We treated 43 acute tears of the calcaneofibular ligament by operation in 43 patients after subtalar arthrography. There were 22 men and 21 women with a mean age of 22.3 years (14 to 61). Anteroposterior (AP), lateral and oblique views were obtained with the foot in 45° of internal rotation and the ankle in the neutral position. Any communication or leakage to the ankle, tendon sheaths, subcutaneous tissue and sinus tarsi was recorded. We examined an oblique view of the microrecess along the interosseous ligament and an AP view of the lateral recess just under the distal end of the fibula. We also studied a control group of 27 patients with isolated injuries of the anterior talofibular ligament without rupture of the calcaneofibular ligament.

The findings in the two groups were significantly different when examined for leakage to the ankle (p = 0.0002), to the peroneal tendon sheaths (p = 0.0347) and to the subcutaneous tissue (p = 0.0222), absence of the microrecess (p = 0.0055) and presence of the lateral recess (p = 0.0012).

Many ankle sprains which involve tearing of the calcaneofibular ligament are accompanied by injuries of the subtalar joint. Combined injuries of the anterior talofibular ligament and calcaneofibular ligament, and isolated injury of the anterior talofibular ligament should be differentiated.

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Patients and Methods

Between April 1991 and May 1996, 79 feet in 79 patients were diagnosed as having tears of the lateral ligament of the ankle, and were operated on in our unit. We performed subtalar arthrography in all patients before operation. The interval between injury and arthrography did not exceed seven days. We excluded those with a history of injury to the hindfoot. At operation, 44 showed acute injuries to the calcaneofibular ligament. One patient with an isolated injury to the calcaneofibular ligament was excluded leaving 43 with rupture of the calcaneofibular ligament and an accompanying injury to the anterior talofibular ligament. There were 22 men and 21 women with a mean age of 22.3 years (14 to 61). A control group consisted of 15 men and 12 women, with isolated injuries of the anterior talofibular ligament and an intact calcaneofibular ligament. Their mean age was 21.4 years (13 to 58).

The diagnosis of a tear of the lateral ligament of the
ankle was based on the history, physical findings and stress radiography. The criterion for instability of the lateral side of the ankle was a talar tilt angle of ≥10°. This represented an increase of ≥5° in the angle of talar tilt over that of the contralateral side. Anterior subluxation of the ankle was diagnosed when the tibiotalar distance was 4 mm or more. The presence of a talar tilt or anterior-drawer sign was essential for the diagnosis.

Stress radiographs were taken without anaesthesia at the first examination using a Telos GA/II stress apparatus (Telos, Weiterstadt, Germany). Two patients with rupture of the calcaneofibular ligament and two without had negative results because of peroneal spasm. In these individuals, supplementary stress radiographs were taken under spinal anaesthesia just before operation and clearly showed mechanical instability. In this study, only the angles of talar tilt and the amount of anterior drawer were measured on stress radiographs taken without anaesthesia.

The angle of talar tilt before operation in the patients with rupture of the calcaneofibular ligament was 15.4 ± 4.9° (3 to 30) and in the control patients without rupture 12.5 ± 5.4° (0 to 24). The preoperative anterior drawer in patients with rupture of the calcaneofibular ligament was 8.1 ± 3.3 mm (3 to 15) and in the control patients 5.6 ± 2.5 mm (3 to 12).

At operation, details of the ruptured calcaneofibular ligament were recorded and the torn ligament and/or the anterior talofibular ligament was repaired.

Subtalar arthrography was carried out under lumbar spinal anaesthesia just before the operation. A 21-gauge needle 5 cm long was introduced at the posterior facet of the talocalcaneal joint from the posterolateral approach as described by Taillard et al, and water-soluble contrast medium injected. The mean volume sufficient to fill the joint was 2.8 ml (2.0 to 7.0). Radiography included AP (Fig. 1a) and lateral (Fig. 1b) views with an oblique view in 45° of internal rotation with the foot in the neutral position (Fig. 1c). Any leakage to the ankle (Figs 2 to 4), tendon leakage was based on the history, physical findings and stress radiography. The criterion for instability of the lateral side of the ankle was a talar tilt angle of ≥10°. This represented an increase of ≥5° in the angle of talar tilt over that of the contralateral side. Anterior subluxation of the ankle was diagnosed when the tibiotalar distance was 4 mm or more. The presence of a talar tilt or anterior-drawer sign was essential for the diagnosis.

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sheaths (Figs 2a and 3), subcutaneous tissue (Fig. 2a) and sinus tarsi (Fig. 5) was recorded. The synovial microrecess along the interosseous ligament was examined on the oblique view (Fig. 3) and the lateral recess just under the distal end of the fibula on the AP view (Fig. 4).

We analysed the arthrographic findings using Fisher’s exact test. Based on the statistical analysis, severity scoring was attempted for the subtalar sprain which accompanied the inversion sprain of the ankle. The scores were calculated according to the site of injury on the calcaneofibular ligament, and compared using the Kruskal-Wallis test. The incidence of rupture of the calcaneofibular ligament, according to the severity of the stress radiographs, was analysed and compared with that of the score of subtalar arthrography. The correlations between the scores and the findings of stress radiography were also analysed.

A 30-year-old man sustained an inversion sprain of his right hindfoot. Subtalar arthrography was performed two days after the injury and showed leakage to the ankle (a,b), to the peroneal tendon sheath and to the sinus tarsi (b), presence of the lateral recess (a) and absence of the microrecess (b). Combined injuries of the anterior talofibular ligament and the calcaneofibular ligament with partial rupture of the interosseous talocalcaneal ligament were seen at operation.

Figure 3 – A 28-year-old man sustained an inversion sprain. The oblique view on subtalar arthrography five days after the injury showed leakage in the ankle to the peroneal tendon sheath and to the sinus tarsi with absence of the microrecess (arrows). Combined injuries of the anterior talofibular ligament and calcaneofibular ligament, and a partial rupture of the interosseous talocalcaneal ligament were seen at operation. Figure 4 – A 21-year-old woman showed combined injuries of the anterior talofibular ligament and calcaneofibular ligament, and partial rupture of the interosseous talocalcaneal ligament. The AP view of subtalar arthrography showed a lateral recess (arrow). Figure 5 – A 41-year-old man had combined injuries of the anterior talofibular ligament, the calcaneofibular ligament and the interosseous talocalcaneal ligament. The oblique view of subtalar arthrography seven days after the injury showed leakage of the contrast medium to the sinus tarsi (arrow).
Table I. Comparative results of subtalar arthrography between the patients with and without rupture of the calcaneofibular ligament (CFL)

<table>
<thead>
<tr>
<th>Findings</th>
<th>CFL rupture (n = 43)</th>
<th>No CFL rupture (n = 27)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage to the ankle</td>
<td>26</td>
<td>4</td>
<td>0.0002</td>
</tr>
<tr>
<td>Leakage to the sinus tarsi</td>
<td>12</td>
<td>5</td>
<td>0.4088</td>
</tr>
<tr>
<td>Leakage to the subcutaneous tissue</td>
<td>11</td>
<td>1</td>
<td>0.0222</td>
</tr>
<tr>
<td>Leakage to the peroneal tendon sheath</td>
<td>13</td>
<td>2</td>
<td>0.0347</td>
</tr>
<tr>
<td>Leakage to the FHL* tendon sheath</td>
<td>5</td>
<td>0</td>
<td>0.1486</td>
</tr>
<tr>
<td>Presence of lateral recess</td>
<td>33</td>
<td>10</td>
<td>0.0012</td>
</tr>
<tr>
<td>Absence of microrecess</td>
<td>16</td>
<td>2</td>
<td>0.0055</td>
</tr>
</tbody>
</table>

* flexor hallucis longus

Table II. Sensitivity and specificity of the arthrographic findings in rupture of the calcaneofibular ligament

<table>
<thead>
<tr>
<th>Findings</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage to the ankle</td>
<td>60.5</td>
<td>85.2</td>
</tr>
<tr>
<td>Leakage to the sinus tarsi</td>
<td>27.9</td>
<td>81.5</td>
</tr>
<tr>
<td>Leakage to the subcutaneous tissue</td>
<td>23.3</td>
<td>96.3</td>
</tr>
<tr>
<td>Leakage to the peroneal tendon sheath</td>
<td>30.2</td>
<td>92.6</td>
</tr>
<tr>
<td>Leakage to the FHL* tendon sheath</td>
<td>11.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Presence of lateral recess</td>
<td>76.7</td>
<td>63.0</td>
</tr>
<tr>
<td>Absence of microrecess</td>
<td>37.2</td>
<td>92.6</td>
</tr>
</tbody>
</table>

* flexor hallucis longus

Results

The results of subtalar arthrography are summarised in Table I. No osteochondral lesion of the posterior talocalcaneal facet was seen.

Positive arthrographic findings were higher in the injured feet than in the control group. The differences were statistically significant as regards leakage to the ankle (p = 0.0002), to the peroneal tendon sheath (p = 0.0347) and the subcutaneous tissue (p = 0.0222), and absence of the microrecess along the talocalcaneal intersosseous ligament (p = 0.0055) and presence of the lateral recess (p = 0.0012).

The sensitivities and specificities of each finding in making a diagnosis of rupture of the calcaneofibular ligament are shown in Table II. Two features showed both a sensitivity and specificity of over 60%. In order to evaluate the damage to the calcaneofibular ligament and the severity of injury at the subtalar joint, a scoring system was designed for subtalar arthrography according to the level of the p value, with four points for leakage to the ankle (p < 0.001), two for absence of the microrecess and presence of the lateral recess (p < 0.01 to p ≥ 0.005) and one each for leakage to the subcutaneous tissue and to the peroneal tendon sheath (p < 0.05 to p ≥ 0.01). There were no items which added three points to the score (p < 0.005 to p ≥ 0.001).

The mean score of the patients with a ruptured calcaneofibular ligament was 5.23 points (0 to 10), with 1.70 (0 to 7) in the absence of such injury. The incidence of rupture of the ligament according to the score is shown in Figure 6. Ruptures were seen in 86.1% of the patients who showed three points or more, 90.0% of those with five points or more, and in all with eight points or more. In contrast, they were seen in only 35.3% of the patients with two points or less.

The incidence of rupture of the calcaneofibular ligament according to the angle of talar tilt and to anterior translation is shown in Table III. Ruptures of the calcaneofibular ligament were seen in 50.0% of the patients who showed less than 15° of talar tilt and in 73.5% of patients with 15° or more. They were seen in 51.1% of patients who had less than 6 mm of talar translation and in 77.1% of those with...

Table III. Results of injury to the calcaneofibular ligament (CFL) according to the severity of talar tilt, anterior translation or score of subtalar arthrography

<table>
<thead>
<tr>
<th>Talar tilt</th>
<th>Anterior translation</th>
<th>Score</th>
<th>Points</th>
<th>Number of feet of CFL intact</th>
<th>CFL ruptured</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15° (n = 36)</td>
<td>≥15° (n = 34)</td>
<td>&lt;6 mm (n = 35)</td>
<td>≥6 mm (n = 35)</td>
<td>0 to 2 (n = 34)</td>
<td>3 to 10 (n = 36)</td>
</tr>
<tr>
<td>Number of the patients with injured CFL (%)</td>
<td>18 (50.0)</td>
<td>25 (73.5)</td>
<td>16 (45.7)</td>
<td>27 (77.1)</td>
<td>12 (35.3)</td>
</tr>
<tr>
<td>p value</td>
<td>0.0526</td>
<td>0.0081</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
just beneath the distal end of the fibula in the presence of the lateral recess.

A communication between the ankle and the subtalar joint is common with a frequency of 20% reported by Resnick, 16 15.6% by Brostrom, Liljedahl and Lindvall 17 and 11% by Gordon. 18 Communication between the ankle and subtalar joints, however, is characteristic of rupture of the capsules of joints or of the septum dividing them. In our study, communication between the joints was seen in 14.8% of the patients with isolated injuries of the anterior talofibular ligament, which is similar to that noted in reports of normal arthrography.

Leakage of the contrast medium to the peroneal tendon sheaths from the subtalar joints was regarded as normal by Meyer and Taillard 3 and as pathological by Goossens et al. 19 In our study, the frequencies of leakage of the contrast medium to the peroneal tendon sheaths in combined rupture of the anterior talofibular ligament and the calcaneofibular ligament and in isolated rupture of the anterior talofibular ligament, were significantly different. The absence of the microrecess just along the interosseous ligament, which is seen when this space is filled with blood clot or fibrinous material, 16 was observed more often in patients with ruptured calcaneofibular ligaments than in those without. The presence of the lateral recess just beneath the distal end of the fibula follows a tear of the lateral wall of the capsule of the subtalar joint which usually involves the calcaneofibular ligament. It was seen more often in combined rupture of the ligaments than in an isolated rupture of the anterior talofibular ligament.

Leakage of the contrast medium into the sinus tarsi indicates rupture of the interosseous ligament or of the anterolateral capsule of the posterior facet. The difference of the frequency of this finding was not significant between the patients with or without ruptured calcaneofibular ligaments.

The mean injury score, according to the site of the injury on the calcaneofibular ligament, was higher in the patients with rupture of the ligaments on the calcaneal side than in those with rupture on the fibular side, but this was not significant. There was no relationship between the score and the site of injury on the calcaneofibular ligament.

Attempts to diagnose injury to the calcaneofibular ligament using ultrasonography have been reported, but lack detail and a comparison with the operative findings. 20,21 MRI can demonstrate accurately torn anterior talofibular

Table IV. Results of subtalar arthrography according to the site of injury on the calcaneofibular ligament, by number and percentage

<table>
<thead>
<tr>
<th>Site of injury</th>
<th>Leakage or communication*</th>
<th>Lateral recess</th>
<th>Absence of microrecess</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AK</td>
<td>PT</td>
<td>SC</td>
<td>ST</td>
</tr>
<tr>
<td>Fibular side (n = 12)</td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Mid portion (n = 9)</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Calcaneal side (n = 14)</td>
<td>9</td>
<td>7</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Longitudinal or elongation (n = 8)</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Total (n = 43)</td>
<td>26</td>
<td>13</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

* AK, ankle; PT, peroneal tendon sheath; SC, subcutaneous tissue; ST, sinus tarsi

6 mm or more. The accuracy of the stress radiographs for the diagnosis of rupture of the calcaneofibular ligament was lower than that of the scores in subtalar arthrography.

There were no significant correlations between the scores and the angle of talar tilt (r = 0.148, p = 0.224) and between the scores and the amount of anterior translation (r = 0.147, p = 0.224).

The incidence of arthrographic findings and the mean scores according to the site of injury on the calcaneofibular ligament are shown in Table IV. The mean score of patients with injury to the calcaneofibular ligament on the calcaneal side was higher than that for injury on the fibular side of the ligament, but the difference was not statistically significant.

Discussion

In Japan, operative treatment of acute tears of the lateral ligament of the ankle has not been completely abandoned because of the better mechanical stability obtained by operation rather than by conservative treatment. With advances in the design of ankle supports and in proprioceptive training, the results of conservative treatment have much improved 11-13 and are now similar to those achieved with surgery. In order to improve the results of conservative treatment it is essential to have more accurate information about the severity and site of the injury to the ankle and to the subtalar joint. At operation we were able to determine the severity and pattern of ligament injury and to show that trauma to the subtalar joint was commonly associated with tears of the lateral ligament which involved the calcaneofibular ligament.

Several attempts have been made to evaluate the instability of the subtalar joint by stress radiography using adduction stress tomography, 14 adduction stress on Broden’s view 5 and measurement of anterior translation of the calcaneus on the lateral view with the ankle in maximum dorsiflexion. 15 In some cases, stress radiography could detect the instability of the subtalar joint in the chronic phase, but not in the acute phase.

Subtalar arthrography is a simple method for determining injury or damage to the subtalar joint. Patients with rupture of the calcaneofibular ligament showed more frequent leakage of contrast medium to the ankle, the subcutaneous tissue, the peroneal tendon sheath, along the interosseous ligament in the absence of the microrecess or

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and calcaneofibular ligaments, but is costly and is not always available in small or local hospitals. Arthrography is a method familiar to all physicians and orthopaedic surgeons who can use an X-ray image intensifier. No patient in our series developed anaphylactic shock.

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