ORIGINAL ARTICLES

A PROSPECTIVE COHORT STUDY OF CLOSED FOOT INJURIES IN A TERTIARY HOSPITAL IN GHANA

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Abstract

Objective: Our objectives were to determine the proportion of closed foot injuries and their treatment outcomes at a large trauma hospital in Accra, Ghana.
Methods: A structured questionnaire was used to record, for each patient, the type of closed foot injury, the mechanism of injury, any concomitant injuries, the time interval between injury and arrival at the KBTH for treatment as well as the type of treatment instituted.
Enrolled patients were followed up for six months, complications resulting from the foot injury or its treatment were recorded for each patient. The function of the foot after healing of the injury was measured using the American Foot and Ankle Society Score.
Results: A total of 46 patients presented with closed foot injuries, males accounted for 58.7% and females 41.3%. Road traffic trauma was by far the most predominant cause of injury accounting for 63% of cases. Soft tissue contusions involving the foot had excellent outcomes after treatment; displaced metatarsal shaft fractures treated with open reduction and internal fixation with K-wires had a good outcome; displaced metatarsal shaft fractures treated with cast immobilization had unfavorable outcomes. Non-operative treatment of Lanfranc fracture-dislocation with cast immobilization resulted in severe limitation of climbing stairs, shoe wear, walking on uneven surfaces and inability to return to previous occupation.
Conclusions: Displaced intra-articular calcaneal fractures cause significant persistent foot pain after treatment and Lisfranc fracture-dislocations have unfavorable outcomes if treated conservatively with cast immobilization alone. Fractures of the foot cause a long-term morbidity with residual foot pain, limitation of foot wear, climbing stairs, walking on uneven surfaces and difficulty integrating into previous occupation. The resulting foot dysfunction is worse if the fracture is not appropriately stabilized.

Key Words: Close Foot, Injuries, Management

Introduction

Injuries constitute a significant cause of morbidity and mortality globally accounting for about 10% percent of the 2013 global burden of disease [1]. In fact, an estimated number of 973 million people were reported to have sustained injuries that required some form of healthcare with 4.8 million mortalities being attributed to it in 2013[1]. Published literature on the burden of injuries to the foot seems limited, particularly in low and middle income countries, however, a number of studies have documented the dramatic impact of foot injuries on the overall health, activity, and emotional status of patients [2,3,4]. Moreover, multiply injured patients who have an associated foot injury tend to have a poorer long term outcome[5]. Furthermore, in spite of appropriate treatment of foot injuries, long term ambulatory dysfunction and neurogenic foot pain may occur[6]. Additionally, foot injuries may be complicated by malunion, bony impingement, joint stiffness, osteonecrosis and post-traumatic osteoarthritis which may be disabling[6].
Motor cycle crashes have been implicated in most injuries [1] with foot injuries being reported as one of the most common consequences of motor cycles accidents[2]. The ultimate goal of treating foot injuries is the restoration of a painless, stable and plantigrade foot[6].

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Methods

Setting

The study was conducted at the Accident Centre of the Korle-Bu Teaching Hospital. The Korle- Bu Teaching Hospital provides diagnostic, therapeutic, rehabilitative and preventive services to people from all over Ghana as well as people from neighboring countries. It provides Trauma and Orthopaedic services for patients 24 hours a day.

It is currently the third largest hospital in Africa and the leading national referral center in Ghana.

The hospital has 2,000 beds and 17 clinical and diagnostic Departments/Units. It has an average daily attendance of 1,500 patients and about 250 patient admissions.

Data gathering

All patients with a closed foot injury who presented to the Accident Centre of the KBTH over a four-month period, from 1st July 2012 to 31st October 2012 and were recruited and followed-up until 30th April, 2013.

A structured questionnaire was used to record the type of closed foot injury, the mechanism of injury, any concomitant injuries, the time interval between injury and arrival at the KBTH for treatment as well as the type of treatment instituted either non-operative or operative. For patients who underwent operative treatment, the type of surgery was recorded. Patients with foot injury in which there was a break in the skin of the foot were excluded.

During the follow-up period, complications resulting from the injury or its management were recorded for each patient. The function of the foot after healing of the injury was measured using the American Foot and Ankle Society Score (Appendix 2).

Clinical examination and radiographs were used as tools.

All necessary radiographic investigations were done accordingly and findings recorded. Information was collected on demographic characteristics, the place, mechanism and duration of injury. A clinical examination was done to assess the general condition of the patient, osseous and soft tissue injuries. X-rays of the foot were taken to confirm the presumptive diagnosis, special views were taken as required. Computerized tomography scan and magnetic resonance imaging were requested as indicated. The imaging results were interpreted with the help of a radiologist where necessary. The type of closed foot injury and the treatment modality were recorded for each patient. Complications of injury and complications of treatment that arose during the follow-up period were recorded as well.

Only patients with injuries to the foot in which there was no break in the skin of the foot, as determined during the treatment of the injuries, were considered for this study.

At six months, the function of the foot was measured using the American Foot and Ankle Society Score and documented.

Patients who refused to take part in the study, patients with non-mechanical trauma to the foot such as burns were excluded from this study, as well as patients who had underlying bone pathology.

Patients with traumatic foot injuries with lack of clear identification, missing or lack of complete history on mechanism of injury and absence of relevant imaging were excluded from the study. Patients with open foot injuries were not considered for inclusion.

Results

Over the 4-month inclusion period, 46 patients presented with closed foot injuries at the KBTH and their characteristics are summarized in Table 1. Most individuals were young adult males who sustained injuries from motor vehicular crashes. There were significant delays from the time of injury to KBTH arrival.

The fracture of the calcaneus and the lisfranc fracture-dislocation involved male patients.

Most of the injuries happened on the road. In addition, motor vehicular accidents (MVA) involving pedestrians, motor cycle riders, pillions and car passengers represented 63% of all causal mechanisms put together.

Substance Use

This study sought to establish whether the patients who sustained closed foot injuries were under the influence of alcohol or not. Out of the 46 patients, three of them representing 6.5% of the patients and presenting within 24 hours after injury had alcoholic foetor on their breath.

The proportion of non-MVA mechanisms of injury represented 37% of cases. Among them, falls had the highest percentage (26.1%). The falls involved: a fall from a height, falls from stair cases, falls following tripping over wet surfaces, falls into gutters and blunt objects falling on the foot.

Pedestrians happened to be most of the victims, following a strike by car or motor bike.

Injuries sustained

The types of closed foot injuries sustained by the patients who were studied were categorized into: painful swollen foot as a result of soft tissue contusion, with no radiographic evidence of a fracture. This category registered the highest number of patients. There were two cases of calcaneal fractures, 4 cases of displaced metatarsal shaft fractures and 1 case of lisfranc fracture-dislocation.

There was no case of bilateral closed foot injury recorded during the study period.

Table 1 Distribution of 46 closed foot injuries by age, gender, site of injury, mechanism of injury and time lapse from injury to hospital arrival

Characteristic	Number	Percentage
Age		
0-5	4	8.7
6-18	5	10.9
19-49	26	56.5
>50	11	23.9
Gender		
Male	27	58.7
Female	19	41.3
Site of injury		
Workplace	5	11
Home	6	13
Sports	3	6
Road	32	70
Mechanism of injury	3	6.5
Motorbike rider	2	4.3
Motorbike pillion	9	19.6
Motorbike pedestrian	12	26.1
Car pedestrian	3	6.5
Car passenger	12	26.1
Fall	4	8.7
Footballer	1	2.2
Workplace trauma		
Foot injury type		
Soft tissue contusion	39	84.8
Metatarsal fracture	4	8.7
Calcaneal fracture	2	4.3
Lisfranc-fracture dislocation	1 **(1 case is not enough)**	2.2
Time lapse from injury to hospital arrival	**16**	35
< 6hours	**13**	28
6-24hours	**17**	37
>24hours		

Out of the 23 males who had painful swollen foot, 14 (60.9) sustained the injury to the right foot and in the remaining 9 males (30.1) the injury involved the left foot.

Seven of the female patients representing 43.9% sustained the injury to the right foot whilst the injury involved the left foot in the remaining 9 (56.1%). Thus, female patients dominated in left foot injuries whilst males dominated in their right foot injuries.

Associated Injuries

Of the patients studied, 3 accounting for 6.5% of the patients had other injuries in addition to the foot injury.

Fall of an object on the left foot

Fig 1: Lisfranc fracture-dislocation of the left foot, showing flattening of the mid-foot.

The associated injuries were distal radial fracture in association with a lisfranc fracture-dislocation, humeral shaft fracture and a patella fracture. All 3 patients who had associated injuries were pedestrians. Two were knocked down by a car and the other by a motor cycle.

Treatment Methods

The foot injuries in this study, were treated in one of several ways depending on the type of closed foot injury.

One of the two calcaneal fractures was intra-articular and displaced.

It was fixed with two 6.5mm lag screws after open reduction and the other one which was extra-articular with minimal displacement was treated with cast immobilization.

Reduction and fixation were verified with the aid of fluoroscopy. The Lisfranc fracture-dislocation was treated with manipulation and casting. One of the 4 metatarsal shaft fractures was treated with open reduction and K-wire fixation and the other 3 patients underwent cast stabilization.

Fig. 2: Check x-ray of open reduction and Kirchner wire fixation of fracture of the shafts of the left 2nd, 3rd, 4th and 5th metatarsals.

Treatment Outcomes

The functional outcomes of the patients enrolled into this study depended on the type of closed foot injury that was sustained and the treatment method administered. The patients who had soft tissue contusions had excellent outcomes at six months. Patients who had closed metatarsal shaft fractures which were treated with open reduction and internal fixation with K-wires had a favorable outcome at six months.

The extra-articular calcanael fracture treated with cast immobilization had a good functional result. The displaced intra-articular calcaneal fracture treated with open reduction and screw fixation had significant heel pain at six months.

The Lisfranc fracture-dislocation which was treated non-operatively had significant pain with severe limitation of climbing stairs, shoe wear, walking on uneven surfaces and had been unable to return to previous occupation at the time of follow-up

Table 2 Distribution of 46 closed foot injuries by injury type, treatment method and functional outcome at 6-months

Injury type	Treatment method	Outcome
Soft tissue contusion	P.O.P cast	All patients in this category had normal gait, foot pain during physical activity ranged from no pain in some subjects to mild pain in others; all subjects could stand on the affected foot, were able to walk on uneven ground and had returned to their previous occupation.
Metatarsal shaft fracture	Closed Reduction + k-wire fixation and P.O.P. cast	All subjects had normal gait; foot pain during physical activity spanned from mild pain in some subjects to moderate pain in others. Those with moderate pain were those who had multiple metatarsal shaft fractures. All patients in this group could stand on the affected foot, two had returned to their previous occupation and two had not on account of foot pain (had multiple metatarsal fractures), walking on uneven ground was painless in three subjects. One subject had mild pain on performing this activity.
	Manipulation + P.O.P casting	Gait was normal for all subjects, foot pain during physical activity was a compliant of all of them, all could stand on the affected foot and had returned to previous occupation; there was pain when walking on uneven ground.

Table 2 Continuation: Distribution of 46 closed foot injuries by injury type, treatment method and functional outcome at 6-months

Injury type	Treatment method	Outcome
Calcaneal fracture	Displaced intra-articular fracture: open reduction + internal fixation with 6.5mm lag screws + Plaster slab	This subject could stand on the affected foot but had a limp, foot pain during physical activity, pain walking on uneven ground, heel pain on wearing normal shoes and failure to resume previous occupation.
	Extra-articular fracture: manipulation + P.O.P. casting	There was no pain standing on the affected foot and the gait was normal. The subject had mild to moderate foot pain during physical activity and when walking on uneven ground, mild heel pain on wearing normal shoes and had returned to previous occupation.
Lisfranc fracture-dislocation	P.O.P. Cast	There was a limp, foot pain during physical activity, had significant pain walking on uneven ground, difficulty wearing normal shoes, Pain on standing on the affected foot longer than 10 minutes and had been unable to resume previous occupation.

Discussion

It was found in this study that the highest rate of closed foot injuries involved people aged between 19 and 49 years. Similarly, a study by Afukaar and colleagues to assess the impact of road traffic trauma in Ghana found that road traffic trauma in Ghana often involved people in their productive age [7]. Although this study looked at only closed foot injuries, it portrayed a similar trend of youth preponderance of foot injuries following road traffic trauma.

In addition, it was identified that more males than females sustained closed foot injuries i.e. 58.7% males as against 41.3% females. This is comparable to findings from Jeffers[3], Boon Tan, Nicolopoulos, Kamath, & Giannoudis, (2004) in their study on the prevalence and patterns of foot injuries following motorcycle trauma in the United Kingdom where 49 males (92.5%) out of 53 patients suffered foot injuries. Also, a study on citywide trauma experience in Kampala, Uganda, found that 73% of 4359 injury patients were males and concluded that injuries in Kampala involved predominantly young adult males [8].

In this study road traffic trauma accounted for 63% of all cases of closed foot injuries and pedestrians predominated, both by car and by motor cycles constituting 45.7% of cases.

There was a statistically significant difference between closed foot injury and the site where it was sustained with injuries occurring on the road accounting for 63% of all sites of occurrence put together (p-value < 0.05).

In a similar vein, Kobusingye et al., (2002)[8] in their study of injuries in Uganda, found that 58% of injuries occurred on the road, 29% at home and 4% in a public building. They, therefore, concluded that injuries in Kampala were mostly due to road traffic accidents.

Motor cycle injuries accounted for 30.4% of cases of closed foot injuries in this study. Naddumba (2001) reported similar findings in Uganda where motorcycle injuries accounted for 25% of all injuries in Mulago Hospital[9]. The high incidence of foot injuries suffered through motor cycle accidents in this study could be due to the increasing number of commercial motor cycle services on the streets of Ghana, most of whom violate the road safety measures in the country.

The influence of alcohol has been associated with a higher than normal risk of injury in a number of studies [10]. It is therefore not surprising that 6.5% of the patients in this study were found to have been under the influence of alcohol. This was established by the patients admitting to the ingestion of alcohol or the detection of alcoholic foeter on their breath, this notwithstanding, a more scientific means of measuring serum alcohol levels or a larger sample size might have detected more patients to have been under the influence of alcohol.

Most (84%,) of the injuries in this study, were minor foot injuries, however only closed injuries to the foot were considered. The right foot (45.7%) more than the left (39%) suffered most of the closed foot injuries, however the reason for the right foot predominance could not be established by the study.

Patient who presented within 6 hours after the injury represented 34.8% of all cases and those who presented between 6-24 hours were represented 28.2%%, and 37% reported after 24 hours. Also, 65.2% of patients presented to hospital after 6 hours following

the injury. This late presentation was probably due to the absence of visible bleeding or trivialization of the foot injury by the patients involved or their guardians.

Most (65.2%) of the patients in this study reported to the health facility after 6 hours following the injury with 34.8% presenting within 6 hours after the injury. Contrary to our findings, Kobusingye and colleagues[8] reported in their study that two thirds of the injured patients arrived in hospital within 30 minutes of injury. Trivialization of foot injuries could account for the late presentation of injuries to the health facility in this study as compared to Kobusingye and colleagues' study in which all injuries were studied.

Three (6.5%) of the patients in this study had other injuries in association with a foot injury. The patients who had associated injuries, in this study, were all victims of road traffic accidents as pedestrians. The presence of associated injuries is likely due to the higher energy transfer involved in road traffic crushes

Functional Outcomes

Treatment outcomes of closed foot injuries in this study depended on the type of closed foot injury. The patients who had soft tissue contusion without a fracture of a bone of the foot, had a good to excellent outcome at six months. The favorable outcome of these injuries was probably due to their minor nature.

Patients who had closed metatarsal fractures which were treated surgically by open reduction and internal fixation with K-wires had a good functional outcome at six months. The group of patients whose displaced metatarsal shaft fractures were treated with cast immobilization had persistent pain and limitation of walking on uneven surfaces at six months.

Open reduction and internal fixation of metatarsal fractures has been shown to have a superior outcome to non-operative treatment such as cast stabilization alone[11]. Arntz, Veith, & Hansen, (1988) also concluded in their study that failure to achieve an anatomic reduction of metatarsal fractures were the most important determinants in the development of posttraumatic arthritis of tarsometatarsal joints.

The poor outcome of displaced intra-articular calcaneal fractures, as found in this study, can be attributed to articular cartilage damage that often accompanies these injuries. It has been shown in other studies, that injuries below the knee are tied to higher rates of unemployment, longer sick leave time, more pain, more follow-up surgeries and decreased overall outcome[12,13,14].

Similarly, at four months follow-up, patients who sustained fractures involving the foot making up 15.2% of all patients studied were unable to wear normal shoes and had significant limitation in terms of performing previous jobs.

The TMC injury that was recorded in this study was treated non-operatively by cast stabilization alone. At six months of follow-up this patient had persistent foot pain that limited ability to climb a staircase, wear normal shoes and to tip toe on the affected foot. Although, our sample size was small, the unsatisfactory outcome of non-operative treatment of TMC injuries has been shown by many other studies[14].

Cassebaum, (1963) explains that nonsurgical management of TMC injuries should be limited to those that were without fracture, nondisplaced, and stable under radiographic stress examination. As little as 2mm of displacement or the presence of a fracture within the TMC warrants fixation[15].

Regardless of the technique used, the goal in the treatment of TMC injuries should be anatomic reduction of the affected joints, as numerous studies have documented that clinical outcome correlates with accuracy of reduction[15].

Conclusions

Road traffic trauma is by far the most predominant cause of closed foot injuries, accounting for 63% of cases in this study.

A limitation of this study was the small number of foot fractures involved **(Admittance of the small sample size).** A larger number of calcaneal fractures and lisfranc fracture-dislocations would have provided a stronger basis to draw conclusions.

Persistent foot pain and limitation of foot function is likely in patients with displaced intra-articular calcaneal fractures treatment.

Additionally, a Lisfranc fracture- dislocation has poor outcomes when treated non-operatively with cast immobilization.

Thus, injuries to the foot cause long-term morbidity and has the potential to confer residual foot pain, limitation of foot wear, climbing stairs, walking on uneven surfaces and difficulty integrating into previous occupation.

Appendix 1

QUESTIONNAIRE

1. Date and time of injury: ……..
2. Demography
(i). Name: ……
(ii). Age: …….

(iii). Sex: ……
(iv). OPD No: …….
(v). Occupation: ……
(vi). Region: ……
(vii). Locality: ……
(viii). Telephone No: ……..

3. Mechanism of Injury
(i). MVA: Car ☐ Motorbike ☐ Bicycle ☐
Rider ☐ Passenger ☐ Pedestrian ☐
(ii). Fall from a height ☐
(iii). Assault ☐
(iv). Gunshot ☐
(v). Others ☐

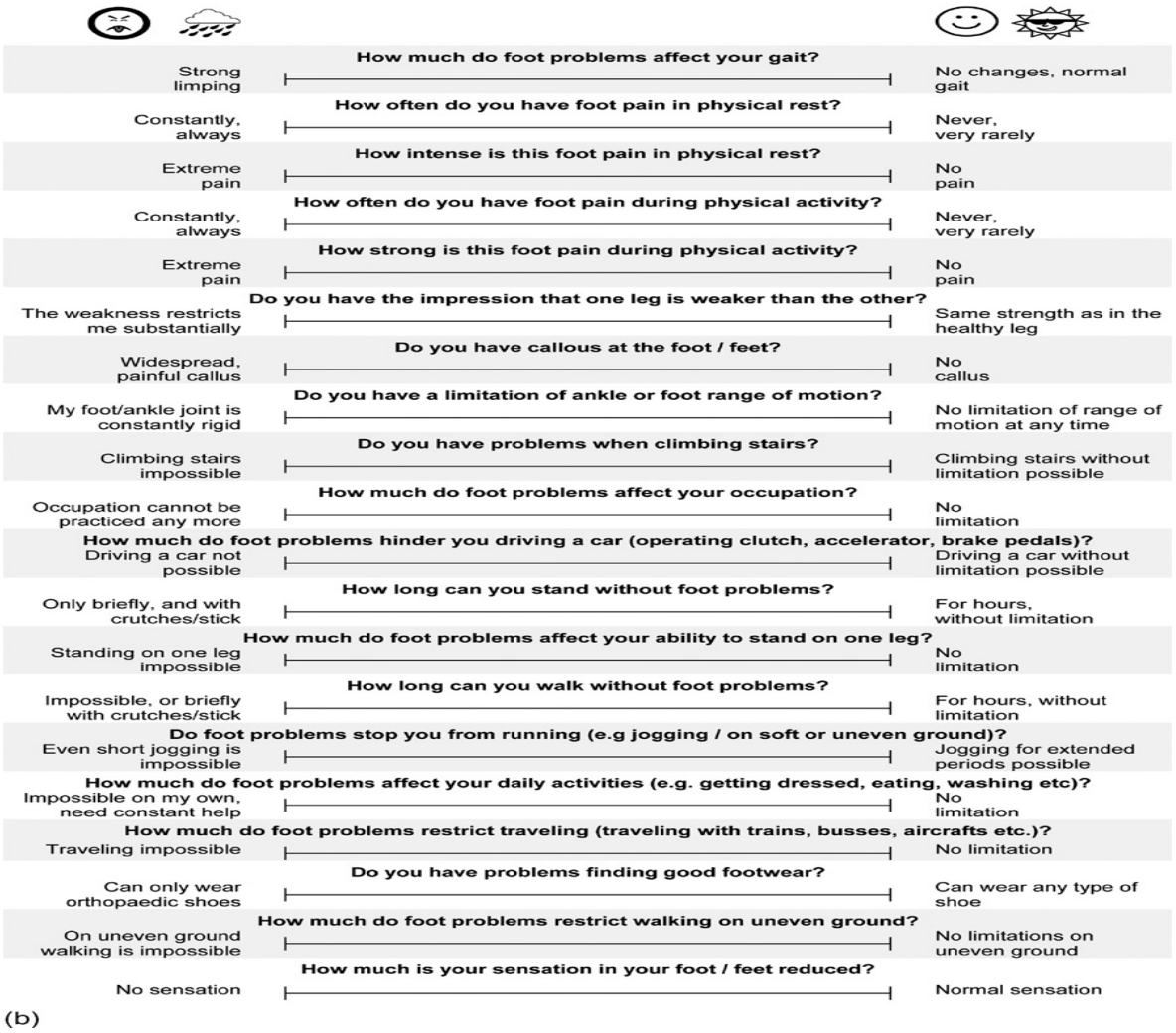
4. Formal Education Level:
a) None ☐ b) Primary ☐ c) Secondary ☐ d) Post-Secondary ☐
e) University ☐
5. Substance use:
a) Alcohol ☐
b) Tobacco ☐
c) Other ☐
6. Radiological Findings and Diagnoses: Open ☐ Closed ☐
7. Site of injury:
(a) Road ☐ (b) Workplace ☐ (c) Home ☐
(d) Others……
8. Associated Injuries
(i). Head ☐
(ii). Chest ☐
(iii). Abdomen ☐
(iv). Pelvis ☐
(v). Other Fractures ☐

9. Time of Presentation after the Injury
(i). Less than 6 hours ☐
(ii). 6-24 hours ☐
(iii). More than 24 hours ☐

10. Treatment: Stabilization
(i). P.O.P cast ☐
(ii) External fixation ☐
(iii). K-Wire Fixation ☐
(iv). Screws ☐
(v). Others ☐

Appendix 2

New Foot and Ankle Outcome Score: Questionnaire Based, Subjective, Visual-Analogue-Scale



(b)

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