Diagnosis of a tear of the tibiofibular syndesmosis

THE ROLE OF ARTHROSCOPY OF THE ANKLE

M. Takao, M. Ochi, K. Oae, K. Naito, Y. Uchio

From Shimane Medical University and Hiroshima University, Japan

In 52 patients we compared the accuracy of standard anteroposterior (AP) radiography, mortise radiography and MRI with arthroscopy of the ankle for the diagnosis of a tear of the tibiofibular syndesmosis. In comparison with arthroscopy, the sensitivity, specificity and accuracy were 44.1%, 100% and 63.5% for standard AP radiography and 58.3%, 100% and 71.2% for mortise radiography. For MRI they were 100%, 93.1% and 96.2% for a tear of the anterior inferior tibiofibular ligament and 100%, 100% and 100% for a tear of the posterior inferior tibiofibular ligament.

Standard AP and mortise radiography did not always provide a correct diagnosis. MRI was useful although there were two false positive cases. We suggest that arthroscopy of the ankle is indispensable for the accurate diagnosis of a tear of the tibiofibular syndesmosis.

Received 17 January 2002; Accepted after revision 27 June 2002

Patients and Methods

We performed arthroscopy of the ankle on 52 patients with acute injuries of the ankle which were treated surgically between April 1999 and December 2000. All gave their consent. There were 31 men and 21 women with a mean age of 35 years (14 to 67); 33 had a malleolar fracture. Using the Lauge-Hansen classification, one had a supination-eversion fracture, 19 a supination-adduction fracture, 12 a pronation-abduction fracture and one a pronation-eversion fracture.
Mortise radiographs of the right ankle showing a) the talocrural angle, b) the medial clear space and c) the talar tilt. The talocrural angle is formed by a line perpendicular to the distal tibial articular surface and a line joining the tips of both malleoli. The medial clear space is the distance from the lateral border of the medial malleolus to the medial border of the talus at the level of the talar dome. Talar tilt takes into account any differences in the widths of the joint space proximal to the medial and lateral talar ridge.

T2-weighted MRI findings. Figure 3a – The AITFL. The left figure shows a normal (arrow) and the right a disrupted (arrow) ligament. Figure 3b – The PITFL. The left figure shows a normal (arrow) and the right a disrupted (arrow) ligament.
fracture. Nineteen had a sprain without a fracture, 13 had a torn AITFL and six had a sprain of the syndesmosis. Before operation, all patients had standard non-weight-bearing AP and mortise radiography and MRI. We evaluated the diagnostic accuracy for the AITFL and the PITFL at arthroscopy. The interosseous tibiofibular ligament was not included because it is attached approximately 1cm or more above the joint line and is difficult to identify at arthroscopy. The transverse ligament was also excluded because it is too thin to identify on MRI.

Standard AP radiographs were obtained with the leg in 20° of internal rotation in men and 15° of internal rotation in women.9 We measured the tibiofibular clear space (syndesmosis AB), and the overlap of the tibia and fibula (syndesmosis BC)3 (Fig. 1) on the AP radiographs. We observed that syndesmosis AB is normally <5 mm and BC normally >10 mm.3 On the mortise views, we measured the talocrural angle,6 the medial clear space5 and the talar tilt4 (Fig. 2). We observed that the talocrural angle is normally 83 ± 4°, that a medial clear space >4 mm is abnormal and that a difference of 2 mm in the talar tilt is considered to be the upper limit of normal.

MRI was performed using a 1.5 T superconducting scanner (Signa; GE Medical Systems, Milwaukee, Wisconsin) and a 20 cm extremity coil. All feet were placed in the neutral position. A section thickness of 3 mm was used with a
0.5 mm intersection gap. Only axial planes were obtained because they are the most useful in the evaluation of the tibiofibular syndesmosis.7 The examination protocol consisted of transverse T1-weighted (TR/TE, 500/18; matrix, 256 x 256; 2 NEX) spin-echo sequences and transverse T2-weighted (TR/TE, 4000/96; matrix, 256 x 256; ETL 8; 2 NEX) fast spin-echo sequences. The diagnostic criteria for determining a tear were discontinuity, a decrease of tension or an abnormal course of the ligament (Fig. 3).

Arthroscopy of the ankle is performed under lumbar anaesthesia with the patient supine. The hip is flexed to 45˚ in a leg holder and the ankle joint displayed by means of the bandage distraction technique with a force of 78.4 N.10 The arthroscope is inserted through anterolateral and anteromedial portals. The AITFL is best viewed from the anteromedial and the PITFL from the anterolateral portal. A stress test of the distal tibiofibular joint is performed by moving the ankle from internal rotation to external rotation under arthroscopy. Close11 reported that the maximum opening of the distal tibiofibular joint was approximately 1.5 mm in the normal ankle and we considered that there was instability if an opening of 2 mm could be identified (Fig. 4). The diagnostic criteria for a torn ligament were12 an abnormal course or discontinuity of the ligament, a decrease in its tension, an avulsion at its attachment to the fibula and tibia, and a positive arthroscopic stress test.

The diagnosis of a tear was made if there was one or more of these criteria (Fig. 5).

We evaluated the AP and mortise radiographs and MRI with regard to sensitivity, specificity, and accuracy when compared with arthroscopy. When rupture of a ligament was diagnosed both by arthroscopy and a comparative method, the result was considered to be true-positive. When no rupture was seen by either examination, it was considered to be true-negative. When injury of a ligament was seen only by a comparative method and not at arthroscopy, it was considered to be false-positive and when seen only at arthroscopy, to be false-negative. Sensitivity, specificity and accuracy were thus defined as follows:

Sensitivity = true-positive/true-positive + false-negative
Specificity = true-negative/false-positive + true-negative
Accuracy = true-positive + true-negative/true-positive+false positive + true-negative + false-negative

Different examiners reviewed the results of radiography, MRI and ankle arthroscopy without knowledge of the patients’ history or any other diagnostic results.

Results

On the basis of arthroscopy, 23 patients had a tear of the syndesmosis of which all had a tear of the AITFL and ten had tears of both the AITFL and PITFL. No patient had an isolated tear of the PITFL.

On standard AP radiography, there were ten true-positive, 29 true-negative, no false-positive and 13 false-negative cases. Therefore, the sensitivity was 43.5%, the specificity 100% and the accuracy 75.0%. On mortise radiography, there were 15 true-positive, 29 true-negative, no false-positive and eight false-negative cases giving a sensitivity of 65.2%, a specificity of 100% and an accuracy of 84.6%. Mortise radiography was therefore slightly more accurate for the diagnosis of a tear of the tibiofibular syndesmosis than standard AP radiography. On MRI, there were 23 true-positive, 27 true-negative, two false-positive and no false-negative cases in the diagnosis of a tear of the AITFL and ten true-positive, 42 true-negative, and no false-positive or false-negative cases in the diagnosis of a tear of the PITFL. Therefore, the sensitivity was 100%, the specifi-
city 93.1% and the accuracy 96.2% for diagnosis of a tear of the AITFL and 100%, 100% and 100%, respectively, for diagnosis of a tear of the PITFL (Tables I and II).

Discussion

Close11 and Inman13 have shown that normal movement of the ankle depends on a precise relationship determined by the syndesmosis. The talus normally articulates with the ankle mortise throughout the range of movement and the intermalleolar distance increases by approximately 1.5 mm as the ankle goes from plantar flexion to dorsiflexion. If the syndesmosis is disrupted, there may be widening of the tibiofibular joint and lateral shift of the talus. Ogilvie-Harris and Reed14 reported that division of each ligament resulted in progressive weakening of the joint between the tibia and fibula, and Ramsey and Hamilton15 reported that when the talus moved laterally by 1 mm the contact area of the tibiotalar articulation was decreased by 42%. Furthermore, Burns et al16 showed that a complete disruption of the syndesmosis combined with a tear of the deltoid ligament caused a decrease of 40% in the tibiotalar contact area and an increase of 36% in the tibiotalar contact pressure. Thus, as large changes may occur after minor ligamentous disruptions, correct diagnosis is essential for the treatment of the injured ankle.

The diagnosis of an injury to the distal tibiofibular ligaments based on radiological examinations which include AP3 and mortise views4-6 is well established. This condition, however, may be difficult to diagnose by radiological examination when the tears are incomplete or if there is no opening of the distal tibiofibular joint. Edwards and DeLee17 reported that distal tibiofibular diastasis without associated fracture could only be identified by stress radiographs. In our study, a tear of the syndesmosis was not always revealed on standard radiographs alone.

There have been a few reports on the diagnosis of a tear of the tibiofibular syndesmosis using MRI. Muhle et al7 reported that high-resolution MRI using a local gradient coil gave excellent delineation of the ligaments of the syndesmosis on a cadaver. Vogl et al8 reported that the diagnostic criteria for identifying an injury to a ligament are an abnormal course, an irregular contour of the ligament, increased signal intensity of the ligament in T2-weighted sequences or in plain T1-weighted sequences and a marked enhancement in T1-weighted images after contrast. Kerr, Forrester and Kingston18 reported that a torn ligament may appear thickened, retracted, or discontinuous, and often has a higher than normal signal intensity. Nevertheless, in spite of these reports, the diagnostic criteria for MRI have not yet been established. In our study, it became clear that MRI, when compared with standard plain radiography, was highly-sensitive and specific for the identification of injury to the syndesmosis. In the two false-positive cases, an area of high intensity was seen in the bundle of the AITFL, which we regarded as a discontinuity of the ligament. We thought that there might be an intraligamentous disruption, which could not be seen on arthroscopy. Our inability to verify this finding is a limitation of the study.

We have previously confirmed12 the finding of Ogilvie-Harris and Reed14 that arthroscopic evaluation is of considerable value in the diagnosis and treatment of disorders of the syndesmosis. By direct visualisation of the ligament and probing, the injury can be accurately assessed and the arthroscopic stress test is useful for evaluating the stability of the tibiofibular articulation.

### Table I. The diagnostic results for each diagnostic method

<table>
<thead>
<tr>
<th></th>
<th>True-positive</th>
<th>True-negative</th>
<th>False-positive</th>
<th>False-negative</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiography</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard anteroposterior</td>
<td>15</td>
<td>18</td>
<td>0</td>
<td>19</td>
<td>44.1</td>
<td>100.0</td>
<td>63.5</td>
</tr>
<tr>
<td>Mortise</td>
<td>21</td>
<td>16</td>
<td>0</td>
<td>15</td>
<td>58.3</td>
<td>100.0</td>
<td>71.2</td>
</tr>
<tr>
<td>MRI*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AITFL</td>
<td>23</td>
<td>27</td>
<td>2</td>
<td>0</td>
<td>100.0</td>
<td>93.1</td>
<td>96.2</td>
</tr>
<tr>
<td>PITFL</td>
<td>10</td>
<td>42</td>
<td>0</td>
<td>0</td>
<td>100.0</td>
<td>100.00</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*AITFL, anterior inferior tibiofibular ligament; PITFL, posterior inferior tibiofibular ligament

### Table II. The sensitivity (%), specificity (%) and accuracy (%) of each diagnostic method in comparison with arthroscopy of the ankle

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiography</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard anteroposterior</td>
<td>44.1</td>
<td>100.0</td>
<td>63.5</td>
</tr>
<tr>
<td>Mortise</td>
<td>58.3</td>
<td>100.0</td>
<td>71.2</td>
</tr>
<tr>
<td>MRI*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AITFL</td>
<td>100.0</td>
<td>93.1</td>
<td>96.2</td>
</tr>
<tr>
<td>PITFL</td>
<td>100.0</td>
<td>100.00</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*AITFL, anterior inferior tibiofibular ligament; PITFL, posterior inferior tibiofibular ligament
We conclude that standard AP and mortise radiography are helpful for diagnosing fractures and evaluating ligamentous injury. We found, however, that the accuracy of these methods was not satisfactory for the consistent diagnosis of a tear of the tibiofibular syndesmosis. MRI was very accurate (96.2%) but there were two false-positive cases. Arthroscopy of the ankle, however, is an indispensable tool for the accurate diagnosis of a tear of the tibiofibular syndesmosis.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References

4. Ashurst APC, Bromer RS. Classification and mechanism of fractures of the leg bones involving the ankle: based on a study of three hundred cases from the Episcopal Hospital. Arch Surg 1922;4:51-129.