Injury, Int. J. Care Injured xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Review

The effect of time to post-operative weightbearing on functional and clinical outcomes in adults with a displaced intra-articular calcaneal fracture; A systematic review and pooled analysis

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ARTICLE INFO

Keywords:
Weightbearing
Calcaneal fractures
Böhler
AOFAS

ABSTRACT

Background: Post-operative weightbearing guidelines for displaced intra-articular calcaneal fractures (DIACF) have been pragmatically developed in the past, however hardly adapted to current health care insights. A period of six to nine weeks of non-weightbearing is usually recommended. It is unknown whether an earlier start of weightbearing is advisable.
Objectives: The primary aim was to evaluate the effect of time to post-operative weightbearing on Böhler's angle. Secondary aims were to determine the effect on functional outcome (*e.g.,* The American Orthopedic Foot and Ankle Society Scale), post-operative pain score, complications (*e.g.,* infections, nonunion, implant removal), and revision surgeries. Finally, the effect of bone void filling on these outcomes was investigated.
Data source: A literature search was performed on January 24, 2017 in the Cochrane Library, Medline Ovid, Embase, Web of Science, Google Scholar, and CINAHL.
Literature selection: Studies reporting on operatively treated patients with a DIACF and time to weightbearing were eligible for inclusion. Studies were excluded when not reporting primary data, solely reporting on open fractures, bilateral fractures, or polytrauma patients. Based upon the time to starting partial weightbearing, patient cohorts were stratified into very early (0–4 weeks), early (4–6 weeks), intermediate (6–8 weeks), or late (8–12 weeks) start of partial weightbearing.
Data extraction: Two investigators extracted data independently using a predefined data sheet.
Results: After applying exclusion criteria, 72 studies remained eligible for analysis. Böhler's and Gissane's angles, calcaneal height, AOFAS, pain scores, and complications had overlapping confidence intervals in all weightbearing groups.
Conclusion: The adverse sequelae which are assumed to be associated with starting partial weightbearing already within six weeks after internal fixation of calcaneal fractures, is not supported by literature data. This systematic review suggests that early weightbearing does not result in impaired outcomes compared with more conservative weightbearing regimes.

Contents

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https://doi.org/10.1016/j.injury.2018.02.021
0020-1383/

Introduction

After fracture reduction of displaced intra-articular calcaneal fractures (DIACFs), it is important to avoid fracture displacement during rehabilitation. In order to maintain reduction, the initial guidelines developed by the Arbeitsgemeinschaft für Osteosynthesefragen (AO) described non-weightbearing until fracture healing was radiographically proven, back then usually after three months [1]. Despite improved operation techniques and materials which allow earlier weightbearing without displacement or implant failure since then, the current guidelines are not much adjusted and non-weightbearing is often recommended for six to nine weeks [2–4]. To reduce the risk of secondary displacement this period is followed by increased restricted weightbearing as tolerated [5].

Non-weightbearing is negatively contributing to long-term rehabilitation and associated high socio-economic costs [4–8], it also affects patients' physical conditions by decreasing muscle strength and bone mass [8–10]. Early partial weightbearing might be a safe option, reduce these physical disadvantages and accelerate mental and physical recovery, daily activities, and work resumption [11]. It is unknown whether early (progressive) weightbearing after calcaneal surgery is as safe as the often recommended start of weightbearing after six to nine weeks.

Objectives

The primary aim of this systematic review was to evaluate the effect of time to post-operative weightbearing on Böhler's angle in operatively treated adult patients with a closed DIACF. Secondary aims were to determine the effect of early weightbearing on post-operative pain, (wound related) complications, functional outcomes (*e.g.,* The American Orthopedic Foot and Ankle Society Scale (AOFAS)), and revision surgeries (*i.e.,* implant removal). Finally, the effect of bone void filling on these radiographic parameters, functional outcomes, complications, and revision surgeries was evaluated.

Methods

Search strategy

This systematic review and pooled analysis was conducted following the PRISMA guidelines [12]. To assess the methodological quality of studies, the methodological items for non-randomized studies (MINORS) instrument was used [13]. The global ideal score is 16 for non-comparative studies and 24 for comparative studies [13]. A literature search was performed on January 24, 2017 in the Medline Ovid, Cochrane Central Register of Controlled trials, Embase, Web of Science, Google Scholar, and CINAHL. The databases were searched on the terms related to 'weightbearing' combined with 'intra-articular', 'calcaneal fractures', and their abbreviations and synonyms. The full search strings per database are shown in Supplement Table 1.

Inclusion criteria were; studies reporting on patients with a displaced intra-articular calcaneal fracture that were treated operatively with internal fixation. Also, the moment at which weightbearing started had to be mentioned explicitly. Exclusion criteria were; studies that did not report primary data for the operatively treated patients, studies that solely reported on open fractures, bilateral fractures, or polytrauma patients, and studies that reported on fractures in patients with congenital deformities of the foot. Furthermore, non-clinical or clinical studies with a level of evidence higher than five according to Mahid et al. (*e.g.,* case reports (level VI), opinions (level VII)) were excluded [14]. There was no language restriction or time period selection.

Selected studies were screened on title and abstract for the exclusion criteria by two investigators (ASDB and GVM) independently [15]. Inconsistencies were resolved by consensus. If a full-text version of a manuscript was not available for the investigators, a request for the full-text version was sent to the author. If no response was received, a single reminder was sent after two weeks.

Data extraction

Two investigators (ASDB and GVM) extracted the data independently, again inconsistencies were resolved by consensus. Study design, patient characteristics, treatment characteristics, injury characteristics, radiographic parameters (*i.e.*, Böhler's and Gissane's angle pre-operatively, post-operatively, and at follow-up, and arthrosis), visual analog scale (VAS) for pain [16], complications (*e.g.,* superficial infection (*i.e.,* can be treated non-operatively, *e.g.*, using oral antibiotics), deep infection (*i.e.,* requiring surgical intervention, readmission or intravenous antibiotics) [17], necrosis, nonunion), functional outcomes (*e.g.,* AOFAS), implant removal (due to implant failure or symptoms), and weightbearing regimes (*i.e.*, time to partial weightbearing and full weightbearing) were extracted.

The time to partial weightbearing was stratisfied into four groups: very early (0–4 weeks), early (4–6 weeks), intermediate (6–8 weeks), and late (8–12 weeks). The time to full weightbearing was stratisfied into three groups: early (0–8 weeks), intermediate (8–12 weeks), and late ($>$ 12 weeks).

Statistical analysis

Radiographic parameters, functional outcome scores, and complication rates for both partial and full weightbearing were

Please cite this article in press as: A.S. De Boer, et al., The effect of time to post-operative weightbearing on functional and clinical outcomes in adults with a displaced intra-articular calcaneal fracture; A systematic review and pooled analysis, Injury (2018), https://doi.org/10.1016/j.injury.2018.02.021