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Epidemiology of fractures during a peacekeeping mission in northern Mali

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Abstract
Introduction: In July 2014, a United Nations Multidimensional Integrated Mission for the Stabilization of Mali (MINUSMA) had started. Soldiers of this mission were frequently attacked and many of them are wounded. Togo's Level 2 hospital has been deployed in Kidal to provide emergency medical and surgical care to all wounded in the northern sector. The purpose of this work was to determine the epidemiological profile of the fractures presented by these wounded.
Materials and methods: It was a continuous prospective study from January 2015 to December 2016, concerning patients who were admitted for a fracture and confirmed by a standard radiography. The parameters studied were the age of the wounded, the sex, the civil or military status, the etiology of the fracture, the seat of the bone lesions, the associated lesions and the type of opening according to the Gustilo-Anderson classification.
Results: Two hundred and fifty patients (250) were admitted for fractures during this period. The etiology of fractures was dominated by firearms (27.2%) and traffic accidents (22.7%). Three hundred and two (302) fractures were reported from the 250 patients. They were in the lower limb in 145 cases (48%), upper limb in 130 cases (43.1%). Fractures were open in 216 cases (71.5%) and dominated by Gustilo-Anderson type III (69.4%).
Conclusion: The fractures found during the peacekeeping missions are associated with other lesions that make their severities. The care of these wounded should be multidisciplinary. Otherwise, the military surgeon deployed in these missions must have many skills to optimize the results of this care.

Keywords: Epidemiology, fractures, level 2 hospital, Mali

Introduction
Fractures are frequent lesions and very varied by their context of occurrence, their etiological mechanism, their seat, and the associated lesions. [1] In civil practice, they occur during road accidents and concern a very young population. The increase in the number of cars leads to an increase in the frequency of these lesions, which are becoming more and more serious, and containing a real public health problem [2]. In case of conflict, etiologies are dominated by firearms [3]. These firearm fractures have peculiarities that differ from those observed in road accidents. They require special care that depends on both the specificities of the lesion, and also the technical and logistical possibilities available in the field. [3].
In july 2013, a United Nations Multidimensional Integrated Mission for the Stabilization of Mali (MINUSMA) was set up to pacify the conflict. Soldiers of the mission were often attacked by firearms, resulting in many wounded. Traffic accidents were also common on poor and very rough roads. The fractures found during these attacks or accidents were associated with injuries that sometimes were life-threatening for soldiers, due to lack of adequate care. In order to provide quality emergency care to the soldiers of mission, a Togo Level 2 Hospital has been deployed in the northern sector of Mali [4]. The aim of this work was to determine the epidemiological profile of fractures found in this sector in order to adapt the management and reduce the morbidity of soldiers deployed for peacekeeping missions.

Materials and methods
Togo's Level 2 Hospital, was located in Kidal (northern Mali), provides emergency medical and surgical care mainly to military of MINUSMA and sometimes to Malian civilians.

The hospital has a medical team, a surgical team, anesthesia and resuscitation team, a radiology unit and a laboratory. It has a capacity of 20 beds and an operational autonomy of two months. The surgical team is composed of a general surgeon, an orthopedic surgeon, a resuscitating anesthetist and six nurses (two anesthesiologists, two instrumentalists, two emergency nurses).

The resources allow for 3 to 5 surgeries per day. The wounded were evacuated from level 1 structures to the level 2 hospital. Injured civilians were brought in for consultation by parents or their relatives.

Our study is a continuous prospective study from January 2015 to December 2016 concerning patients who were admitted for a fracture and confirmed by a standard radiography. The parameters studied were age of the injured, sex, civilian or military status, etiology of fractures, seat of bone lesions, associated lesions, and type of opening according to the Gustilo-Anderson classification.

Results

During this period, six hundred and fifty (650) patients were admitted to the surgical unit, of which 250 (38.46%) had fractures. These were 209 (83.6%) males and 41 (16.4%) females, a sex ratio of 5. The mean age of the patients was 31.4 years old with the extremes of 18 and 51 years. We identified 141 (56.4%) military and 109 (43.6%) civilians. Firearms were the most common etiology (27.2%), followed by traffic accidents (22.7%) and work accidents (Figure 1).

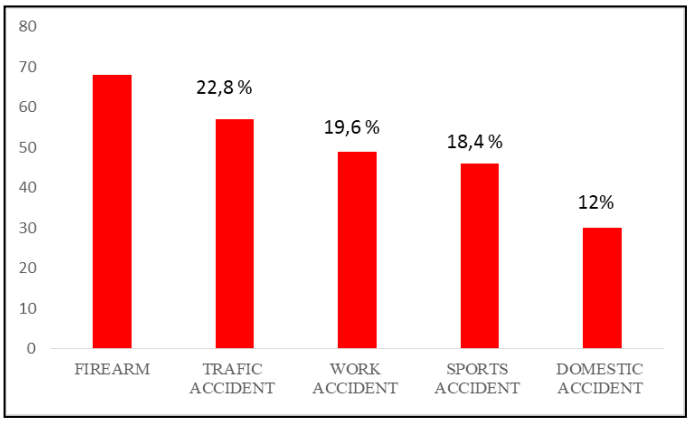

Fig 1: Distribution according to the etiology of the fractures

When considering the military or civilian status, we found that among the military population, a predominance of etiologies by firearm (34.7%) followed by accidents at work (27%). Traffic accidents were found in a proportion of (10.7%). In the civilian population, traffic accidents (38.5%) were the leading causes followed by domestic accidents (19.3%) and firearms (17.4%). Table 1.

Table 1: Distribution of fracture etiologies by injury status

	Soldiers		Civilians	
	Numbers	Percentage (%)	Numbers	Percentage (%)
Firearm	49	34,7	19	17,4
Traffic Accident	15	10,7	42	38,5
Work Accident	38	27	11	10,1
Sports Accident	30	21,3	16	14,7
Domestic Accident	9	6,3	21	19,3
TOTAL	141	100	109	100

Three hundred and two (302) fractures were identified on the 250 patients. Most patients (80%) had a single fracture, 12.8% had two fractures and 7.2% had three or more fractures. These fractures were opened in 216 cases (71.5%) and closed in 86 cases (28.5%). Among the open fractures, Gustilo-Anderson type III openings were predominantly found (69.4%) (Table 2).

Table 2: Distribution of open fractures according to Gustilo-Anderson classification

	Numbers	Percentage (%)
Type I	27	12,5
Type II	39	18,1
Type IIIA	51	23,6
Type IIIB	64	29,7
Type IIIC	35	16,1
Total	216	100

Fractures were seated in the lower limb in 145 cases (48%), the upper limb in 130 cases (43.1%) and the spine in 27 cases (8.9%). In the lower limb, leg (12,9%) and ankle (11,9%) fractures were most affected, while the upper limb fractures predominated in the hand and shoulder (Table 3).

Table 3: distribution by seat of fractures.

	Numbers	Percentage %
Shoulder	33	10,9
Arms	12	4,0
Elbow	10	3,3
Forearm	11	3,6
Wrist	16	5,3
Hand	48	15.9
Hip	10	3,3
Thigh	12	4,0
Knee	23	7,6
Leg	39	12,9
Ankle	36	11,9
Foot	25	8,4
Spain-Skull	27	8,9
Total	302	100

More than one quarter of the fractures (26.1%) were associated with other lesions. Thus we found 35 cases (11.6%) of vascular lesions, 18 cases (5.9%) of tendon lesions, 9 cases (2.9%) of nerve lesions, 17 cases (5.6%) of thoraco-abdominal lesions. Vascular lesions were preferentially located in the leg (13 cases) in the foot (8cas) and wrist (4). Six of 9 cases of nerve damage were secondary to spine fractures.

Discussions

Traumatology plays an important role in conflicts and accounts for 40-70% of surgical activities performed in level 2 and 3 hospitals. Rescue techniques in combat (tourniquet, haemostatic bandage, airway release, wounds placed in the security position) taught to soldiers and the quickly evacuation of the wounded to health care facilities saved a great number of the wounded. The surgeon must then face serious lesions due to the violence of the mechanisms [5]. The average age of the wounded seems similar across the literature data. She was 30.6 years old in the Laurant M *et al* series [6]. The age group which was the most concerned in the series of Babier O *et al* [5] was 31-45 years. This average age testifies to the youth of the subjects deployed for these operations. Hence the need for appropriate medical and surgical care to prevent or minimize the functional sequelae associated with these injuries. More than 80% of our casualties were male because very few women were deployed. Those who were admitted for a fracture were admitted after a traffic accident or a domestic accident.

The main etiology of the fractures differed according to the status of the wounded. Indeed, we found a predominance of firearm etiologies among the military, while among civilians, it was mainly traffic accidents. Rasdolaw [7] reported 87.1% of firearm injuries during stabilization missions in Afghanistan. Kathryn Chu and al [8] also found 94% of gun injuries in North Kivu. In northern Mali, mortar and rocket fire were directed against the MINUSMA's camp. Explosive device explosions occurred during passage of soldiers' convoys and during patrols explaining the higher frequency of firearms fractures. The poor state of the roads explained the traffic accidents that occurred in the civilian population as well as in the military.

Insufficient individual protective measures (fighter with ball vest and helmet) leave members vulnerable and explain the predominance of limb injuries [8, 9]. These fractures were often open. Frederico Carlos *et al* [10], Nirmal Raj Gopinathan *et al* [11] reported respectively 73.5% and 64% of open fractures in their studies. The proximity of the lower limbs to the ground further exposes them to improvised explosive device explosions, resulting in many associated injuries and traumatic amputations.

In the upper limbs the explosion of these devices during their handling causes serious injury to the hand and face [12]. In civil practice, more than 84% and fracture fracture of limbs are related to traffic accidents according to Ali and al [13]. Type IIIb open fractures were the most common in our series followed by type IIIa and IIIc lesions. Kombate and al [14], Fréderico and al found a predominance of type IIIa lesions. The type III lesions of Gustilo Anderson reflect the violence of the mechanisms. Improved personal protection tools for soldiers and prevention of traffic accidents is necessary to reduce the occurrence of these fractures.

Conclusion

This study conducted at Togo Level 2 Hospital in Kidal reflects the distribution of fractures and their characteristics during peacekeeping operations. These fractures are associated with numerous lesions that can immediately become life-threatening or leave functional sequelae.

In view of the diversity of the lesions found in these field, any orthopedic military surgeon deployed for peacekeeping mission must have skills in hand surgery, foot surgery, plastic surgery and reconstruction, vascular surgery and neurosurgery. He must be trained to handle massive influxes of wounded, and to work with a minimum of resources to save the maximum number of wounded.

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