



Short Communication

Etiologies and Management of Femoral Shaft Non-Union in Togo

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Abstract

A non-union is a fracture that will not consolidate without any further intervention. The aim of our study was to identify the etiologies of non-union of femoral shaft in Togo, to describe their management and to analyse results. Methods : this was a retrospective study that took place from January 1, 2015 to December 31, 2019. It concerned the medical records of patients treated for non-union of the femoral shaft in three hospitals in Togo. Results : Fifty-two medical records were retained. The mean age of the patients was 41 years old and the sex-ratio was 2.46 in favor of men. Fractures were caused by road accident in 49 cases (94,23%). Non-union occurred after closed fracture in 45 cases (86,5%), and after open fracture in 7 cases (13,5%). There was aseptic non-union in 46 cases (88,5%) and septic non-union in 6 cases (11,5%). The initial treatment was surgical (39 cases, 75%), traditional (12 cases, 23%), and orthopedic (1 case, 2%). The causes of failure of the initial treatment identified were dominated by instability of the fracture site and significant periosteal removal during the first surgery. The surgical management of non-union was performed in 50 cases. In two cases, the transfemoral amputation was done. Osteoperiosteal decortication was performed with or without autologous graft in 31 cases (62%). The intramedullary nail was used (38 cases, 76%). The consolidation rate was 96%. According to the criteria of the « Association for Study and Application of the Method of Ilizarov », the functional results were excellent in 23 cases (44,2%), good in 19 cases (36,6%), fair in 6 cases (11,5%) and poor in 4 cases (7,7%). Conclusion : Femoral shaft non-union affected young patients. It is most often favored by high energy trauma, by traditional treatment and by imperfect osteosynthesis. The functional results of the surgical management are satisfactory.

Keywords: Femur; Non-union; Osteoperiosteal decortication; Togo

Introduction

A uniform definition of non-union does not exist [1]. Some authors define it as a fracture that has not healed beyond six months of treatment or repeated surgery [2,3]. Others define non-union as a cessation of the healing process, usually six to nine months after the trauma, in the absence of consolidation [4]. For

the European Society of Tissue Regeneration in Orthopaedics and Traumatology (ESTROT), A non-union is a fracture that will not consolidate without any further intervention [5]. The frequency of non-union accounts for 1 to 12% of complicated long bone fractures [6]. The frequency of non-union of the femoral shaft is estimated to be between 5 and 10% of all fractures of this bone [7]. It is one of the most dreaded complications and often involves young socially active subjects. There are several risk factors. Among the general factors we have tobacco, alcohol and diabetes.

Local factors include the energy of the trauma, vascular damage around the fracture site and infection. In sub-Saharan Africa, other risk factors justify the occurrence of these non-union, including poor operative indications and poor management of patients by traditional medicine [8]. There are several surgical techniques that aim on the one hand to stabilize the fracture site, and on the other hand to promote bone consolidation. The aim of this study was to identify the etiologies of femoral shaft non-union in Togo, to describe the different techniques of management of these lesions and to expose the results of the treatment.

Material and Method

Patients with femoral shaft non-union were managed in three different hospitals, including one Teaching Hospital, between January 2015 and December 2019, a five-year period. Their records were analyzed retrospectively. We included patients aged 15 years and older whose records were well documented with good follow-up. Unusable records, non-union on pathological fractures, and lost to follow-up were excluded. The parameters studied were age, sex, contributing history, etiology of the initial fracture, treatment and potential factors that led to the non-union, the method for managing the non-union, and the results of this treatment. A standard anteroposterior and profile radiograph of the thigh was performed in all patients to confirm the non-union. We used the radiological classification that distinguishes hypertrophic, eutrophic, and atrophic non-union [6]. For hypertrophic and eutrophic non-union, the surgical technique consisted of a direct approach to the site of non-union, followed by osteomuscular decortication according to Judet [9]. Then the medullary canal was re-permeabilized, followed by curettage and re-cutting of the bone margins. Osteosynthesis associated or not with a cortico-cancellous graft had been performed. In atrophic pseudarthrosis, grafting was systematically performed. Septic pseudarthroses were treated sequentially using the induced membrane technique [10]. The results were evaluated after a mean follow-up of 29 months [12-56 months] by ASAMI (Association for Study and Application of Method of Ilizarov) anatomic and functional criteria [11]. Statistical analysis was performed using EPI Info7.1.0.6 software.

Results

The Series: During the study period, 52 operated patients had a usable file. The series was composed of 37 men and 15

women, i.e. 71.15% and 28.85% respectively. The sex ratio M/F was 2.46. The average age of the patients was 41 years. Alcohol was the most common risk factor. The initial fracture was caused by a traffic accident in 49 cases. The femoral shaft fracture was isolated in 46 cases (88.46%), and associated with a neck fracture in two cases (3.85%). In four cases (7.7%), the line extended into the subtrochanteric region. For the initial treatment, 12 patients (23%) had been treated traditionally and only one case had received orthopedic treatment. The other patients were treated surgically. The characteristics of the series are shown in Table 1.

Clinical Aspects: The non-union was hypertrophic in 19 cases, eutrophic in 25 cases and atrophic in eight cases. It was septic in 6 cases. (Table 1). The centromedullary nail, whether locked or not, was found in 26 cases (50%), followed by the screwed plate in nine cases (17.2%). The causes of failure of the initial treatment are listed in Table 2. They were dominated by instability of the fracture site and significant de-periostealization during the first surgery.

Treatment and Outcome : The average time for management of non-union was 7 months [4, 19 months]. Fifty patients underwent a cure of the non-union; trans-femoral amputations were performed because of the extent of the infection and sepsis in two patients with septic non-union. For the other cases of septic non-union, staphylococcus aureus was isolated in three cases, and pseudomonas aeroginesa in one case. These germs were multi-resistant. The carcinological excision of the mortified and infected tissues around the site of non-union, combined with two-stage surgical treatment according to Masquelet, followed by appropriate antibiotic therapy, led to the healing of the infection in three cases. For cases of aseptic pseudarthrosis, the 11- and 12-mm diameter centromedullary nail was used in most cases (38 cases; 76%). Osteoperiosteal decortication with or without grafting was performed in 31 cases (Table 3). Consolidation was achieved in 48 patients (96%). The average time to consolidation was 7 months [5-13 months]. Four patients were reoperated a second time for failure to consolidate. Of these, two patients, including a septic pseudarthrosis, did not achieve consolidation. Limb shortening was greater than 2.5 cm in 31 cases. Intraoperative knee arthrolysis combined with intensive postoperative rehabilitation resulted in satisfactory functional results. The results of the treatment are shown in Table 4.

Characteristics of the series	Number of patients (%)
Age	
Average age	41 ans [23-70]
Sex	
Male	37 (71,15%)
Female	15 (28,85%)
Circumstances of occurrence	
Road accident	49 (92,23)
Accident at work	2 (3,85)
Fall from a high place	1 (1,92)
Initial skin opening	
Yes	7 (13,46%)
No	45 (86,54%)
Initial treatment	
Surgical	39 (75%)
Traditional	12 (23%)
Orthopedic	1 (2%)
Type de non-union	
Hypertrophic	19 (36,54%)
Eutrophic	25 (48,08%)
Atrophic	8 (15,38%)
Presence of osteosynthesis material	39 (75%)
Lack of osteosynthesis material	13 (25%)
infection of non-union	
Septic	6 (11,54%)
Aseptic	46 (88,46%)

Table 1: Characteristics of the series.

Causes	Number (%)
High energy of the trauma	50 (96,15%)
Instability of the site	24 (46,15%)
Rigid mounting	7 (13,46%)
Important deperiostealization	24 (46,15%)
Complex fracture	7 (13,46%)
Infection	6 (11,54%)
Alcohol	10 (19,23%)
Tobacco	2 (3,85%)

Table 2: Factors identified that led to non-union.

Implant used	Associated procedure	Hypertrophic nonunion	Eutrophic nonunion	Atrophic nonunion	Subtotal
Locked nail	Decortication + Graft	6	3	5	14
	Decortication	6	5		11
	Graft	3	4	2	9
	Masquelet			1	1
Unlocked nail	Decortication + Graft			1	1
	Decortication	1			1
	Graft			1	1
Gamma nail	Decortication + Graft		2		2
	Graft			1	1
Screwed plate	Decortication	1			1
	Graft		2	2	4
	Masquelet			2	2
Dynamic hip screw	Decortication	1			1
External fixator	Graft			1	1
TOTAL					50

Table 3 : Operating techniques.

	Bone results (Number,%)	Functional results (Number, %)
Excellent	18 (36%)	23 (44,23%)
Good	25 (50%)	19 (36,54%)
Fair	1 (2%)	6 (11,54%)
Poor	6 (12%)	4 (7,69%)
Total	50 (100%)	52 (100%)

Table 4: Bone and functional results.

Discussion

We conducted a retrospective study in three centers with multiple operators in order to analyze the different procedures for the management of femoral shaft non-union and to improve our practices if necessary. In Africa, femoral shaft non-union mostly affects young males. The mean age in our series was 41 years, and males accounted for 71.15% of cases. This is similar to the results of Touré et al. (44.3 years), and Seriba et al. (38.4 years) [12,13]. Indeed, femur fractures occur most often in young male subjects, following public road accidents [14]. It is these fractures poorly or untreated that evolve into non-union, hence in our series the etiology of the initial trauma was largely represented by public road accidents. The major causes of non-union that were identified were the high energy of the trauma that led to the fracture of the femur in almost all cases, associated with perifracture vascular damage, but also the traditional treatment, and errors in the practice of surgical technique. Non-union was secondary to traditional treatment in 84.5% of cases for Touré in Mali, and in 40% of cases for Mensah in Benin [12,15]. This type of treatment uses methods that are unsuitable for fractures. It consists of massage sessions, splinting with bamboo rods and application of some unidentified products. It involves microtrauma to the vessels [15]. The practice of this treatment in Africa is related to ancestral beliefs, but especially to financial difficulties. In the patients initially operated on, the technical defects were extensive de-periostealization, the use of implants offering an unstable or too rigid mounting. These factors were most often associated and related to the experience of the operators. According to Panagiotis, non-union may result from a mechanical or biological problem of the fracture site; poor vascularity and instability of the fracture site being the most important factors. Inadequate vascular supply may be caused by the high energy of the trauma or by surgery [16].

Therapeutically, osteomuscular decortication was performed in 60% of cases. In the other cases, the significant displacement of the fragments, whose reduction imposed dislocating gestures, explained the fact that the periosteum could not be preserved to achieve the correct decortication as described by Judet [9]. Grafting was done in 66% of cases, among which were all atrophic non-union. For Panagiosis, the technique used in the treatment of long bone non-union depends not only on the type of non-union, but also on the alignment of the fragments; therefore, the treatment of non-union is aimed at promoting mechanical and/or biological aspects at the site of non-union. The treatment of atrophic non-union requires, after resection of the fibrosis and non-viable bone ends, stabilization of the site and filling of the defect with an autologous bone graft. This graft also provides mesenchymal cells, as well as growth and differentiation factors necessary to enhance bone formation [16]. For many authors, decortication brings cortical bone chips into the non-union site that act as pedicle grafts, thus playing the role of an autograft [8, 9]. As for hypertrophic or vital non-union, the instability of the site accounts for their occurrence, and thus the treatment requires an improvement in the means of stabilization [16]. The locked nail has been the most widely used for stabilization of non-union site. This is because of its availability

and biomechanical advantage. For several authors, nailing appears to be the gold standard method for the treatment of aseptic femoral non-union [17,18]. Indeed, the reaming of the femoral canal and its local biological effect, as well as the mechanical advantages of placing a larger and stronger centromedullary nail, have been proven [19]. As for septic non-union, apart from the 2 cases of amputations due to sepsis on admission, sequential treatment allowed us to achieve healing of the infection and consolidation in 3 cases. Our bone and functional results are satisfactory and are comparable to the results of Touré et al. in Mali, and Sériba et al. in Morocco [12,13]. The poor functional results are due to the two cases of amputation and the two cases of non-union despite revision.

Conclusion

Femoral shaft non-union in Togo is most often encountered in young subjects, who present with femur fractures following road accidents. These high-velocity traumas will cause periosteal and vascular damage around the fracture site and compromise consolidation. Secondly, the traditional treatment widely practiced in sub-Saharan Africa due to ancestral beliefs and financial difficulties, is a source of femoral pseudoarthrosis. Finally, the indications and surgical procedures, which are often left to young surgeons in teaching hospitals, may be the source of technical defects and lead to non-union, hence the need for assistance from senior surgeons. When the management of non-union is well conducted, with osteomuscular decortication of the Judet and the addition of autologous grafting if necessary, the results are satisfactory, as in our case.

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