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Diaphyseal Femoral Fracture Fixation: Outcome of 108 Consecutive Fixations in a Tertiary Hospital

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Abstract **Original Research Article**

Background: femoral shaft fractures are common orthopaedic problems and usually result from high energy impact with increased risk of associated injuries. Though global trend is moving towards early and effective fixation of fractures using options that cause minimal disruption of the soft tissue envelope around the fracture site, the practice in countries with weak health systems may vary from standard as predicted by available resources and skill. ***Aim:*** we present the outcome of surgical fixation of 108 femoral shaft fractures within a three year period. ***Method:*** Patients who meet inclusion criteria were recruited into the study after consent was obtained. Data was analyzed using SPSS 17 for windows and results were presented in frequency tables. Graphs and charts. ***Result:*** Femoral shaft fractures represents 3.8% of the total number of patients with orthopaedic conditions within study centre at the period of the study. The mean age was 31.2± 14.7 years with a M:F ratio of 2.1:1. There were more closed fractures (97; 89.2%) than open fractures (11, 10.8%) with transverse fractures being the most common fracture pattern (50.5%, n=46/108). Most fractures were treated by open reduction and locked intramedullary nailing (78/108, 72.5%) with bone union rates of 75% and 96% at 12weeks and 18 weeks post intervention respectively. There was no statistically significant difference in the union rate between the interlocking group and the plating group at both 12 weeks and 18 weeks post intervention (p=0.24). Bone infection, non-union and mal-union rates were 1.8% (n=2/108). ***Conclusion:*** femoral diaphyseal fractures can be effectively fixed with open locked IM nailing with optimal options are not available.

Keywords: Fractures Of The Femoral Shaft, Open Nailing, Fracture Fixation Outcome.

INTRODUCTION

Femoral fractures are common orthopaedic problems globally. They occur when a force greater than the intrinsic strength of the femur is applied to it [1]. Due to its anatomic location, close to the axial skeleton and its articulation at two mobile joints proximally and distally, it plays a major role in the locomotive functions of the limbs [2].

Diaphyseal fractures are commoner in children and young adults accounting for 35% of all fractures [3] and 57.4% of femoral fractures in children [4]. Dencker [5] defined femoral shaft (diaphyseal) fractures as those fractures occurring in the part of the femur between 5 centimetre distal to the lesser trochanter and 6 centimetre proximal to the most distal point of the medial femoral condyle.

The high energy involved in these fractures also cause multi-systemic injuries, that dictates the treatment modality, influences the treatment outcome and make patient's management more difficult [6-8]. Other predictive factors for choice of treatment and outcome of care include, the site and type of fracture, age of the patient, pre-fracture bone state, affordability of care and the level of surgical skills and resources available [6, 7].

Though global trend is gradually moving towards early and effective fixation of fractures using options that cause minimal disruption of the soft tissue envelope around the fracture site [9-11] the practice in countries with weak health systems, where most citizens are still made to make out-of-pocket payment for health care, is still over- burdened by unaffordable care and frequent recourse to use of available conservative or more invasive operative modalities of treatment [12].

The prolonged period of Immobilization arising from late presentation, long pre-operative waiting period as well as more conservative treatment options will significantly affect the treatment outcome, increase the patient's morbidity and deplete hospital resources as well as increase the burden of care on an already over-burdened health system.

Closed reduction and locked intramedullary nailing has become the treatment modality of choice for all closed and some open femoral diaphyseal fractures. It provides stable fixation with minimal soft tissue disruption, through impingement of the nail in the bone, permitting early weight bearing, joint movement and minimal post-operative care [11, 13].

When this treatment modality is not available or contraindicated, other options like plate osteosynthesis and external fixation can be used. This paper reviewed the treatment out of 108 consecutive femoral diaphyseal fractures in adults.

AIM

To evaluate the outcome of fixation of fractures involving the femoral shaft

Study design

This study was a prospective study of patients with femoral shaft fractures who presented to theorthopaedic department of the University of Port Harcourt Teaching Hospital (UPTH) from 1st of June 2018 to the 31st of May 2021 (Three year period).

Sampling

All patients who presented at the Accident and Emergency unit and Orthopaedic Out-patient clinic of UPTH with femoral shaft fractures within the study period were consecutively sampled and recruited into the study.

EXCLUSION CRITERIA

The following patients were excluded from the study.

a. Patients who did not give consent.
b. Patients who opted out of the study even after giving consent.
c. Patients who are unable to do simple radiological investigations like plain radiographs of the affected limb.
d. Patients presenting with fracture complications involving the femoral shaft i.e. where primary treatment was received outside the study centre.
e. Patients with pathologic femoral shaft fractures.

METHODOLOGY

Patients who met the inclusion criteria, at presentation were recruited into the study. Detailed clinical evaluation was carried out focusing on patient's bio-data, time interval between onset of symptoms and presentation at UPTH, possible aetiology, severity of trauma involved, presence or absence of open wound and initial treatment at trauma scene. Other aspects of clinical history obtained include; patients' previous medical condition, nutritional history, history of long term medications, occupational history and other relevant aspects of history. Initial primary survey and adequate resuscitation followed by a detailed secondary survey was carried out.

Patients were further evaluated with relevant radiographs. A radiograph of the affected limb which adequately reveals the fracture site, as well as, adjoining joints was carried out. This aided clinical diagnosis of femoral shaft fracture, described the fracture pattern, and revealed injuries to contiguous portions of the femur. Radiographs of the contra-lateral limb and other areas of suspected injuries were also obtained.

Treatment was based on standard clinical criteria and includes the following modalities:

1. closed reduction and locked intramedullary nailing
2. open reduction and locked intramedullary nailing
3. open reduction and internal fixation with limited contact plate and screws
4. External fixation.

All surgeries were performed by the primary investigator and other orthopaedic surgeons in the study facility. Post- operatively the patients were given intravenous fluids, analgesics, and intravenous antibiotics (third-generation cephalosporin and metronidazole) for five days. Physiotherapy was commenced early guided by the fracture pattern and the peculiarities of treatment.

Initial follow-up visits were done 2weeks and 6weeks post intervention. Subsequently, patients were seen 12weeks, 18weeks, and 24 weeks post intervention.

Treatment outcome was monitored clinically and with serial radiographs of the limb which was done on the first post-operative day, six weeks later, twelve weeks later and 18 weeks later. Radiographs were also done at other times as required.

A fracture was considered to have united if no tenderness was elicited on palpation or attempted motion at the fracture site, attainment of full painless weight-bearing status as well as radiologic evidence of union across the fracture site.

Outcomes measured include

1. Length of hospital stay
2. Duration of time from commencement of treatment to radiologic evidence of fracture union
3. Functional range of motion in the ipsilateral hip and knee at the point of radiologic union
4. Wound healing

5. Return to work and school
6. Weight bearing status at 12 weeks post-intervention.

DATA ANALYSIS

Frequencies and cross tabulations were used to create two- way and multi-way tables. Charts and graphs were used to display appropriate variables. Certain results were also expressed in mean, median (inter-quantile range), proportion and standard deviation. Where appropriate, P values were determined using standard chi- square test. A p-value of less than or equal to 0.05 was considered statistically significant. Statistical methods were carried out using the statistical package for social sciences (SPSS) 17 for windows.

Translation of protocols/ confidentiality

The procedure was translated to the language the patient's/ parents/guardian understood, to enable him/her get the full knowledge of the study. The hospital number of the patient was used, instead of the name, for data collection.

Consent and right to withdraw from the study

Each patient gave written informed consent and was clearly informed on their right to withdraw from the study at any time, without any penalty.

RESULTS

A total of two thousand eight hundred and eight (2808) patients with musculo-skeletal conditions were seen at the accident and emergency department and orthopaedic outpatient clinicof the hospital within the study period. One hundred and ninety-three patients (193) had fractures and fracture complications involving the femur. One hundred and two (102) patients had one hundred and eight (108) fresh femoral shaft fractures and constituted the study population. This represents 3.8% of the total number of patients with musculo-skeletal conditions seen at the study centre within the study period.

Gender and age distribution of patients

Sixty-three (69; 67.6 percent) were male while twenty-eight (33; 32.3percent) were female patients giving a male to female ratio of 2.1: 1. Patients' ages ranged from 18years to 80 years. Mean age was 31.2± 14.7years.

Table-1: Age distribution

Age groups(years)	Frequency	Percentage (%)
>18-30	32	31.4%
31-40	37	36.3%
41-50	20	19.6%
51-60	8	7.8%
61-70	2	1.9%
71-80	2	1.9%
81-90	1	1%
TOTAL	102	100%

Mechanism of injury

The most common injury mechanism was road traffic accidents (64; 70.3%) either as motor vehicular accidents or motor cycle accidents. Gunshot injury and assaults also made significant contributions.

Table-2: Distribution of injury mechanisms

Mechanisms of injury	Frequency	Percentage %
Assaults	11	10.8%
Falls	7	6.8%
Gunshot	11	10.8%
Road traffic accidents	69	67.6%
Others	4	3.9%
Total	102	100

Patient's status at trauma site

Thirty-three (33; 47.8%) of the patient's involved in RTA were passengers, 25; 36.2% were pedestrians while 11; 15.9% were drivers.

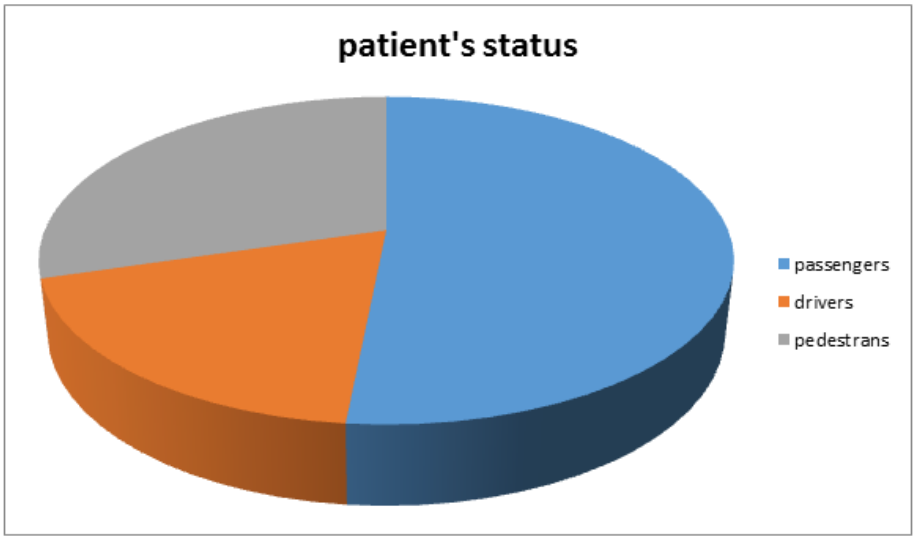

Fig-1: Patients' status at trauma site

Laterality of injury

Thirty-seven (47; 43.5%) of the patients had left femoral shaft fractures, 55; 50.9% had right femoral shaft fractures while 6; 5.5% had bilateral femoral shaft fractures.

Associated soft injuries

Non osseous injuries found in this study include urethral injuries, splenic injuries, ophthalmic injuries, traumatic brain injuries and others as shown in Table 3.

Table-3: Distribution of associated soft tissue injuries.

Injuries	Frequency	Percentage
Traumatic brain injuries	3	10.7%
Maxillo-facial soft tissue injuries	3	10.7%
Ophthalmic	2	7.1%
Splenic injuries	1	3.6%
Urethral injuries	2	7.1%
Abrasions and contusion	18	64.3%
Total	28	100

Associated fractures

Associated bone injuries are as shown in Figure-2

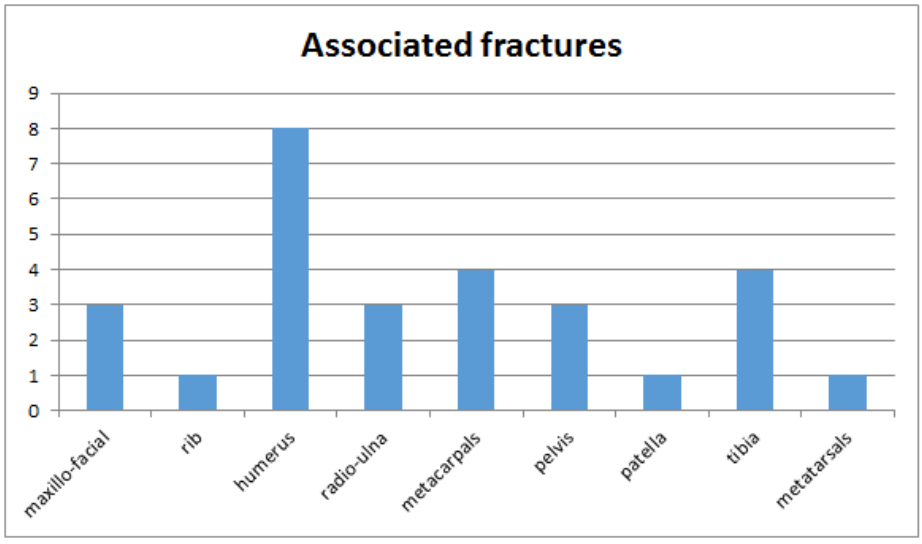

Fig-2: Associated fractures

Fracture type

Most femoral shaft fractures found in this study were closed fractures (97; 89.2%). There were however 11 (10.8%) open fractures giving an open: closed fractures ratio of 1: 8.2). Type IIIb fractures were the most common type of open fractures seen accounting for six; 54.5% of all open fractures. Others were IIIc fractures (2; 18.1%) and IIIa fractures (3; 27.3%).

Radiographic pattern

On radiographic evaluation, the commonest fracture pattern was transverse fracture (46; 50.5%).

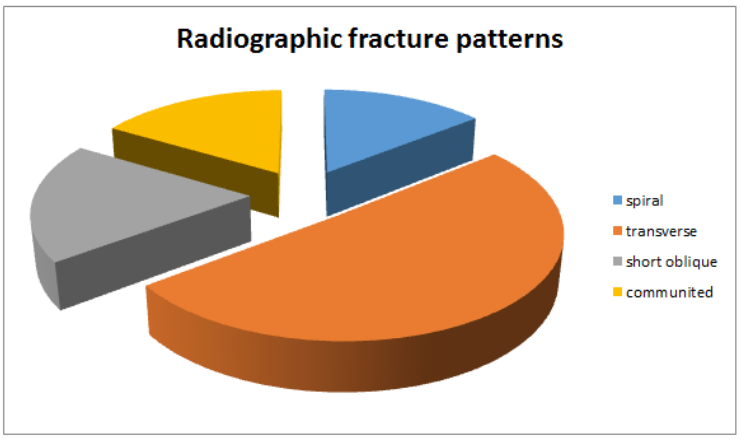

Fig-3: Radiographic fracture patterns

Methods of treatment

Open reduction and internal fixation (ORIF) with locked intra-medullary nailing was the most common method of operative fixation (72; 39.0%). six patients had closed reduction and locked IM. Above knee amputation was done for one of the patients with open Type IIIc fracture for failed vascular repair.

Table-4: Treatment methods

Treatment	Frequency	Percentage
Orif with interlocking nail	78	72.2%
Crif with locked im nail	6	5.5%
Orif with plate and screws	15	13.9%
External fixation	7	6.5%
Above knee amputation	2	1.9%
Total	108	100

Outcome measures

Hospital stay

The hospital stay profile is as shown in the figure below.

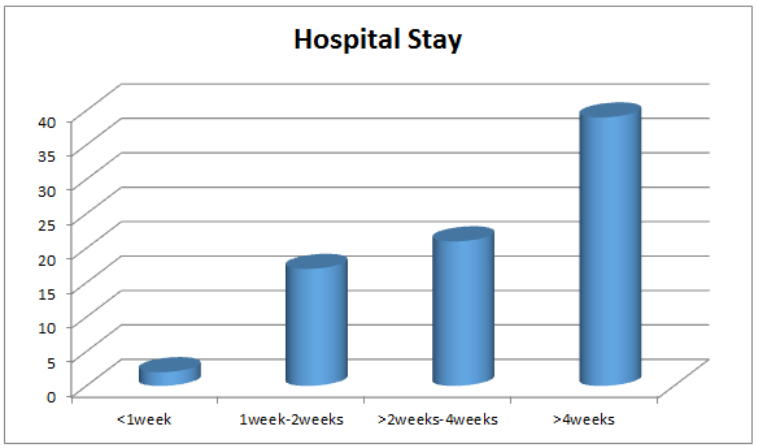

Fig-4: Duration of hospital stay

Wound healing

The duration of time it took for the surgical/traumatic wounds for the closed and open fractures to heal is as outlined in Table 5. The duration is assessed by the time from incision to removal of all skin sutures without any evidence of infection (for closed fractures) or from trauma to removal of sutures without any evidence of infection (for open fracture with delayed primary closure) or complete epitheliazation /graft take (for other traumatic wounds)

Table-5: Wound healing

Duration	Frequency	
	Closed fractures	Open fractures
≤2weeks	77	0
>2weeeks -4weeks	19	6
>4weeks	1	5
Total	97	11

Clinical and radiographic evidence on bone union

The duration for bone union to occur from clinical evaluation and periodic evaluation of radiographs for patients treated with various methods are as outlined in Table 6. Union was considered to have occurred in the absence of tenderness on palpation or attempted motion at the fracture site, attainment of full painless weight-bearing status as well as radiologic evidence of union across the fracture site.

Table-6: Duration for union with radiographic evidence

	Orif with interlocking nail	Crif with locked intrmedullary nail	Orif with plate and screws	External fixation	Total
≤6 weeks	0	0	0	0	0
6weeks to 12weeks	62(79.5%)	5(83.3%)	8(53.3%)	0	75(70.8)
12weeks to 18weeks	12(15.4%)	1(16.7%)	5(33.3%)	2(28.6%)	21(19.8)
>18weeks	4(5.1%)	0(0%)	2(13.3%)	5(71.4%)	11(10.4%)
Total	78	6	15	7	106

COMPLICATIONS

There were a total of four (4) wound infections. Three of the infected cases were from open fractures while the other was from a closed fracture treated with locked intramedullary nail. Infection was established by clinical evidence of pain and purulent suppuration in the wound as well as microbiologic evidence. Bony complications observed include non-union (n=2) and bone infection (n=2).

Table-7: Distribution of early and late complications

Complications		Frequency	Percentage
Wound infection			
	Closed fractures	1	0.9%
	Open fractures	2	1.8%
Malunion			
	External fixation	2	0.9%
Non union			
	Septic	1	0.9%
	Aseptic	1	0.9%
Bone infection			
	Closed fracture	1	0.9%
	Open fracture	1	0.9%
Crutch palsy		1	0.9
Limb length discripancy		1	0.9%
Mortality		1	0.9
Total		12	11.1%

Active range of motion in the hip and knee at fracture union

Table 8 shows the active ranges of motion (ROM) in the ipsi-lateral hip and knee at fracture union.

Table-8: Range of motion in ipsilateral hip and knee.

	Rom (degrees)	Frequency	Perecntage
HIP	FLEXION		
	120-140	98	90.7%
	90-120	10	9.2%
	<90	0	0%
	EXTENSION		
	10-0	108	100%
	<0	0	0%
KNEE	FLEXION		
	110-90	102	94.4%
	<90	6	5.5%
	EXTENSION		
	0	108	100%
	>0	0	0%
TOTAL		108	100%

Weight bearing status at twelfth post-operative week

By the end of the twelfth post-operative week, 83 patients (76.8%) were bearing full weight on the affected limb. This number increased to 103 (95.3%) by the end of the eighteenth post-operative week.

Return to work or school

68 patients (63%) returned to school/work 12 weeks from the onset of treatment while 30 (27.8%) did so within 12 to 18 weeks. The other patients returned to work after 18 weeks.

DISCUSSION

Femoral shaft fractures contribute significantly (n=108, 3.8%) to the burden of musculo-skeletal injuries at the study centre. Males were more commonly affected (m: f = 2.3:1) with the 31-40 years age group was the most involved similar to findings by Douglas *et al.* [14] *and* Mbamali [15].

Road traffic accidents (RTA) n=69, 67.3% and falls made significant contributions to fracture mechanisms. Jensen *et al.* [16] in Denmark (68%), Dencker [5] in Sweden (70%) and Mbamali [15] in Zaria (92%) have all shown similar pattern. Wong [17] however showed an increasing contribution of falls in a mixed Asian population in Singapore.

Open reduction and internal fixation using locked intramedullary nails was the most common treatment offered in this study (78; 72.2%). Closed reduction and locked nailing started in this center few moths to the conclusion of the study accounting for its low utilization (n=6, 5.5%) as a treatment modality. The recent acquisition of a functional intra-operative fracture table and image intensifier made open reduction the treatment of choice as at the time of the study. The S.I.G.N (Surgical Implant Generation Network Inc.) interlocking nails were the most commonly used nail in this study. Panti *et al.* [18] in a similar study in the Philippines showed good outcome in the treatment of 48 patients with isolated femoral shaft fractures using the S.I.G.N (Surgical Implant Generation Network Inc.) interlocking nails.

Measured parameters in their study include clinical and radiographic union, knee range of motion, weight bearing status and complications. The studybtPanti *et al.* also showed no significant difference between patients treated with the SIGN interlocked nails and those with similar fractures treated with cannulated interlocked intramedullary nails in terms of the above- stated outcome measures. Gosselin *et al.* [19] in Cambodia have also shown better clinical outcome in patients with femoral shaft fractures treated with interlocked SIGN nails with more cost effectiveness compared to matched cohort treated with Perkin's traction.

Ikem *et al.* [20] had also earlier reported such treatment modality of 85% of forty (40) shaft fractures using the SIGN nail without image intensifier. They concluded that with the aid of external jigs and slot finders, interlocking nailing can be achieved without image intensifier.

Open reduction and internal fixation using plate and screws was used in the treatment of only 13.9% of femoral fractures most of which were spiral in configuration and close to the lower end of the diaphysis.

All open fractures in this study were either treated by external fixation (type IIIA and IIIB fractures) or above –knee amputation (type IIIC fractures). The severity of vascular and soft tissue injuries, late presentation (>24hours) and failure of initial vascular repairs necessitated the choice of amputation for these injuries. This contrasts findings by Rosental *et al.* [21] on twenty-one (21) patients with vascular injuries associated with femoral fractures. They reported successful vascular repair in seventeen (81.0%) of the patients with 19% amputation rate.

Outcome measures used in this study include; duration of hospital stay, soft tissue healing, radiographic union, range of motion in the knee and hip joints, weight bearing status at twelfth week visit, interval from onset of treatment to return to work or school and post-operative complications.

Sixty-nine patients stayed in the hospital for more than 4weeks. This long period of hospitalization mainly due to long pre –operative waiting periods.

Bone union rate at 12 weeks post intervention was 75%. This increased to 96% at the 18 weeks post intervention. There was no statistically significant difference in the union rate between the interlocking group and the plating group at both 12 weeks and 18 weeks post intervention (p=0.24). Deepak *et al.* [22] in India reported similar union rate (96.6%) at 16.5weeks for thirty diaphyseal femoral fractures treated with closed intramedullary interlocked nails.

Generally, wound infection rate from this study was 2.7%. (n=3/108) Both Deepak *et al.* [22] in India and Bohler [23] reported higher rates of 16.7% and 9% respectively among patients with mostly closed fractures treated with intramedullary nailing. Mbamali [15] in Zaria, Katchy [24] in Enugu and Salawu [25] in Zariahad also reported higher overall wound infection rate: 13% in 74 femoral fractures treated by open intramedullary nailing or plating, 5.2% and 6.5% respectively.

Bone infection rate was 1.8% comparable with results from other workers [22, 24]. The predominant infective organism in all infected cases was *stappyloccocus aureus.* Obunge and Ekere [26] had similar finding in their series.

Non-union and mal-union rates from this study were 1.8% (n=2) and 1.8% (n=2) respectively.Ruedi *et al.* [27] and Magerl *et al.* [28] had higher non-union rates (5% each) for femoral shaft fractures treated by plate osteosynthesis although there were more patients in both series compared to this study.

Although most patients had good range of active motion in the ipsi-lateral hip and knee, 5.5% (n=4) of patients could not achieve up to 90^0 ofipsi-lateral knee flexion. These patients had communited fractures and were initially treated with skeletal traction for up to 6 weeks. It is therefore difficult to determine the roles played by the severity of the primary injury, prolonged period of immobilization and inadequate physical therapy in the resulting knee stiffness. Bezabeh *et al.* [29] in Addis Ababa, Ethiopia showed higher knee stiffness rates (10.3%, n=7/69) in their series on the use of Perkin's traction for the treatment of adult femoral shaft fractures.

The burden of femoral fractures clearly expresses the need for adequate preventive measures as the first step to femoral shaft fracture management. It also shows the need for care centres in this sub-region to adopt proven, efficient and cost effective methods of treatment of femoral shaft fractures based on clinical evidence. This study could contribute to such discussions and potentially stimulate further related research for appropriate clinical decision –making and good health policy formulation.

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