

Injury of the distal Tibiofibular Syndesmosis of the Ankle: Assessment with contrast enhanced 3D-FSPGR MR imaging

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Introduction

Injury of distal tibiofibular syndesmosis could accompany with severe ankle injury especially in athletic activity. It has been reported to be associated with other ankle injury from 1 to 20% in its incidence. Injury of the syndesmotom ligaments of the ankle is known to cause recurrent ankle sprain resulting in prolonged recovery and poor prognosis. Stability of the distal tibiofibular syndesmosis is maintained by four separate ligaments including anterior inferior tibiofibular ligament (AiTFL), posterior inferior tibiofibular ligament, transverse tibiofibular ligament, and interosseous ligament. There have been many reports about MRI findings of these ligaments, which are normal or injured, corroborated by many researchers. But in the objective explanation of injury to AiTFL which is most commonly injured among syndesmotom ligaments, there could be some debate in that it might not be seen in its entire length in one transverse image which was adopted in many studies for the judgment of acute or chronic injury. The purpose of our study was to establish more objective standard leading to conclusion of syndesmosis injury especially in AiTFL and nearby anterior syndesmosis with contrast enhanced-fat suppressed 3D GRE sequence by comparing this standard with that which has been adopted using routine transverse T1, T2, and proton density weighted MRI sequence.

Materials and Methods

The study group comprised 45 patients with 45 ankles (26 man, 19 women; mean age 32.1) with demonstration of ankle sprains and pain who underwent arthroscopic surgery between January 2002 and August 2004. Mean time interval between symptom and MRI and surgery was 64.3 weeks ranged from 1 to 103 weeks. MR imagings were performed preoperatively for all of these patients with time interval between MRI and surgery ranged from 3 to 90 days.

Arthrographic procedure of ankle was performed under spinal lumbar anesthesia or general anesthesia induced in the patients. Instability of syndesmosis suggesting injury was examined through anterolateral portal using 2mm-width probe. Arthroscopic diagnosis of syndesmosis injury was judged when the probe could be inserted into syndesmosis which means that the syndesmosis is widened more than 2mm in width. It is well known that widening of intraarticular distal tibiofibular syndesmosis could be possible within width less than 1mm.

MR examinations were performed with a 1.5-T imager (Signa; General Electric Medical Systems, Milwaukee, WI) using a dedicated extremity coil. The patients were examined in supine with ankle placed in a neutral position in which motion artifact by pain could diminish. For each patient we acquired transverse T1-(TR/TE;700/11ms), T2- and proton density- weighted (TR/TE1/TE2;200/20/70) spin echo image as a routine set with slice thickness 4mm without interslice gap, and coronal gadolinium-enhanced fat-suppressed three-dimensional fast spoiled gradient recalled (3D-FSPGR) sequence (TR/TE;20.9/2.2msec, flip angle; 15°, 9cm thick slab was partitioned into 60 sections resulting in 1.5mm section thickness) as a contrast enhancement set (CE set). Coronal view was adopted for ideal inspection of the synovial recess of syndesmosis and viewing of full length of AiTFL in a single slice. Three cadaveric section and histology was done to correlate the enhancing linear structure within syndesmosis in CE set with histology.

Two experienced musculoskeletal radiologists who were blinded to the patients' clinical history and arthroscopic results reviewed two sets of MR images in random order. Analysis was done divided into 2 sets (routine set and CE set) of sequences with DICOM viewer. Thickenings, discontinuity, wavy pattern, nonvisualization of AiTFL were regarded as syndesmosis injury in routine set (Fig 1a). Nodular enhancing lesion at AiTFL and anterior syndesmosis were considered syndesmosis injury in CE set (Fig 1b). The MRI results were correlated with arthroscopic results, and the sensitivity, specificity, and accuracy of MRI was calculated comparing the result of CE set with that of routine set. In CE set maximum height of linear enhancing synovial recess was measured, for each ankle, and the mean height was compared between the group with syndesmosis injury and the group without syndesmosis injury. Statistical analysis was done with Mann-Whitney U test for assessing significance of difference between these 2 groups in average height of synovial recess.

Results

Ankle arthroscopy revealed syndesmotom disruption in 25 of the 45 patients and the remaining 20 patients did not demonstrated syndesmosis instability in arthroscopy. Judgment of syndesmotom injury with MRI showed sensitivity of 96%, specificity of 75%, and accuracy of 86.7% in CE set. The MRI diagnosis of syndesmotom rupture was made with sensitivity of 76%, specificity of 60%, and accuracy of 68.9% in routine set (table 1). All the sensitivity, specificity, and accuracy were superior in CE set compared with routine set.

(a)			(b)		
Routine set	MR(+)	MR(-)	CE set	MR(+)	MR(-)
Arthro(+)	19	6	Arthro(+)	24	1
Arthro(-)	8	12	Arthro(-)	5	15

Table 1. MRI results compared with arthroscopy in routine set (a) and CE set (b).

The maximum height of tibiofibular recess within syndesmosis measured in CE set was mean of 12.65 Cm in arthroscopically proven stable syndesmotom group, and mean of 16.16 Cm in the ruptured syndesmotom group with statistical significance ($p < 0.05$). Tibiofibular recesses were well visualized histologically in all 3 cadaveric specimens as previously reported in several articles (Fig 1c).

Fig.1. MR features of syndesmotom dysruption

a. Syndesmotom dysruption in routine set

Discontinuity of AiTFL (arrow) is noted at the level of tibial plafond on transverse proton density weighted image.

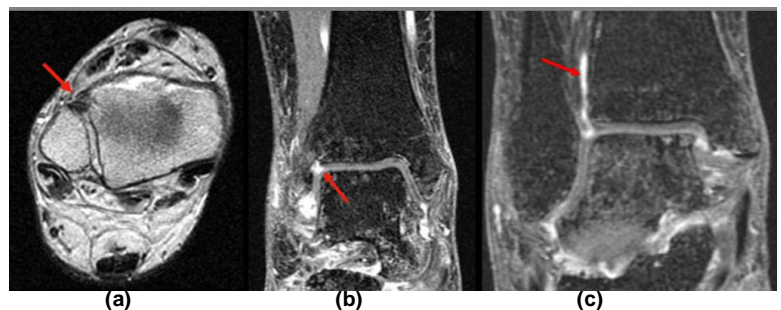
There was no arthroscopic evidence of syndesmotom dysruption.

b. Syndesmotom dysruption in CE set

Nodular contrast enhancement of AiTFL (arrow) in arthroscopically proven syndesmosis dysruption

c. Tibiofibular recess within syndesmosis in CE set

Linearly enhancing lesion within syndesmosis suggesting tibiofibular recess which is lined by synovial membrane (arrow).



Conclusion

Contrast enhanced 3D-FSPGR MRI of the ankle was more sensitive and specific in assessing of distal tibiofibular syndesmosis injury comparing with routine transverse MRI. Accordingly the sequence can be more objective than transverse routine axial image is, with additional visualization of tibiofibular recess, the maximum height of which could be possible MRI criteria for syndesmosis instability.

References

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2. Oae et al. Radiology 2003 Apr;227(1): 155-161