CLINICAL AND EPIDEMIOLOGICAL FEATURES OF DIAPHYSEAL FEMORAL FRACTURES IN DOUALA

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I- BACKGROUND

The femur, which is the strongest bone in humans, is often put under stressful constraints during the daily life trauma that can lead to consequences such as fractures. The causes of these stresses can be either traumatic, including road accidents [1,2,3] or non-traumatic often resulting from bone tumors at a primary stage [4] or bone metastasis from organic cancers at a second stage [5]. Femoral diaphyseal fracture (FDF) is the commonest lesion in young adults [6-10]. It is a trauma emergency that can put the victim’s life in danger by causing an acute hemorrhage or a fat embolism. Epidemiological data of FDF’s vary across the world, with an estimated annual incidence of 1-1.33 cases / 10,000 people among adults worldwide in 2007 [11]. Worldwide, the majority of femoral fractures are FDF [12]; and most of the victims are men aged between 20 and 60 years [13]. In 2015, their frequency oscillated from 1 to 2.9 million cases with an annual average incidence rate between 14.5 and 42 FDF / 100,000 people [14]. In the United States, 51% of femoral fractures are diaphyseal fractures [12]. In Europe, the victims’ profile changes depending on age factor: before the age of 35, mostly men are concerned, and after 80 years old, they are more women [15]. The same way the general frequency of FDF is 10 to 12.1 cases / 100,000 people [2]; more especially, the national incidence is 10 cases / 100,000 inhabitants in France [15], 9.9 to 12 / 100,000 inhabitants in Spain [16], 10 / 100,000 inhabitants in Sweden [17]. In Australia, the frequency is 21 cases / 100,000 [18]. In Africa, FDF accounts for 51.82% of femoral fractures in Nigeria [6], and 12.9% of limb fractures in Burkina Faso [19]. In Africa, road accidents (62.8%) and minor falls (18.7%) are the main causes of FDF (2); they account for 12.9% of all limb fractures [19]. In our context, “Farikou & al” categorized FDF as the first traumatic lesion of the musculoskeletal system (12.4%) in 2011 [20]. Data available on FDFs are incomplete and insufficient because the epidemiologic, anatomic and clinical characteristics of FDFs are still unknown. This research aimed to contribute to a better knowledge of FDFs in our context by studying their socio-demographic and anatomo-clinical characteristics for adults in the city of Douala in 2016.

II- METHODS

1. Type of study

This cross-sectional descriptive study was carried out from October 1st, 2015 to March 31st, 2016 in the surgical emergency wards and orthopedic surgery departments of five public hospitals in the city of Douala. Douala is the largest cosmopolitan and populated economic capital of Cameroon with more than 2.5 million inhabitants. These hospitals were chosen based on their attendance rate and the
quality of their technical facilities in FDFs management.

2. Population of study
The population of study was composed of all the hospitals users, chosen in the frame of the study. We included all the patients who visited the study settings for a recent femoral diaphysis fracture, those who accepted to participate in the study or those whose legal representatives had accepted to participate in the study. Other hospital users were not included in the study.

The sampling was a simple random one; and the minimum sample size was 167 patients. It was calculated with the Lorentz formula at the error threshold of & = 5%, a prevalence of p = 12.4% for the FDFs in the General Hospital of Douala found according to “Farikou and al” [20].

3. Data collection
The data collection was carried out by a multidisciplinary team made up of a group of senior medical students, under the supervision lecturers from the Faculty of Medicine and Pharmaceutical Sciences of the University of Douala. The study was approved and we first obtained an ethical clearance and a research authorization from the Regional Delegate of the Ministry of Public health in the Littoral region. The aim, objectives and benefits of study were explained to the participants to obtain their informed consent. The interviews were conducted using a mixed questionnaire to collect the socio-professional characteristics of the participants (age, gender, marital status, occupation, seniority and professional status), the characteristics of the accidents (type of accident, location of the accident, lesion mechanism, causal factor), clinical signs (local signs, general signs, deformation, associated lesions) and para-clinical signs (lesion site, fracture line).

4. Data processing and analysis
Data were handled simultaneously with the collection process in order to correct filling or missing errors so as to obtain accurate and high-quality data. Data were registered using EPI Info 7.0 software and then transferred to SPSS 21.0 software for analysis. The analysis was descriptive and analytical. The analytical results consisted in the investigation of possible associations between FDFs and certain variables using the chi square test, at the error threshold & = 5% and the significance degree p <5%.

5. Ethical Considerations
The study was carried out in full consideration of the ethical principles of the Helsinki declaration and in strict compliance with the fundamental principles for human health research in Cameroon.

The study obtained the ethical clearance n° CEI-UD/364/01/2016/T issued by the Institutional Ethical Committee of the University of Douala. An informed consent was obtained from the participants or their legal representatives, before their involvement in the study. Data were collected in strict compliance with medical confidentiality and the survey forms were made anonymous and coded in order to ensure data confidentiality throughout the collection process. The rights of participants, their dignity, privacy and confidentiality of individual data were protected during and after the study.

III – RESULTS

1. Socio-demographic characteristics
One hundred seventy one respondents including 118 males (69%) and 53 females (31%) met the inclusion and exclusion criteria and fully completed the survey (response rate: 93.44%).

Their socio-demographic characteristics are shown in table I below.

The gender ratio is equal to 2.22 in favor of men. The mean age of the total sample was 35.92 years (range: 2 - 80 years). The modal class was that of patients aged between 21 to 30 years (33.92%). The main occupational groups represented in the sample were those of pupils and students (28.07%) and workers (19.29%). The majority of participants were single (53%).

2. Characteristics of the accident
We recorded 113 cases of lesions associated with FDFs. There were 32 cases of leg fractures (28.3%), 27 cases of cranial trauma (23.9%) and 18 cases of abrasions of the face and limbs (15.9%). Some combined lesions were less frequent: 8 cases of malleolus fractures (7.1%), 7 cases of forearm fractures (6.2%), 4 cases of fractures of the pelvis (3.5%), 4 cases of trochanter fractures (3.5%) and 4 cases of leg injuries (3.5%). In addition, we observed lesions of the soft tissues, including 3 cases of perineal lesions (2.6%), 2 cases of haemoperitoneum (1.8%), brachial plexopathy (0.9%); we also noted isolated cases of leg crushing (0.9%), foot crushing (0.9%) and pubic disjunction (0.9%

IV - DISCUSSION

1. Study limits
The main limitation of the study was technical, due to the non-availability of healthcare workers during the working hours. With a good method of collection, we succeeded in the control of collection and information bias.

2. Comparison of results
2.1 Socio-demographic characteristics
Overall participation is satisfactory, around 93.44% (171/183). Male participants predominate in the sample (69%) with a gender ratio of 2.22. Men are the preferred targets of FDFs according to the results of several researches. Barra de Moraes and al obtained a similar male predominance in Brazil in 2009 (70%) [21], while less predominance’s were obtained by Myssayev and al in Kazakhstan in 2014 (65.3%) [13] and Anyaehie and al in Nigeria in 2015 (63.7%) [6]. This increased exposure could result from the fact that men are more mobile than women and routinely involved into dangerous and risky socioprofessional activities. Participants’ ages ranging between 2 and 80 years confirm that FDFs is a common pathology that could occur at any age, although young adults between 21 and 40 years are the most affected victims with the majority of cases (56.73%). The mean age of participants which is 35.92±7.42 years
is higher than the mean age of Doukoure and al in Burkina Faso in 2013 (34 years) [22]. The age of participants confirms the age-distribution of the population in Cameroon among which the majority is less than 20 years old, those aged below 15 years represents 43% of the general population and those above 65 years representing 3.5% of the general population [23]. Similar trends are noticed in other Sub-Saharan countries in Africa with young populations aged below 30 years old [23]. Pupils and students are more represented in the sample (28.07%) because they’re routine motorbike-taxis users and they prefer this mean of transportation to get to school or university and vice versa. This new mode of transportation is very common in many sub-Saharan African countries since the last two decades. The fast development of this alternative mode of transportation was enabled by the general context of fast growing populations and lack of road infrastructures [24,25]. According to Chichom and al, victims of motorbike-taxis accidents usually suffer multiple types of lesions with various sites such as the limbs, the head, the neck and the abdomen located [25]. These characteristics of the participants confirm those of the industrial workforce which is usually young and masculine, and mainly constituting the strongest and most productive segment of the labour force [26].

2.2. Accidents characteristics

- **Type of accident**

Road accidents (RA) represent the main cause of the FDFs in this study as well as in other studies. RA have caused 3 out of 4 traumatic accidents in this study (76%), 70% of FDFs in India in 2013 [27], 74% of FDFs in Swedish males in 2005 [17], 62% of FDFs in Nigeria in 2015 [6] and 62.8% of FDFs in Australia in 2013 [18].

Domestic accidents represent the second aetiology of FDFs (10%), affecting children below 10 years and adults above 51 years. Our results are different from those of other authors’ such as Salminen and al in Finland (25%) [28], Madougou and al in Benin (8.15%) [29], Bahebeck and al. in Yaounde (17%) [30] and Myssayev and al (38.9%) [13].

Less than one in ten cases of FDFs (9%) occurred during work-related accidents; more than the result obtained by Myssayev and al in 2014 in Kazakhstan (6.3%) [13]. Despite the minor difference noticed between the two results, our data confirm that FDFs consecutive to work-related accidents are lower in European countries compared to sub-Saharan African countries.

- **Time of occurrence**

The accidents that caused FDFs mostly occurred at night (45%). The combined effects of fatigue and circadian hormones might explain this high risk level of accidents occurring at night [31]. At workplace, night-time is considered as a hazardous period of work for the safety and health of workers [31,32]. Indeed, reports states that the largest recent industrial disasters of Chernobyl, three miles Island and Bophal occurred at night [33].

- **Mechanisms**

The mechanism that caused injuries was either a direct or an indirect shock. Direct shocks were the main causes of FDFs occurring in 3 out of 4 road accidents (76%). Collisions between vehicles and motorcycles were the main cause of in our study (28%) and that of Madougou and al in Benin in 2015 [29]. The sudden increase of the number of imported vehicles and motorcycles in the city of Douala might have contributed to the increase of road accidents and their physical consequences. Therefore, motorbike-taxi activity that flourishes in the cities of Cameroon has become one of the leading causes of RA, as more of the users prefer the motorbike-taxis despite the hazards associated to this mean of transportation, the lack of experience and training of the bikers and the non-respect of road safety rules. Concerning the indirect shocks, the majority of FDFs were caused by the falls from height (66%), unlike the results of Anyaehie and al. in Nigeria in 2015 (11.2%) [6]. This major difference is due to the fact that Anyaehie and al. considered the fall from standing as aetiology of FDFs. Falls from standing were the
second aetiology of FDFs after traumas. Our result (18%) is similar to the result of Anyaehie and al. in Nigeria (18.7%) [6], but lower than the result of Weiss and al. in Sweden (50%) [17]. Falls from standing are dangerous in extreme ages and specifically in seniors above 65 years old. Their frequency varies with age: from 01 fall per year for 1/3 of seniors above 65 years old, to more than 50% of falls in the elderly of 85 years [34]. Cases of falls from standing occurring to elders are more frequent in Europe where the life expectancy is higher than in Africa. So cases of falls from standing are very high in Sweden, as the overall life expectancy is higher than 80 years [17].

1.1. Anatomical and clinical characteristics

- **Dyaphyseal side**

Cases of bilateral FDFs are scarce in our sequence (3.38%). Similar results were found in European studies. In 2006, Bonnomet and al found 2.10% cases in France [15], while Salminen and al obtained 4% of FDF cases in Finland in 2005 [28]. The low representation of bilateral FDF in our study confirms the exceptional strength of the femoral bone when faced with external trauma. The occurrence of bilateral lesion requires a set of high intensity forces, which was exceptional in our series since 3/4 of the FDFs occurred in the urban perimeter of Douala city following collisions between vehicles and motorcycles. The side of the diaphysis is randomly exposed to trauma depending on several factors linked to the individual himself, the source of the trauma and the accident immediate environment. Left side diaphysis was the main affected side in our study (53%) and that of Barra de Moraes and al. in Brazil in 2009 (50.5%) [21].

- **Site of injury**

According to the study of Meyreuis on bone biomechanics applied to the fractures treatment, the most targeted area of the femoral diaphysis is located 10 cm above the small trochanter, which corresponds to the medium third [35]. This was the case in our study (64%) and that of Salminen and al. in Finland in 2005 (79%) [28].

- **The line of fracture**

The feature of fracture was cross-sectional in most of the cases in this study study and that of Salminen and al. in Finland [28]. For young people, trauma induced by direct shock could be the cause of cross-sectional FDFs according to Bonnomet and al [15].

- **Classification of fractures**

According to AO classification of FDFs, type 32 A simple fractures predominates in our study (64%) and that of Salminen and al. (48%) [28]. According to the principles of biomechanics, the number of fractures lines is determined by the energy that is absorbed by the bone during the trauma; thus, the more energy is absorbed, greater will be the number of fractures lines [4]. Due to its exceptional resistance against external traumas, the traumatized femur will often suffer more simple fractures than complex ones.

- **Comorbidities**

FDFs are usually closed, but in some cases they may be associated with musculoskeletal, bones or other lesions. It was the case for the majority of FDFs of the study (53%), and that of Myssayev and al. in Kazakhstan (50.2%) [13]. FDFs can also occur in a context of multiple traumas [2,13,15]. Combined fractures are more frequent than isolated ones; specifically, the ipsilateral leg-fracture was the most frequently associated lesion with FDFs (26.23%). In France, the floating-knee was the most frequent lesion associated to FDFs according to Bonnomet and al. (10-20%) [15]. Opened fractures are uncommon in the study (9%) and those of Moraes and co. in Brazil in 2009 [21], Bonnomet and al. in France in 2006 [15] and Weiss and al. in Sweden in 2009 [17].

We think that the structure of the thigh could be an advantage and constitutes a physical barrier that could prevent the occurrence of skin injuries in case of bones traumas. Therefore, the femur seems less exposed than the other bones of the legs because it is surrounded by many layers of muscles that prevent any skin injury during external traumas.
CONCLUSION

Our results revealed that FDFs occur to young men aged between 21 and 30 years old, who are usually injured during road accidents. Direct shock is the main causal mechanism of these injuries. Almost all the FDFs were closed and the majority were associated to other injuries, especially the ipsilateral leg-fracture. In the majority of cases, the fracture line was cross-sectional, located in the medium third of the leg. Type 32A fracture was the most common fracture according to AO classification. This study highlights the place of road accidents among the causes of morbidity of young Cameroonians and their consequences to the victims. On behalf of these results, our recommendation to the public authorities is to implement a strong regulation for the motorbike-taxi activity, sensitization and safety-training of the road users.

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Table I: Sociodemographic characteristics.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Number (n)</th>
<th>Percentage (%)</th>
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<tbody>
<tr>
<td>Gender</td>
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<tr>
<td>Men</td>
<td>118</td>
<td>69</td>
</tr>
<tr>
<td>Women</td>
<td>53</td>
<td>31</td>
</tr>
<tr>
<td>Age</td>
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<tr>
<td>≤ 10 years</td>
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<td>11 – 20 years</td>
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<td>6.43</td>
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<td>21 – 30 years</td>
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<td>31 – 40 years</td>
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<td>41 – 50 years</td>
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<td>61 – 70 years</td>
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</tr>
<tr>
<td>≥ 71 years</td>
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<td>4.68</td>
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<td>Marital status</td>
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<tr>
<td>Single</td>
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<td>53</td>
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<tr>
<td>Married</td>
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<tr>
<td>Occupation</td>
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<tr>
<td>Pupils &amp; Students</td>
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<td>28.07</td>
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<tr>
<td>Worker</td>
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<td>19.29</td>
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<tr>
<td>Unemployed</td>
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<tr>
<td>Traders</td>
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<tr>
<td>Motobike riders</td>
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<td>8.2</td>
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<tr>
<td>Staff</td>
<td>23</td>
<td>13.45</td>
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<tr>
<td>Others</td>
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<td>4.67</td>
</tr>
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</table>

Table II: Fractures classification

<table>
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<tr>
<th>FDFs classification</th>
<th>Quantity (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
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<tr>
<td>According to Gustilo-Anderson (n=17)</td>
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<td></td>
</tr>
<tr>
<td>I</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>II</td>
<td>12</td>
<td>71</td>
</tr>
<tr>
<td>IIA</td>
<td>3</td>
<td>17</td>
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<tr>
<td>According to AO (N=171)</td>
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</tr>
<tr>
<td>32 A</td>
<td>109</td>
<td>63.7</td>
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<tr>
<td>32 B</td>
<td>27</td>
<td>15.8</td>
</tr>
<tr>
<td>32 C</td>
<td>35</td>
<td>20.4</td>
</tr>
</tbody>
</table>

Figure 1: patient distribution by type of accident.

VI – REFERENCES


Dr. Owona Manga Léon Jules Etal / Clinical And Epidemiological Features of Diaphyseal Femoral Fractures In Douala


