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Original article

Locking plate fixation versus antegrade nailing of 3- and 4-part proximal humerus fractures in patients without osteoporosis. Comparative retrospective study of 63 cases



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ABSTRACT

Introduction: There is no consensus on the treatment of proximal humeral fractures. The goal of the present retrospective observational study was to compare functional and radiological results and complications of internal fixation using locking plates versus antegrade nailing in the treatment of non-osteoporotic Neer classification 3- and 4-part fractures after a least 1 year of follow-up.

Material and methods: Internal fixation was performed in 67 fractures (1 bilateral): 35 by locking plate (1 lost to follow-up, 1 deceased) and 32 by intramedullary nailing (2 lost to follow-up) between January 1st, 2004 and December 31st, 2010. Thus, the study included 33 plates (21 3-part and 12 4-part fractures) and 30 nails (21 3-part and nine 4-part fractures). Final functional assessment was based on the Oxford, Constant, Relative Constant and QuickDASH scores and percentage of handicap. Radiological follow-up included immediate postoperative, 6 weeks, 3 months and 1 year AP and Lamy lateral views. All complications were recorded prospectively.

Results: Mean Oxford, Constant, Relative Constant and QuickDASH scores and percentage of disability for the plate and nail groups respectively were: 23.8 vs. 23.3, 59.7 vs. 60.6, 73.5 vs. 79.3, 20.9 vs. 21.0, 22.6 vs. 22.6. Multivariate analysis did not show any significant difference in functional scores or quality of reduction: final unsatisfactory reduction on AP view, 30.3 vs. 36.7%; lateral view, 3.2 vs. 10.0%; greater tuberosity, 9.1 vs. 16.7%. Four-part fracture ($P < 0.05$), frontal reduction defect at follow-up ($P < 0.05$) or greater tuberosity defect ($P > 0.05$) had negative impacts on functional scores. The complication rates corresponded to those in the literature and did not differ between the techniques ($P = 0.1901$) except for three infections in the plate group.

Discussion-Conclusion: Internal fixation is the treatment of choice for 3- and 4-part fractures in non-osteoporotic patients. Although no difference was found in the present study between locking plate and intramedullary nailing, the former seems to be less well adapted and more aggressive.

Type of study: Retrospective observational study.

Level of evidence: Level 4.

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1. Introduction

Although they are common, fractures of the proximal humerus remain an issue because of disagreement on optimal treatment [1–3].

They represent 5% of all fractures and occur in both elderly patients with osteoporosis following low energy falls, and in young patients from high-energy trauma. Three- and four-part fractures

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Table 1
Overall results.

	Plate	Nail	P
Patients	34	32	0.92
Fractures	35	32	
Lost to follow-up	1	2	
Death	1	0	
Mean age (years) ^a	49.6 ± 17.5	64.1 ± 15.8	0.001
Gender ration men/women	19/14	Nov 19	0.09
Dominant limb (%)	60.6	60	0.96
Mean duration of follow-up (months) ^a	24.7 ± 19.9	42.8 ± 24.8	0.002
Type of fracture	21/63.6 12/36.4	21/70.0 9/30.0	0.59

^a Significant difference between the two groups.

occur in 13–16% of these cases [1] and the prognosis is less good [4].

Twenty per cent of these fractures are displaced, defined as displacement of more than 1 cm or an angle of greater than 45° according to the Neer classification, and require surgical management [5].

There are few studies that specifically evaluate the results of 3- and 4-part fractures treated by locking plates or intramedullary antegrade nailing [1,6–8].

The goal of our study was to compare the functional and radiographic results as well as the postoperative complications of fractures treated by both methods.

2. Patients and methods

2.1. Series

This is a retrospective comparative multicentre study performed in two orthopedic and traumatology surgery units at the Central University Hospital of Nancy (between January 1st, 2004, and December 31st, 2010) comparing 63 3- or 4-part fractures confirmed by preoperative radiographic evaluation (AP, and lateral Y-views).

Patients were included who presented with recent, closed, post-traumatic 3- or 4-part fractures of the proximal humerus on non-pathological or osteoporotic bone (Giannotti cordicomedullary index of > 0.231) [9], with fused growth plate cartilage; with a follow-up of at least 1 year. Fixation used included locking plates only in one hospital unit, (PHILOS^{TM1}, plates and Humeral Suture Plate^{TM2}) and in the other unit intramedullary antegrade nails only (2nd, 3rd and 4th generation Télégroph^{TM3}, Trigen^{TM4} and T2^{TM5}) proximal humerus nails.

We used the Neer classification [5].

Mean follow-up in the locking plate group was 24.7 ± 19.9 months and included 33 fractures, with two that were bilateral: 21 3-piece fractures (64%) and 12 4-piece fractures (36%). The mean age of the 32 patients was 49.6 ± 17.5 years old (Table 1).

Before the intervention one patient presented with a supraspinatus tendon tear which was sutured during open surgery during the same operation, two presented with injury to the axillary artery (a lateral wound sutured with separate stitches and thrombosis requiring humeral subclavian bypass), and four

presented with neurological sensory loss that regressed within 12 months (one of the median nerve, one of the radial nerve, and two cases of circumflex nerve injury).

Patients underwent surgery an average of 2.7 ± 5.3 days after injury by junior and senior surgeons (ACC: *assistant chef de clinique* and PH: *praticien hospitalier*) with experience in this type of fixation, under general anaesthesia in the beach chair position by deltopectoral approach and with fluoroscopic control of reduction and plate position. The fracture parts were reduced using traction wires placed at the insertion of the rotator cuff tendons. If humeral head reduction was unstable in 4-part fractures, it was maintained by a temporary glenohumeral arthrorisis Kirchner wire. When reduction was obtained and considered to be satisfactory, it was temporarily maintained by Kirchner wire to stabilize the tuberosities and the humeral head. A plate was then placed 1 cm under the tip of the greater tuberosity and attached to the humeral diaphysis by a non-locking screw placed in the oblong hole. Once correct reduction was obtained, the head and the diaphysis were stabilized by locking screws.

Patients presenting with a surgical site infection were included in the study of postoperative and radiographic complications but were excluded from the study of functional outcome scores at the final follow-up.

Mean follow-up in the group of patients treated by intramedullary nailing was 42.8 ± 24.8 months. The study included 30 patients, mean age 64.1 ± 15.8 years old (mean age 14.5 years older than the locking plate group) with 30 fractures: 21 3-part fractures (70%) and nine 4-part fractures (30%) (Table 1).

Two patients presented with preoperative neurological sensory loss that regressed after 12 months (circumflex nerve).

Patients were operated on a mean 1.1 ± 0.4 days after injury under the same conditions by anterolateral route. The nail was introduced through the opening located along the axis of the humeral diaphysis, at the tip of the head, in the articular zone so that the muscles of the rotator cuff would be crossed through muscle tissue. The nail was then inserted until its proximal end was located approximately 5 mm under the subchondral bone of the humeral head. When reduction of the humeral head was unstable before nailing in 4-part fractures, it was stabilized by a temporary glenohumeral arthrorisis Kirchner wire. The fragments were reduced with traction wires placed at the rotator cuff tendon insertions. Distal and proximal locking was performed (static or dynamic) using an ancillary system when reduction and the position of the nail were considered to be satisfactory under fluoroscopic control.

The incision was closed in both groups on a Redon drain, which was left for 48 hours. All patients were immobilized after surgery in a sling. Immobilization and the time until rehabilitation began varied from 1 to 6 weeks depending on the practitioner.

Patients presenting with early fixation failure and revised by arthroplasty were included in the study of postoperative and radiographic complications but were excluded from the study of functional outcome performed at the final follow-up.

2.2. Follow-up study

Patients underwent clinical and radiographic follow-up at 6 weeks, 3 months, 12 months then later depending on outcome and complications. Patients underwent a triple follow-up.

Clinical follow-up to determine the Oxford score [10], the Constant score [11] the Relative Constant score for age and gender [12] and the QuickDASH [13] score to calculate the percentage of disability. These functional scores were determined during a consultation with a surgeon who was independent from the surgeons who had managed the patients.

Standardized radiological follow-up: AP views (angle α: valgus-varus angle) and Y-view (angle γ: anteversion-retroversion angle).

¹ Proximal Humeral Internal Locking System, Synthes®, Stratec Medical Ltd, Mezzovico, Switzerland.

² Arthrex®, Naples, FL, USA.

³ FH Orthopedics®, Heimsbrunn, France.

⁴ Smith&Nephew®, Memphis, USA.

⁵ Stricker®, Newbury, UK.

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