drawer position (ATFL stress) (Fig 2).

A  B 

Fig 1. Stress Tests: A) Anterior drawer test to assess the integrity of the ATFL. The left hand used supports the leg. Fingers of right hand cup calcaneal tuberosity posteriorly and the thumb is placed on lateral malleolus B) Talar tilt test to assess the integrity of the ATFL and CFL. Positive talar tilt test due to increased talus inversion because of CFL injury.

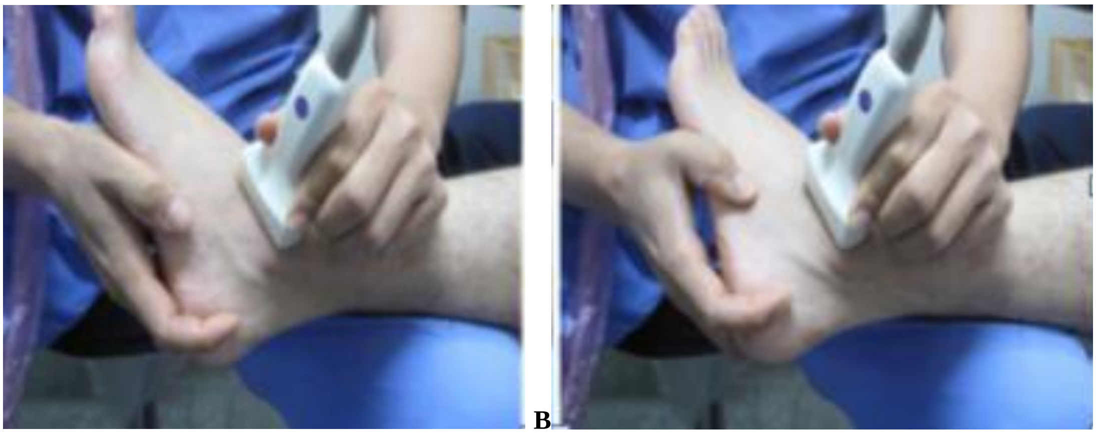

Fig 2. Ultrasound (US). The patient's leg is placed on the examiner's knee, ankle joint in slightly flexed (ca 15° plantar flexion). The transducer is positioned on ATFL parallel to the sole. Both resting position (A) and stress position (B) were examined via US.

Magnetic resonance imaging (MRI) was done for all patients where the patients' feet were kept in the neutral position. We noticed that the axial view was the most beneficial for assessing ATFL (Fig 3). Ligament Non-visualization, enhanced signal intensity inside the ligament, an aberrant course, and a wavy, irregular shape of the ligament were all diagnostic criteria for a ligamentous injury. Bilateral ankle stress radiography was applied.

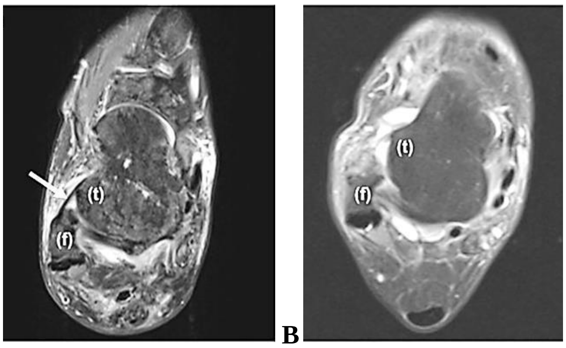

Fig 3. Magnetic resonance imaging (MRI). A) Normal ATFL (white arrow) appears as wide black line extending between the fibula (f) and the talus (t). B) ATFL tear, with disrupted ligamentous spanning between the fibula (f) and talus (t) (adapted from [9]).

For clinical assessment, the anterior drawer stress was applied. The lateral radiography was implicated for the assessment of talus anterior translation. The degree of talus anterior displacement was estimated between the tibial posterior lip and the closest articular surface of the talus. ATFL injury was considered when aberrant translation of 5 mm or more was found. Inversion stress to hind foot was applied. The angle formed by tibial plafond and talar dome was measured using AP radiography. Talar tilt greater than 10–15°of the injured ankle or a 5° difference in Comparison to the contralateral ankle indicate ligamentous injury.

Ankle arthroscopy was done for patients with persistent symptoms at least one year with no satisfactory results after all conservative measures (physical therapy, orthosis and medical treatment). Ankle arthroscopy was done using a 2.7-mm ankle arthroscope via standard anteromedial as well as anterolateral portals. Diagnostic criteria for determination of a ligamentous injury included an aberrant course, reduced tautness and ligament discontinuity with or without fibrous tissue-filled defect, and ligament avulsion from its attachment.

Results obtained from ankle arthroscopy were compared with those acquired via the clinical examination and the three used diagnostic imaging modalities (MRI, US and stress radiography). Data analysis was done by SPSS software Version 25.0. (IBM Corp, 2017).

RESULTS

This study was conducted at Mansoura university hospital on a total of 20 patients, 10 males and 10 females with mean age 26.7 ± 6.5 (range from 18 to 42 years) with post-traumatic lateral ankle tenderness, swelling, worsening of lateral ligament pain under stress and repeated giving way (14 patients were right sided affection while 6 patients were left sided) during the period from July 2019 to July 2020 after obtaining the approval from institutional review board (IRB), Faculty of Medicine, Mansoura University.

The clinical assessment demonstrated that 50% of the patients (10 cases) were positive as regards anterior drawer test and talar tilt test, while the other 50% of patients (10 cases) were negative (Fig 4A).

Our results showed that US had the ability to diagnose lateral ankle ligament instability with a sensitivity of 42.9%, specificity of 100%, positive predictive value (PPV) of 100%, negative predictive value (NPV) of 42.9% and accuracy 60%. US demonstrated insignificant correlation with arthroscopy in terms of the diagnosis of lateral ankle ligament instability (P>0.05) (Table 1, Fig 4B, D).

We found that MRI had the ability to diagnose lateral ankle ligament instability with a sensitivity of 100%, specificity of 33.3%, PPV of 77.8%, NPV of 100% and accuracy 80%. MRI was demonstrated to be significantly correlated with arthroscopy in terms of the diagnosis of lateral ligament instability of the ankle joint (P=0.02) (Table 1, Fig 4C, D). Stress radiography had the ability to diagnose lateral ligament instability of the ankle joint with a sensitivity of 71.4%, specificity of 100%, PPV of 100%, NPV of 60% and accuracy 80%. Stress radiography was demonstrated to be significantly correlated with arthroscopy in terms of the diagnosis of lateral ankle ligament instability (P=0.003) (Table 1).

Table 1. Comparison between ultrasound, magnetic resonance imaging and stress radiography in diagnosis of lateral ankle ligament instability.

Parameters	Ultrasound	MRI	Stress radiography
Sensitivity	42.9	100	71
Specificity	100	33.3	100
Positive predictive value (PPV)	100	77.8	100
Negative predictive value (NPV)	42.9	100	60
Significance Correlated to arthroscopy	(P>0.05)	(P=0.02)	(P=0.003)
Accuracy	60	80	80

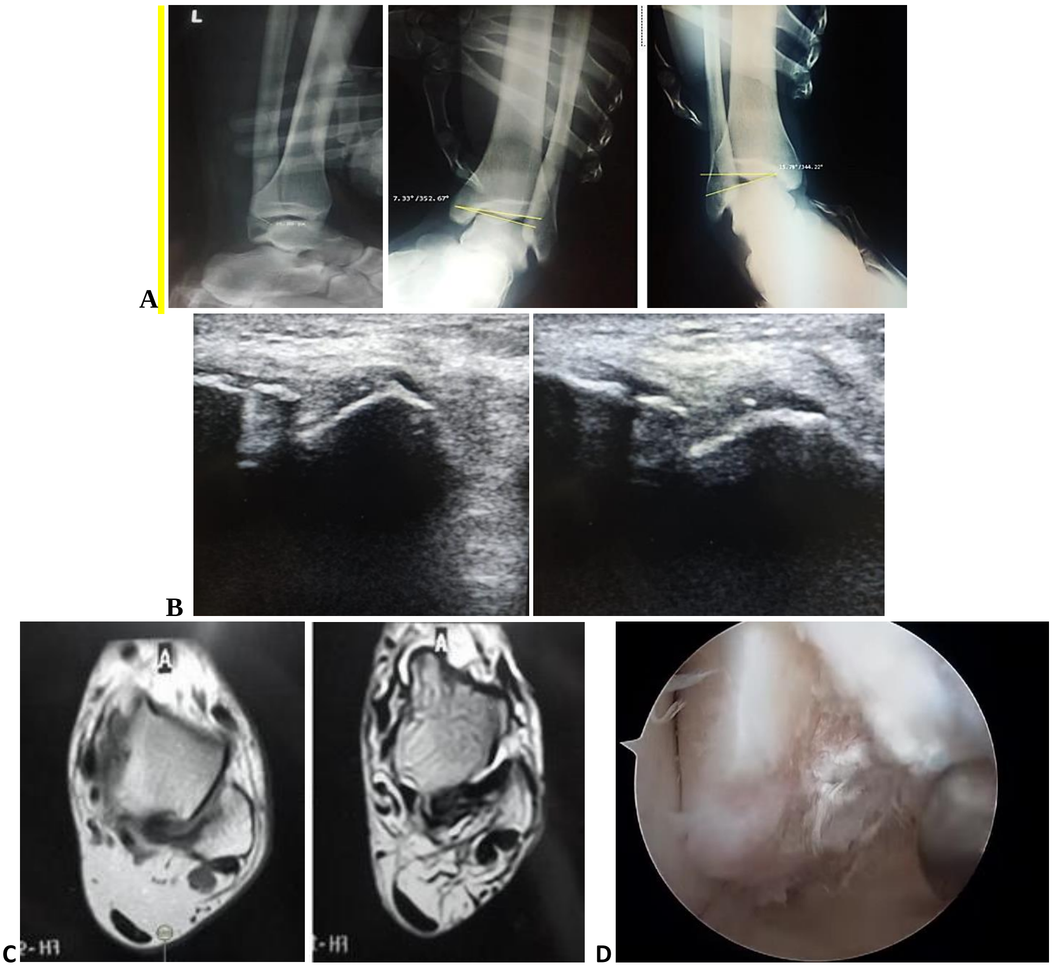

Fig 4: Patient 1, A) Ant drawer stress xray,ant translation of the talus on the tibia=12,5 mm in the Rt side and 9 mm in the lt side. Talar tilt stress xray, talar tilt angle to the Rt side =15,5 degrees and to the Lt side=7,3 degrees. B) Ultrasonography showing avulsion of the fibular attachment of the lateral collateral ligament. C) MRI showing torn ATFL. D) Arthroscopy showing torn ATFL.

DISCUSSION

Ankle instability is one of the main complications after ankle sprain of and is considered as one of the most prevalent disabling diseases. In addition to carful history taking and clinical examination, appropriate investigations such as imaging, are necessary to avoid misdiagnosis [15]. Generally, radiological modalities including direct methods like stress radiography and indirect methods such as peroneal tenography, ultrasound, and MRI are able to assess mechanical but not functional instability. The use of higher sensitive tools including US, MRI, and arthroscopy spot the light on the limitations of radiographic-based tools such as stress radiography and peroneal tenography in diagnosing ligament injury. Thus, recently it is recommended for the assessment of ankle injury to shift from radiographic-based techniques to cross-sectional examinations [16].

In terms of the anterior drawer and talar tilt tests, the half of our patients (10 cases) showed positive findings, while the other half (10 cases) were negative. Thus, such tests couldn't be used as reliable tests in the context of diagnosis of Lateral Ligament instability of the Ankle joint.

Fujii and his colleagues demonstrated that the manual anterior drawer test has low reliability, most likely because the average of significant clinical talocrural laxity is limited and varies greatly, making it difficult to detect with a manual test [17]. In harmony with current study, Gaebler and his colleagues demonstrated that, The accurate lateral ankle ligament pathology couldn't be determined via the talar tilt test, however, it represents a reliable indication for a total double-ligament tears (ATFL and CFL) in cases showing talar tilt of 15 degrees or greater than the healthy side [18]. As regards the comparison between US and arthroscopy in evaluation of ankle lateral ligament instability, US demonstrated insignificant correlation with arthroscopy in terms of the diagnosing ankle lateral ligament instability (P>0.05).

In addition, the current study demonstrated that, US is capable of diagnosing lateral ankle ligament instability and shows a 42.9% sensitivity, 100% specificity, 100% PPV, 42.9% NPV of and 60% accuracy. This is in agreement with, Mokbel and colleagues who demonstrated that, that US exhibit a 75% sensitivity, 100% specificity and 92.2% accuracy in detection of tears of lateral ankle ligament [19]. As regards to the comparison between MRI and arthroscopy for diagnosing lateral ankle ligament instability, MRI was demonstrated to be significantly correlated with arthroscopy in terms of evaluation of lateral ankle ligament instability (P=0.02). The present study revealed that, MRI was able to detect lateral ankle ligament instability showing 100% sensitivity, 33.3% Specificity, 77.8% PPV, 100% NPV and accuracy of 80%. This is in disagreement with Kumar and his colleagues who demonstrated that the sensitivity and specificity of the MRI was poor for diagnosis of lateral ankle ligament instability (Sensitivity 50% and specificity of 86.2%) [20] as well as with a previous report showing low diagnostic efficacy of MRI [21].

These discrepancies may be due to including patients who exhibit subjective instead of clinical signs of lateral ankle ligament instability. Noteworthy, accuracy of MRI exhibit some limitations because of anatomical variations of TAFL and CFL that render them challenging to be identified in magnetic resonance sequences [22].

In terms of comparison between Stress and arthroscopy for diagnosing lateral ankle ligament instability, stress radiography was demonstrated to be significantly correlated with arthroscopy in terms of evaluation of lateral ankle ligament instability (P=0.003).

The present study revealed that, stress radiography is capable of diagnosing lateral ligament instability of the ankle joint with a sensitivity of 71.4%, Specificity of 100%, PPV of 100%, NPV of 60% and accuracy 80%. Thus, stress radiography demonstrated a very high specificity (100%) and reasonable sensitivity (71.4%) as regards lateral ligament instability of the ankle joint diagnosis. In the same line, Jolman et al. (2017) demonstrated that, stress radiography is able to diagnose lateral ligament instability of the ankle joint with a sensitivity of 66.1%, specificity of 97.3%, PPV of 98.7%, NPV of 48% and accuracy 74% [14].

CONCLUSION

Radiological modalities used for diagnosis of chronic lateral ankle ligament instability which include US, MRI, stress radiography and arthroscopy are important tools in the diagnosis of chronic ankle instability. However, their sensitivities and specificities differ among each other's and also among various researches.

The current study demonstrated that, MRI and stress radiography had significant agreement with arthroscopy in terms of the diagnosis of lateral ankle instability. MRI had high sensitivity but low specificity; however stress radiograph and ultrasound proved very specific.

REFERENCES:

1. Doherty, C., et al., The incidence and prevalence of ankle sprain injury: a systematic review and meta-analysis of prospective epidemiological studies. Sports Med, 2014. 44(1): p. 123-40.
2. Fong, D.T., et al., A systematic review on ankle injury and ankle sprain in sports. Sports Med, 2007. 37(1): p. 73-94.
3. Waterman, B.R., et al., The epidemiology of ankle sprains in the United States. J Bone Joint Surg Am, 2010. 92(13): p. 2279-84.
4. Ferran, N.A. and N. Maffulli, Epidemiology of sprains of the lateral ankle ligament complex. Foot Ankle Clin, 2006. 11(3): p. 659-62.
5. Herzog, M.M., et al., Epidemiology of Ankle Sprains and Chronic Ankle Instability. J Athl Train, 2019. 54(6): p. 603-610.
6. Hertel, J., Functional Anatomy, Pathomechanics, and Pathophysiology of Lateral Ankle Instability. J Athl Train, 2002. 37(4): p. 364-375.
7. Slater, K., Acute Lateral Ankle Instability. Foot Ankle Clin, 2018. 23(4): p. 523-537.
8. Attarian, D.E., et al., Biomechanical characteristics of human ankle ligaments. Foot Ankle, 1985. 6(2): p. 54-8.
9. Hur, E.S., D.D. Bohl, and S. Lee, Lateral Ligament Instability: Review of Pathology and Diagnosis. Curr Rev Musculoskelet Med, 2020. 13(4): p. 494-500.
10. Kerkhoffs, G.M., et al., Immobilisation and functional treatment for acute lateral ankle ligament injuries in adults. Cochrane Database Syst Rev, 2002(3): p. Cd003762.
11. Hertel, J. and R.O. Corbett, An Updated Model of Chronic Ankle Instability. J Athl Train, 2019. 54(6): p. 572-588.
12. Arnold, B.L., C.J. Wright, and S.E. Ross, Functional ankle instability and health-related quality of life. J Athl Train, 2011. 46(6): p. 634-41.
13. Golditz, T., et al., Functional ankle instability as a risk factor for osteoarthritis: using T2-mapping to analyze early cartilage degeneration in the ankle joint of young athletes. Osteoarthritis Cartilage, 2014. 22(10): p. 1377-85.
14. Jolman, S., et al., Comparison of Magnetic Resonance Imaging and Stress Radiographs in the Evaluation of Chronic Lateral Ankle Instability. Foot Ankle Int, 2017. 38(4): p. 397-404.
15. Park, S., et al., Prediction of suspicious ankle instability using the calcaneofibular ligament cross-sectional area. Quant Imaging Med Surg, 2021. 11(2): p. 533-539.
16. Griffith, J.F. and J. Brockwell, Diagnosis and imaging of ankle instability. Foot Ankle Clin, 2006. 11(3): p. 475-96.
17. Fujii, T., et al., The manual stress test may not be sufficient to differentiate ankle ligament injuries. Clin Biomech (Bristol, Avon), 2000. 15(8): p. 619-23.
18. Gaebler, C., et al., Diagnosis of lateral ankle ligament injuries. Comparison between talar tilt, MRI and operative findings in 112 athletes. Acta Orthop Scand, 1997. 68(3): p. 286-90.
19. Mokbel, M.A.-M.I., K.M. Shawky, and M.A.E.-G. Hamed, The Diagnostic Value of High-Resolution Ultrasound in Evaluation of Ankle Sports Injuries: A Comparative Study with MRI. The Egyptian Journal of Hospital Medicine, 2020. 81(1): p. 1209-1216.
20. Kumar, V., et al., CHRONIC LATERAL ANKLE INSTABILITY: COMPARISON OF STRESS VIEWS AND MRI WITH ARTHROSCOPY. Orthopaedic Proceedings, 2009. 91-B(SUPP_I): p. 142-142.
21. Mayerhoefer, M. and M. Breitenseher, MRI of the lateral ankle ligaments: Value of three-dimensional orientation. RöFo : Fortschritte auf dem Gebiete der Röntgenstrahlen und der Nuklearmedizin, 2003. 175: p. 670-5.
22. Erickson, S.J., et al., MR imaging of the lateral collateral ligament of the ankle. AJR Am J Roentgenol, 1991. 156(1): p. 131-6.