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Factors delaying the management of open fractures at Alexandria main University Hospital

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ABSTRACT

Introduction: Open fractures represent a major orthopaedic condition as they can involve significant morbidity and the correct and timely management of these injuries can benefit our patients and lead to more favourable outcomes.
Aim: to estimate the incidence of open fracture types admitted to Alexandria Main University Hospital, to calculate the start-up time of local management of open fractures and to investigate the factors of delay of management of open fractures.
Patients and methods: Cross-sectional study was adapted to provide data about types of open fractures admitted to Alexandria Main University Hospital (AMUH) and time of starting the local management and factors of delay of management if any. The study was carried out in the Emergency Department of AMUH for 3 months period of the study. Data collected included demographic data, Mode of trauma, date of arrival, time of arrival, start time of surgery, surgery within 24 hours and reasons of delay if done after 24 hours, clinical data collected during examination.
Results: Patients presented with fractures among all trauma patients represent 21.3%, and those having open fractures represent 7.65%.The mean age was 30.65 years. Males were 88.1% while females were 11.9%.The most common cause of open fractures was road traffic accidents (66.7%). The most common site of open fractures was the leg (35.7%) followed by hand (26,2%). The most common grade was II (61.4%). Closed fractures were the most common associated injuries (33.3%).
32.4% of patients had delayed surgery (after first 24 hours). The unavailability of theatre facilities and blood products were the most significant causes of delay of open fracture management regarding hospital related factors while the associated injuries and age were the most significant factors of delay regarding patient related factors.

Key words: open fractures, delay, road traffic accidents, males, leg, closed fractures

Introduction

Open fractures are a spectrum of injuries sharing the common feature of fractures that have communication with the environment. These range from small inside-out puncture wounds to more extensive injuries representative of high-energy trauma. Acknowledgement of the significant damage to surrounding tissues (skin, subcutaneous layer, muscle, tendons, and neurovascular structures) is a must (O'Brien et al., 2014).

Open fractures represent a major orthopaedic condition as they can involve significant morbidity; the greater tissue destruction in higher energy cases leads to increased risk of developing complications of wound infection or non-union (Pollak AN et al, 2010; Charalambous CP et al, 2005).

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Open fractures are classified according to the Revised Gustilo and Anderson classification (Zalavras CG et al, 2007).The Gustilo-Anderson classification system remains the preferred system for categorizing open fractures despite its limited inter-observer agreement (Horn BD et al, 1993; Brumback RJ et al, 1994).

The correct and timely management of these injuries can benefit our patients and lead to more favourable outcomes.

The aim of this study is to estimate the prevalence of open fracture types admitted to Alexandria Main University Hospital, to calculate the start-up time of local management of open fractures and to investigate the factors of delay of management of open fractures.

Material and Methods

Patients and methods:

Study design:

Cross-sectional survey was adapted to provide data about types of open fractures admitted to Alexandria Main University Hospital and time of starting the local management and factors of delay of management if any. The study was carried out in the Emergency Department of Alexandria Main University Hospital for 3 months period of the study (December 2014 to February 2015).

Sampling:

All patients suffering from open fractures admitted to Alexandria Main University Hospital during the period of the study were included.

Data collection tools:

All patients suffering from open fractures were admitted to surgery unit of Emergency Department.
Data collected included the following:

I. Demographic data (Age and sex).
II. Date of arrival, time of arrival, mode of trauma, surgery within 24 hours and reasons of delay if done after 24 hours. (factors related to hospital, and factors related to patients)

I. Clinical examination:

As most of the patients presented by open fractures were polytrauma patients, so they were assessed according to ATLS protocol by the American College Of Surgeons (2008) as the following:

1. Primary survey:

During the primary survey, life-threatening conditions were identified if present, and management was instituted simultaneously. This process constituted the ABCDEs of trauma care.

During primary survey, patients presented with long bone fractures resulting in significant bleeding like femoral fractures were recognized, haemorrhage was controlled, aggressive fluid resuscitation was supplied and PRBCs units were ordered.

Fracture immobilization was done as adjunct to the primary survey to control blood loss, reduce pain, and prevent further soft tissue injury.

2. Secondary survey:

Secondary survey was done after the primary survey was completed and normalization of the vital functions had been demonstrated. The secondary survey included head to toe examination. Special procedures such as specific radiographic evaluation and laboratory studies were also performed at this time.

A. Local examination:

After photographing and irrigation of the fracture, the following data were collected:
-Site of the fracture.
-Type of the fracture.
-Grading of the open fractures according to Gustilo and Anderson classification.
Then the fractures were immobilized if not yet done in the primary survey.

B. Investigations:

-Radiological investigation:
Plain x-ray was done one joint above and one joint below the suspected site of fractured bone.
-Laboratory investigation:

1. Complete blood count (CBC)
2. Coagulation profile including: Prothrombin activity (PA), partial thromboplastin time (PTT), international normalized ratio (INR).
3. Blood group. (ABO and Rh type)
4. Serum creatinine, blood urea, sodium, and potassium.

Results

This study was conducted on 168 patients suffering from open fractures presented to Emergency Department (ED) of the Alexandria Main University Hospital in the period from 1st December 2014 to 28th February 2015.

The total trauma patients presented to Alexandria Main University Hospital in ED in the study period was 2196 patients, the number of patients presented with fractures among all trauma patients was 468 patients (21.3%), and the number of patients presented with open fractures among all trauma patients was 168 patients (7.65%). with an average of 1.87 cases per day.

Out of the 468 patients suffering from fractures in the study period, 300 patients were presented with closed fractures (64.1%), 112 patients were

presented by open fractures (23.9%) and 56 patients was presented by both open and closed fracture (12%). The prevalence of open fractures among all fractures is 35.9%.

Regarding the age; the age distribution among open fracture patients showed that one third (33.3%) of cases were less than 20 years, about one fifth (21.4%) of cases were between 41-60 years and the minority (4.8%) of cases were above 60 years old. The mean age was 30.65 years. The age of cases ranged from 2.5 to 68 years. The mean age of cases was 30.65 years ± 5.

Regarding the gender; the majority of cases were males representing 88.1%. The mean age of male cases was 27.71 years and the mean age of female cases was 43.17 years and the difference was statistically significant (P=<0.001*)

The time of admission in the study group was as the following: 56 patients (33.3%) were presented to ED in the morning shift from 8 am to 2 pm, 52 patients (31%) were presented in the evening shift from 2 pm to 8 pm and 60 patients (35.7%) in the night shift from 8 pm to 8 am.

Regarding the mode of trauma in the study group of open fracture; two thirds (66.7%) of patients had road traffic accident while only 4 patients experienced falling from height representing 2.4%, 12 patients had alleged assault representing 7.1% and 40 patients had local trauma representing 23.8%. (Table I).

Table-1. Classification of open fractures according to mode of trauma (n=168)

Mode of trauma	No.	%
Road traffic accident	112	66.7
Falling from height	4	2.4
Alleged assault	12	7.1
Local trauma	40	23.8
Total	**168**	**100.0**

The distribution of patients according to the site of open fractures in the study group was as the following: 20 patients (11.9%)had open fractures in the thigh, 60 patients(35.7%)had open fractures in the leg, 12 patients (7.1%) had open fractures in the forearm, 12 patients (7.1%) had open fractures in the arm, 8 patients (4.8%) had open fractures in the foot, 44 patients (26.2%) had open fractures in the hand and 12 patients (7.1%) had open fractures in multiple sites. (Fig. 1).

The classification of open fractures according to Gustillo's classification in this study group was as the following: 29 patients (15.7%) had fractures of grade I, 113 patients (61.4%) were of grade II and 42 patients (22.9%) were of grade III; of which 16 patients were of grade IIIa representing 8.7%, 22 patients were of grade IIIb representing 12% and 4 patients were of grade IIIc representing 2.2%.

Regarding the associated injuries: 16 patients of the total 168 open fracture cases were associated with chest injury representing about 9.5% of cases, 24 patients (14.3%) were associated with head injury, 20 patients (11.9%) were associated with abdominal injuries, 12 patients (7.1%) had associated spinal injuries, 56 patients (33.3%) were associated with closed fractures and 40 patients had isolated open fracture representing 23.8% of cases.(Table II).

Table-2. Distribution of the studied cases according to associated injuries (n=168)

	No.	%
Associated injuries		
Free	40	23.8
Chest	16	9.5
Head	24	14.3
Abdomen	20	11.9
Spine	12	7.1
Closed fracture	56	33.3
Total	**168**	**100.0**

Analysis of factors of delay of open fracture management:

The total number of open fracture cases was 168 patients, 8 patients of which were arrested before 24 hours of admission and 12 patients were transferred to another hospital before 24 hours of admission, so the analysis of the factors of delay was held on 148 patients only.

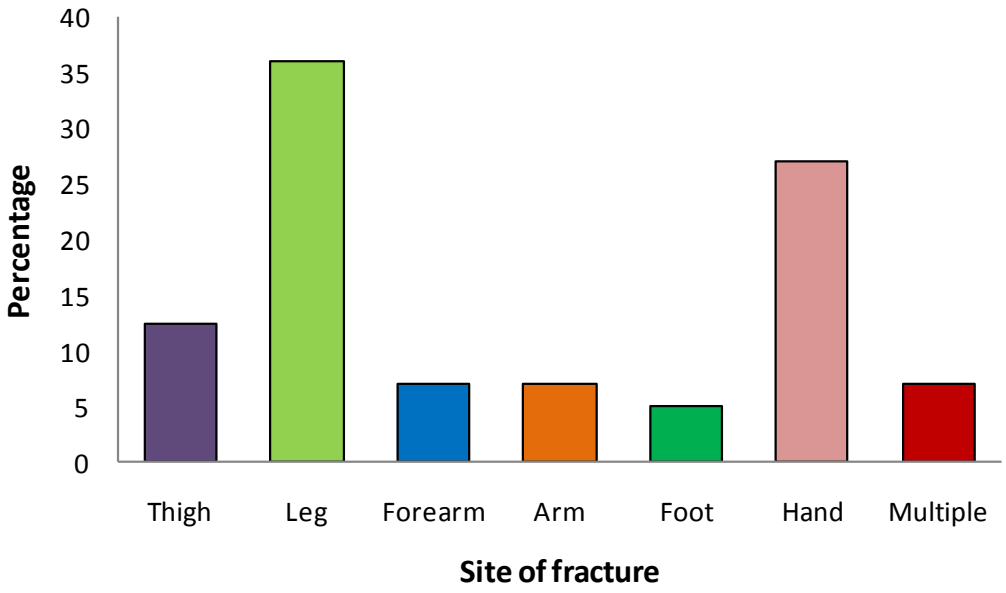
Two-thirds of patients (67.6%) had surgery done within the first 24 hours of admission and 48 (32.4%) of patients had delayed surgeries after the first 24 hours of admission.

The factors of delay were classified into patient related (20 patients representing 13.51% of 148 patient) and hospital related factors (44 patients representing 29.73% of 148 patients). (Fig. 2)

The patient related factors were further classified as the following: In 12 patients, the associated injuries were the cause of delay representing 8.11% of the 148 patients. In 4 patients, the hemodynamic instability was the cause of delay representing 2.7% of the 148 patients. In 4 patients, coagulopathy was the cause of delay representing 2.7% of the 148 patients. **(Table III).**

The hospital related factors were further classified as the following: In 16 patients, the unavailability of blood products was the cause of delay representing 10.81% of the 148 patients. In 16 patients, the unavailability of theatre facilities was the cause of delay representing 10.81% of the 148 patients. In 12 patients, the delayed decision was the cause of delay representing 8.11% of the 148 patients. Although delay due to breakout in imaging device was factor of research, it was found that despite it happened, but

Figure-1: distribution of open fracture patients according to the site of fracture



didn't cause delay for more than 24 hours as the outbreak occurred for short periods. (**Table III**)

Figure-2. Analysis of factors of delay of open fractures management

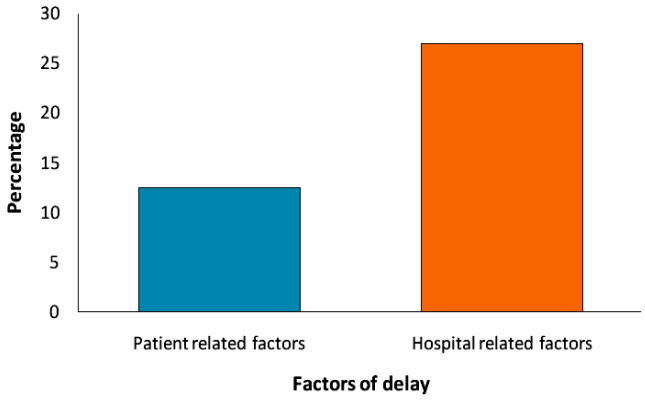


Table-3. Analysis of factors of delay of open fractures management (n=148)

Factors of delay	No.	%
Patient related factors	**20**	**13.51**
Associated injuries	12	8.11
Hemodynamic instability	4	2.7
Coagulopathy	4	2.7
Hospital related factors	**44**	**29.73**
Blood products availability	16	10.81
Theatre facilities	16	10.81
Delayed decision	12	8.11
Imaging	0	0.0

Delayed and non-delayed cases were compared according to age, sex, site and grade of fracture as shown in **table IV**.

Discussion

Comparing the number of open fractures and the average number of cases per day; Arruda et al (2009) reported 342 patients in 19 months study (September 1st 2005-November 31st 2007) with an average of 0.59 cases per day and Court-Brown et al (2012) reported 2206 patientsin a 15 years study (1995-2009) with an average of 0.41 cases per day.This revealed the high prevalence of open fractures in Egypt compared to other countries. This high prevalence is due to higher frequency of high energy accidents like road traffic accidents and falling fromheights as a result of lack of safety measures. In addition, the AMUH is the main hospital that receives accidents; it serves four governorates (Alexandria, Behira, Matrouh and Kafr-Elshiekh)

Regarding the sex, The results of our study are in agreement with the literature; Arruda et al (2009) reported that male to female ratio was 86.84: 13.16 in Brazil, Court-Brown et al (2012) and Allison et al (2005)reported that male to female ratio was 69.1: 30.1 and 80: 20 respectively in UK, Ibeanusi et al (2007)reported that male to female ratio was 2.5: 1 in Nigeria and Magoumou et al (2014) reported that male to female ratio was 92.2: 7.8 in Morocco. The high prevalence of open fractures in males is a result of high physical activity in males and their involvement in high risk jobs like drivers and labours compared to females.

Table-4.Ccomparison between delayed and non-delayed cases according to age, sex, site and grade of fracture

		Within 24 hours	After 24 hours	□□	FEp
Sex	**Male**	96	44	1.191	0.275
	Female	4	4		
				□□	MCp
Age	**0-20 years**	36	20	11.372*	0.011*
	20-40 years	44	20		
	40-60 years	20	4		
	> 60 years	Zero	4		
Site of fracture	**Thigh**	12	Zero	15.209*	0.010*
	Leg	36	20		
	Forearm	8	4		
	Arm	8	Zero		
	Foot	4	Zero		
	Hand	24	20		
	Multiple	8	4		
Grade of fracture	**G I**	8	8	7.505	0.196
	G II	64	24		
	G IIIa	8	8		
	G IIIb	8	4		
	G IIIc	4	Zero		
	Multiple	8	4		

χ^2: Chi square test *: Statistically significant at p ≤ 0.05
FE: Fisher Exact test
MC: Monte Carlo test

The results of age distribution in the open fracture group in our study were in agreement with most of the previous similar studies; Arruda et al (2009)reported that the peak age group was (21-30) years with average age 30.41 years, Court-Brown et al (1998) reported that thepeak age group was (21-30) years with average age 44.9 years and Ibeanusi et al (2007)reported that the peak age group was (20-29) years representing 38.6% of his study group. But Allison et al (2005) reported that the peak age group was (40-49) years with average age of 66 years which is much higher than the average of similar studies.Court-Brown et al (1998) reported that the average age of males in his study group was 36.7 years compared with 61.1 years for females.

Regarding the time of admission, there was no significant difference between the rate of admission in different shifts whileArruda et al (2009) similar study in Brazil reported that the highest rate of admission was in the period (7 pm to midnight) representing 41.52% of cases with P value less than 0.001.

The results of the mode of trauma in the study group of open fracture were in accordance with all the similar previous studies in the literature; Arruda et al (2009), Court-Brown et al (1998) and Allison et al (2005)reported that road traffic accidents was the most common mode of trauma representing 57.3%, 57.7% and 56% respectively. The frequency of road traffic accidentswas much higher in Ibeanusi et al (2007) and Magoumou et al (2014) studies representing 91.4% and 86.7% respectively.

The analysis of the site of open fractures in our study showed that the most commonsite of open fracture was the leg followed by the hand. This is in accordance with the literature, Arruda et al (2009) reported that the most common site of open fracture inhis study was the leg followed by the hand representing 37.86% and 16.47% respectively.

The frequency of multiple open fractures in this study is also in accordance with Court-brown et al (1998) that reported the percentage of multiple fractures was 7.2%.

The classification of open fractures according to Gustillo's classification in this study group wasn't in agreement with similar previous studies from the literature, where open fractures grade IIIb was the most common type followed by grade II; Arruda et al (2009) and Court-Brown et al (1998) reported that the percentage of grade III open fractures was 45.36% and 43.8% respectively and the percentage of grade II open fractures was 25.54% and 24.8% respectively. Magoumou et al (2014) classified open fractures according to Duparc and Cauchoix

classification and reported that 64% of the fractures was of type I, 33% of the fractures wasof type II and 3% of the fractures was of type III.

The type of open fracture of least frequency in this study was type III c which is in concordance with all similar previous studies; Arruda et al (2009) and Allison et al (2005) reported that the percentage of type IIIc of open fractures was 11% and 4% respectively.

Our study showed that the most frequent associated injury was closed fracture, which is concordant with Arruda et al (2009) who reported that closed fracture was the most frequentassociated injury representing 38.7% and also reported the percentage of isolated openfractures as 22.61%. But, this isn't the case in Magoumou et al (2014) who reported that the headinjury was the most frequent associated injury representing 26.14% and also reported thepercentage of isolated open fracture as 60.78%.

The percentage of patients with delayed surgery after first 24 hours in our study is much higher (32.4%) compared with previous similar studies; Reuss B et al (2007) in USA reported that 90.1% of open tibial fracture patients was operated within 24 hours and 9.9% was delayed after 24 hours of admission, Charalambous et al (2005) in UK reported that 97.39% of open tibial fracture patients was operated within first 24 hours and 2.61% was delayed after 24 hours of admission and Namdari et al (2011)reported that 76% of open tibial fracture cases was operated within 24 hours and 24% was operated after 24 hours of admission.

The unavailability of theatre facilities and blood products were the most significant causes of delay of open fracture bone fixation in this study regarding hospital related factors while the associated injuries and age were the most significant factors of delay regarding patient related factors.Charalambous et al (2005) studied 383 cases with open lower-leg fractures presenting in seven hospitals in the north-west of England and found that delayed treatment of some fractures was due to the non-availability of an operating room or presentation of patients outside normal working hours when conditions may not be optimal.Namdari (2011)in the United States found that the causes of delay were related either to patients (elderly patients, patients with head injury or severe chest trauma) or to the system of care (management protocol, availability of the surgeon, staff and operating room) and showed a statistically significant association between these factors and the time to debridement.

In conclusion, the prevalence rate of open fracture cases admitted to ED in AMUH is high compared to similar studies in other countries. The unavailability of blood products and theatre facilities are the most common hospital related factors while old age and associated injuries are the most common patient related factors of delay of management of open fracture cases and further studies concerning open fractures should be performed. It is preferred to be multi-centre studies to get more accurate results.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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