

## Analysis of 213 currently used rehabilitation protocols in foot and ankle fractures

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### KEYWORDS

ankle fracture  
calcaneus fracture  
midfoot fracture  
rehabilitation  
immobilization  
weight bearing  
orthosis

### ABSTRACT

**Introduction:** Fractures of the ankle, hind- and midfoot are amongst the five most common fractures. Besides initial operative or non-operative treatment, rehabilitation of the patients plays a crucial role for fracture union and long term functional outcome. Limited evidence is available with regard to what a rehabilitation regimen should include and what guidelines should be in place for the initial clinical course of these patients. This study therefore investigated the current rehabilitation concepts after fractures of the ankle, hind- and midfoot.

**Methods:** Written rehabilitation protocols provided by orthopedic and trauma surgery institutions in terms of recommendations for weight bearing, range of motion (ROM), physiotherapy and choice of orthosis were screened and analysed. All protocols for lateral ankle fractures type AO 44A1, AO 44B1 and AO 44C1, for calcaneal fractures and fractures of the metatarsal as well as other not specific were included. Descriptive analysis was carried out and statistical analysis applied where appropriate.

**Results:** 209 rehabilitation protocols for ankle fractures type AO 44B1 and AO 44C1, 98 for AO 44A1, 193 for metatarsal fractures, 142 for calcaneal fractures, 107 for 5<sup>th</sup> metatarsal base fractures and 70 for 5<sup>th</sup> metatarsal Jones fractures were evaluated. The mean time recommended for orthosis treatment was 6.04 (SD 0.04) weeks. While the majority of protocols showed a trend towards increased weight bearing and increased ROM over time, the best consensus was noted for weight bearing recommendations.

**Conclusion:** Our study shows that there exists a huge variability in rehabilitation of fractures of the ankle-, hind- and midfoot. This may be contributed to a lack of consensus (e.g. missing publication of guidelines), individualized patient care (e.g. in fragility fractures) or lack of specialization. This study might serve as basis for prospective randomized controlled trials in order to optimize rehabilitation for these common fractures.

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### Introduction

Injuries of the foot and ankle are common. Fractures of the ankle and metatarsals show the fourth and fifth highest incidence of fractures in the adult population [1]. Treatment strategies for foot and ankle fractures may be managed by non-operative or operative means, dependent on fracture type and localization as well as individual patient related factors. Recommendations for fracture care in foot and ankle fractures are offered by several national and international scientific organizations such as the Arbeitsgemeinschaft für Osteosynthesefragen (AO) [2], the American Foot and Ankle Society (AOFAS) [3] and the European Foot and Ankle Society (EFAS). Both – operative and non-operative approaches depend on supportive and well-designed rehabilitation protocols to gain good to excellent results. Smeeing et al.

[4] reported in a recent meta-analysis a significant earlier return to work and daily activities with ankle exercises after fracture treatment, while early versus late weight bearing did not show any significant differences. Other studies [5] showed no differences between early and late exercise or reported on improved outcomes after early weight bearing rehabilitation protocols [6]. Weight bearing, range of motion (ROM) and early versus late physiotherapeutic exercises are critical contributors to swelling, wound infection, pain, non-union and long term malfunction.

However, prospective randomized controlled studies with representative patient numbers are lacking and retrospective assessments are difficult to compare. This is due to the existence of a variety of treatment procedures for a given pathology. For example for fractures of the fifth metatarsal different surgical options (open reduction and screw fixation, plate fixation or cerclage) as well as non-operative treatment are described and widely accepted [7]. In addition, individual patient related factors such as bone quality, systemic disease and ability for physical activity require individualized rehabilitation protocols. Moreover, compliance to rehabilitation protocols and patients' expectations have major influence of outcomes after rehabilitation.

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Systematic reviews have attempted to summarize the variety of studies on rehabilitation protocols but have also limited power due to the variability of treatments and outcomes of the included studies [8]. Currently, societies such as the German Society for Orthopaedics and Trauma (DGOU) are working amongst others on establishing recommendations for rehabilitation programs in the field of foot and ankle fractures.

Because of lack of consensus in early treatment strategies of foot and ankle fractures in the literature, in this study we analyzed a large group of orthopedic and trauma surgery institutions providing a service in foot and ankle injuries and investigated their current recommendations for rehabilitation after non-operatively or surgically treated foot and ankle fractures.

**Materials and methods**

An epidemiological survey of institutions offering orthopedic and orthopedic trauma service with written rehabilitation protocols was carried out in Germany. We focused on currently used rehabilitation concepts in hind foot, mid foot and ankle fractures. All included institutions were screened for availability of rehabilitation protocols covering particularly the first 6 weeks posttrauma/postoperatively. We evaluated all rehabilitation protocols for fibula fractures type Weber A, Weber B and Weber C (AO 44A1, AO 44B1, 44C1) [9], calcaneal fractures, 5<sup>th</sup> metatarsal base (MT-5 B) fractures, 5<sup>th</sup> metatarsal “Jones” (MT-5 Jones) fractures and general metatarsal fractures (metatarsal). Protocols were also assessed whether they discriminated between operative and non-operative treatment. If major differences in operative treatments, e.g. treatment of an ankle fracture with or without stabilization of the syndesmosis, were available, we also evaluated if protocols discriminated between these different operative treatments. Categories that were not covered by the protocol were not included in the final analysis as well as time points that were not covered by the protocol.

Each protocol was analyzed according to the underlying pathology for weight bearing recommendations, restriction of range of movement (ROM), utilization of orthoses, and recommendations for physiotherapy. All of these categories were analyzed for all provided options within the rehabilitation protocol. Thus, weight bearing was divided in four categories (no weight

bearing, partial weight bearing (e.g. >20kg), half body and full weight bearing). ROM was divided in up to 6 categories depending on the underlying pathology and physiotherapy was specified for recommendation given or missing recommendation. Recommendation for the use of an orthosis was divided in a vacuum based orthopedic boot with ankle stabilization in 0-,15- or 30 degree plantar flexion, that also allowed for defined ROM e.g. -10/+10, where -10 stands for 10° plantarflexion, +10 stands for 10° dorsal flexion of the ankle. In addition orthoses included an orthopedic boot without ankle stabilization and a functional ankle splint. The mean duration of treatment by orthosis was also calculated. All evaluated categories were analyzed on a weekly basis for the first 6 posttraumatic/postoperative weeks.

For each proposal the most frequently recommended rehabilitation protocol was calculated for week one and week six.

*Statistical analysis*

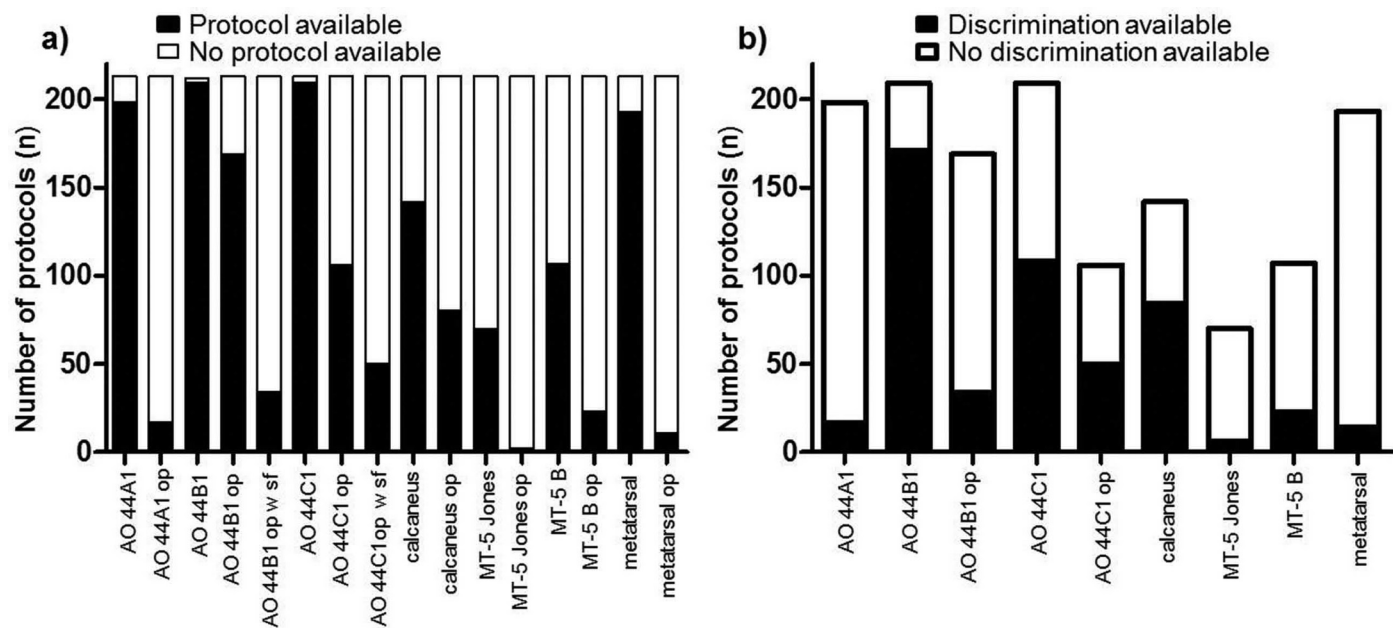
All data were evaluated using SPSS® (Version 20, IBM, Armonk, NY, USA). Where appropriate, data were analyzed for mean and/or highest percentage.

**Results**

213 orthopedic and orthopedic trauma services offered rehabilitation protocols in written form. There were 8 (3.8%) university hospitals, 183 (85.9%) regional and local hospitals and 13 (6.1%) orthopedic offices, while 9 (4.2%) institutes were not classifiable.

The most common offered rehabilitation protocols (209 (98.1%)) were for ankle fractures type AO 44B1 and AO 44C1. Other offered protocols were for ankle fractures type AO 44A1 (198/213; (93%)), metatarsal fractures (193/213; (90.6%)), calcaneal fractures (142/213; (66.7%)), MT 5-B fractures (107/213; (50.2%)) and MT 5-Jones (70/213; (32.9%)), (Fig. 1a).

We found that ankle fractures type AO 44B1, AO 44C1 and calcaneal fractures were the only pathologies for which more than 50% of institutions discriminated between operative and non-operative treatment (AO 44B1 169/209 (80.9%); AO 44C1 106/209 (50.7%) and calcaneal fractures 84/142 (59.2%) respectively). Only few institutions discriminated between operative



**Fig. 1.** a) Availability of written protocols per fracture category; op = operatively treated; op w sf = operatively treated with syndesmosis fixation b) Number of protocols that discriminate between operative and non-operative treatment and as the case may be between operative treatment with and without syndesmosis fixation (only relevant for AO 44B1 and AO 44C1).

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