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Weightbearing Radiographs Facilitate Functional Treatment of Ankle Fractures of Uncertain Stability

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ABSTRACT

The most important determinant in the treatment of malleolar fractures is stability. Stable fractures have an intact deep deltoid ligament and do not displace with functional treatment. If the deep deltoid/medial malleolar complex is disrupted, the talus is at risk of displacement. Weber (2010) showed that weightbearing radiographs predicted stability in patients with undisplaced ankle fractures. We developed clinical criteria for potential instability and applied them to a prospective series of patients. The criteria included a medial clear space of <4 mm; medial tenderness, bruising or swelling; a fibular fracture above the syndesmosis; a bimalleolar or trimalleolar fracture; an open fracture; and a high-energy fracture mechanism. A prospectively documented series of 43 patients chose functional brace treatment of the potentially unstable fractures. Weightbearing radiographs were performed with the patient wearing the brace before treatment and free of the brace at clinical union (6 to 9 weeks for all patients). The patients were encouraged to bear full weight and actively exercise their ankles in the brace. All fractures healed without displacement. The risk of displacement was 0% (95% confidence interval 0% to 9.5%). The results of the present preliminary series give support for the use of weightbearing radiographs to guide treatment of undisplaced ankle fractures.

Ankle fractures are among the most common injuries presenting to the orthopedic department, and the correct treatment is essential because these injuries involve a weightbearing joint critical to mobility (1). The ultimate goal in the treatment of ankle fractures is to obtain an anatomic position of the ankle mortise and a stable, mobile, and painless ankle joint (2). Early motion at the ankle joint is important, because excessive immobilization causes atrophy, contracture, synovial adhesions, and cartilage degeneration (3). The treatment of choice for undisplaced fractures has largely been determined by the stability of the fracture and the likelihood of subsequent displacement if managed nonoperatively (4). Undisplaced isolated lateral malleolar fractures with no medial tenderness to signify a medial ligamentous injury are likely to be stable injuries. They can be treated with excellent results using functional bracing and early mobilization, which has also been shown to be more cost-effective (5–11).

The treatment of those patients with an undisplaced lateral malleolar fracture but with signs of possible medial ligament injury is more controversial. The integrity of the deep deltoid ligament must be determined if one is to infer the stability of the ankle joint and manage these fractures nonoperatively. The deep deltoid (tibiotalar) ligament is a key anatomic structure that functions to maintain ankle stability (12). It should not be confused with the superficial deltoid ligament, which lies more anteriorly and will be seen during fixation of the medial malleolus and which has little influence on ankle fracture stability (12). If the deep deltoid ligament is intact, axial loading of the ankle will result in the talus moving slightly laterally and becoming fully congruent with the plafond articular surface, which then acts as an additional stabilizer (12,13). It follows, therefore, that if the deep deltoid ligament is intact, weightbearing will make the ankle more stable, not less, and will not result in talar displacement.

One method to assess the integrity of the deltoid ligament is to search for medial signs such as medial tenderness and ecchymosis. Egol et al (14) reported that in combination, the specificity of these 2 signs is 97% in predicting a positive stress radiograph (a medial clear space of >4 mm, which at that time was the radiographic criterion for surgical management). Other studies, however, have suggested that medial symptoms are poor indicators of deltoid insufficiency. McConnell et al (15) reported medial tenderness and ecchymosis in only 37% and 6% of undisplaced unstable injuries, respectively.

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Stress radiographs, using manual force or gravity, have also been studied as a method of defining stability. Manual stress of approximately 10 lb is applied to the ankle in 10° of internal rotation with the joint in dorsiflexion. A positive finding is defined as a medial clear space of >4 mm that was also >1 mm more than the superior joint space (14,15). A positive manual stress radiograph has been taken as an indicator of deltoid insufficiency and therefore was used by Egol et al (14) and McConnell et al (15) to indicate the need for operative management.

Gravity stress radiographs are taken with the patient in the lateral decubitus position on the side of the injured ankle, allowing the distal half of the leg, ankle, and foot to hang off the table. A standard mortise view is taken in 10° of internal rotation of the tibia, with the positive values the same as those for the stress radiograph (16). It has been shown that the gravity stress radiograph is as reliable and is perceived by patients as more comfortable in detecting a talar shift compared with the manual stress radiograph (16,17).

More recently, some investigators have advocated the use of weightbearing radiographs to evaluate the stability in isolated lateral malleolar fractures, because they believe stress radiographs overestimate the number of unstable injuries (18–20). Weber et al (18) found "performing weightbearing radiographs to distinguish unstable from stable isolated lateral malleolar fractures is an easy, pain-free, safe, and reliable method to choose non-operative or operative treatment, with respect to clinical outcome."

Hoshino et al (19) reported a study of weightbearing radiographs in 36 patients who had undisplaced malleolar fractures, medial tenderness, bruising or swelling, and positive findings on external rotation stress radiographs. Only 3 showed an increased medial joint space on weightbearing radiographs; the other 33 were successfully treated nonoperatively. This supports Weber's conclusion that stress radiographs substantially overestimate the instability in undisplaced ankle fractures.

Within our unit, all stable ankle fractures are treated in a brace unless the patient's requests otherwise. Patients with fractures of uncertain stability were normally treated from 1998 to 2010 in below-the-knee walking casts, with a very low displacement rate (2%). Of these patients with potentially unstable injuries, 25 patients, having seen other patients in braces, specifically requested braces and were therefore treated in weightbearing braces after a discussion of the risks involved. Since the report by Weber et al (18) in 2010, we have used weightbearing radiographs to evaluate stability and enable us to actively offer patients the choice between a brace or cast.

The present study is a report of our initial experience of treating undisplaced malleolar fractures of uncertain stability in functional braces using weightbearing radiographs to judge the stability. The main outcome of the present study was radiographic and clinical union without displacement.

Patients and Methods

All skeletally mature patients treated entirely by our unit, attending the senior author's (J.L.B.) fracture clinic with a malleolar fracture from January 1, 1998 to June 30, 2013, were evaluated for inclusion in a study of the management of undisplaced, potentially unstable malleolar fractures. We excluded patients with pathologic or neuropathic fractures. At each review, the patients were reviewed by the senior author (J.L.B., consultant trauma/orthopedic surgeon with subspecialty training and practice in foot and ankle surgery). Inclusion was determined radiographically and clinically by the presence of any of the following criteria (15):

Medial tenderness, bruising, or swelling
Medial/posterior malleolar fracture
Suprasyndesmotic ankle fracture (Arbeitsgemeinschaft fuer Osteosynthesisfragen [AO] type C)
High-energy injury
Open fracture

In total, within the study period, 211 patients met the inclusion criteria and were included within the wider study. Until 2010, they were recommended treatment in a below-the-knee weightbearing cast. As noted, 25 patients requested brace treatment and accepted the risks despite the uncertainty about the stability of their fractures. Since the report by Weber et al (18) in 2010, we have actively been offering these patients the choice of a brace or a weightbearing cast and an additional 18 patients have been treated with a brace. These 43 patients formed the present group. The orthosis used was an Actimove brace, made by Smith & Nephew (supplied by BSN Medical, Hamburg, Germany; Fig. 1).

Weightbearing radiographs were taken in the brace after fitting as a baseline and to ensure no displacement had occurred in the interval between the patient attending the casualty clinic and the fracture clinic. The patients were encouraged to fully weight bear as pain allowed and to actively exercise their ankles. They were encouraged to wear the brace at all times and to contact the plaster room if any problems developed. Weightbearing radiographs were repeated free of the brace at clinical union at 6 to 8 weeks in all cases to ensure congruity of the ankle mortise, with a medial clear space of >4 mm demonstrating displacement. Clinical union was determined by the absence of bony tenderness at the fracture site and by radiographic evidence of union. We did not exam patients beyond this point, because it would not be our normal clinical practice, and groups commissioning healthcare through the National Health Service would not pay for additional consultations without a clinical indication. We encouraged patients to contact us with any problems; however, none did so. The 95% CIs were calculated for the proportion of patients whose ankle fracture had displaced during the follow-up period.

Results

Of the group treated in a brace, 27 (63%) were female and 16 (37%) male, with a median age of 57 (range 27 to 79) years. Of these 43 patients, 37 (86%) had trans-syndesmotic fractures (AO group B, Lauge-Hansen supination-external rotation), and 6 (14%) had suprasyndesmotic fractures (AO group C, Lauge-Hansen pronation-external rotation). Also, 3 patients (7%) had small posterior malleolar fractures involving <20% of the articular surface on the lateral radiograph. No patients had medial malleolar fractures or open or high-energy injuries.

All 43 patients treated in a brace had clinical union at a median of 7 (range 6 to 9) weeks. None of the fractures had displaced as evidenced by a repeat weightbearing radiograph at clinical union; thus, the repeat displacement rate was 0% (95% CI 0% to 9.5%, Clopper-Pearson exact method; Fig. 2).

All patients had radiographic evidence of trabeculae crossing the fracture site on the final weightbearing radiograph without the brace. Because no patients had tenderness over the fracture site, we did not consider additional radiography to be clinically indicated. The patients were encouraged to contact the clinic if they experienced continuing or worsening pain or any other problem after discharge, and none did so.

However, 1 patient (2%) returned to the clinic because of pain on mobilization after 1 week of treatment and chose to have the brace changed for a weightbearing cast. This patient still went on to heal with no displacement of his fracture.

No patient experienced deep vein thrombosis or other compromises of skin integrity because of pressure from the brace. A summary of the study and results is presented in Fig. 2.

Discussion

Weber et al (18) first published the use of weightbearing radiographs to predict the stability of supination external rotation ankle fractures defined using the Lauge-Hansen classification. Their aim was to assess whether weightbearing radiographs could be used to distinguish between stable supination external rotation type 2 injuries (SER 2) fractures and unstable supination external rotation injuries type 4 (SER 4) fractures. The retrospective study by Weber et al (18) analyzed the radiographs of 57 patients who were believed to have SER 2 injuries. Of these patients, 51 had stable injuries and were