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Research Article

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Peculiarities of Locked Intramedullary Nailing in A Deprived Setting

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Abstract

Introduction: *Diaphyseal fractures of the femur and tibia are common worldwide with an increased incidence in low- and middle-income countries and are an immense economic burden on the populace. Locked intramedullary nailing is not readily available. We explore the challenges of starting this kind of procedure in a developing country setting.*

Methods: *We study the first 45 consecutive cases of locked intramedullary nailing of the femur and tibia in the Cape Coast Teaching Hospital of the Central Region of Ghana from the period of 2016 to 2019.*

Results: *There were 29 Males and 16 Females with a mean age of 39.8 years and with 76% being in the informal sector of the economy. Road traffic accidents were the commonest cause of injury accounting for 68.9% of fractures. There were 24 femur and 21 Tibia fractures with 51%, 16% and 33% being type A, B and C fractures respectively. Most patients presented within 24 hours of injury and the average waiting time before surgery was 6.1 days. All cases were done via ante grade nailing with an average operating time of 199 minutes for the femur and 147 minutes for the tibia. Average time on admission before discharge was 12.5 days.*

Conclusion: *It is possible to consistently perform locked IM nailing for femur and Tibia diaphyseal fractures even in deprived environments but the surgical teams will require adequate training in the use of specialized equipment and health systems must provide for funding for orthopaedic instrumentation and implants so that these procedures can be undertaken in a timely fashion avoiding complications.*

Keywords: Diaphyseal fracture, Femur, IM nailing, Tibia

Introduction

Musculoskeletal injuries constitute a significant part of any country's trauma burden. Timely and proper care of these conditions result in better outcomes for the individuals, reduced period of hospitalization and an earlier return to pre-injury levels of function [1, 2].

About 4.8 billion of the world's population have limited or no access to surgery [3]. Most of these people live in Low and Middle Income Countries (LMIC's) where over 90% of injuries leading to fatality occur. A rise in the frequency of Road Traffic Accidents (RTA's) has brought about a commensurate increase in fatalities and disability from musculoskeletal trauma [1, 4]. A combination of lack of access to surgical care, increasing injuries from RTA's, socio-cultural beliefs that enshrine and promote traditional bone setting practices can lead to devastating consequences requiring at best more complex surgical procedures or limb loss in the worst case scenario [5-7].

Among patients who consent to available orthodox care, displaced fractures of the femoral and tibia shafts are commonly seen either as isolated injuries or in combination with other injuries. There is overwhelming evidence that diaphyseal fractures of the femur and tibia are best treated by locked intramedullary nailing and this is currently the gold standard worldwide [2, 8]. Sadly, in LMICs only a small percentage of patients have access to locked IM nailing [9, 10]. Less than optimal methods of treatment like prolonged traction and treatment by traditionalists is still common-place [6, 11-13].

Locked IM nailing is more cost-effective and is becoming more popular with the introduction of the Surgical Implant Generation Network (SIGN) through which implants are made available for patients who cannot afford them [2, 14, 15]. We present our experience of locked intramedullary nailing of femur and tibia diaphyseal fractures in a sub region where the burden of trauma exceeds the human and material resources available for essential fracture care.

Methods

Study carried out in Cape Coast Teaching Hospital reviewing the first 45 consecutive cases of locked intramedullary nailing (IM) of femur and tibia shaft fractures. Humeral shaft fractures were not included in this study. All patients who had locked IM nailing since the procedure was started in our hospital were included in the study. Information obtained from patient records includes demographics details, time between injury and presentation, presentation with fracture complications, duration of surgery, specific Operating Room

(OR) challenges, nail size and duration of hospitalization. The ante grade method was used in all cases and we employed the use of the external jig for proximal locking and free-hand placement of locking screws under C-Arm Image intensifier guidance in all cases. We aim to identify common problems with beginning such a procedure in a country with limited resources.

Results

There were 45 fractures treated by locked intramedullary nailing with 29 (64%) Males and 16 (36%) Females. All patients who had locked intramedullary nailing of the femur and tibia were included in this study with an age range of 21-75 years. There were 24 (53%) femur fractures and 21 (47%) tibia fractures. The mean age of those with femoral fractures was 40.7 while those with tibia fractures had a mean age of 38.7 years. 28 (62%) were less than forty years while those who were forty years and above accounted for 17 (38%) cases. Overall, 11 (24%) were employed in the formal sector while 34 (76%) of the patients were involved in the informal sector of the economy (Table 1).

Table 1: Demographic characteristic of fracture cases

variable	levels	Type of fracture		Overall (N=45)	P-value
		Femur (N=24)	Tibia (N=21)		
Age (years)					
	Mean (sd)	40.7 (16.8)	38.7 (13.9)	39.8 (15.4)	
	Min - max	21-75	26-66	21-75	
	<40	14 (58.3)	14 (66.7)	28 (62.2)	0.396[a]
	≥40	10 (41.7)	7 (33.3)	17 (37.8)	
Sex					
	Female	9 (37.5)	7 (33.3)	16 (35.6)	0509[a]
	Male	15 (62.5)	14 (66.7)	29 (64.5)	
Occupation					
	Government worker	4 (16.7)	7 (33.3)	11 (24.4)	0.631[a]
	Trader	3 (12.5)	3 (14.3)	6 (13.3)	
	Artisan	4 (16.7)	3 (14.3)	7 (15.6)	
	Unemployed	2 (8.3).	3 (14.3)	5 (11.1)	
	Others*	8 (33.3)	3 (14.3)	11 (24.4)	
	Not statedz	3 (12.5)	2 (9.5)	5 (11.1)	

Figures were presented in number (percentage) or mean (standard deviation)

*Others include students (3), Pastor (1), security personnel (1), retired (2), filling station worker (1), hotel waiter (1), farmer (1) and housewife (1)

aChi-square (X2) test and bFisher exact test of association

The cause of injuries is shown in Figure 1 with Road Traffic Accidents (RTA's) accounting for the majority of injuries i.e. 31(68%) of fractures. Domestic injuries like falls accounted for 7(16%) of the fractures and all other causes (sports, assault, pathological fractures) made up the remaining 7(16%) cases (Figure 1).

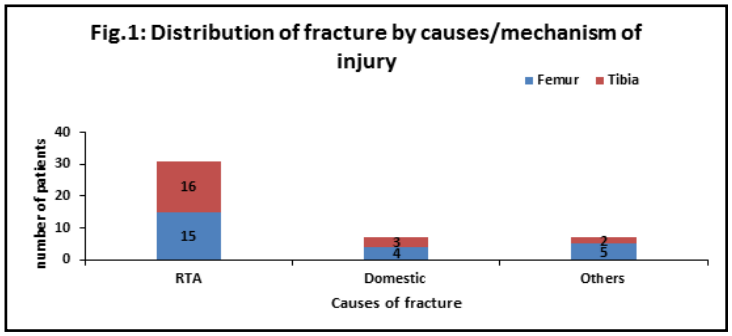

Figure 1: Distribution of fracture by causes/ mechanism of injury

The fracture patterns obtained from plain radiographs were classified using the AO/ASIF classification of diaphyseal fractures. Type A, B and C fractures accounted for 10(42%), 2(8%) and 12(50%) of femur fractures. For the tibia fractures, Type A fractures were13(62%), type B 5(24%) and Type C 3(14%) (Figure 2).

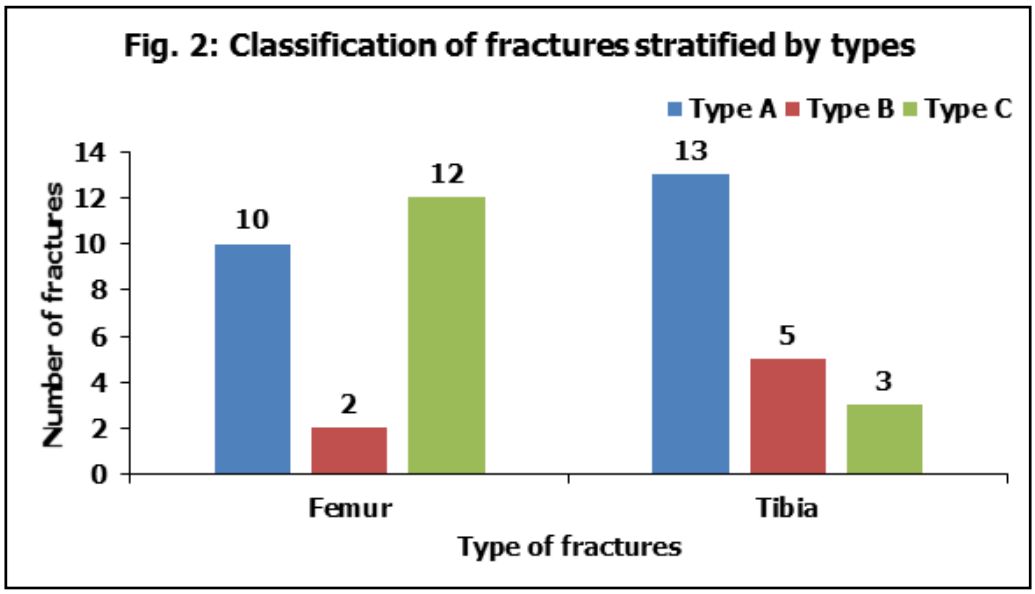

Figure 2: Classification of fracture stratified by types

The majority of patients presented as fresh fractures with 30 (67%) presenting within the first 24 hours after the injury, twelve patients (27%) presented as non-unions or mal-unions following treatment by traditional bonesetters, the longest period before presentation being 5 years (Figure 3).

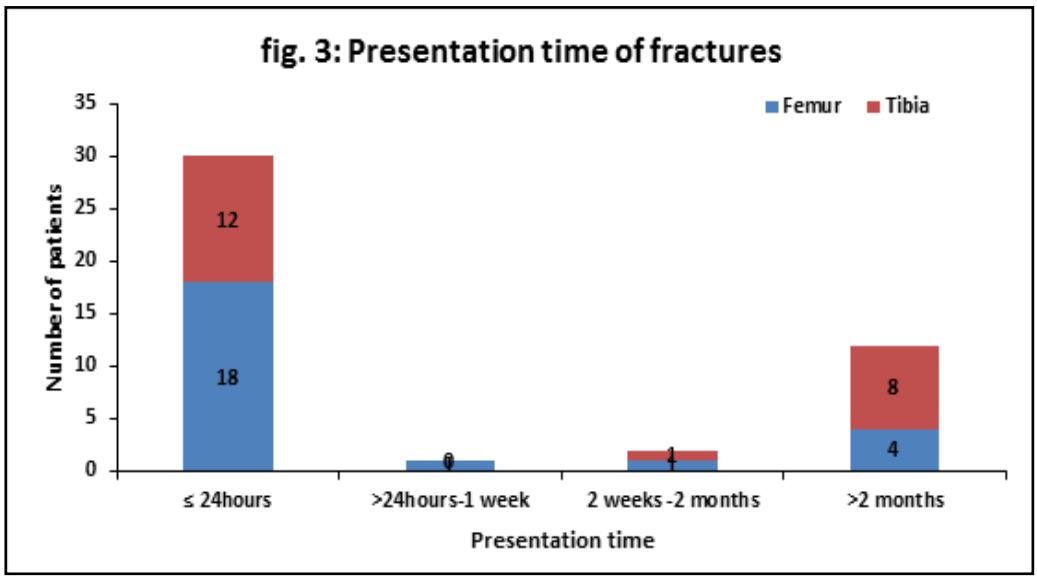

Figure 3: Presentation time of fractures

Average waiting time on admission before surgery was 9 days for femur fractures (range of 1 to 34 days) and 3.3 days for Tibia fractures (range of 0 to 8 days) with the longest waiting time being 34 days as a result of lack of funds. Closed nailing was achieved in 57% (n=12) of tibia fractures and 29% (n=7) of femoral fractures. The mean operating time for femur fractures was 199 minutes with 13(54%) cases done under three hours (range of 55 – 320 minutes). The average operating time for tibia fractures was 147 minutes with 76%(n=16) of cases done in less than three hours (range of 60 – 232 minutes). (Table 2) 9mm diameter nails were most commonly used, being employed for 16(67%) femoral fractures and 18(86%) tibia fractures (Table 2).

Table 2: Operative variables of fracture cases

Variable	levels	Type of fracture		Overall	P-value
Variable	level	Femur (N=24)	Tibia (N=21)	(N=45)	
Nailing type					
	Closed	7 (29.2)	12 (57.1)	19 (42.2)	0.124[a]
	Open	17 (70.8)	9 (42.9)	26 (57.8)	
Nail diameter					
	9 mm	16 (66.7)	18 (85.7)	34 (75.6)	0.33[b]
	10 mm	5 (20.8)	2 (9.5)	7 (15.6)	
	11 mm	3 (12.5)	1 (4.8)	4 (8.9)	
Awaiting surgery time (days)					
	Mean (sd)	8.6 (9.7)	3.3 (2.4)	6.1 (7.6)	
	Least-Most	1-34	0-8	0-34	
	Category				
	≤1 week	16 (66.7)	19 (90.5)	35 (77.8)	0.058[a]
	>1 week	8 (33.3)	2 (9.5)	10 (22.2)	
Operation time (mins)					
	Mean (sd)	199.6 (67.1)	146.8 (47.9)	175.0 (64.1)	
	Least-Most	55-320	60-232	55-320	
	Category				
	<90mins	1 (4.2)	1 (4.8)	2 (4.4)	0.038[b]
	90mins-2hrs	1 (4.2)	8 (38.1)	9 (20.0)	
	>2hrs-3hrs	11 (45.8)	7 (33.3)	18 (40.0)	
	>3hrs	11 (45.8)	5 (23.8)	16 (35.6)	
Post-operative stay (days)					
	Mean (sd)	14.1 (10.0)	10.7 (13.9)	12.5 (12.0)	
	Least-Most	6-38	2-66	2-66	
	Category				
	≤1 week	8 (33.3)	12 (57.1)	20 (44.4)	0.096[a]
	>1 week	16 (66.7)	9 (42.9)	25 (55.6)	

Figures were presented in number (percentage) or mean (standard deviation)

[a]Chi-square (X2) test and bFisher exact test of association

Average time spent on admission post-operatively was 14 days for femur fractures and 10.7 days for tibia fractures, the longest time spent being 38 days in a patient with a pathologic closed femur shaft fracture secondary to an Enneking stage III Osteosarcoma of the right femur (Table 2).

Discussion

The majority of the fractures we treated were as a result of Road Traffic Accidents(RTA), lending credence to the fact that injuries from RTA's in LMICs are on the rise as most other studies reveal that RTAs are the most common proximate cause of fractures of the shafts of the femur and tibia in developing countries [1,4]. The increased incidence among males is also supported in findings by other researchers in the sub region, with this being attributed to more "risk-taking" behaviour and a tendency for males to commute farther away from the homestead in search of a means of livelihood [16,17].

More than a quarter of the patients (27%) presented with non- or mal-unions as complications of treatment by traditional bonesetters who are sometimes preferred by the population for fracture care. Our observation is not out of the ordinary in this part of the

world where poverty, illiteracy, superstition and other socio-cultural factors conspire to prevent patients from seeking orthodox fracture care [6, 7].

Our patients spent an average of 18.6 days in hospital with an average post-operative stay of 12.5 days. This was necessitated by a need for in-patient physiotherapy as this service isn't uniformly available country-wide. The average total hospital stay is comparable to the 11.5 days reported by Kamau et al. but shorter than the 14 days recorded by Gosselin et al. in a Cambodian study [11, 18].

Traction as a form of treatment for femoral shaft fractures will require 6-12 weeks of in-patient care making Locked IM nailing more efficient and cost-effective with improved rehabilitation time and fewer complications [8, 11, 15, 18]. Type C femoral fractures accounted for half of the femoral fractures reflecting the high energy nature of these injuries. The relative predominance of multifragmentary patterns in our study emphasizes the need for locked IM nailing, as this uniformly has better outcomes than other methods like traction and plating [19]. Plating and Kuntscher nailing are relatively easier and faster techniques for osteosynthesis of shaft fractures of the femur and tibia but the clinical outcomes aren't as predictably reliable and complications like malunion, loss of fixation and implant failure occur more often than when locked IM nailing is employed [15, 18, 19].

Closed Locked IM nailing with freehand distal locking takes more OR time than other methods of fixation [20]. On the average, it took 199 minutes (range of 55-320minutes) to fix the femur and 147 minutes (range of 60-232 minutes) for tibia surgery. Sanders et al. reported an OR time of 151 minutes while Oluwadiya and his colleagues did all cases open with an average OR time of 148 minutes [21, 22]. The reasons for our extended OR times include OR personnel not being familiar with the procedure, lack of a dedicated peri-operative/scrub nurse team, old fractures requiring mobilization, excision of fibrous tissue before reduction and freehand distal locking.

Although there is little data describing the characteristics of the diameter of the femoral canal at the isthmus in our sub region, the nail size most frequently used after reaming (two reamer sizes above eventual nail size) was 9mm in three-quarters of the patients implying that our patients had narrower medullary canals than those routinely found in Caucasians [23].

Conclusion

There is no gainsaying the fact that locked IM nailing is by far the best method for fixing diaphyseal shaft fractures of the femur and tibia. The disparities in healthcare systems and accessibility to essential surgery between rich countries and LMICs implies that more has to be done to ensure that the execution of basic procedures like locked IM nailing should become standard for managing these injuries which are common and are on the rise due to a concomitant rise in road traffic accidents. Beginning these procedures in deprived environments is possible but apart from the availability of skill and equipment, the operating room personnel will require more training and specialization to ensure or times are reduced, early presentation and a reduction in waiting times may obviate the need to open the fracture site and violate the soft tissue covering around the fracture.

In planning procurement of implants, it is also vital to have smaller diameter nails as this would reduce waste and ensure more efficient use of scarce resources. Financial constraint was also a major factor that prevented patients from opting for surgical management whiles in the hospital. The National Health Insurance System (NHIS) in Ghana doesn't cover for Orthopaedic implants so patients would have to foot the bill of implants which would usually cause a delay in operative management. There is however a need to strengthen the NHIS to cover some implants especially when majority of the patients were young adults and would get back to work to contribute to the growth of the economy.

Our series showed the tremendous benefits of locked IM nailing with regards to short hospital stay post operatively, and early return to social and work life. This is supported by other research findings on the benefits of locked IM nailing.

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