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JINJ 7669 No. of Pages 8
ARTICLE IN PRESS

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

Contents lists available at ScienceDirect

Injury

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

Incidence and severity of malreduction of the tibiofibular syndesmosis following surgical treatement of displaced ankle fractures and impact on the function –Clinical study and MRI evaluation

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ARTICLE INFO

Keywords:
Syndesmosis
Ankle fracture
Malreduction
Magnetic resonance imaging

ABSTRACT

Purpose: To compare tibiofibular reduction quality in different types of operatively treated ankle fractures and the impact on clinical and functional outcome at mid-term follow-up.
Patients and methods: One hundred patients with an acute ankle fracture who had undergone open reduction and internal fixation were included. Eighty-eight patients who suffered from ligamentous ankle injury with neither fracture nor syndesmotic lesions served as a control group. Tibiofibular alignment was measured on MR images in all 188 patients. In case of tibiofibular malreduction tibiotalar positioning was determined as well. Clinical and functional outcome was assessed using the AOFAS hindfoot score as well as the SF-36.
Results: No tibiofibular malreduction was found in type Weber B fractures, irrespective of syndesmotic instability followed by syndesmotic screw placement, as compared to the control group. A significant tibiofibular malreduction was detected in bimalleolar/trimalleolar/dislocated type Weber B fractures and in isolated type Weber C fractures with syndesmotic screw, in comparison to the control group. Tibiotalar displacement could not be detected. Clinical and functional outcome analysis revealed no significant differences between the treatment groups.
Conclusion: Three-dimensional imaging may improve tibiofibular malreduction visualization in bimalleolar/trimalleolar/dislocated type Weber B fractures and in isolated type Weber C fractures with syndesmotic transfixation. The clinical impact of improving tibiofibular positioning remains highly questionable since there was no correlation between tibiofibular alignment and the clinical outcome at mid-term follow-up.

Introduction

Ankle fractures account for approximately 9% of all fractures with an incidence of about 187 per 100.000 people each year [1,2]. Most of these fractures are isolated lateral malleolar fractures, while 15 to 20% are bimalleolar, and 7 to 12% are trimalleolar [1]. Fracture classification according to AO-Danis-Weber into type A, B, or C is based on location and its relationship to the syndesmosis [3]. It can be utilized for an uncomplicated evaluation of ankle stability [3]. If a type B or C fracture is classified as unstable, open reduction and internal fixation (ORIF) is the treatment of choice [3–5]. Accompanied syndesmotic injuries are typically associated with instability and can be found in about 10–45% of all ankle fractures. Intraoperative evaluation of syndesmotic instability is a mandatory step and can be either performed by the external rotation stress test, the bone hook test or direct visualization [6,7]. In

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https://doi.org/10.1016/j.injury.2018.04.027
0020-1383/

consequence, syndesmotic instability is managed by reduction and fixation. Tibiofibular transfixation using one or two 3,5 mm syndesmotic screws is well established though other techniques such as isolated suturing of the syndesmosis, syndesmotic hooks, bioabsorbable screws, Endo Buttons (Smith and Nephew Endoscopy, Andover, Massachusetts), and the TightRope device (Arthrex, Naples, Florida) have been proven to ascertain good results as well [8–12]. Recent studies suggested the need for intraoperative or immediate postoperative computed tomography scans to evaluate tibiofibular reduction quality since the reliability of fluoroscopic imaging for the detection of tibiofibular malreduction is known to be limited [2,6,13–17]. Most of these studies evaluated tibiofibular malreduction in ankle fractures as a broad collective and could not define predictive factors. Still, the clinical and functional consequence of tibiofibular malreduction after ORIF of ankle fractures remains controversial [2,10,18–25]. The aim of this study was to compare tibiofibular reduction quality in different types of operatively treated ankle fractures and the impact on clinical and functional outcome at mid-term follow-up.

Patients and methods

Patient selection

One hundred patients with an acute ankle fracture who had undergone open reduction and internal fixation (ORIF) according to the AO principles at our institution between February 2009 and February 2011 were included in this study, as reported in a previous publication [26]. All of them provided informed consent following institutional review board approval. Patient selection was performed in accordance to Spiro et al., [26]. Preoperative radiographs were evaluated and the fractures were categorized according to the AO-Danis-Weber classification [3]. Several exclusion criteria were defined as followed: AO-Danis-Weber type A fracture, systemic inflammatory disease; signs of osteoarthritis at the time of inury; complaints of the ankle prior to injury; history of ankle injury prior or after the ankle fracture; poor fracture reduction; complaints after surgery including impaired wound healing and infection; open ankle fracture; nonunion; operative treatment on the affected ankle after open reduction and internal fixation except implant removal [26]. A special telephone questionnaire was designed, the medical records were reviewed and postoperative radiographs were screened to check for the exclusion criteria [26]. Eighty-eight patients who suffered from ligamentous ankle injury in 2011 served as a control group in this analysis [27]. In this study, we defined ligamentous ankle injury as the absence of a fracture or syndesmotic lesion proven by X-Ray and MRI. All patients were admitted to the emergency department of our University hospital immediately after injury [27].

Surgical management

Operative treatment was performed after a mean of 6.8 days (range, 1–22 days). AO-Danis-Weber type B and type C fractures were treated by ORIF using a one-third tubular plate (DePuy Synthes, Umkirch, Germany). Two screws or a combination of a screw and a Kirschner-wire were used to treat medial malleolar fractures. Posterior malleolar fractures were fixed from the front with two screws. Ankle fracture dislocations were managed by closed reduction with or without external fixation first and ORIF after soft-tissue recovery. After stabilization of all concomitant bone injuries by osteosynthesis as described above, intraoperative evaluation of syndesmotic instability was performed in each case either by the external rotation stress test, the bone hook test or direct visualization of the syndesmosis. In case of syndesmotic instability, the reduction maneuver was performed using a pointed reduction clamp (Weber clamp) applied at the level of the ankle joint. Reduction quality was then proved by fluoroscopy (mortise view) and by direct visualization if applicable, before one 3.5-mm syndesmotic screw was inserted across three cortices (two fibular cortices and a lateral tibial cortex) from lateral to medial and from posterior to anterior at an angle of 30° using the standard AO technique. Reduction quality and screw positioning was assured via intraoperative fluoroscopy (mortise view and lateral view). Due to the fact that in most cases ORIF was performed to treat AO-Danis-Weber type B and type C fractures, syndesmotic screws were

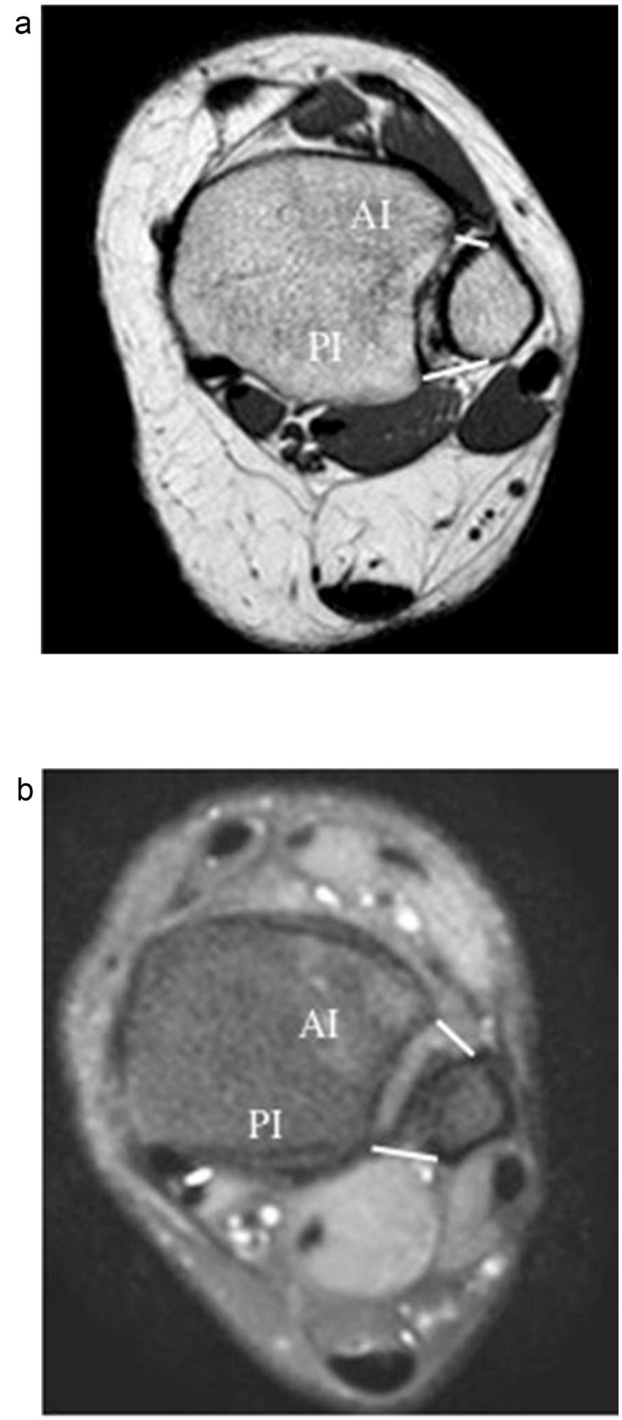

Fig. 1. MRI images depicting PI (posterior incisur) and AI (anterior incisur) measurements in the control group (a) and study group (b) as an example of pathological findings.

Please cite this article in press as: D. Ntalos, et al., Incidence and severity of malreduction of the tibiofibular syndesmosis following surgical treatement of displaced ankle fractures and impact on the function –Clinical study and MRI evaluation, Injury (2018), https://doi.org/10.1016/j.injury.2018.04.027