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Research Article

Emergency Treatment of Open Leg Fractures with an Interlocking Nail at the Departmental Teaching Hospital of Ouémé-Plateau (R. Bénin)

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Summary

Introduction

The tibial diaphysis is the most prevalent site of open fractures. The parts care is well codified. Controversies exist regarding these fractures stabilization in emergency. The purpose of this work was to assess the results of the treatment of open leg fractures treatment with emergency interlocking intramedullary nails.

Patients and Methods

This was a retrospective study of patients operated on between June 2013 and December 2017, at the departmental teaching hospital of Ouémé Plateau, for open leg fractures. A total of 37 patients were included in this study. At the time of the initial trauma, the mean age was 37.6 years (with extremes of 24 and 70 years). There were 26 men for 11 women. The therapeutic results were assessed according to Karlström and Olerud criteria.

Results

Thirty-three (33) patients consolidated within an average of 4.2 months (2.2 and 8.3 months). Three patients had pseudoarthrosis. We had three surgical site infections (SSIs) successfully treated with antibiotic therapy. The functional assessment was done according to Karlström and Olerud criteria. There were 20 cases of excellent results, 6 cases of good results, 3 cases of acceptable results and 4 cases of poor results.

Conclusions

In open tibia fractures of grade I, II and some type III fractures, locked intramedullary nailing can be performed with minimal complications and excellent functional results.

Key Words: Open Fractures; Legs; Emergencies; Locked Nail

Introduction

Tibial diaphysis is the most prevalent site of open fractures [1-6]. Open tibia fractures treatment remains controversial and is a real challenge for the orthopaedic surgeon [7]. Soft tissue care is almost similar [8,9]. There is a considerable difference in fracture stabilization methods [10-16]. To reduce the risk of complications such as pseudoarthrosis and infection, the current strategy basic concepts for caring these fractures are as follows [17,18,19]: immediate intravenous antibiotics, urgent and repeated surgical debridement, immediate rigid skeletal stabilization, early and appropriate coverage, early subsequent bone grafting under stable soft tissue coverage.

In addition, for stabilization, several types of materials were reported: an external fixator or a nail (locked or not with or without bore) [20,21], an Ender nail or a screwed plate [20,22,23,24].

The purpose of this work was to assess the results of open leg fractures treatment with emergency locked intramedullary nails.

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Material and Methods

Patients

This was a retrospective study of patients operated on between June 2013 and December 2017 for open leg fractures. These patients were operated on in the general surgery service of the Ouémé-plateau departmental hospital.

Tibial diaphysis is the portion of the tibia between the proximal and distal epiphyses, which are delimited by the HIEM square law. The fracture was open when there was communication between the fracture site and the external environment. Fractures were classified according to AO/OTA [25] classification and the opening according to GUSTILO and ANDERSON [26] classification. The inclusion criterion referred to the existence of an open diaphysis fracture of both bones or isolated from the tibia treated with a locked intramedullary nail. Closed fractures, open epiphyso-metaphyso-diaphyseal fractures and open diaphyseal fractures treated with another implant were excluded from this study. Out of a total of 44 patients, 7 were excluded. At the time of the initial trauma, the mean age was 37.6 years (with extremes of 24 and 70 years). There were 26 men for 11 women. Table I specifies the patients characteristics.

Therapeutic Protocol

The care average time was 8 hours (with extremes of 4 hours and 14 hours). Thirty-one patients (31 cases) were operated on under local anaesthesia and six (6 cases) under general anaesthesia. The patients were placed in decubitus, a support at the level of the popliteal fossa allowed a flexion up to 120°. The wound was then washed, brushed and degummed and carefully trimmed after systematic wound enlargement, particularly in open Type I and sometimes Type II fractures. It was then washed with hydrogen peroxide and rinsed with saline. Osteosynthesis was then performed by intramedullary nail with or without bore. Under suction drainage, the fractured foci cover were made by tension-free skin suture or by flap. The locking was static or dynamic depending on the case. (9 and 10mm nails were preferred to avoid the bore, locking is done by 4.9mm screws). Functional rehabilitation was systematic and partial support was allowed in the dynamic assemblies as soon as the pain facilitated it. The flap sampling sites are secondarily, when necessary, grafted with thin skin.

Evaluation Methods

Patients were reviewed for a surgical site morbidity study, an assessment of knee and ankle joint mobility. Consolidation is considered to be achieved when three or four bone bridges between the fractured ends exist on both orthogonal incidences, front and side, within 5 months. From the 6th month the pseudoarthrosis diagnosis was mentioned. Therapeutic results were assessed according to Karlström and Olerud criteria [27] (Table I) which takes into account pain, professional activity, sport, existence or not of malunion and joint mobility.

Table I: Criteria for evaluating KARLSTROM and OLERUD functional results

Excellent result
no subjective complaints in the lower limb normal walk resumption of the same professional activity and resumption of sport no malunion and no loss of joint mobility
Good result
little pain no change of job but decrease in sport activity malunion with angulation or rotation < 10°, shortening < 1 cm and decreased mobility < 20° (hip and knee)
Acceptable result
function loss due to pain decrease in the walking perimeter change of work to a lower activity malunion with angulation or rotation > 10° and < 20°, shortening > 1 cm and < 3 cm and loss of mobility > 20° and < 40° (hip and knee)
Poor result
considerable loss of function due to pain canes for walking instability in standing position malunion > 20°, shortening > 3 cm and loss of mobility of more than 40° at the hip

Tableau II: Patients data

Patient	Sex	Care time limit	Age (year)	Causes	Type AO/ OTA	Site	type according to G and A	Nail size	Boring Linguee Dictionary	Locking type	Complications	Consolidation time	Recoil (month)	Karlström et Olerud
1	M	14	48	RA	B1	1/3 medium	II	9	No	s	No	2.2	13	Excellent
2	M	10	25	RA	A3	1/3 medium	I	9	No	s	No	2.9	20	Excellent
3	M	8	50	RA	A3	1/3medium-1/3proximal	II	9	No	S	No	3	14	Excellent
4	M	11	42	RA	B2	1/3medium-1/3distal	IIIA	9	Yes	S	SSI	5.1	16	Excellent
5	M	4	34	RA	C1	1/3medium-1/3proximal	I	11	No	DD	No	3	20	Excellent
6	F	9	70	DA	A1	1/3medium-1/3proximal	II	10	No	DD	Pseudoarthrosis	Lost	Lost	Lost
7	M	6	46	RA	A3	1/3medium	II	9	No	s	No	4	20	Good
8	F	5	45	RA	A3	1/3medium	I	10	No	DP	No	4.1	15	
9	M	12	48	RA	A3	1/3medium	I	11	No	DD	No	3.4	16	Excellent
10	M	8	25	RA	C2	1/3proximal	I	9	No	s	No	3.1	21	Excellent
11	F	6	25	RA	B3	1/3 distal	IIIA	10	No	DD	Malunion in valgus	5	24	Poor
12	M	4	40	RA	B2	1/3 distal	II	9	Yes	s	No	3.7	15	Excellent
13	M	12	45	RA	A1	1/3 distal	II	9	No	s	No	3.1	16	Excellent
14	F	9	42	RA	A3	1/3medium	I	10	No	S	Lost	Lost	Lost	Lost
15	F	9	55	Brawl	A3	1/3medium	I	9	No	s	No	4.2	18	Good
16	M		30	RA	A3	1/3medium	II	9	No	s	No	5.2	18	Excellent
17	M	8	40	RA	A2	1/3proximal	I	10	No	DD	No	3.4	16	Excellent
18	M	12	40	RA	A3	1/3medium	II	10	No	DP	Pseudoarthrosis	8.3	21	Poor
19	M	8	24	RA	A3	1/3 distal	I	9	No	S	Malunion in valgus	3	22	Poor
20	F	7	25	RA	A3	1/3medium	I	9	No	S	SSI	2.6	19	Good
21	F	12	24	RA	A3	1/3 distal	I	9	No	S	No	3.3	16	Excellent
22	M	9	35	RA	B2	1/3proximal	I	9	No	S	Lost	Lost	Lost	Lost
23	M	10	30	RA	A1	1/3medium-1/3proximal	II		No	S	No	4.6	14	Excellent
24	M	8	41	RA	C2	1/3medium	I	9	No	S	No	4	18	Excellent
25	M	9	35	RA	B2	1/3 distal	I	10	No	DD	No	3.3	19	Excellent
26	M	9	28	RA	A3	1/3medium	IIIB	9	No	S	SSI	5.8	18	Acceptable
27	F	9	32	RA	A3	1/3medium	I	9	No	S	No	3.9	17	Excellent
28	M	6	33	SA	A3	1/3medium	I	11	No	DD	No	3.5	13	Good
29	M	8	24	RA	A1	1/3medium-1/3proximal	IIIA	9	No	S	Pseudoarthrosis	No	17	Poor
30	F	9	35	RA	A3	1/3medium-1/3distal	IIIA	9	No	S	No	5.6	15	Excellent
31	M	10	34	RA	A3	1/3 distal	I	10	No	DD	No	3.8	17	Excellent
32	M	5	32	RA	C2	1/3medium	IIIA	10	No	DD	No	5.4	18	Acceptable
33	M	6	38	RA	A3	1/3medium-1/3distal	I	9	No	S	No	3.5	19	Good
34	M	7	35	DA	C1	1/3medium-1/3proximal	II	11	No	DD	No	4.7	18	Acceptable
35	F	6	45	RA	A3	1/3medium	II	10	No	S	No	3.6	20	Good
36	F	6	42	RA	A3	1/3medium	II	10	No	S	No	3.1	21	Excellent
37	M	8	51	RA	B2	1/3medium	I	10	No	DP	No	3.3	20	Excellent

Three patients were lost to follow-up and one (01) patient still has not consolidated at the last recoil. Thirty-three (33) patients were consolidated in a 4.2-month period (2.2 and 8.3 months).

These were 22 type A fractures, 6 type B fractures and 5 type C fractures. According to the Gustilo and Anderson Classification, there were 17 Type I fractures, 11 Type II fractures and 5 Type III fractures.

Table I shows the distribution of complications observed. Three patients had pseudoarthrosis; these were 2 cases of open type II fractures (1 A1 and 1 A3 fracture) and 1 case of type IIIA fractures (A1 fracture). Their treatment consisted in removing the nail, boring more or less cortico-muscular decortication and placing a nail of larger diameter.

We had three surgical site infections (SSIs) successfully treated with antibiotic therapy. These were two open type IIIA fractures and one type IIIB fracture. According to the AO/OTA classification, there were 2 type A3 fractures and 1 type B2 fracture.

There were three cases of shortening greater than 1 cm. There was also a case of valgus >10° - varus > 5°.

The functional assessment was done according to Karlström and Olerud criteria; there were 20 cases of excellent results, 6 cases of good results, 3 cases of acceptable results and 4 cases of poor results.

Discussion

Tibial fractures are among the most common fractures. Intramedullary nailing has gained popularity because of the development of locked nails with improved ancillary equipment [28].

Patients characteristics in this series are classic. The majority of patients were young, male, and road accidents were the main causes [2-5]. Also the fracture was mainly transverse and short oblique and sat at 1/3 medium [2,3,4,6].

In our series, 18 cases/37 were operated on between 0 and 8 am. Atul reports 10 cases out of 28.

Two of our patients have been lost to care. We carried out a static assembly in 35 cases or 94.6%. Dynamic modification was performed in 11 cases where there was no evidence of consolidation between 6 and 10 weeks. Whittle [29] and al. insisted that, in a no-bore nailing, dynamic modification should only be performed if there is a minimum of malunion at the fracture site at 12-16 weeks follow-up. For Bone [30] and Ruiz [31], pro-action is probably the most common technique used to treat a consolidation delay.

The average consolidation time is 4.2 months in our series. Yokoyama [32] and al reported an average time of 15 months in more than 50% of type III fractures, whereas this average delay in their series was 6.6 months, comparable to that of our series and the series of Atul1 A and al (5 months).

We have identified 3 surgical site infections (1 type I fracture, 1 type IIIA and 1 type IIIB). These were a superficial infection (type I fracture) and two deep infections.

Gustilo and Anderson [26] reported an incidence of 2 to 16% of infections, of which majority were type III lesions. ***Atul*** [1] and ***Joshi*** [33] reported an infection rate of 10% and 10.7% respectively. ***Shashi*** [34] reported an infection rate of 7.5%. Sargeant [35] and al. report that cortical necrosis is less likely to occur when nailing without a bore than when nailing with a bore. Open fractures boring would spread contamination of open wounds along the medullar canal and devitalize small bone fragments by freeing them from soft tissue attachments. But ***Lee*** [36] did not report any complications in his series

Atul [1] used in 37% of cases a 8 mm in diameter nail and this would be related to a narrow medullar canal in Indian population. ***Gustilo*** [37] and ***Muller*** [38] recommend small nails use without bores for reducing infection risk. In our series, we used a 9mm nail in 20 cases (54%). We generally use the first size of nail that passed through the medullar canal. Sometimes we had to bore because of the medullar canal narrowness (2 cases).

Nail's mechanical strength being proportional to its diameter, small diameter nails are relatively small, especially in bending. Nails at the locking holes are also more prone to rupture, as stresses are concentrated at the junctions of the holes and screws and at the level of unused holes. The minimal endorsed contact of unbored nails also concentrates stress at the holes and screws, which could be responsible for nail or screw rupture [35]. ***Hahn*** [39] advocated a cautious approach for such fractures by locking all holes to reduce stress concentration on the distal part of the assembly.

Tension-free closure was achieved in 31 cases (83.8%). These were type I and II fractures. In 3 cases (8.1%), a fasciocutaneous flap covered the fracture site, in 2 cases a discharge incision and 1 case of a soleus muscle flap was made. ***Atul*** [1] reports that a tension-free closure in first intention in 60% of cases and in 40% of cases the closure is obtained by lateral skin release, skin graft or flap. ***Yokoyama*** [32] and al reported 70.2% of cases.

We observed 3 cases (8.1%) of pseudoarthrosis. ***Atul*** [1] reported 3.3% and ***Joshi*** and al. reported 10.7% of cases and ***Shashi*** [34] reported 7.5%. ***Aso*** [40] reported 23.1% (65 cases).

To date, we have no equipment failures. Atul and al. have not reported any equipment failures. It should be noted that in their series, all locking holes were used.

The care average time is 8.1 hours (4-14 hours).

Assessed for 33 patients, the average consolidation time is 4.22 months (3.42 months for Type I fractures, 3.83 for Type II fractures and 5.4 for Type III fractures). ***Atul*** [1] and ***Yokoyama*** [32] report average consolidation times of 5 months (16 weeks for Type I, 18.3 weeks for Type II and 23.6 weeks for Type III) and 6.6 months respectively. For more than 50% of type III fractures in Yokohama's series, the average consolidation time is 15 months. ***Yih-Shiunn*** [41] reports a delay of 18+/-3.3 weeks for patients treated with locked nails in her series and her results suggest that open fractures consolidation time is shorter in locked intramedullary nailing than in external fixation. The same applies to the infection risk. This was supported by other studies results [1,30,31,31,36,42].

The average recoil is 17.7 months (13-24 months). ***Lee*** [36] reports an average follow-up time of 13.6 months (6-18 months).

Our functional results evaluated for 34 patients, according to Karlström and Olerud criteria, are excellent in 20 cases (58.8%), good in 7 cases (20.6%), acceptable in 3 cases (8.8%) and poor in 4 cases (11.8%).

Our work has limitations related to the size of the study population and the absence of emergency bacteriological sampling.

Conclusion

In conclusion, these results show that in grade I and II open tibia fractures, locked intramedullary nailing can be performed with minimal complications and excellent functional results. For grade III open tibia fractures, modern management techniques (including locked nailing), combined with the skills of experienced orthopedic surgeons and plastic surgeons, consistently restore excellent limb function in a very large number of patients.

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