



Research Article

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Treatment of fractures of the femoral shaft by locked intramedullary nailing in adults at the University Clinics of Bukavu

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Abstract

Introduction: The objective was to report the experience of the University Clinics of Bukavu on the treatment of fractures of the femoral shaft by locked intramedullary nailing in adults. **Patients and method:** This is a descriptive prospective study of a series of 31 cases collected in two centers: the University Clinics of Bukavu and the Skyborne Hospital from January 1, 2018 to December 31, 2019. The data collected includes epidemiological, clinical aspects and treatment of patients and had been analyzed by the software Epi Info version 7.2. **Results:** The mean age of our patients was 34.6 ± 13.2 years (range: 16-68 years) with a sex ratio of 1.2. Spinal anesthesia was used in 29 (93.55%) patients and 29 patients were installed in a supine position contralateral to the lesion. Open reduction predominated (83.87%). SIGN and TIBA type nails were used, and their dimensions varied depending on the size of the patient's femur. Static locking was performed in 29 (93.55%) patients. The mean operating time was 88.2 ± 18.2 minutes (range: 60-120 minutes). The mean length of hospital stay was 11.3 ± 3.16 days (range: 7-21 days). The average number of postoperative rehabilitation sessions was 26.8 ± 3.86 (range: 20-35 sessions). The mean follow-up was 14.87 ± 3.93 months (range: 9-20 months). The mean time to union was 3.33 ± 0.55 months (range: 3-5 months) and, 8 patients presented complications, i.e. 3 cases of hemorrhagic shock on admission, 3 cases of shortening of 1cm, one superficial infection and one case of delayed union and 30 (96.78%) patients were satisfied with their functional results. Socio-professional or school reintegration was observed in 28 (90.32%) patients. **Conclusion:** Locked intramedullary nailing has proven to be an effective osteosynthesis technique in the surgical treatment of fractures of the femoral shaft at the University Clinics of Bukavu and at Skyborne Hospital.

Keywords: Locked intramedullary nailing, Fracture, Femoral shaft.

INTRODUCTION

Intramedullary nailing is an internal osteosynthesis technique based on the use of nails in order to obtain a solid fixation of the fracture site [1]. It was introduced by Gerhardt Küntscher in 1940 before the German Congress of Surgery and was applied for the first time in France according to the principles recommended by the author, on 12/20/1944 at the Strasbourg trauma center [2]. A special tribute was paid in 1980 to Küntscher, during a session of the academy by Robert Merle d'Aubigné who declared: "if a single name were to be retained in the treatment of fractures, as benefactor of humanity, it would be that of the creator of this method, Gerhardt Küntscher" [3].

In 1978, Gross and Kempf refined it, improved by the principle of static and dynamic blocking [1]. Locked intramedullary nailing involves using the vacuum of the medullary canal to introduce a nail perforated at both ends to ensure the rigidity of the fractured bone until consolidation, and locking is provided by screws introduced transversely into the bone and nail holes to avoid telescoping and poor rotational stability [4].

Locked intramedullary nailing remains the method of choice when surgical treatment is indicated for a diaphyseal fracture of the lower limb. It is an osteosynthesis technique based on the use of a locked nail. It requires an orthopedic table and an image intensifier [5]. This expensive equipment is most often not available in developing countries. The Küntscher nail which is used in these countries has significant

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mechanical complications in terms of shortening and rotational defect [6]. Despite this progress, complications to this treatment are not exceptional. They depend on the one hand on the complexity of the fracture but on the other hand on the realization of the technique. This attractive technique was little used with us but in recent years, initially introduced because of difficulties in acquiring implants and the unavailability of the orthopedic table. Faced with this finding, we initiated this first-of-its-kind study at the university clinics of Bukavu with the aim of evaluating our results in order to show the place of locked intramedullary nailing (ECMV) in diaphyseal fractures of the femur.

METHODOLOGY

This is a bicentric prospective observational study on a series of 31 cases of locked intramedullary nailing collected at the University Clinics of Bukavu and at the Skyborne hospital over a period of 2 years, from

January 1, 2018 to December 31, 2019. We included in this study the patient aged 16 years and over, admitted for a fracture of the femoral shaft treated by intramedullary nailing, locked with a complete medical file. The data were collected on a pre-established survey form based on patient registers, medical records, and operative reports, and were entered into Microsoft office 2014 software and analyzed using Epi Info software version 7.2.

RESULTS

Epidemiological and clinical data

Male subjects were the most affected with 54.84% against 45.16% for the female sex with a sex ratio of 1.2. The age group between 11 and 20 years was the most concerned with 11 cases or 35.48%. The mean age of our patients was 34.6 ± 13.2 years with the extremes of 16 and 68 years. Officials were the most concerned with 10 cases or 32.25% (Table 1).

Table 1: Distribution of patients according to socio-demographic data, the etiological circumstances of the trauma, the site of the fracture line, the classification of the OA

Sex	Effective(n=31)	Percentage (%)
Male	17	54,84
Female	14	45,16
Age (an)	Effective(n=31)	Percentage (%)
10 - 20	4	12,90
21 - 30	11	35,48
31 - 40	8	25,80
41 - 50	5	16,12
51 - 60	1	3,22
61 - 70	2	6,45
Profession	Effective(n=31)	Percentage (%)
Officials	10	32,25
Driver / Biker	03	9,67
Trader	03	9,67
Student / pupil	06	19,35
Without	09	29,03
Total	31	100

Table 2: Distribution of patients according to the etiological circumstances of the trauma, the site of the fracture line, the classification of the OA

Etiology	Effective(n=31)	Percentage (%)
Domestic accident	03	9,68
Accident at work	05	16,13
Aggression	01	3,23
Public road accident	14	45,16
Fall from his height	07	22,58
Sports fall	01	3,23
The site of the fracture line	Effective(n=31)	Percentage (%)
Fracture of the junction of the proximal 1/3 and the middle 1/3	2	6,45
Fracture of the junction of the middle 1/3 and the distal 1/3	2	6,45
1/3 proximal	4	12,9
1/3 medium	17	54,84
1/3 distal	6	19,35
The classification of the OA	Effective(n=31)	Percentage (%)
A: Simple fracture		
A1: spiroid	2	6,45
A2: Slant more than 30 °	9	23,03
A3: Cross or oblique less than 30 °	7	22,58
B: Wedge fracture		
B1: With intact torsion wedge	8	25,81
B1: With intact bending wedge	3	9,68
B3: Fragmented corner	1	3,23
C: Complex fracture		
C1: Spiroid complex	1	3,23
C2: Intermediate segment complex	0	0,00
C3: Non spiroid complex	0	0,00

Road accidents were the main etiological circumstances of the trauma with 14 cases, ie 45.16%. The high-energy mechanism accounted for 27 cases, or 87.10%. The left side was the most affected with 17 cases, i.e. 54.84% than the right side with 14 cases. Closed fractures were more observed with 27 cases or 87.10%; and 80.65% had no associated lesions. Femoral shaft fractures were most often found in the middle third with 17 cases, ie 54.84%. Our series included 18 simple fractures, ie 2 of type A1, 9 of type A2 and 7 of type A3; 12 wedge fractures, 8 of type B1, 3 of type B2 and 1 of type B3; and a complex fracture or 1 of type C1 according to the classification of the osteosynthesis association (OA) (Table 2).

Therapeutic data

All of our patients were operated on by orthopedic surgeons, the posterolateral transvastid lateral approach was used in 26 patients and no patient was re-operated. The cast splint was the most used waiting treatment with 23 cases or 74.19%. The mean preoperative time was 1.51 ± 0.72 days with the extremes of 1 and 3 days. The preoperative time of 1 day predominated in 19 cases, ie 61.29%. Spinal anesthesia was used in 29 patients, ie 93.55%. The mean operating time was 88.2 ± 18.2 minutes with the extremes of 60 and 120 minutes. The operating time of 61 to 120 minutes was the most observed with 26 cases, ie 83.87%. The recumbency contralateral to the lesion on an ordinary table was the type of installation most used in patients with 29 cases, or 93.55%. Supine decubitus with the knee flexed 60° on a knee bar was the setup mode for retrograde nailing in 2 patients, or 6.45%. The open-focus reduction mode predominated with 26 cases, i.e. 83.87% against 5 reduced closed-focus fractures.

In our series we used SIGN type nails as well as TIBA nails. SIGN and TIBA nails were applied to two and twenty-nine patients, respectively, after gradually increasing mechanical reaming. The nail diameter was 2

mm smaller than that of the last reamer. The 380 mm long and 10 mm diameter nail was used in 11 patients, i.e. 35.48%, followed by the 380 mm long and 11 mm diameter nail in 8 patients, i.e. 25.81%. Static locking was performed in 29 patients, ie 93.55%. The nail was locked proximally with 2 screws in 29 patients and 1 screw in 2 patients while distally it was locked with 2 screws in 24 patients and 1 screw in 7 patients. The mean length of hospitalization was 11.3 ± 3.16 days with the extremes of 7 and 21 days. All the patients underwent functional rehabilitation postoperatively. Rehabilitation was started the day after surgery. It consisted in the first place of an isometric contraction of the quadriceps, verticalization, putting the patient in a seated position, passive mobilization of the hip and the knee, and ambulation with partial support. It was continued at the end of the second postoperative week by active and passive mobilization of the hip and knee flexion -extension, walking and crutching with partial support. Walking with full support was authorized 3 months postoperatively. The average number of rehabilitation sessions was 26.8 ± 3.86 sessions with the extremes of 20 and 35 sessions.

Evolution and complications

The mean time to union was 3.35 ± 0.55 months with extremes of 3 and 5 months.

Eight patients, or 25.81%, presented complications including 3 cases of hemorrhagic shock on admission, 3 cases of 1cm shortening, 1 case of superficial infection of the surgical site and 1 case of delayed union. In our series, 93.55% of patients had a normal walk. Nonetheless, we noticed that one of our patients had a limp and another had pain when walking. The mean follow-up is 14.87 ± 3.93 months with the extremes of 9 and 20 months. Thirty patients or 96.78% had a good and very good result after the treatment. Socio-professional or school reintegration was observed in 28 patients, i.e. 93.33%.

Table 3: Distribution of patients according to length of hospitalization, complications, time to union, socio-professional reintegration and level of satisfaction based on subjective functional score

Length of hospitalization	Effective (n=31)	Percentage (%)	Average
Less than 7 days	0	0,00	11.3 ± 3.16
7 to 14 days	29	93.54	
15 to 21 days	2	6.45	
Over 21 days	0	0,00	
Complications	Effective (n=31)	Percentage (%)	
Any	23	74.19	
Hemorrhagic shock	3	9.68	
Infection	1	3.23	
Shortening (1cm)	3	9.68	
Delay in consolidation	1	3.23	
Time to union	Effective (n=31)	Percentage (%)	Average
At 3 months	21	67.74	3.35 ± 0.55
At 4 months	9	29.03	
At 5 months	1	3.23	
Number of rehabilitation sessions	Effective(n=31)	Percentage (%)	Average
20 - 30	14	46.66	26.8 ± 3.86
26 - 30	15	53.34	
Over 30	1	3.33	
Socio-professional reintegration	Effective (n)	Percentage (%)	
No	1	3,33	
yes with change of position	1	3,33	

yes with retention of the same position	28	93,33	
Level of satisfaction	Effective(n=31)	Percentage (%)	
Bad	0	0.00	
Moderately good	1	3.23	
Good	13	41.94	
Very good	17	54.84	

DISCUSSION

Epidemiological data

In our series, the male sex was more represented with 17 cases, ie 54.84% and a sex ratio of 1.2; this agrees with the results of several series [3,7–11]. This male predominance, reported by several studies, is justified by the great exposure of men to jobs with more risk.

The mean age of our patients was 34.6 ± 13.2 years with the extremes of 16 and 68 years. The average age in our series remains lower compared to the series of Razzouki, Kempf, Borel [12] and higher than the other series [13–16]. We deduce that the fracture of the femoral shaft can occur at any age but is of more interest to the young active population and this is explained by the fact that the latter is much more exposed to this type of fracture given the frequency of accidents from the public highway.

Civil servants as well as students / pupils were the most represented in our series with respectively 32.25% and 19.35% of cases. Our results are comparable to those of Kone [17] who found civil servants as the most

Clinical data

In our series, road accidents were the most frequent aetiology with 14 cases, or 45.16%, followed by a fall with 7 cases, or 22.58%. This finding is consistent with those found in other series [10,11,18–20]. This observation could be explained on the one hand by the high number of young active adults in our study and on the other hand by excessive speed, non-compliance with the Highway Code and the very growing number of automobiles.

In our series, the high-energy mechanism predominates with 27 cases, ie 87.10% against 4 cases, or 12.9% for the low-energy mechanism. This high energy mechanism has been found in other series [9,21,22]. These results would be justified by the fact that high-energy fractures predominate in young adult males who moreover make up the majority of our patients and low-energy fractures are frequent in elderly women, postmenopausal and osteoporotic constituting the minority.

In our series, we found a slight predominance of involvement on the left side with 17 cases or 54.84%. These results are close to those found in the series of Traoré and Bensaidoune [4,23] and contrary to those reported in other series [11,24,25]. This could be explained by the fact that this distribution is often due to chance because both limbs are exposed to trauma to the same degree of risk.

In our series, we had 27 closed fractures and 4 open fractures including 2 of type I and two others of type II according to Cauchoix and Duparc. Our results are identical to those found in other series [4,10,26]. The rarity of the skin opening is explained by the importance of the musculature around the femur which undoubtedly contributes to reducing the risk of opening, in particular in the opening mechanism from outside to inside.

In our series, out of 31 patients 6 or 19.35% had lesions associated with their fractures of which 4 or 12.9% had a skin opening and a cranioencephalic trauma, and 2 others or 6.45% had respectively a trauma

cranioencephalic and thoracic injury. The lesions associated with diaphyseal fractures of the femur are found to vary from one series to another [11,26].

In our series, the fracture line was located at the level of the middle 1/3 of the femoral shaft in 17 cases, i.e. 54.84%, compared with 6 fractures whose line was located at the level of the distal 1/3, i.e. 19.35% and 4 fractures at the level of the proximal 1/3 or 12.9%. These results are identical to those found in other series [21,27–29]. This would be justified by the frequency of attack of the young subject during road traumas causing direct violent shocks.

Our series included 18 simple fractures, ie 2 of type A1, 9 of type A2 and 7 of type A3; 12 wedge fractures, 8 of type B1, 3 of type B2 and 1 of type B3; and a complex fracture or 1 of type C1 according to the classification of the OA. Testa (29) had 32 type A fractures, i.e. 43.9%, 24 type B fractures, or 32.9%, and 17 type C fractures, or 23.2%. Deqing Luo (30) reported in his series of 18 fractures that all fractures or 100% were of type C2. These results are close to those found in several studies [25,29,31,32] and differ from those of Deqing Luo.

Therapeutic and evolutionary data.

In our series, the waiting treatment involved immobilization with a plaster splint in 23 cases, ie 74.19%. This waiting treatment has been observed by other authors [4,21].

In our study, the mean preoperative time is 1.51 ± 0.72 days with the extremes of 1 and 3 days. Our results vary from those found in other series [11,10,15]; this can be explained by a lack of means to obtain osteosynthesis material, as is the case in all developing countries. Spinal anesthesia was used in 29 (93.55%) patients versus 2 patients undergoing general anesthesia. This is identical to the results of the other series [4,19,29]; this would be justified by the fact that 25 of our patients had an isolated fracture whereas general anesthesia is indicated in polytrauma patients and elderly patients. The mean operating time was 88.2 ± 18.2 minutes in our series with the extremes of 60 and 120 minutes. The average operating time of our series is greater than that of the series of Narjis, Blachut [33] and less than that of Kamareddy [34]. This variability of our results compared to other series can be explained by the surgeon's experience.

In our study, recumbency contralateral to the lesion on an ordinary table was the type of installation most used in patients with 29 cases or 93.55%.

Our results are identical to those reported by Abdoulaye and variables from the other series, Bensaidoune, Guifo, Razzouki. The use of this type of installation is linked to the opening of the hearth as a reduction mode for lack of image intensifier and the orthopedic table in developing countries.

In our series, the open-hearth reduction mode was used with 26 cases, ie 83.87%. These results join those of Guifo, Abdoulaye, Kone, are variable to those of the other series [9,23] and are opposed to those of Narjis [26]; this could be explained on the one hand by the fact that the opening of the fracture site allows a more anatomical reduction and on the other hand by the absence of materials for closed nailing. Closed

intramedullary nailing with image intensification is the currently preferred treatment for the reduction of femoral fractures [35].

The advantages of closed-hearth nailing are many demonstrated by Kempf [8]: respect for the quadriceps and fracture hematoma, respect for the periosteal vascularization which is essential after reaming which destroys the medullary vascularization, aesthetic interest, a short incision and decreased incidence of postoperative infections.

In our series, the 380 mm long and 10 mm diameter nail was placed in 11 patients, i.e. 35.48%, while the 380 mm long and 11 mm diameter nail was placed in 8 patients, i.e. 25.81 %. The dimensions of the intramedullary nail are variable to those found in other series [10,36]. This is explained by the fact that the choice of nail depends on the diameter of the medullary canal and the length of the femur but also the morphological variability of the femur depending on the ethnic group.

In our series, static locking was performed in 29 patients, ie 93.55%. The nail was locked proximally with 2 screws in 29 patients and 1 screw in 2 patients while distally it was locked with 2 screws in 24 patients and 1 screw in 7 patients.

This has been observed by several authors [15,26,37,38]. The management of these diaphyseal fractures by static locked intramedullary nailing remains the surgical technique par excellence which guarantees very good anti-rotational and length stability, respecting both the anatomical axes and the biomechanics of the bone segment [39].

In our series, the length of hospitalization varied between 7 and 21 days with a mean duration of 11.3 ± 3.16 days. These results are close to those found by Kone, Niyondiko and diverge from those of the other series [10,26,40]. This distribution could be explained by the fact that the length of hospitalization depends above all on the availability of osteosynthesis material, which poses a problem in many developing countries and the immediate postoperative consequences.

In our series, the average number of rehabilitation sessions was 26.8 ± 3.86 sessions with the extremes of 20 and 35 sessions. These results are similar to those of Alagnide [41] and Fisher. Nevertheless, joint, hip and knee mobility, muscle strength and functional capacity were sufficiently improved in the majority of patients.

Our series reveals that 21 patients, i.e. 67.74%, consolidated at 3 months with a mean time to union of 3.35 ± 0.55 months with extremes of 3 and 5 months. This delay is close to those found in the series of Narjis and Court-Brown [26,42] and less than those of Kone and Gaebler [17,43]. This could be explained by the fact that our study population is made up largely of young adults (average age of 34.5 years) and the interfragmentary compression exerted on the fracture site during support is a favorable factor for consolidation as specified by Muller [44].

In our series, on 31 patients; 8 or 25.81% presented complications including 3 cases of hemorrhagic shock, 3 cases of shortening of 1cm, 1 case of superficial infection and 1 case of delayed union. Complications vary depending on the series [17,19,21]; however, infection and delayed union have been observed by other authors [17,19]. Pahud [32] demonstrated that the risk of infection increases with the duration of the operation because the bacterial inoculum becomes more and more important in the wounds: The longer the operation, the greater the risk of infection. .

In our series, the mean follow-up is 14.87 ± 3.93 months with the extremes of 9 and 20 months. Our mean follow-up is less than that of Janzing [45] and greater than that of by Niyondiko and Razzouki. The decline in our series is similar to that of the literature, which predicts the average decline of 15.1 months with extremes of 6 to 35 months [12].

In our series, 30 patients or 96.78% had a good and very good result after the treatment. Our results are identical to those found in other series [12,17] with predominance of very good and good results and diverge from those of Tepka [46]. This deviation from Tepka can be explained by the difficulties in the management of fractures of the femur in certain developing countries due to the lack of suitable materials.

In our series, socio-professional or school reintegration was observed in 28 patients, i.e. 93.33%, one patient returned to work with a change of position because of advanced age and two others did not return to work because of poor functional results, one had a limp and the other had pain when walking. These results are close to those of Najris [26] and Nwagbara [37]; this could be explained by the fact that locked intramedullary nailing reduces the period of hospitalization, promotes early mobilization and rapid resumption of activities.

CONCLUSION

The management of these diaphyseal fractures by static locked intramedullary nailing remains the surgical technique which guarantees very good anti-rotational and length stability, respecting both the anatomical axes and the biomechanics of the bone segment. This technique describes an effective osteosynthesis technique in the surgical treatment of fractures of the femoral shaft at the university clinics of Bukavu and at CH Skyborne.

Authors' Contributions

This work was carried out in collaboration between all authors.

Conflict of Interest

The authors declare no conflict of interest.

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