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Nonunion of the humeral shaft: About 42 cases in the orthopaedic-traumatology department of the CHU ignace deen in Conakry

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Abstract
Introduction: Nonunion or pseudarthrosis is the leading late complication of humerus shaft fractures. This study's objective was to report our department's experience managing pseudarthrosis of the humeral shaft.
Patients and Methods: This was a cross-sectional study with a retrospective collection of descriptive type lasting ten (10) years from January 2010 to December 2020. It focused on the files of patients hospitalized and treated for nonunion of the humeral shaft.
Results: We recorded 42 cases of nonunion of the humeral shaft. The average age of the patients was 20 years old, with a male predominance of 66.67% and a sex ratio of two. The closed fracture was the most frequent initial lesion in 88.10%, and the traditional treatment was carried out in 73.91% of patients. Aseptic nonunion was the most found in 71.43%, of which 38.10% were hypertrophic. Osteosynthesis by screwed plate was the most performed in 71.43%, allowing the union to be obtained in 95.24% of patients within an average period of five months.
Conclusion: Nonunion of the humeral shaft is a frequent late complication of humeral fractures whose surgical treatment gives satisfactory results.

Keywords: Nonunion, shaft, humerus, complications

Introduction

We speak of nonunion or pseudarthrosis when inter-fragment mobility persists, and it is proven that initially instituted treatment will not lead to fracture consolidation [1]. Nowadays, it is defined by the absence of radiologically significant bone callus [2].

Nonunion is one of the most challenging complications for orthopaedic surgeons to treat [3] and is the leading late complication of humeral shaft fractures [4, 5].

The treatment of humeral nonunion, whether with or without loss of bone substance, is complex and involves a non-negligible rate of complications and failures [6]. The controversy surrounding the treatment of non-consolidation of the humerus is still lively. Proponents of closed treatment advocate locked intramedullary nailing or external fixator to decrease the risk of sepsis and radial paralysis. Conversely, open treatment with a screwed plate is preferred by those who wish to correct the deformity anatomically, obtain absolute stability and stimulate osteogenesis [7]. These proposed treatments will tend to block the torsion and distraction forces that are mainly exerted [8]. This surgical stabilization should be associated with compression of the focus and stimulation of osteogenesis by bone grafting and osteo-muscular decortication, according to Judet *et al.* [9].

We report our department's experience in managing nonunion of the humeral shaft.

Patients and Methods

This was a cross-sectional study with a retrospective collection over ten (10) years from January 2010 to December 2020. We targeted the files of patients hospitalized for nonunion of the humerus. The study population consisted of records of patients hospitalized for nonunion of the humeral shaft.

For this, we included patients hospitalized, treated and followed up for nonunion of the humeral shaft. The study variables were quantitative and qualitative.
On the clinical level, we looked for the presence or not of pain, the persistence of abnormal mobility (except in cases of armed nonunion), and damage to the radial nerve, and we measured the range of motion of the shoulder and elbow. We determined the dominant side, the initial lesion, the etiologies and the nonunion.
All the patients underwent digital radiography of the humerus (AP and profile), thus allowing the lesions to be typed.
Therapeutically, general anaesthesia was performed in all patients and the anterolateral approach. We performed debridement with sampling for bacteriology associated with the placement of external fixators in cases of septic nonunion; intermuscular decortication plus the addition of a cortico-cancellous graft taken from the iliac wing in cases of atrophic pseudarthrosis with loss of bone substance; fibrinolysis with decortication and permeabilization of the medullary canal in cases of atrophic nonunion without loss of substance and freshening associated with permeabilization in cases of hypertrophic nonunion. Osteosynthesis by screw plate was performed in aseptic cases. Radial paralysis was treated by the palliative method (triple tendon transfer).
We recorded a case of disassembly of the material (caused by the rarefaction of the bone capital) which required a revision for a new osteosynthesis; two cases of elbow mobility limitations, one case of 90° elbow stiffness, which was managed by physiotherapy and two cases of non-consolidation.

Results

We recorded and treated 42 cases of nonunion of the humeral shaft. Patients under 48 years of age were significantly affected in 75% of cases, with an average age of 20 years, the extremes of nine years and 73 years. The male sex was predominant in 28 cases (66.67%) against 14 female cases (33.33%), with a sex ratio of two. The aetiology was dominated by road accidents in 20 cases (47.61%), followed by falls in 12 cases (28.57%).

Table 1: Distribution of patients according to aetiologies

Aetiologies	Number	Percentage
Road traffic accident	20	47,61
Drop	12	28,57
Sports accident	5	11,90
Domestic accident	3	7,14
Work accident	2	4,76
Total	42	100

The closed fracture was the predominant initial lesion in 37 cases (88.1%), followed by five cases (11.9%) of open fracture, including three cases of type II and two cases of type 3.
The initial treatment was dominated by the traditional treatment in 31 cases, followed by eight cases of orthopaedic treatment and three cases of surgical treatment, including two osteosyntheses by screwed plate and open intramedullary nailing.

Table 2: Distribution of patients according to initial treatment

Type of treatment	Number	Percentage
Traditional treatment	31	73,91
Orthopaedics	8	19,04
Surgery	3	7,14
Total	42	100

Clinically, aseptic nonunion was found in 30 cases, 71.43%, followed by 12 cases of septic nonunion, 28.57%.
Digital radiography of the humerus revealed 16 cases of hypertrophic nonunion, 14 cases of atrophic nonunion (eight cases with loss of bone substance and six cases without loss of bone substance) and 12 cases of eutrophic nonunion.

Table 3: Distribution of patients according to the type of nonunion

Type of nonunion	Number	Percentage
Clinic		
Aseptic nonunion	30	71,43
Septic nonunion	12	28,57
Radiology		
Hypertrophic nonunion	16	38,10
Atrophic nonunion	14	33,33
Eutrophic nonunion	12	28,57
Thérapeutic		
- Armed nonunion	3	7,14

Osteosynthesis by screwed plate was performed in 30 cases (71.43%) against 12 cases of placement of external fixators (28.57%). We carried out the freshening associated with the permeabilization of the medullary canal in 16 cases (38.10%); debridement with the placement of external fixators in 12 cases (28.57%) osteo-muscular decortication plus the addition of corticocancellous graft in eight cases (19.05%), decortication plus permeabilization of the medullary canal in six cases (14,28%).

Table 4: Distribution of patients according to surgical treatment

Surgical treatment	Number	Percentage
Freshening + resealing+ PV	16	38,10
Debridement + placement of FE	12	28,57
Decortication + graft contribution + PV	8	19,05
Décortication + resealing + PV	6	14,28
Total	42	100

PV: Screwed plate, FE: External fixator.

Consolidation was obtained in 40 cases or 95.24% against two cases of non-consolidation with an average consolidation time of five months.
We recorded two cases of radial paralysis treated by tendon transfer with satisfactory results, two cases of limitation of elbow movements, one case of elbow stiffness managed by physiotherapy and one case of disassembly of osteosynthesis material which motivated a resumption of a new osteosynthesis.

Discussion

The frequency of nonunion of the humeral shaft varies according to the authors. The series report from 0% to more than 30% nonunion in the event of orthopaedic treatment of a humeral fracture, whereas after surgical management, the figures fluctuate between 4% and 30% [10-12]. In this series, it was difficult to establish a reliable percentage because all our patients were initially treated elsewhere, and we received them already in a state of nonunion.
The average age of the patients was 20 years, with extremes of nine years and 73 years. This result is lower than those of Dahmani *et al.* [13] in Morocco in 2013 and Ngongang *et al.* [14] in Cameroon in 2016, who respectively found an average age of 41 years and 38 years. Young people constitute our population's largest and most active layer and are most often exposed to trauma.
There was a male predominance of 66.67% with a sex ratio of

two. The same observation was made by Chantelot *et al*. [15] in France in 2005, reporting a male predominance of 66.67% and a sex ratio of two. The activity of men and their risk-taking could justify this predominance.

The closed fracture was the predominant initial lesion in 37 cases or 88.10%, and the road traffic accident constituted the most frequent aetiology in 47.61% of the cases. Soumaré B *et al*. [3] in Morocco 2017 reported in their study that the closed fracture was the initial lesion in 87.5% of the cases, and the aetiologies were represented by home falls in 56.3% followed by 31.3% road traffic accident.

The traditional treatment in 73.91% dominated the initial treatment. Sallemi *et al*. [16] in Tunisia 2020 found 84.5% surgical treatment against 15.5% orthopaedic treatment. The high rate of traditional treatment in our context would be linked to its economic accessibility and the population's attachment to tradition. As for the initial treatment of the fracture that led to the nonunion, apart from open fractures, primarily type III, where bone devitalization is inevitable due to the violence of the trauma, we have identified technical causes, such as the insufficiency of mounting, inadequacy of osteosynthesis material, excessive deperiosteal removal during initial open treatment, misalignment or interfragmentary gap in orthopaedic treatment. Thus, we can say that the nonunion of the humeral shaft is not the direct consequence of the choice of the treatment used initially (whether bloody or orthopaedic). However, it is linked to how this treatment is applied. Orthopaedic treatment of humeral shaft fracture remains our choice method, given its many advantages. On the other hand, we only use surgical treatment in specific indications of necessity, such as in polytraumatized patients, poly-fractured patients, in cases of fractures complicated by vascular-nervous lesions, and in certain subjects (obese subjects, discomfort) unable to withstand the orthopaedic treatment.

Nonunion was aseptic in 71.43%, including 38.10% hypertrophic nonunion and 33.33% atrophic nonunion. Obert *et al*. [17] in France 2015 listed 13 cases (81.25%) of atrophic nonunion, two cases (12.5%) of hypertrophic nonunion and one case (6.26%) of eutrophic nonunion.

The aim of the treatment of pseudarthrosis must meet two imperatives: obtain consolidation of the heart, and restore the function of the upper limb while avoiding stiffness of the elbow and shoulder joints. We performed 71.43% osteosynthesis by screwed plate against 28.57% external fixation. Consolidation was obtained in 95.24% of cases within an average of five months. Raissouni *et al*. [18] in Morocco in 2007 proceeded to the freshening of the hearth followed by osteosynthesis by screwed plate associated with a spongy bone autograft in six cases (40%), or with an osteo-muscular decortication in three cases (20%). Gaillard *et al*. [6] in France in 2020 achieved union in all patients within an average of 4.6 months with extremes of four and nine months. Surgical treatment remains the best alternative for managing nonunion of the humeral shaft. Osteosynthesis using a screwed plate stabilizes the nonunion site while providing an osteogenic supplement essential for consolidation. However, the best treatment for nonunion of the humerus remains that of managing the initial fracture.

Conclusion

Nonunion of the humerus is one of the most frequent late complications of humeral fractures and the most difficult to treat. They often occur after a faulty initial treatment, and surgical treatment provides satisfactory results. Only an adequate and correctly conducted initial treatment of the humeral shaft fracture can prevent the onset of nonunion.

Conflict of Interest
Not available

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Not available

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