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ORIGINAL PAPER

Trauma related to falls from trees treated in a specialized trauma centre in Burkina-Faso—one hundred and six cases treated in one year

Patrick W. H. Dakouré[1] · Malick Diallo[1] · André-Charles V. Traoré[1] · Salifou Gandéma[1] · Sie Drissa Barro[1] · Ibrahim Alain Traoré[1] · Cyprien Zaré[1]

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Abstract
Purpose Falls from trees related traumas are rarely reported in literature. They are public health problems in developing countries where their frequency is still important. The aim of the study is to describe falls from trees related trauma patterns and to present preventative measures.
Methods An annual ongoing prospective study was held in our trauma emergency department (ED) about all the patients who sustained an injury after a recent fall from tree. A questionnaire related to the patient and to the trauma was established. The data were encoded and analysed by a statistical software.
Results One hundred six patients who sustained a fall from tree trauma, out of a total of 139, were studied. Most patients were under 15 years old (76.4 %); they were injured in fruits season (33 %) after a fall from a fruit tree (mango trees, Shea trees, *Néré*, etc.) and were received late (86 %). Injuries were polymorphic from traumatic brain injuries (51.8 %) and spine injuries (13.2 %) to thoraco-abdominal (21.6 %) and limbs injuries (46.2 %). Three housewives were pregnant at the time of the trauma with secondary abortions. Patients were managed medically (33.9 %), surgically (19.8 %) or by casting (34.9 %) with good outcome in 59 cases. Twelve patients refused medical care and two died.
Conclusion Education programs must focus on picking fruits and leaves in order to make them safe and prevent injuries related to these traditional or professional activities.

Keywords Falls from tree · Trauma · Developing countries · Prevention

✉ Malick Diallo
malikijallo@yahoo.com; malick.diallo@univ-bobo.bf

Patrick W. H. Dakouré
patdakoure@yahoo.fr

André-Charles V. Traoré
forghocharles@gmail.com

Salifou Gandéma
gandemasalif@yahoo.fr

Sie Drissa Barro
drissab@yahoo.fr

Ibrahim Alain Traoré
itraore80@gmail.com

Cyprien Zaré
zcyprien@yahoo.fr

[1] Institut Supérieur des Sciences de la Santé, Université Polytechnique de Bobo-Dioulasso, 01 BP 1091, Nasso, Bobo-Dioulasso, Burkina Faso

Introduction

Climbing trees is a usual occupation in rural lands of developing countries. Some trees are tall and falls can lead to severe injuries and death [1–3]. Falls from tree traumas (FFTT) are rarely reported in literature [1, 4–7]. The knowledge of these trauma injuries may help to take preventative measures in developing countries.

The objective of our study was to describe epidemiological, injury and therapeutic patterns of traumas due to falls from trees and to present preventative measures.

Materials and methods

A twelve months ongoing prospective study was held in the trauma emergency department (ED) of our University Hospital. All the patients received for a recent trauma by fall from tree with a confirmed injury were included in the study. A

questionnaire was established. Data such as the period of trauma, the time of admission, the age, the sex, the occupation, the physical condition, the circumstance of trauma (the tree kind, the climb motif), the mechanism of injury, the injury site, type and associated complications, the method of treatment and the outcome features were collected. Datas were encoded and analysed by the statistical software Epi Info version 3.5.2 (Center for Disease Control and Prevention, Atlanta –Georgia, USA).

Results

In the study time, 139 FFTT among 2483 trauma patients (5.6 %) were diagnosed. Only 106 cases matched to our sample, the others were lost of view.

Time features

The majority of FFTT cases occur in April (n=33 %). January, February and September were less involved (Fig. 1). Seventy-two patients (67 %) were received within 24 hours after the trauma and 20 patients (18.8 %) came two days after their fall.

Socio-demographic features

The mean age of the patients was 14 years old (Fig. 2). The youngest was four years old and the oldest 65. Eighty-one victims were children under 15 years old (76.4 %). The male:female ratio was 2.78. Among the 28 female cases, three were pregnant at the time of trauma. The distribution of occupations showed 53 students, 23 out-of-school children, 15 farmers, 12 housewives, one tailor and one lumberjack.

Circumstances and mechanisms of injury

Falls most often occurred within farm work and fruit picking (n=70, 66 %). The others falls took place at home (28.2 %) and at school (5.6 %). Eight kinds of trees were identified,

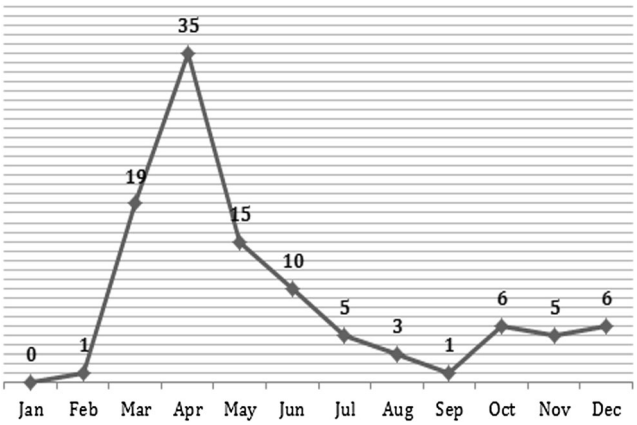

Fig. 1 Annual distribution of falls from tree trauma (FFTT) cases

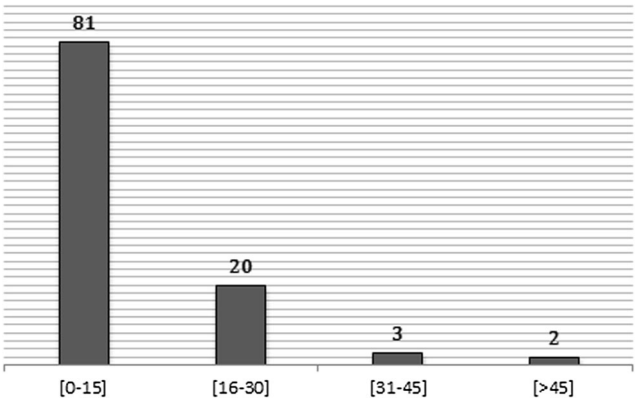

Fig. 2 Distribution of falls from tree trauma (FFTT) cases by age

which were mostly fruit trees such as mango trees (50.9 %), Shea trees (21.7 %) and African locust bean trees or "Néré" (6.6 %) (Table 1). The mean distance of fall was 5.23 metres. The fall height varied from ten metres to two metres. Many circumstances led to falls. Slipping on a branch (60.4 %) and breaking of a branch (34.9 %) were most common. Less commonly, an insect bite with loss of balance (2.9 %) and an incorrect assessment jump (1.8 %) were the other circumstances of trauma.

Injuries

Lesions were polymorphic and rarely isolated. There were nine polytraumas (8.4 %). The anatomic site distribution of a total of 148 injuries showed 55 cases of head traumas, six cases of maxillofacial traumas, 14 cases of spine traumas, 23 cases of thoraco-abdominal traumas and 49 cases of limb traumas (Table 2).

Table 1 Cases of falls from tree trauma (FFTT) distributed by tree type

Tree	Cases (n)	Percentage (%)
Mango tree *Mangifera indica*	54	50.9
Shea nut tree *Butyrospermum parkii*	23	21.7
African locust bean tree or "Néré tree" *Parkia biglobosa*	7	6.6
Coconut tree *Cocos nucifera*	4	3.8
Kapok tree *Ceiba pentendra*	4	3.8
Baobab *Adansonia digitata*	3	2.8
Seagrape tree *Coccoloba uvifera*	2	1.9
Cailcedrat *Khaya senegalensis*	3	2.8
Not determined	6	5.6
Total	106	100

Table 2 Falls from tree trauma (FFTT) cases by injuries

Anatomical site	Cases (n)	Percentages (%)
Upper limb	31	
Wrist (colles fractures, distal radius and distal ulna fractures …)	21	67.74
Forearm (radius and ulna fractures)	6	19. 35
Humerus fractures	1	3.23
Clavicule fractures	3	9.68
Lower limb	18	
Pelvic fractures	7	67.74
Femur fracture*s*	5	19. 35
Leg (tibia and fibula fractures)	4	9.68
Ankle (bimalleolar fractures)	1	3.23
Metatarsal fractures	1	
Total	67	100

Head traumas were responsible for traumatic brain injuries (TBI). According to the Glasgow Coma Scale (GCS), TBI were categorized as severe (n=13), moderate (n=17) and mild (n=25) disabilities. There was one open head injury, one intracranial hemorrhage and 52 cerebral contusions. In seven cases, the coma was over 24 h.

Spinal injuries locations were dorso-lumbar (n=10) and cervical (n=4). Associated spinal cord injuries were complete in nine cases (64.3 %). All spinal injuries were treated non-surgically.

Minor thoracic trauma occurred in four cases, one patient presented costal fractures and another patient, a hemopneumothorax. In 16 abdominal traumas, 12 (75 %) presented a splenic rupture. Theses splenic ruptures were classified type I (n=2) and type IV (n=10) according to the American Association for the Surgery of Trauma (AAST). The others abdominal injuries were superficial abdominal contusions (n=2), a colic perforation (n=1) and liver wound (n=1).

The upper limb was more often fractured (n=31) than the lower limb (n=18) (Fig. 3). Wrist fractures were the main injury (n=21), followed by pelvic fractures (n=. Diaphyseal fractures of long bones were less important. Bilateral fractures of wrist (n=2), of femur (n=1) and of tibia (n=1) were noted (Fig. 4 and 5). One patient sustained a pelvic fracture with an associated posterior hip dislocation. Open fractures were found in 17 cases (34 %). These open fractures were classified type II (n=11) and type IIIB (n=1) according to the Gustillo Classification.

For pregnant housewives, no baby survival was recorded after an FFTT.

Treatment and outcome

A total of 73 patients were hospitalized. Twelve patients refused medical care and 27 others were treated as out-patients. A surgical management was performed for 14 cases of abdominal trauma with ten splenectomies, one colic suture and one liver wound packing. Non-surgical management such as closed reduction, casting and functional measures were performed for the majority of limb fractures. Only four of the limb fractures were managed surgically by open reduction and internal fixation (Table 3).

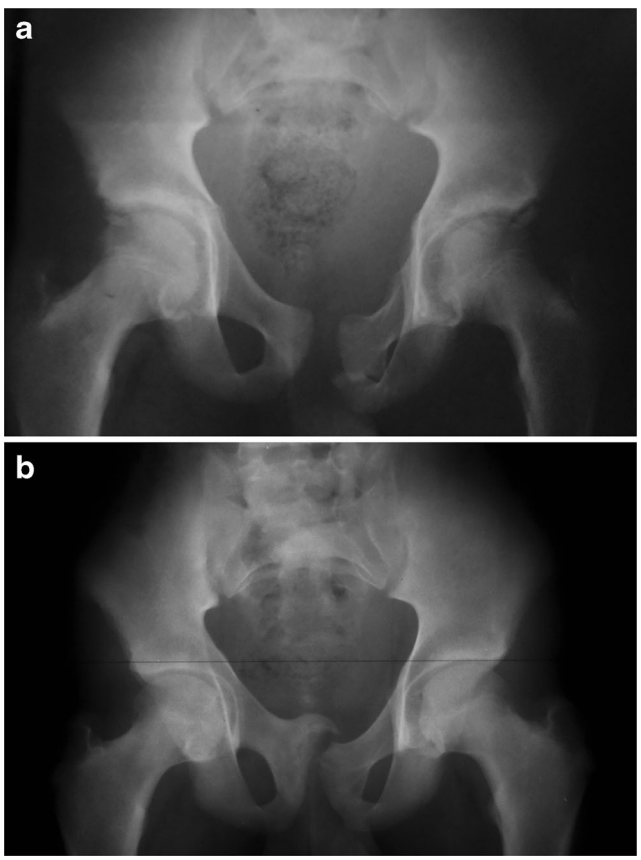

Fig. 3 Anteroposterior pelvic radiographs of a 14-year-old boy. A fracture of the left ischio-pubic branch (**a**) and its consolidation with pubic symphysis ossifications (3 years latter) (**b**) are shown

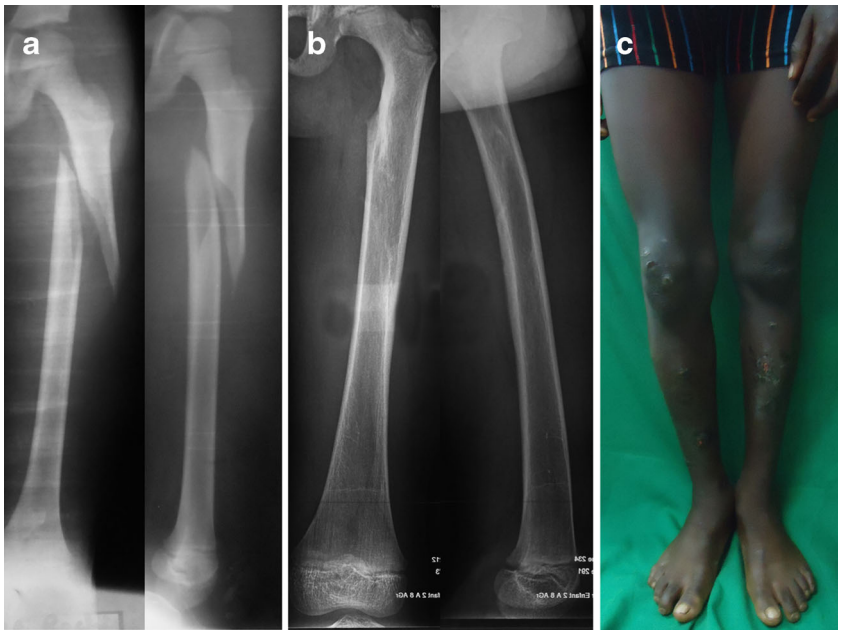

Fig. 4 Radiographs and condition of the left femur of an 11-year-old boy. Immediate (**a**), late (3 years) (**b**) anteroposterior views and lateral views of the femur shown a diaphysis fracture and a remodeling. The clinical condition (**c**) showed a corrected leg discrepancy

Hospitalized cases were evaluated. The outcome was good in 59 cases (80.82 %). Morbidities were splenectomies (n=10), paraplegias (n=8) and mal-unions (n=5). Two patients, one case with severe TBI and another case of polytrauma with massive hemoperitoin, died at ED.

Discussion

Falls from tree traumas (FFTT) are common in developing countries [4, 6]. These were responsible for 5.6 % of all trauma admissions. A Melanesian study in 1984 by Barss et al. [2] found a higher percentage.

Falls from trees occurred throughout the year but were increased during the fruit maturation period [4, 5, 8, 9]. Sixty-five percent of current study cases occurred in the fruit maturation period. In tropical Africa, fruit maturation occurs in the warm season (March to May). About one-fifth of our patients arrived two days after trauma at ED. This was explained by the long distance to travel (100–200 km) and behaviours concerning witch-doctors. Delayed admissions may have worsened injuries [1].

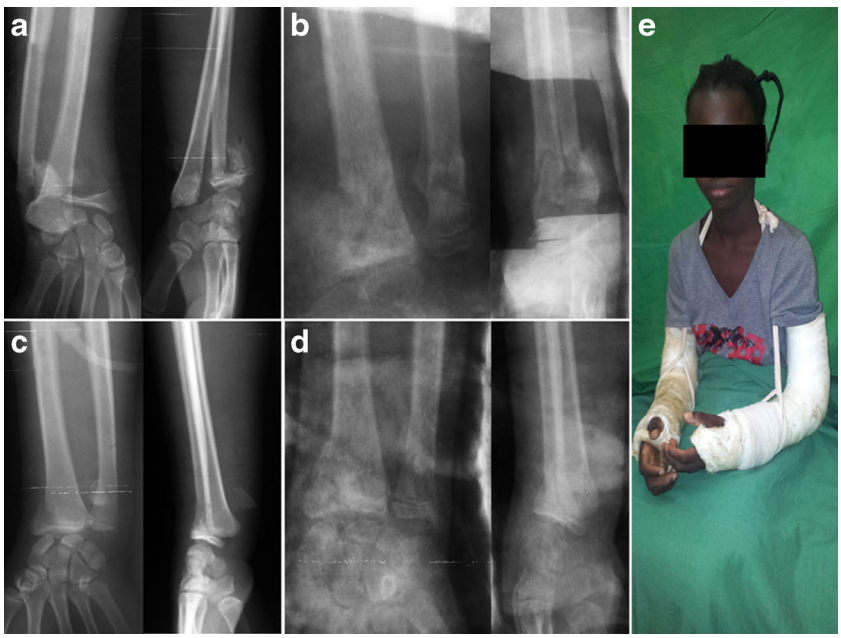

Fig. 5 Wrist bilateral fractures of a nine year-old girl. Immediate (**a** and **c**) and late (two months) (**b** and **d**) anteroposterior views and lateral views of the right and left wrists treated by casting (**e**)

Table 3 Falls from tree trauma (FFTT) treatment

Treatment	Cases (n)	Percentage (%)
Pure medical treatment	36	33.96
Cast	37	34.91
Surgery	21	19.81
Simple sutures	13	12.26
Spenectomy	10	9.43
Colic suture	1	0.94
Liver wound packing	1	0.94
ORIF	4	3.77
Refusal	12	11.32
Total	106	100.00

ORIF open reduction and internal fixation

Common mean age of FFTT was around 30 years old [1, 4, 8], but most authors agreed that these traumas occur frequently in young people [2, 4, 6, 8]. We found 81 cases (76.4 %) of children under 15 with a mean age around 14 years old. The youngest of our study population might be explained by some cultural practices. Adults in our rural land send children to pick fruit or leaves instead of climbing trees themselves.

The majority of series showed a large male dominance of cases, between 69 % and 100 % [1, 2, 4, 5, 8], with the exception of a Malawian study [6]. Traditionally, young girls spend more time at home to help their mother and they were less exposed than young boys in climbing experiments. Muula et al. stated that their significant sex difference may be explained by Malawian girls dress and social liberties [6]. Rarely, housewives climb trees to pick leaves for cooking. In this situation, a FFTT is dramatic in pregnancy. However, many falls of palm-trees workers were also reported [2, 4].

In rural land, children climb trees for recreational reasons like hide-and-seek, swinging games and fruit picking. The type of fruit tree was related to climate. In African studies, mango trees and palm trees were mostly involved [4, 9]. Walnut trees in Kashmir [1], coconut trees and mango trees in Melanesia [2], as well as mulberry trees and apple trees in Iran [8] were also responsible of FFTT. We confirmed the importance of mango trees in FFTT aetiologies. Other fruit trees specific to our region including Shea trees and African locust bean trees were also included. Diallo et al. [5] stated that an important height of falls (20 m) led to spinal cord injuries. Slipping on a branch [2, 4, 5], breaking of a branch [4, 5] and a falling tree or branch [2] were usual circumstances.

FFTT led to spectrum of injuries. The height of falls, the landing patterns such as impact area and effective protective reflexes and the landing surface determine the injury. Injuries features were different for each study [1, 2, 4, 8]. We found more head traumas and upper limb traumas than thoraco-abdominal, lower limb and spinal traumas. Loss of balance, incorrect assessment jumps and protective reflexes in landing may explain head trauma and limb injuries. Landing on two upper limbs was responsible for bilateral fractures [8]. The main location of spinal injuries was dorso-lumbar [4] but some authors reported more cervical injuries [5]. About two-thirds of spinal traumas presented a neurological injury. An associated spinal cord injury varies from 17 % [1] to 100 % [5]. We think that abdominal injuries such as splenic ruptures were due to acceleration and deceleration mechanisms during the fall. Thoracic injuries were rare [1], as focused in the present study because of costal grid plasticity in children.

Treatment of FFTT injuries is an economic burden [2, 8]. Poverty and behaviors led 12 of our patients to refuse hospital treatment at admission or a few days later. Injuries in children are mainly treated by conservative methods. The youngest of our study sample explains the important rate of conservative treatments. Contrary to limb injuries, abdominal injuries required more surgery.

Reported morbidities related to FFTT were paraplegia [1, 5, 8] and splenectomy.

Cases of death were polytraumas, severe head traumas, thoracic traumas and delayed care [2].

We propose an education program in rural lands to prevent FFTT events:

- Keeping children away from tall trees
- Promoting security in climbing activities (good weather, safety belts)
- Supporting safe fruit picking (picking-bits, regular cutting of fruit trees to keep them short)

Conclusion

Despite its lower frequency among trauma etiologies in our hospital, falls from trees are responsible of numerous of injuries. Poverty and traditional habits contributes to increase them and led to therapeutic problems. So, an education program must be created to prevent FFTT.

Conflicts of interest The authors declare that they have no competing interests to declare.

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