The Deteriminate Value of the Medial Clear Space For Deltoid Integrity In Lateral Malleolar Fractures: A Correlative Analysis of Arthroscopic and Radiographic Findings

David R. Colman,† DPM, FACFAS, Myles Knutson,‡ DPM, Irina Bazovan, DPM
1. Attending Staff, Kaiser San Francisco Bay Area Foot & Ankle Residency Program, San Francisco, CA; 2. Chief Resident PODS, Kaiser San Francisco Bay Area Foot & Ankle Residency Program, San Francisco, CA; 3. Staff Surgeon, Santa Clara Valley Medical Center, Santa Clara, CA

STATEMENT OF PURPOSE

The reliability of the radiographic medial clear space (MCS) as a criteria for treatment of displaced lateral malleolar ankle fractures remains unclear. This study aims to establish a reliable plain film MCS threshold that more accurately predicts deltoid integrity. The accuracy of the Lauge-Hansen classification system as a predictor of deltoid injury was also evaluated.

METHODOLOGY

The deep deltoid ligament was assessed arthroscopically by a single surgeon on 144 consecutive isolated lateral malleolar ankle fractures. Partial tears were classified as ruptured. Fractures were classified by the Lauge-Hansen system based on non-weightbearing radiographs. MCS were measured on pre- and post-operative ankle mortise radiographs on Philips PACS® image viewing system at 3 different points (Figure 1) by a single reviewer blinded to the arthroscopic findings (Figure 2). MCS values were averaged, rounded to the nearest half millimeter, and compared to results of arthroscopic inspection (intact vs ruptured) using Fisher’s exact test. Correlative indices were established for each incremental millimeter of MCS widening to determine the predictive value for rupture. Multivariate logistic regression was performed to identify independent risk factors for a ruptured deep deltoid ligament. Wilcoxon rank-sum test was used to compare variables such as patient age, preoperative MCS, and post-operative MCS based on deep deltoid ligament integrity. Patient demographics were also reviewed.

LITERATURE REVIEW

When the fibula is fractured in the absence of medial ankle injury, the deltoid ligament maintains the tibia beneath the tibial plafond and prevents changes in tibial position (1-5). Specifically, the deep deltoid ligament limits external rotation of the talus, along with lateral-translational and anterior displacement (2,4,8). When isolated lateral malleolar fractures treated without surgery demonstrate favorable long term outcomes (6-12). Treatment decision-making in such injuries is based on MCS, yet the predictive value of this radiographic finding remains unclear. Historically a MCS >2 mm has been thought to represent deltoid ligament rupture (13,14). More recent studies correlating arthroscopic and radiographic MCS measurements to show that deltoid ligament integrity was uncertain at an MCS of 4.8 mm (6-9). Recent work has correlated MCS measurements with both cadaveric models and clinical outcomes. In this study ankle specimens had both a bimalleolar osteotomy and release of deep deltoid ligament, were vertically loaded, and MCS did not change compared to unloaded cadaveric ankle (16). In a prospective trial of patients with stress positive isolated lateral malleolar ankle fractures who underwent either conservative or surgical treatment demonstrated a difference in complication rates, functional outcome scores, or to time to healing (17). These studies culled into question the reliability and utility of MCS measurements for decision-making in the treatment of patients with an isolated lateral malleolar fracture. Other studies demonstrated that majority of patients with isolated lateral malleolar fractures are stable (18, 19).

RESULTS

The most sensitive MCS measurement for predicting an intact deep deltoid ligament was ≥3.5 mm (98.2% specificity, p-value<0.001). Figure 3 depicts diminishing sensitivity based on increased MCS value, each with a p-value<0.001. Figure 4 correlates MCS with deltoid ligament integrity.

Six patients (11%) with deep deltoid ligament ruptures had MCS measurements ≤3.5 mm. Eleven patients (12.5%) with an intact deep deltoid ligament had MCS measurements ≥5.5 mm, whereas 25 patients (46.2%) with deep deltoid ligament rupture had MCS measurements ≤5.5 mm. The most notable finding for deltoid ligament integrity based on the Lauge-Hansen classification scheme was that 2 of 10 patients with PER injuries had an intact deep deltoid ligament.

Table 1. Summary of Results

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Overall</th>
<th>N=144</th>
<th>N=144</th>
<th>N=50</th>
<th>N=44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>86 (59.8%)</td>
<td>86 (59.8%)</td>
<td>50 (40.2%)</td>
<td>43 (75.9%)</td>
</tr>
<tr>
<td>Age: mean (range)</td>
<td>56.0 (40.3%)</td>
<td>56.0 (40.3%)</td>
<td>43 (75.9%)</td>
<td>15 (27.8%)</td>
<td></td>
</tr>
<tr>
<td>Initial MCS: N (%)</td>
<td>9.3 (6.0)</td>
<td>9.3 (6.0)</td>
<td>4.2 (2.1 - 7.2)</td>
<td>6.4 (4.7 - 14.3)</td>
<td></td>
</tr>
<tr>
<td>MCS Classification,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lauge-Hansen</td>
<td>Left</td>
<td>74 (51.5%)</td>
<td>74 (51.5%)</td>
<td>62 (61.2%)</td>
<td>12 (22%)</td>
</tr>
<tr>
<td>Right</td>
<td>62 (42.8%)</td>
<td>62 (42.8%)</td>
<td>59 (58.3%)</td>
<td>19 (35.8%)</td>
<td></td>
</tr>
<tr>
<td>Bilateral</td>
<td>2 (1.4%)</td>
<td>2 (1.4%)</td>
<td>3 (3.0%)</td>
<td>2 (3.6%)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Ankle radiographic MCS measurement method

Figure 2. MCS Sensitivity for Deltoid Integrity

Figure 3. MCS Sensitivity for Deltoid Integrity

Figure 4. MCS Measurement & Deltoid Integrity

REFERENCES

17. Abe K, Kato Y, Maehara K, et al. Deep deltoid ligament rupture at ≤3mm (98.2% specificity), patients with MCS measurements ranging from 3 to 4.5 mm, were not operated due to the presence of a narrow (4-5 mm) and only 3 patients exhibited unexpected findings according to ankle mortise radiographs.
18. With increased attention to the evaluation of isolated lateral malleolar fracture stability, the results of this study highlight the challenges of assessing the significance of medial clear space widening on ankle injury radiographs.

ANALYSIS & DISCUSSION

The results of this study show that MCS measurements between 3-7 mm cannot accurately determine deltoid ligament injury (Figure 4). This broad range of uncertainty suggests that the most common radiographic threshold for a lateral malleolar ankle instability is unreliable. In fact, the deep deltoid ligament was more often intact for MCS measurements in the range of 4.9 mm, almost twice as often as it was ruptured. While the MCS is most accurate at ruling out deep deltoid rupture at ≥5mm (52.2% specificity), patients with MCS measurements up to 7 mm could have a stable lateral malleolar fracture. This study also shows that the Lauge-Hansen system to be an unreliable predictor of deltoid injury: 4 patients with pertumbal fractures and 18 patients with presumably unstable Lauge-Hansen fractures had an intact deep deltoid ligament. These results echo the findings of a similar study on smaller patient population, though the MCS range was 2.0 to 3.0 mm, instead of the range of 2.0 to 3.4 mm. Other studies have demonstrated that many patients with isolated lateral malleolar fractures are stable (18, 19).