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Original Article

Functional treatment of isolated stable Weber B fractures of the lateral malleolus with immediate weightbearing and joint mobilization

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Abstract

Objective: This study aimed to evaluate the clinical and radiographic outcomes of conservative treatment in patients with isolated Weber B fractures of the lateral malleolus.

Methods: Medical charts of 30 patients with isolated, stable Weber B fractures of the lateral malleolus with less than 2 mm of displacement were retrospectively evaluated. All patients underwent early weightbearing and joint mobilization, with treatment involving the use of a controlled ankle motion walker boot for a period of six to eight weeks. Clinically, qualitative variables such as the presence of residual pain, tibiotalar joint motion, and total return to physical activities were evaluated. Radiographic parameters included bone healing time, healing rate, and fracture displacement.

Results: Among the 30 patients, 6 (20%) experienced residual pain, while 25 (83%) successfully resumed their previous physical activities within an average period of 3.4 months. Limited joint mobility was observed in six (20%) patients. Radiographically, 22 (73.3%) patients had fracture deviation of 1 mm; 6 (20%) patients, of 2 mm; and 2 (6.7%) patients showed no deviation. Average time for bone healing was seven weeks. Three (10%) patients developed pseudarthrosis. Return to physical activities was correlated with time and rate for fracture healing. Residual pain was associated with pseudarthrosis, dyslipidemia, and hypothyroidism. Bone healing did not correlate with age, displacement, or comorbidities.

Conclusion: The present study demonstrated that the proposed conservative treatment yielded satisfactory clinical and radiographic results, with a high rate of bone healing and successful return to previous physical activities.

Level of Evidence IV; Retrospective case series.

Keywords: Ankle fractures; Conservative treatment; Treatment outcomes.

Introduction

Ankle fractures are common injuries encountered in daily practice, accounting for approximately 10% of all fractures. Among these, isolated trans-syndesmotic fibula fractures (type B) are the most prevalent[1]. Optimal treatment is basically determined by preservation of joint stability and congruency, which are maintained by both bony and ligamentous structures – most notably, the deltoid and syndesmotic ligaments[2]. A fracture is considered incongruent when fragment displacement exceeds 2 mm. Similarly, when the deltoid ligament is completely ruptured, the fracture is

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classified as unstable[3]. To assess stability, stress radiographs, including external rotation, single leg weightbearing, and gravity tests, are routinely performed. If the fracture is stable, non-operative treatment can yield good to excellent long-term outcomes in terms of pain and function[4,5,6].

The most commonly used immobilization methods for non-surgical treatment include casts and orthoses as the controlled ankle motion walker boot (CWB)[7]. For some time, plaster cast immobilization without weightbearing on the affected limb was the standard treatment. However, the absence of joint loading and mobilization increases the risk of complications, such as leg muscle atrophy, joint stiffness, and deep vein thrombosis[8,9,10]. Long-term consequences can occur, such as persistent calf muscle weakness, gait abnormalities, and complex regional pain syndrome[11]. However, there is limited information on whether functional protocols involving removable orthoses and early joint mobilization may be associated with adverse events[12].

The aim of this study was to evaluate the clinical and radiographic outcomes of a group of patients with acute, stable, isolated Weber B fracture of the lateral malleolus (displacement of less than 2 mm) treated with a CWB and early weightbearing and joint mobilization. A secondary objective was to assess the correlation between clinical variables and radiographic findings.

Methods

Study design and studied population

This is a retrospective study involving a series of patients with acute, stable Weber B fractures of the lateral malleolus with less than 2 mm of displacement and treated non-surgically with early weightbearing and joint mobilization. The study was conducted at a single center, from January 2016 to July 2022 and approved by the Institutional review board (IRB) under the number 71256023.8.0000.5442. All patients had their first appointment with a foot and ankle specialist within one week of the trauma. Of the 52 ankle fractures treated during the described period, a total of 30 patients met the inclusion and exclusion criteria. Mean age of patients was 53.83 (range, 30–80) years. Fourteen (47%) patients were female, and 16 (53%) patients were male. During the visit, they were initially evaluated for deltoid ligament injury (Figure 1). If medial pain and/or edema was present, a rotation stress view was obtained to assess fracture stability, focusing on the widening of the medial clear space and on the position of the distal fragment of the malleolar fracture (Figure 2). Where the clear medial space widening was less than 4 mm, non-surgical functional treatment was indicated. Where the widening exceeded 4 mm, surgical treatment was indicated. In the absence of pain and swelling on the medial side, conservative treatment was indicated. Literature has reported that these findings suggest the deltoid ligament is either intact or partially ruptured, rather than completely torn[13]. The functional protocol consisted of the use of a CWB and immediate joint mobilization for a period of six to eight weeks. Patients were instructed to perform daily plantar flexion and ankle extension exercises, with weightbearing on the CWB allowed as tolerated. The CWB removal was allowed during sleep. All patients were treated by two trained, experienced foot and ankle surgeons. Routine serial radiographs were taken at two and six weeks of treatment and, in some cases, at eight weeks, depending on the progression of bone healing. The study enrolled patients aged 18 years and older with stable Weber B lateral malleolus fractures with less than 2 mm of displacement. Exclusion criteria included a history of prior ankle surgery, bilateral fractures, bimalleolar and trimalleolar fractures, smoking habits, and comorbidities such as diabetes mellitus and inflammatory arthropathies.

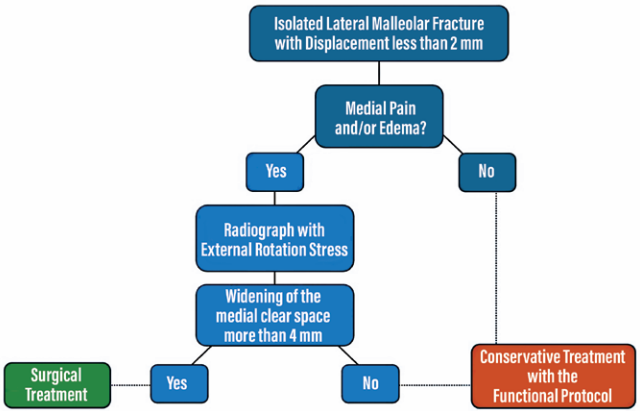

Figure 1. Flowchart for treatment decision.

Figure 2. Evaluation of joint stability with stress test in external rotation. (A) radiographic view at rest and (B) under stress.

Clinical and radiographic variables

Clinical data for the study were obtained through a retrospective review of medical records. For clinical evaluation, qualitative variables, such as the presence of any residual pain on physical examination or patient-reported complaint, range of motion (ROM) of the tibiotalar joint compared with the contralateral side, mainly extension restrictions, and complete return to physical activities, were assessed. All patients engaged in recreational activities, most commonly gym workouts, walking, running, and soccer. Radiographic parameters included bone healing time, fracture displacement, and progression to pseudoarthrosis. Fracture nonunion was confirmed by computed tomography images obtained six months after the trauma. Radiographic data and measurements were obtained using the Vue Motion software (Carestream Health, Rochester, NY, USA).

Statistical analysis

For statistical analysis, a convenience sample (non-probabilistic) comprising all patients treated during the specified period who met the inclusion and exclusion criteria was used. We evaluated the correlation between qualitative clinical variables and healing time, fracture displacement, age, and comorbidities. Additionally, the relationship between consolidation time and fracture displacement, age, and comorbidities were also assessed. Pearson and Spearman correlation tests were applied, with all statistical analysis conducted using JASP software version 0.16.2. A p-value of less than 0.05 was considered statistically significant.

Results

At an average follow-up of 4.24 (range 4–9) months, 6 (20%) patients reported residual pain and 25 (83%) patients had returned to their previous physical activities within an average of 3.4 (range, 2–8) months. Some limitation in ROM was observed in six (20%) patients on physical examination. Regarding comorbidities, 11 (37%) patients had hypertension, 4 (13%) patients had dyslipidemia, and 4 (13%) patients had hypothyroidism (Table 1). Radiographically, 22 (73.3%) patients had a fracture displacement of approximately 1 mm, 6 (20%) patients had a displacement of 2 mm, and 2 (6.7%) patients showed no displacement. The average bone healing time was seven (range, 5–12) weeks. Three (10%) patients developed pseudarthrosis and underwent surgical treatment (Table 2). None of the patients without medial pain or edema experienced further fracture displacement during treatment.

The return to physical activities was correlated with the time required for fracture healing and the presence of pseudarthrosis, indicating that a longer healing period directly affected the duration of physical activity suspension. Patients with pseudoarthrosis were unable to resume physical activities. No correlation was found between ankle ROM limitation and the time to return to activity. Residual pain was correlated with pseudarthrosis, dyslipidemia, and hypothyroidism. However, the time to union showed no correlation with age, fracture displacement, or comorbidities (Table 3).

Discussion

Malleolar fractures at the level of the distal tibiofibular syndesmosis are common injuries and can be effectively managed through conservative or surgical treatment, depending on joint stability and congruency[6]. Additionally, previous guidelines strongly recommend functional treatment and weightbearing as soon as tolerated[14,15]. Our study demonstrated that conservative treatment of isolated Weber B lateral malleolar fractures using a functional approach, with

Table 1. Demographic data and clinical outcomes

Patients	Age	Gender	RPA	TRPA (months)	Residual Pain	ROM Limitation	Comorbidities
30	53.83 (range, 30–80)	14 F:16 M	25 (83%)	3.4 (range, 2–8)	6 (20%)	6 (20%)	19 (53%)

RPA: return to physical activities; TRPA: time to return to physical activities; ROM: range of motion.

Table 2. Radiographic data and outcomes

Patients	Without displacement	1 mm displacement	2 mm displacement	Bone healing (weeks)	Pseudoarthrosis
30	2 (6.7%)	22 (73.3%)	6 (20%)	7 (range, 5–12)	3 (10%)

Table 3. Correlation between Clinical and Radiographic Variables

	Displacement	Age	Gender	Healing time	Residual pain	Range of motion	Pseudoarthrosis	Hypertension	Dyslipidemia	Hypothyroidism
Return to physical activities	0.48	0.75	0.15	0.005*	0.65	0.02	0.001*	0.69	0.18	0.68
Range of motion	0.29	0.98	0.29	0.17	0.87	X	0.56	0.20	0.30	1.0
Residual pain	0.29	0.22	0.86	0.09	X	0.83	0.034*	0.59	0.002*	0.013*
Healing time	0.61	0.76	0.146	X	x	X	x	0.60	0.36	1.0

Pearson and Spearman correlation tests.
*Statistical significance when $p < 0.05$.

immediate weightbearing and early joint mobilization, yields satisfactory results, with an 83% rate of return to previous physical activities and a 90% rate of bone consolidation.

Conservative treatment options for stable lateral malleolar fractures have been reported with varying protocols regarding types and duration of immobilization, as well as timing for initiating weightbearing and joint mobilization. Overall, studies have demonstrated satisfactory results, but they primarily consist of case series and comparative assessment involving plaster cast, functional bracing, CWB, and customized shoes[16]. Functional treatments with early weightbearing have shown to be safe and effective, yielding better clinical scores compared to traditional cast immobilization[17]. Brink et al.[8] conducted a study comparing the use of an ankle brace with a CWB in 66 patients, evenly divided into two groups. They found that both dynamic braces provided good pain relief within four weeks and allowed for a return to work by six weeks. All fractures showed union at 12 weeks of radiographic follow-up. However, the CWB group experienced greater pain relief, increased ROM, and an earlier return to ambulation[8]. van den Berg et al.[18] compared functional treatment using a removable brace with cast immobilization in a group of 44 patients with stable type B fracture. All patients initiated weightbearing one week after the fracture. At the 52-week follow-up, clinical and functional outcomes were similar between the two groups. However, the brace group showed a wider ROM[18]. Zeegers et al.[19] applied a stabilizing shoe, designed for functional treatment, following surgical treatment in a group of 24 patients with fractures of the lateral malleolus, intact deltoid ligaments, and fragment displacement of less than 2 mm. It consisted of a laced shoe that allowed flexion and extension of the tibiotalar joint, but featured lateral reinforcement to prevent supination, pronation, eversion, and inversion of the foot. At the final follow-up, 11 of the 13 active patients had returned to their previous physical activities, 7 (29%) patients reported residual pain, and there was no relevant reduction in ankle ROM[19]. Compared to the studies mentioned above, our patients were likely less immobilized, wearing the CWB only while walking. They were permitted to remove it during sleep and periods of rest. With the applied protocol, most patients returned to their pre-injury activity levels within an average of 3.4 months, with only a few reporting residual pain and limitations in ROM.

When treating ankle fractures nonsurgically, stability is a key concern. On initial radiographs, stable supination-external rotation stage II fractures, according to the Lauge-Hansen classification, may appear identical to unstable stage IV fractures. Therefore, it is paramount to accurately assess joint stability before proceeding with the functional conservative treatment[20]. Clinical signs like medial pain and ecchymosis are unreliable, as they do not necessarily indicate a complete rupture of the deltoid ligament[21]. Different stress radiographic tests, including external rotation, gravity, and weightbearing, have been described. However, systematic reviews and meta-analyses have not yet determined the most effective test[22,23,24,25]. In this study, patients with medial symptoms underwent external rotation test, which was performed by one of the two foot and ankle surgeons responsible for their treatment.

When the treatment approach is appropriately chosen based on fracture stability, both conservative and surgical treatment for stable Weber B ankle fractures can yield comparable clinical and functional outcomes[26,27,28,29]. Laurence et al.[29] assessed a cohort of 49 patients with Weber B fractures, with 20 patients receiving operative treatment and 29, undergoing conservative management. The mean follow-up periods were 6.9 years and 6.7 years, respectively. The non-operative group scored better on four clinical and functional questionnaires[29]. Overall, most systematic reviews and meta-analyses indicate that, while outcomes of both treatments were comparable, clinical complication rates were lower for the conservative approach[30,31]. Regarding bone healing, Willett conducted a study involving 620 patients who were randomly assigned to either a surgical or non-surgical treatment group. In the surgical group, no cases of non-union were observed, while the non-surgical group reported a 2.9% incidence of non-union. Although our non-union rate was higher, it is important to consider that this rate may be overestimated due to the smaller sample size in our study[32].

Although our study is not the first to evaluate the functional treatment of stable Weber B fractures using CWB, it is among a few studies correlating clinical and radiographic variables, including those related to return to physical activities. Additionally, we detailed a protocol that allowed patients to mobilize the ankle joint daily and sleep without the boot.

The study has limitations, including its retrospective design and small sample size. Despite these constraints, statistically significant correlations were found between clinical and radiographic variables. Another limitation is the absence of a control group to compare our results with other types of immobilizations, different joint mobilization protocols, and varying weightbearing periods. Additionally, the clinical variables analyzed were qualitative, and we did not quantitatively measured ROM and functional outcomes. Nevertheless, positive correlations between clinical and radiographic variables were observed, which may be relevant for daily medical practice. Moreover, patients studied also exhibited heterogeneity in age and levels of physical activity.

The study demonstrated that the proposed treatment yielded satisfactory clinical and radiographic results, with a high rate of bone healing and return to pre-injury physical activities. However, further prospective studies with larger populations are necessary to more comprehensively evaluate the conservative treatment of stable Weber B ankle fractures. Comparing different functional treatment protocols will help establish clearer guidelines for optimal clinical and radiographic outcomes.

Author's Contribution: Each author personally and significantly contributed towards the development of this article: DRCN *(https://orcid.org/0000-0003-0227-2440) Conceived and planned the activities that led to the study, interpreted the results of the study, wrote the paper, participated in the reviewing process; FAD *(https://orcid.org/000-0001-6871-2491) Conceived and planned the activities that led to the study, interpreted the results of the study, wrote the paper, participated in the reviewing process; ESS *(https://orcid.org/0009-0006-0087-1983) Conceived and planned the activities that led to the study, wrote the paper, participated in the reviewing process; VS *(https://orcid.org/0009-0009-7097-4090) Conceived and planned the activities that led to the study, wrote the paper, participated in the reviewing process; PAP *(https://orcid.org/0000-0001-9667-0006) Participated in the reviewing process; FCPF *(https://orcid.org/0000-0002-8907-0472) Interpreted the results of the study, participated in the reviewing process; BRM *(https://orcid.org/0000-0002-5306-2972) Interpreted the results of the study, participated in the reviewing process; AAMM *(https://orcid.org/0000-0002-2818-9939) Interpreted the results of the study, participated in the reviewing process; MPP *(https://orcid.org/0000-0003-0325-8050) Interpreted the results of the study, participated in the reviewing process. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID).

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