

Etiology, treatment and long-term results of isolated midfoot fractures

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Abstract

Purpose: Etiology, treatment and long-term results of patients with isolated midfoot fractures were evaluated to create a basis for treatment optimization.

Method: Injury cause, type and extent, treatment and long-term results (American Association of Foot and Ankle Surgery-Midfoot-Score (AOFAS-M), Hannover Scoring System (HSS), own Questionnaire (Q)) of isolated midfoot fractures (avulsions and Chopart/Lisfranc fracture dislocations excluded) were determined.

Results: Fifty-eight patients with isolated midfoot fractures were included. Injury causes were vehicular trauma ($n = 40$), falls ($n = 13$), contusions ($n = 3$) and others ($n = 2$). The fractures were located as follows: cuboid, $n = 28$; naviculare, $n = 23$; cuneiforme I, $n = 19$; cuneiforme II, $n = 11$; and cuneiforme III, $n = 9$. 91.4% ($n = 53$) of cases were treated operatively, 15 times with closed and 38 times with open reduction. Five patients were treated conservatively.

Forty-seven (81.0%) patients had follow-up after 9 (1–22) years. The mean follow-up scores of the entire group were AOFAS-M = 66.7, HSS = 62.8, and Q = 62.2. No significant score differences were determined with regard to age, sex, and time or type of treatment. The highest scores were observed in non-displaced fractures or after early anatomic reduction.

Conclusion: Isolated midfoot fractures without Chopart's or Lisfranc's joint fracture dislocation are uncommon. The long-term results are mostly characterized by minimal functional restrictions. In cases with poor results, the initial restoration of anatomic conditions have been unsatisfactory. Therefore, we recommend the early reduction and internal fixation in all displaced fractures. The reduction should be open if the closed reduction does not achieve anatomic conditions.

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1. Introduction

Isolated fractures of the midfoot, i.e. fractures without dislocation of the Chopart/Lisfranc joint are rare [1]. The long-term outcome of those isolated fractures has not been investigated in detail to date, where as much more is known about fracture-dislocation of the Chopart- and/or Lisfranc joint [2,3]. It would be expected that the outcome in isolated fractures is better than in fracture dislocations [1–3]; however, this notion has also not been analyzed. Only a few

case reports with divergent results of isolated midfoot fractures had been reported in the literature [4–7].

Aim of this study was to create a basis for optimized treatment and minimization of a poor long-term outcome, a retrospective study of patients with isolated midfoot fractures treated in our level 1 Trauma Center was performed.

2. Methods

2.1. Inclusion criteria

Patients with isolated midfoot fractures who were treated in the Trauma Department of the Medical School Hannover during 1972 and 1997 were evaluated retrospectively.

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2.2. Exclusion criteria

Avulsions and fractures associated with Chopart- or Lisfranc dislocation were excluded.

2.3. Treatment

The indications for non-operative treatment were (1) sufficient closed anatomic reduction; (2) sufficient stability after reduction in anatomic position; and (3) contraindications for operative treatment. The non-operative treatment was performed in a cast with partial weight bearing for 6 weeks.

When the closed reduction was successful, but the reduced fractures were not considered to be in a stable position, an internal fixation with 1.6–2.0 mm K-wires or 3.5-mm screws was performed. A cast (geisha shoe or short leg cast) was applied in the operating room, and rehabilitation was performed in the cast with partial weight bearing for 6 weeks. After 6 weeks the cast was removed and patients started with full weight bearing.

In remaining cases, an open reduction was performed. Additionally, an open procedure was performed in all open injuries and in all patients with compartment syndrome. If massive swelling without compartment syndrome was observed, the operating procedure was postponed until the swelling had subsided. In those patients a closed reduction was initially performed and a cast was applied. These patients rested in bed with elevation, cooling of the foot, and non-steroidal anti-inflammatory drugs (NSAID's) were prescribed.

When primary skin closure was not possible, a temporary wound closure (Epigard TM, Orthomed Medizintechnik, Vienna, Austria) was used. A secondary skin closure was normally possible and a skin graft was not necessary.

Heparin prophylaxis against deep venous thrombosis was only done in patients with a short leg cast and not in patients treated with a geisha shoe.

2.4. Data acquisition

In addition to demographic data, the causes of the injuries and method of treatment were analysed. Long-term results of included patients were evaluated using four different scoring systems (American Association of Foot and Ankle Surgery-Midfoot-Score (AOFAS-M); sum of all AOFAS Score sections; Hannover Scoring System (HSS), Hannover Questionnaire) [8,9].

2.5. Statistics

Values are expressed as mean \pm standard error of the mean. Statistical analysis was performed with SigmaStat (SPSS, Chicago, USA). The *t*-test and the Chi²-test were utilized for the statistical analysis of score differences. Significance level was defined, $p < 0.05$.

3. Results

3.1. Epidemiology

In the observed 25-year-period 58 patients matched the inclusion and exclusion criteria. During this time about 100,000 patients were treated, resulting in an incidence of 0.058%. Males (38) were affected twice as often as females [20] (remark: in the same time period, 100 patients with Chopart's/Lisfranc's dislocations fractures were treated). The mean age at time of accident was 34.7 (7–71) years. Three patients were younger than 18 (5.2%). The cause of injury was, in most cases, motor vehicle accidents (Fig. 1).

The right side was affected more often (right, $n = 34$; left, 22), and two patients (3.4%) had bilateral midfoot fractures. Most affected was the cuboid in 28 patients (48.3%), followed by the navicular in 23 patients (39.7%) (Fig. 2). Associated fractures of the lower extremity were found in 38 (65.6%) cases (Fig. 3). Twenty-two patients (37.9%) had multiple injuries.

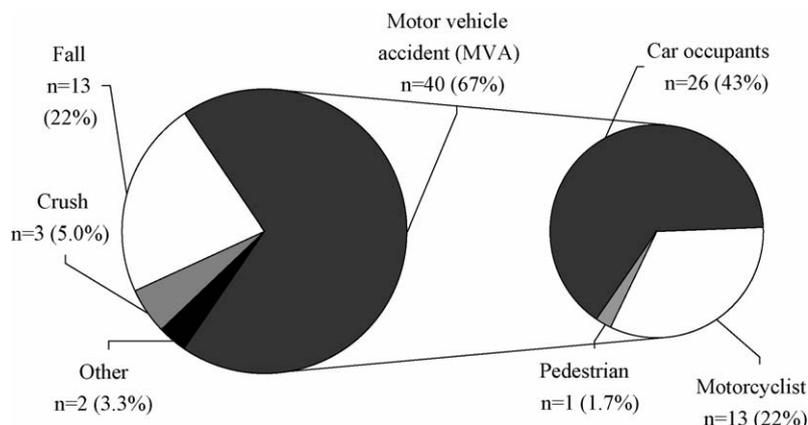


Fig. 1. Injury origin in 58 patients with isolated midfoot fractures.

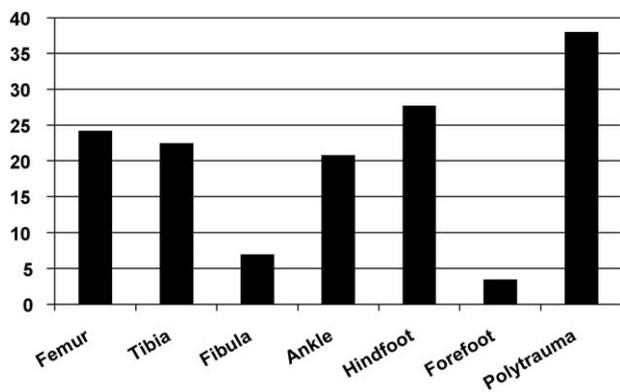


Fig. 2. Location of midfoot fractures (%).

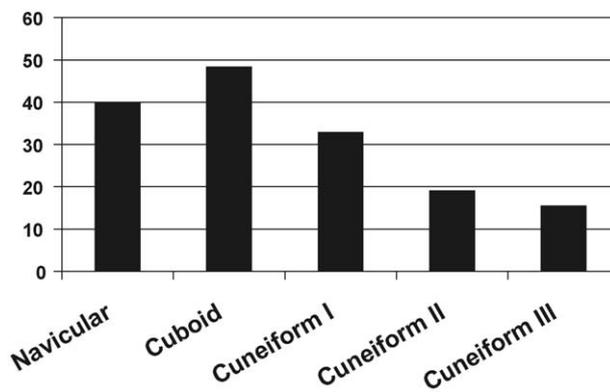


Fig. 3. Incidence of associated fractures of the lower extremity and polytrauma in 58 patients with isolated midfoot fractures (%).

3.2. Treatment

The primary treatment was operative in 91.4% ($n = 53$) of the patients. In 15 patients (25.9%) a closed reduction was possible. Forty-nine patients (84.5%) received internal fixation including K-wires alone in 21 cases (36.2%), K-wires and screws in 12 (20.7%) and screws only in 4 (6.9%) cases. In 15 cases (25.9%) an external fixateur was utilized as an adjunct in operative therapy. In six cases (10.3%) a fasciotomy was performed. A bone transplantation was necessary in five (8.6%) and a primary arthrodesis in two patients (3.4%). No amputation was necessary.

In three patients (5.2%) a secondary arthrodesis had to be performed.

3.3. Outcome

Forty-seven patients (81.0%) had a follow-up examination after 9.8 (1–22) years. In six cases the examination was less than 2 years after the accident. One patient, who had multiple injuries, was amputated due to injury of the lower leg.

Different scores (AOFAS-M, sum of all AOFAS Score sections, HSS, Hannover Questionnaire) were determined during examination [1]. No significant differences regarding age, gender, treatment or reduction were observed (Table 1, Fig. 4 a–d).

4. Discussion

Due to the improvements of car safety, injury patterns have changed during recent years [10,11]. While seat belts have become mandatory and airbags protect the trunk, cervical spine and prevent from brain injury, fractures of the lower extremity have increased in last 25 years [10,12]. This is supported by our study where two-thirds of the patients sustained foot injuries related to traffic accidents. We performed a retrospective study analyzing incidence, causes, and long-term results of isolated midfoot fractures. Because of low incidence of this injury a long observation period was necessary. However, during this long period patients were treated by a plurality of surgeons with unequal experience in foot surgery thereby influencing postoperative results.

Fractures of the midfoot are primarily associated with Chopart- or Lisfranc dislocations or fracture-dislocations [13]. In the context of multiple injury midfoot fractures are frequently not diagnosed during the primary examination [14]. Late diagnosis leads to inadequate treatment – especially in compartment syndrome – which is responsible for high complication rate [15,16]. These factors contribute to poor long-term results [17–19]. Isolated midfoot fractures seem to have seldom long-lasting impairments [20–23], while fractures associated with fracture-dislocations in Lisfranc or/and Chopart joint display worse outcome.

Table 1
Foot scores of 30 patients

	AOFAS-M	AOFAS-S	HSS	HQ	Significance
Total	66.7 ± 16.2	311.2 ± 54.5	62.8 ± 16.1	62.2 ± 13.6	
Male	67.1 ± 18.7	310.3 ± 66.4	62.1 ± 19.4	63.9 ± 15.5	$p > 0.05$
Female	66.0 ± 11.7	312.9 ± 26.0	64.0 ± 10.5	59.2 ± 9.5	
≤45 years	67.3 ± 15.5	308.7 ± 57.8	62.2 ± 16.3	60.0 ± 12.2	$p > 0.05$
>45 years	64.7 ± 19.4	319.4 ± 45.1	64.7 ± 16.5	69.3 ± 16.4	
Operative	66.8 ± 16.5	311.7 ± 55.4	62.7 ± 16.4	62.2 ± 13.8	$p > 0.05$
Non-operative	64.0 ± 0.0	297.0 ± 0.0	65.0 ± 0.0	62.0 ± 0.0	
Open reduction	65.3 ± 18.1	314.5 ± 59.8	63.0 ± 17.0	63.7 ± 14.3	$p > 0.05$
Closed reduction	71.0 ± 10.0	303.1 ± 41.1	62.0 ± 10.8	57.3 ± 11.9	

HSS, Hannover Scoring System; HQ, Own Questionnaire; AOFAS-M, AOFAS Midfoot Score; and AOFAS-S, sum of all AOFAS score sections. Statistical significance was tested using students *t*-test.

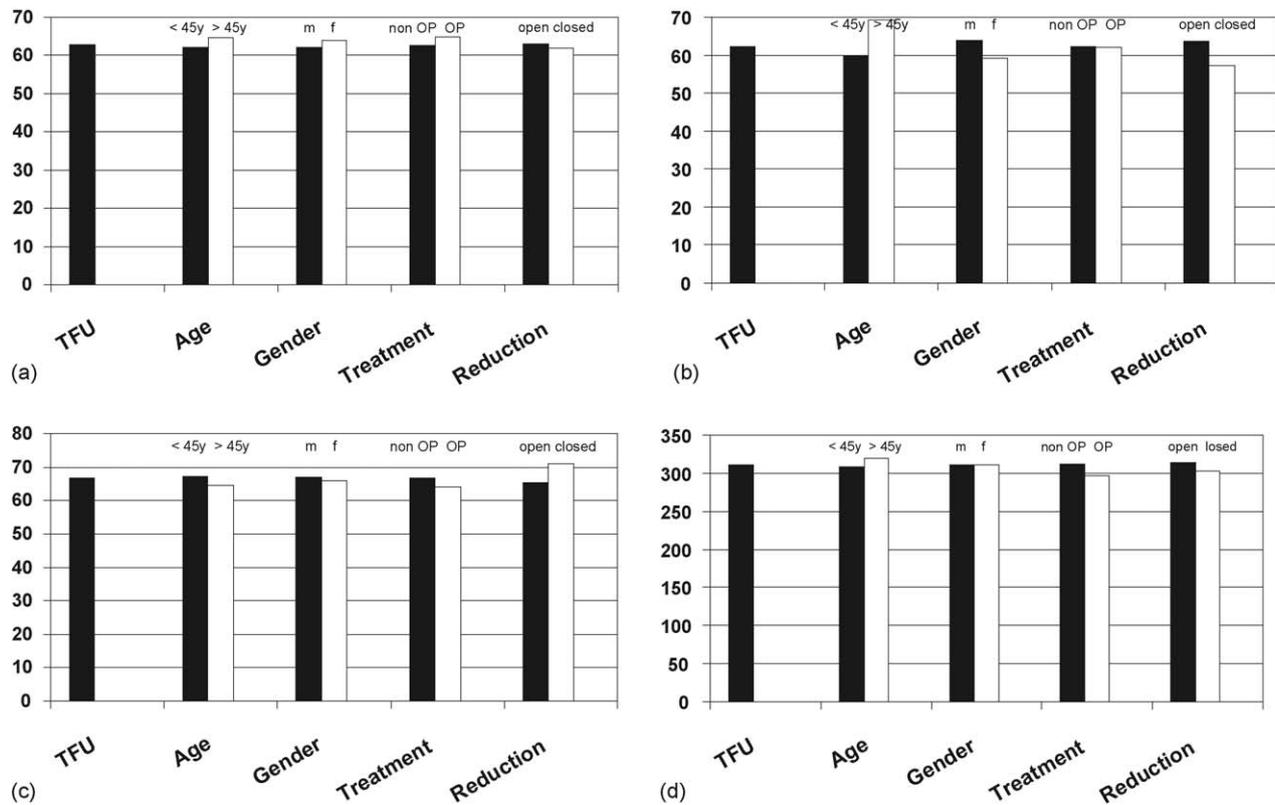


Fig. 4. Foot scores of 30 patients: (a) Hannover Scoring System; (b) Own Questionnaire; (c) AOFAS Midfoot Score; and (d) sum of all AOFAS score sections (abbreviations: TFU, total follow-up group; age, age at time of trauma in years; gender: m, male; f, female; treatment: non-OP, non-operatively; OP, operatively; reduction: open, open reduction; closed, closed reduction). No statistical significance with students *t*-test.

In these fractures an open reduction is recommended as appropriate therapy [24,25]. However, isolated midfoot fractures are often underestimated leading to non-operative treatment [26].

Our results confirm that isolated midfoot fractures are rare injuries. During the observed time period, fractures with dislocation of Chopart or Lisfranc joint, showed doubled incidence (data not shown). Contrary to these injuries, we could not find any significant influence of sex, age, treatment or kind of reduction on clinical outcome measured with established scores [27,28]. However, better results (but not statistically significant) were seen in patients with initial open reduction, which supports results from numerous case reports in published literature [29–31]. In the last years operative treatment of these fractures was favored [32,33]. Operative treatment is especially recommended in articular fractures with displacement or fractures with consequent alteration of the longitudinal or transverse arches of foot [34,35].

Compared to 10 years before, we are more aggressive in operative treatment. We recommend an open reduction and internal fixation during early clinical stage in all complex midfoot fractures. If a compartment syndrome is apparent, surgical intervention should be performed immediately when allowed by the patient's overall condition. A primary arthrodesis should be limited to those cases where reconstruction of the joint surface is not possible.

The high rate of additional injuries results in overlooking and underestimating midfoot injuries. For primary diagnosis, we recommend radiographs of the affected foot in 3 plains (dorsolateral, lateral, oblique). In case of a present injury or in doubt, a CT scan should be performed.

In conclusion, isolated midfoot fractures without Chopart's or Lisfranc's joint fracture dislocation are uncommon. The long-term results are mostly characterised by minimal functional restrictions. In cases with poor results, the initial restoration of anatomic conditions had been unsatisfactory. Therefore, we recommend the early reduction and internal fixation in all displaced fractures. The reduction should be open if the closed reduction could not achieve anatomic conditions.

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