

Non-Union of the Humeral Shaft in Adults: Does Osteomuscular Decortication and Iliac Graft Support Promote Bone Consolidation? A Prospective Study of 50 Cases

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Abstract

Introduction: Non-union are the most common complications of diaphyseal fractures of the humerus. The management of this condition varies on the type of pseudarthrosis. The objective of the study was to assess the results of our treatment.

Patients and Methods: We conducted a Prospective study between April 2016 and March 2021, involving 50 cases of non-union of the humeral shaft in our department. Non septic non-unions without bone defect were treated by osteomuscular decortication with or without iliac grafting. The patients were aged 18 years or older, followed and evaluated at a minimum follow-up of 12 months. The non-unions were distributed by septicity and vitality based on Weber and Čech classification. The osteomuscular decortication with or without iliac graft was the most used surgical technique. The Stewart-Hundley criteria were used to assess the functional results of the affected arms. The data were analyzed using Epi info 2010 version 3.5.2. The Chi² test was used to compare the pre-operative and post-operative outcomes for a significance level retained at 0.05.

Results: There were 47 cases (94%) of vital non-union and 3 cases (6%) of non-vital humeral shaft non-union. One pseudarthrosis was septic. The osteosynthesis used plate in 46 cases (92%), intramedular pinning in 3 cases (6%) and the external fixator in the only case of septic pseudarthrosis after recovery from infection (2%). The postoperative was free of infection and disassembly of the osteosynthesis material allowing to significantly reduce the risk of complications (RR 0.84) (95% CI 0.7443 - 0.948) (p = 0.0014). All the patients consolidated (p = 0.000). The mean time to union was 17.2 weeks (range: 10 and 22). The postoperative functional results according to the Stewart and Hundley score compared to the preoperative ones were very good in 35 cases (70%), good in 13 cases (26%) and quite good in 2 cases (4%) (P = 0.0000) (95% CI: 5.108 - 243.8).

Conclusion: The treatment of non-union of the humerus shaft without defect by osteomuscular decortication and osteosynthesis using plate leads to a bone, with satisfactory clinical and functional outcomes.

Keywords: Humeral Shaft; Osteomuscular Decortication; Iliac Graft Support; Bone Consolidation

Introduction

A uniform definition of non-union does not exist. It is defined as an absence of union, six to nine months after the fracture [1]. This definition has been reconsidered recently, no longer taking into account the time factor. Thus, we name pseudarthrosis, the fracture which, for a biological or mechanical reason, will not lead to spontaneous bone consolidation [1-3,5]. Non-union is the main late complication of diaphyseal fractures of the humerus [2-4]. It represents roughly 5% to 10% of all fractures [5-7]. It can be classified by vitality of the affect of bone [8]. The middle third of the humerus represents its frequent location [4,6,7,9]. The treatment of humeral non-union is a challenge for the surgeon. This treatment depends on the type of the non-union [9-11].

The humeral shaft non-union was frequent in our department. We conducted this study to evaluate the outcomes of our surgical treatment.

Hypothesis: Does osteo-muscular decortication lead to bone consolidation?

Patients and Methods

A Prospective study on diaphyseal pseudarthrosis of the humerus was conducted between 2016 and 2021 in the only Orthopedics-Traumatology department in Bangui. All types of septic or aseptice, hypertrophic or atrophic pseudarthrosis were studied. Patients consenting to treatment were followed up and evaluated at a minimum follow-up of 12 months. The lost of follow-up and metaphyseal-epiphyseal localizations were excluded.

Pseudarthrosis was classified by vitality and septicity based on Weber-Cech classification [14]. The patients arms were functionally assessed in pre and postoperative times using the Stewart and Hundley criteria [15] (Table 1). All the patients were operated by osteomuscular decortication for the hypertrophic (vital) forms.

The diagnosis of pseudarthrosis was made after clinical and radiological examinations. The vital non-unions were treated by decortication without adding a bone graft. Avital non-unions were also treated by the same procedure but with the addition of bone graft. The debridement with a control of the infection before surgery was used in the septic forms. The unique septic pseudarthrosis was treated by external fixation. The bone consolidation was clinically confirmed by the lack of mobility at the site of the old fracture, an absence of pain and apparition of a mature callus.

A survey sheet including the socio-demographic characteristics, clinical, therapeutic and follow-up aspects was used to collect the data from each patient. The data analysis was performed using Epi info 2010 version 3.5.2. The Chi² test was used to compare the pre-operative and post-operative outcomes for a significance level retained at 0.05.

Results

The study included 50 patients (37 men and 13 women). The mean age of the series was 41.6 years (range 22 and 75 years). There were 31 (62%) cases of non-union of the right humerus versus 19 (38%) non-union of the left humerus. The middle third of the right humerus was the most affected. The most frequent fracture lines were oblique (49%) and transverse (32.7%). The causes of fractures complicated by non-union were road accidents in 36 cases (72%), firearms in 5 cases (10%). The initial management of fractures before the onset of pseudarthrosis was carried out in 7 cases (14%) by bonesetter consultants and 43 (86%) by doctors. The initial treatment was orthopedic in 21 cases (42%), surgical in 20 cases (40%) and traditional in 9 cases (18%). Iliac graft was used in 15 cases. A patient with septic nonunion consolidated without infection after stabilization with an external fixator. All the patients consolidated (p = 0.000). The mean time to union was 17.2 weeks (range: 10 and 22). The postoperative functional results according to the Stewart and Hundley

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score compared to the preoperative ones were very good in 35 cases (70%), good in 13 cases (26%) and quite good in 2 cases (4%) (P = 0.0000) (95% CI: 5.108 - 243.8).

Very good	<ul style="list-style-type: none"> Absence of pain Normal mobility Good radiological alignment
Good	<ul style="list-style-type: none"> No pain or climatic pain Shoulder and elbow stiffness less than 20° Vicious cal less than 20°
Good enough	<ul style="list-style-type: none"> Minor pain Shoulder and elbow stiffness between 20° and 40° Vicious cal greater than 20°
Bad	<ul style="list-style-type: none"> Persistent pain Shoulder and elbow stiffness greater than 40° Pseudthrosis

Table 1: Score of Stewart and Hundley.

		n	%
Age median		41.62	
Age groups			
	22-40	27	54
	40-75	23	46
Sex			
	Male	37	74
	Female	13	26
	Sex ratio	2.84	2.84
Profession			
	Informal	18	36
	Student	12	24
	No employed	9	18
	Employed	7	14
	Private	3	6
Education			
	Higher	15	30
	secondary	27	54
	Primary	8	16
Wealth quintile			
	Lowest	17	34
	Middle	28	56
	Highest	5	10

Residence			
	Bangui	46	92
	Province	4	8
Type of accident			
	Traffic	36	72
	Gunshot	5	10
	Work	4	8
	Domestic	4	8
	Sport	1	2
Affected side			
	Right	31	62
	Left	19	38
Seat of fracture			
	upper third	3	6
	Middle third	39	78
	Lowest third	8	16
Type of fracture line			
	Spiroid	2	4.1
	Oblique	24	49
	Transverse	16	32.7
	Torsion wedge	4	8.2
	Flexion wedge	1	2
	Comminuted	2	4.1
	Wedge fracture	14	28
	Complex fracture	36	72
Skin opening			
	Yes	6	12
	No	44	88
Initial consultant			
	Health care provider	43	86
	No health care provider	7	14
Type of Initial treatment			
	Orthopedics	21	42
	Surgery	20	40
	Traditional	9	18
Timeframe of diagnostic (weeks)			
	Mean	8.62	
	6 - 7	17	
	8 - 9	20	

Table 2: Sociodemographic characteristics of all participants.

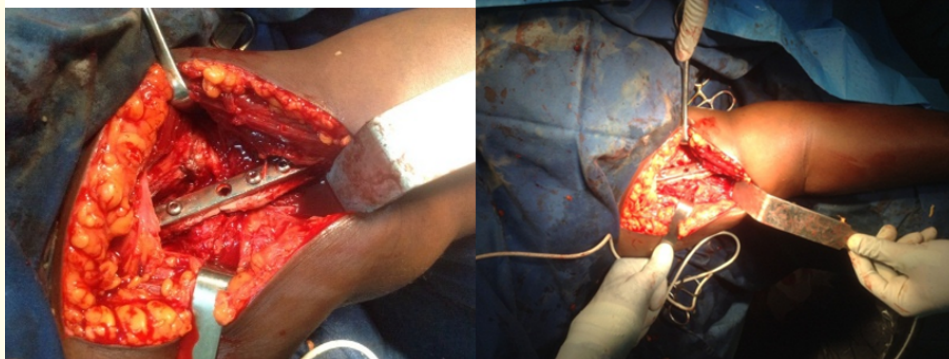


Figure 1: Osteomuscular decortication followed by iliac graft in a 33-year-old patient.

	Pre-operative		Post-operative		RR	95% CI	p-value
	n	%	n	%			
Non-union vitality							
Vital	47	94	50	100			
Non vital	3	6	0	0	2.064	(1.681 - 2.534)	0.06
Non-union septicity							
Non septic	49	98	50	100			
Septic	1	2	0	0	0.9792	(0.9396 - 1.02)	0.2449
Type of osteosynthesis							
Plate	46	92					
pinning	3	6					
External fixation	1	2					
Iliac graft							
Yes			15	30			
No			35	70			
Infection of the operative site							
Yes	1	2	0	2			
No	49	98	50	98	1	(0.06433 - 15.55)	0.5
Disassembly of the osteosynthesis material							
No	42	84	50	100			
Yes	8	16	0	0	0.84	(0.7443 - 0.948)	0.0014
Bone Consolidation							
No	50	100	0	0			
Yes	0	0	50	100			0.0000

Consolidation duration in weeks							
Mean			17.22				
10 - 15			15	30			
16 - 19			25	50			
20 - 22			10	20			
Follow-up in months							
Mean			19.46				
12 - 18			24	48			
19 - 24			26	52			
Stewart and Hundley score							
Very good	0	0	35	70	35.29	(5.108 - 243.8)	0.0000
Good	0	0	13	26			
Enough good	0	0	2	4			
Bad	50	100	0	0			

Table 3: Pre-operative and post-operative evaluation.

Discussion

The population of the study is young and could be explained by the hyperactivity of young populations and the proliferation of two-wheeled vehicles in our country in recent years [7,16-21]. Most of our patients were males [7,16,20,22]. Public road accidents were the most cause with 72% of cases followed by gunshot injuries with 10% of cases. On the one hand, this result was explained by traffic accidents [12,23]. For instance, there has been increase in two-wheeled vehicles in the Central African Republic, in particular motorcycle taxis with a net increase in the number of accidents linked to them in recent years [23]. On the other hand, the increase in the number of firearm accidents in our series is explained by the military-political crisis in the Central African Republic [12]. The line of the initial fractures was predominantly oblique [4] followed by the transverse line. Similar results were reported in the literature by Padhye, Dahmani [6] and Baba [29]. The initial traditional treatment of fractures before the onset of non-union in our series was not negligible. These practices remain common in the Central African Republic as in some African countries, unlike the trends in some European countries whose authors have reported surgical treatment as the primary cause [4,13].

Our timeframe for diagnosing the non-union was similar to that reported by Tall, Abalo, Martinez and Mohammed [16-18,20].

We had a case of septic non-union. This was the only patient in our series who was treated with the external fixator after the management of the infection [4,7]. This isolated infection in preoperative time was controlled after regular dressings and appropriate antibiotic therapy adjusted by an antibiogram before surgery. The postoperative time was uncomplicated and led to consolidation. The author Lavini, *et al.* had also used the external fixator like us for the treatment of septic non-union in their study [30]. Among the 50 patients, 15 received iliac graft treatment. The majority of our patients was treated by osteomuscular decortication and screw plate. The iliac graft was provided in 15 cases (30%). This method of treatment by screwed plate associated or not with an iliac graft supply was preferred in our country because of the technical platform and the competence of human resources. It also remains the most found and described method in the literature concerning the treatment of non-union of the humeral shaft [7,12,16,24,27,28]. Rarely, some authors used other treatment methods with Kuntcher nails, Hacketal and modified intramedullary nails which tend to be abandoned [21].

Our treatment made it possible to eliminate the septicitis of the non-union with a statistically significant test threshold in post-operative time. None of our patients presented with paresis or paralysis of the radial nerve after surgery [17,18]. All the non-union that occurred on the osteosynthesis materials and complicated to disassemble were treated in our series and we did not have a post-operative disassembly [12,18,27].

All the non-union of our operated patients consolidated with a timing similar to those reported by several authors [18,26].

We chose our follow-up with externs of 12 and 24 months to properly assess our patients and get satisfactory functional results. This duration led to a bone consolidation and allowed the necessary time for the patients to participate in the kinesitherapy sessions and recover to their maximum functionality before the pseudarthrosis. Several authors had results close to our follow-up [4,12,18,20].

We had very satisfactory and statistically significant post-operative functional results postoperatively according to the based on Stewart and Hundley score. Dahmani, *et al*, Gogoua, *et al*. [6,12,15] observed similar results in their series. Our result was due to the good quality of care we provide to our patients.

Conclusion

Non-union is a late and frequent complication of humeral shaft fracture that can be successfully treated using screw-retained plate associated with the bone graft for better post-operative functional results.

Conflicts of Interest

The authors has not declare conflicts of interest.

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