

# Functional bracing is a safe and cost effective treatment for isolated Weber B fracture

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## Research article

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# Abstract

## Background

Despite the current recommendations that stable Weber B ankle fractures can be treated with functional bracing and weightbearing as tolerated, some reluctance exists among trauma surgeons to follow these recommendations. We report on our institution's experience in managing these injuries and compare it to the national guidelines.

## Patients and Methods

Consecutive patients with isolated Weber B fractures referred to the local outpatient clinic over the period of six months were included in the study. Radiographs and clinic letters were examined, the patients were interviewed via telephone to obtain outcome scores (Olerud and Molandar score). Method of immobilisation, weightbearing status, radiological fracture union, clinical outcomes and complications were all assessed and analysed.

## Results

One hundred and twenty-three patients with isolated Weber B fractures were identified. This cohort of patients did not show clinical or radiographic evidence of instability, they were deemed stable and were initially treated non-operatively. Minimum follow-up period was six months. Sixty-two patients were treated in plaster and were non-weight bearing on the affected limb, while 61 were treated with functional bracing in a boot and were allowed early weight bearing. Three patients showed displacement requiring surgical fixation. All fractures progressed to union and patients were discharged irrespective of the method of immobilisation or weightbearing status during treatment. There was no statistically significant difference in the functional outcome measures between the two groups. The protocol of functional bracing and weightbearing was associated with fewer outpatient clinics and a reduced number of radiographs obtained in the clinic and fewer complications.

## Conclusion

Isolated trans-syndesmotic Weber B ankle fractures, that are clinically and radiologically stable, can be safely treated with functional bracing in a boot and weightbearing as tolerated. Weightbearing radiographs are reliable in confirming the stability of such fractures.

## Introduction

Ankle fracture is one of the most common fractures in all age groups, the overall incidence rate in the UK is estimated to range between 7.5 and 12.2 per 10 000. (1, 2) Some studies reported ankle fractures to be the most common fracture in patients between 15–59 years old in United Kingdom (UK) and account for more than 3 million hospital admissions in UK between 2004–2014 (3). Ankle fractures has significant financial cost, it is estimated that direct healthcare cost of unstable ankle fracture can be as high as

\$19,555 with direct and indirect cost for ankle sprain to range from \$1809 and \$5271 (4). The difference in healthcare cost is directly related to the type and stability of the fracture as well as the treatment method.

The stability of the ankle joint following an ankle fracture is a major determinant of the method of managing these fractures. Stable ankle fractures can be treated non-operatively with a favourable and predictable outcome (5). Hence, defining the stability of ankle fracture is of utmost importance. Certain fracture patterns are inherently unstable. Such fractures include fracture dislocations, bimalleolar and trimalleolar fractures, and high fibula fractures (Weber C) as part of pronation external rotation injuries. (6) Unstable ankle fractures are widely treated surgically, with general belief it yields better outcome, however, recent studies cast doubts on this belief with no difference in short term outcome between operative and non-operative management of unstable ankle fractures (6–8).

Weber A fractures are widely agreed upon to be stable. The stability of isolated, trans-syndesmotic Weber B supination external rotation (SER) type fractures remains controversial. However, there is a growing body of evidence in the literature from research that is improving our understanding of such injuries and helping in determining which trans-syndesmotic Weber B fractures are unstable.

In isolated Weber B fibula fracture, the integrity of the medial deltoid ligament is an essential predictor of a stable fracture configuration. Clinical as well as radiological signs can be useful in assessing the integrity of the deltoid ligament in SER isolated distal fibula fractures. All of these signs have their own limitations. Aside from instability, other factors influence the management of these injuries such as fibula length and rotation. Instability, fibula shortening and malrotation are all indications for surgical fixation (9).

In our study, we examined the management of isolated Weber B type fractures with no evidence of instability or displacement. We compared two management philosophies followed by the trauma surgeons in two institutions in terms of method of immobilisation and weight bearing status. We highlight an avoidable workload and its effect on busy fracture clinics and the cost saving related to early weight bearing treatment.

## **Patients And Methods**

We performed a retrospective review of all Weber B ankle fractures that were referred to our fracture clinic over a period of six months from the emergency department. All initial radiographs were examined. We excluded bimalleolar and trimalleolar fractures, any fracture with talar shift of more than 2 mm and any Weber B fracture as part of a fracture dislocation, as all of these are widely regarded as unstable fractures, hence beyond the scope of this paper. We identified 123 patients with isolated trans-syndesmotic distal fibula fracture (Weber B), and these were the subjects of our study.

As per the institution's protocol for managing patients with such injuries, all patients had initial radiographs prior to the application of a below knee plaster slab in the emergency department. Further

radiographs were obtained in plaster in the emergency department to confirm that the position in plaster remains satisfactory. Patients were then instructed to remain non-weightbearing until seen in fracture clinic for further management. Patients were seen in fracture clinic within 2 weeks (average 8 days). In the fracture clinic, patients were assessed to determine if they were suitable candidates for non-operative management (no fibular shortening or rotation malalignment, and the ankle mortise remains congruent). If suitable, non-operative management was implemented, the choice of which pathway to follow was taken according to the treating surgeon's preference.

Two non-operative pathways existed, the first [cast – Non weight bearing (NWB)] is to apply full cast, obtain a check radiograph and keep the patient non-weight bearing for 6 weeks. These patients were instructed to attend the fracture clinic the following week for radiographic assessment to check for displacement. Patients were seen at 6 weeks for removal of cast, check radiographs and to start weight bearing and physiotherapy rehabilitation. The second pathway is to allow weight bearing in a long walking boot [functional bracing] at the first fracture clinic appointment. Patients were also seen the following week to check for displacement and subsequently seen at 6 weeks for removal of boot and final radiographs. In both protocols, patients were discharged from the clinic only when there were clinical and/or radiological signs of fracture healing and they were discharged to physiotherapy for rehabilitation. The choice of which pathway to implement was left entirely at the discretion of the treating surgeon.

We examined all patients' initial radiographs and any further ones taken subsequently in our clinic. The medical notes and clinic letters were also reviewed. We screened for medical problems particularly diabetes. We examined all patients course of treatment, total number of outpatient clinic appointments, total number of radiographs obtained and whether any fracture failed the non-surgical management and needed further intervention (manipulation or fixation). We also checked for any complications that occurred during treatment.

Finally, we also conducted telephone interviews with the patients to obtain Olerud and Molandar scores to quantify their functional progress and their satisfaction at a minimum of 6 months after their discharge from our fracture clinic.

## Results

One hundred and twenty-three patients were identified as having isolated trans-syndesmotom Weber B fracture and hence fitted our inclusion criteria. The mean age was 51.7 (range 18 to 92). There were 66 female patients (53%) and 57 males (47%). sixty-one patients (50%) were treated with functional bracing in a weight bearing walking boot, while the remaining 62 patients were immobilized non-weight bearing in cast. Seven patients were diabetics (5 in the functional bracing group and 2 in the cast group). There was no significant difference in patients' demographics as shown in Table 1.

Table 1  
patient demographics

	<b>total</b>	<b>Functional bracing</b>	<b>Plaster cast</b>
Number of patients	123	61	62
Male : Female	53 : 70	29 : 32	24 : 38
Mean age (range)	51.7 (18–92)	50.3 (18–85)	52.9 (25–92)
diabetics	7	2	5

All fractures in the functional bracing group had healed on the final review at 6 weeks without any complications and patients were subsequently discharged from the clinic. In the cast group, there were 5 complications. One patient developed DVT and was treated accordingly. One patient had delayed union. This was treated with low-intensity pulsed ultrasound (Exogen®) and subsequently progressed to union at 4 months. Three patients had displacement of their fractures at the first fracture clinic review and were offered surgery. These patients had open reduction and fixation and made full recovery. There was no complication in the diabetic patients in either management group.

We examined the effect of the treatment protocol on the number of outpatient appointments and the number of radiographs obtained in the clinic. A significant reduction of approximately 50% in these parameters was found between the two groups (cast vs functional bracing). Mean number of outpatient appointments per patient in the cast group was 3.75 vs 1.96 for the boot group ( $p < 0.01$ ). Mean number of radiographs per patient was 3.2 for plaster group vs 1.8 for boot group ( $p < 0.01$ ). Yet, there was no difference in the clinical or radiological outcomes.

Finally, we collected Olerud and Molandar scores via telephone interviews with the patients. We were able to interview 94 patients (76%). The average score for the whole group was 92 (range 75 to 100). The functional bracing group (49 responses) had an average score of 92.2 while the cast group (45 responses) had an average score of 90. There was no significant difference between the two groups ( $p = 0.33$ ). The results are shown in Table 2.

Table 2  
comparison between functional bracing and plaster of Paris immobilisation

	<b>Functional bracing</b>	<b>Plaster</b>
Number of patients (total 123)	61	62
Average number of radiographs	1.8	3.2
Average number of clinics	1.96 (range 2–3)	3.75 (range 2–4)
Number of complications	0	5
Olerud-Molandar Score (N = 94)	92.2 (N = 49, range 75–100)	90 (N = 45, range 78–100)

## Discussion

There is a growing consensus among foot and ankle surgeons to support that trans-syndesmotic distal fibula fractures without medial column injury are stable fractures and could be safely treated by functional bracing and early weight bearing (10–12). This consensus was further strengthened by the findings of the recently published Combined Randomised and Observational Study of Surgery for type-B Ankle Fracture Treatment (CROSSBAT) (13) and the British Orthopaedic Association Standards for Trauma (BOAST) guidelines published in 2016 (14). Both recommend the use of functional bracing and weight bearing as tolerated in ankle orthotic.

However, some understandable concern remains among trauma surgeons regarding identification of stable ankle fracture. As such fractures may still displace if patients are allowed to weight bear in a brace. This concern arises from that fact that a seemingly stable supination external rotation (SER) stage II fracture according to Lange-Hansen classification may look identical to the unstable SER stage IV fracture on the initial radiographs (15). Hence, identifying unstable fractures is necessary if we are to adopt these recommendations.

Various methods were proposed to assess the stability of isolated trans-syndesmotic distal fibula fractures. These include medial tenderness, medial ecchymosis, gravity stress radiographs, manual stress radiographs and weight bearing radiographs. Medial tenderness and ecchymosis could be a result of an injury to the superficial part of the deltoid ligament, the ankle stability is not usually compromised in this situation as the deep part of the deltoid ligament is intact (16). Despite this unreliability, medial tenderness and bruising remain the only clinical sign of possible instability. Stress radiographs (manual and gravity) are difficult to obtain, poorly tolerated by patients and could lead to over-diagnosis of ankle instability (17, 18). Weight bearing radiographs have also been examined for their ability to detect ankle instability. Weight bearing radiographs were reported to result in significant reduction in the need for operative management for SER fractures when used. In his series of 57 patients, Weber et al stated that weightbearing radiographs are “easy, pain-free, safe and reliable” in detecting instability. (19, 20).

In our study, all patients who had weight bearing radiographs to examine for the ankle stability were allowed early weightbearing. Our observation is consistent with the findings of other published studies that weight bearing radiographs facilitated the functional treatment of ankle fractures (21–23).

Our results did not show statistical difference in the fracture union or patient reported outcome score (Olerud - Morander Score) regardless of the method of immobilisation or the weight bearing status. However, the benefit of functional bracing was clear. Functional bracing and early weight bearing have resulted in less outpatient appointments, fewer number of radiographs needed and less complications.

Cost of treatment is a significant ongoing concern in the UK National Health System (NHS) and any other health system. One outpatient appointment costs the NHS £36 (minimum), while one radiograph costs approximately £25. At the current rates, the ankle orthotic (boot) used by our trust costs £21, while polymer casts (which need to be changed at least once through the course of treatment) cost

approximately £32 each. Therefore, if all our 123 patients were treated according to BOAST guidelines (one outpatient appointment and discharged, weight bearing in a boot), we estimate potential saving of over £10000 that could have been saved within 6 months.

This study is not without limitations, the retrospective nature of the data collection, the lack of randomisation and relatively short follow-up period are the main limitations. We recommend a prospective randomised controlled trial with longer follow-up to help answer this clinically relevant question. We also recommend a thorough investigation of the value of obtaining weight-bearing radiographs in these situations. One could argue that weight bearing radiographs could be obtained on the first visit to the emergency department, functional bracing and early weight bearing could be decided at this stage. To our knowledge, there are two ongoing trials, currently recruiting, with the aim to answer these issues (24, 25).

## Conclusion

We conclude that in the absence of clinical and radiological evidence of instability, Weber B trans-syndesmotic isolated fractures could be treated safely with functional bracing and early weight bearing. We also recommend the use of weight bearing radiographs in the first outpatient appointment as a reliable method to confirm ankle stability. Our recommendations are in line with the current guidelines and we question the rationale behind the frequent clinical and radiographic review for such injuries.

## Abbreviations

UK

United Kingdom

SER

Supination external rotation

NWB

Non weight bearing

CROSSBAT

Combined Randomised and Observational Study of Surgery for type-B Ankle Fracture Treatment

BOAST

British Orthopaedic Association Standards for Trauma

NHS

National Health System

## Declarations

**Ethics approval and consent to participate:**

This is a retrospective study, no new intervention, all patients provided their consent to participate in the study as part of the PROMS assessment

**Consent for publication:**

No patient identifying data submitted for publications

**Availability of data and materials:**

Original data available upon request

**Competing interests:** none applicable

**Funding:** none applicable

**Authors' contributions:**

Mr A Abdelaal: Data collection, PROMS questionnaire, analysis, manuscript write up

Mr Sherif Elnikety: Data analysis, manuscript write up

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