SURGICAL TREATMENT OF THREE-PART PROXIMAL HUMERAL FRACTURES

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The majority of proximal humeral fractures may be managed with nonsurgical treatment. However, three-part displaced fractures require surgery with two goals : obtaining an anatomic reduction and providing enough stability to allow an early rehabilitation program. This article describes a simple technique of internal fixation with Kirschner wires that can be applied in fracture-dislocations and three-part fractures of the proximal humerus.

A retrospective study of 29 consecutive cases of three-part fractures of the proximal humerus treated with this procedure is presented. Excellent or satisfactory results were achieved in 79.3% of cases using Neer's criteria at minimum 12 months follow-up. Eighteen patients (62.1%) had no pain or had only mild pain not interfering with daily activities. Twenty-four shoulders (75.9%) had more than 130° active elevation, and 15 patients (51.7%) had at least 130° active abduction.

The complications were one avascular necrosis, one osteitis and one early loss of reduction that required a new operation. In conclusion we recommend this technique for operative treatment of three-part fractures of the humerus because of its simplicity and satisfactory results.

Keywords : shoulder ; internal fixation ; proximal humerus ; three-part fracture.

Mots-clés : épaule ; ostéosynthèse ; humérus proximal ; fracture à trois fragments.

INTRODUCTION

The majority of proximal humerus fractures occur in elderly individuals and traditionally have been amenable to nonsurgical treatment.

In 1970, Neer (11) proposed a classification based on the four principal anatomic segments of the proximal part of the humerus. Use of this classification has proved beneficial as a guide for therapeutic decisions.

Open reduction and different methods of internal fixation have been proposed to correct the displacement of the fragments and thus improve functional results. However, the majority of these fractures occur in elderly individuals with osteoporotic bones, and the conventional methods of osteosynthesis with T-plates, semitubular angled plates or blade plates (10, 18) and external fixation (8) are difficult or impossible to apply.

In 1986 Hawkins *et al.* (5) outlined the "tension band" method which requires a less extensive approach and reduces the risk of fixation failure and avascular necrosis in comparison with traditional internal fixation methods. Some authors, in a more aggressive way, advocated prosthetic replacement of the proximal humerus (6, 12) or osteosynthesis with a cemented intramedullary rod (7). Others, (20) more recently, continue to advocate nonsurgical treatment in elderly patients. We have used a new method of simple, stable and versatile

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Table I. — Age : Age in years. F : female. M : Male. Fr Type : Fracture type : All of them are variants of the three-part fracture type of Neer's classification. VALGUS : Valgus displacement, MD : Metaphyseal displacement, F-DISL : Fracture-dislocation, VARUS : Varus displacement. SIDE : R :Right L : Left. FOLLOW-UP is given in months. Rating based on Neer score : Excellent > 89 points ; Satisfactory : 80-89 points ; Insufficient : 70-80 points and Failed < 70 points

CASE	AGE	GENDER	FR. TYPE	SIDE	FOLLOW-UP MONTHS	RATING BASED ON NEER SCORE	COMMENT
1	60	F	MD	R	12	Failed	Infection
2	54	F	MD	R	17	Failed	Avascular necrosis
3	64	F	VALGUS	L	23	Excellent	
4	64	F	VALGUS	L	12	Excellent	
5	64	F	MD	L	12	Excellent	
6	56	F	VALGUS	L	36	Excellent	
7	61	F	VARUS	R	30	Satisfactory	
8	72	F	VALGUS	L	12	Satisfactory.	
9	70	F	MD	R	20	Excellent	
10	75	F	MD	R	13	Insufficient	
11	59	F	VALGUS	R	31	Excellent	
12	72	F	VALGUS	L	40	Excellent	
13	31	F	MD	L	35	Excellent	
14	62	F	VALGUS	L	16	Insufficient	
15	61	F	VALGUS	L	12	Satisfactory.	
16	66	F	VALGUS	R	36	Excellent	
17	77	F	MD	R	24	Excellent	
18	69	F	VARUS	R	12	Insufficient	
19	62	F	VALGUS	L	12	Satisfactory	
20	56	F	VALGUS	L	16	Excellent	
21	42	F	MD	L	37	Excellent	
22	46	M	F-DISL.	L	33	Excellent	
23	29	M	F-DISL.	R	12	Excellent	
24	67	F	VALGUS	R	12	Failed	
25	72	F	VALGUS	R	31	Excellent	
26	45	F	VALGUS	L	12	Excellent	
27	52	F	F-DISL.	L	12	Satisfactory	
28	60	F	VALGUS	R	18	Satisfactory	
29	63	F	VALGUS	L	12	Satisfactory	

internal fixation for the treatment of three-part displaced proximal humeral fractures. The purpose of our study was to evaluate clinical results and complications in a series of 29 three-part fractures of the proximal humerus.

PATIENTS, MATERIALS AND METHODS

We present a retrospective study of 29 three-part proximal humeral fractures according to Neer's classification, treated by open reduction and a simple technique of Kirschner wire osteosynthesis. The study extended from January 1996 to June 1998 with an average follow-up of 20.7 months (range : 12 to 40 months).

The criteria for inclusion were a diagnosis of displaced three-part fracture confirmed by three independent observers, sufficient mental and physical health, adequate cooperation in rehabilitation and well documented follow-up of at least 12 months.

There were 16 three-part fractures impacted in valgus, 8 three-part fractures with metaphyseal displacement, three fractures dislocations and two three-part fractures with varus displacement. In 13 cases the injury affected the right shoulder and in 16 cases the left shoulder (table I).

The average age of the patients was 59.7 years (range : 29 to 77 years) and 27 of the patients were females. The causes of the fractures were accidental falls in 23 cases, traffic accidents in 4, one occupational

accident, and one sports injury. Seven patients presented associated lesions : four fractures of the distal extremity of the radius, one fracture of the anterior glenoid rim, one fracture-dislocation of the ankle and one fracture of the femur. Two patients had nondisplaced fractures of the contralateral proximal humerus.

Surgical technique

It consists in a three-point fixation system of the cephalic articular fragment to the humeral metaphysis using Kirschner wires (KW) and suture of the greater tuberosity with two transosseous sutures (fig. 1).

With the patient in a “beach chair” position, a deltopectoral approach is carried out. A nontraumatic dissection technique is necessary to avoid stripping the residual soft tissue linking the various fragments. The subcapital fracture is reduced with the arm in adduction and internal rotation and, with simultaneous traction applied to the arm, the surgeon uses his thumb to apply counterpressure posterolaterally in the area of the fracture. When the head is displaced medially and inferiorly, a blunt elevator is advanced from the anterior aspect, following the bone as far as the anatomical neck, and the head segment is then raised. After reduction, a first 2-mm K-wire is passed through the lesser tuberosity crest of the metaphyseal fragment into the posterior aspect of the cephalic fragment. The second K-wire is introduced lateral to the first one, through the greater tuberosity crest towards the center and posterior part of

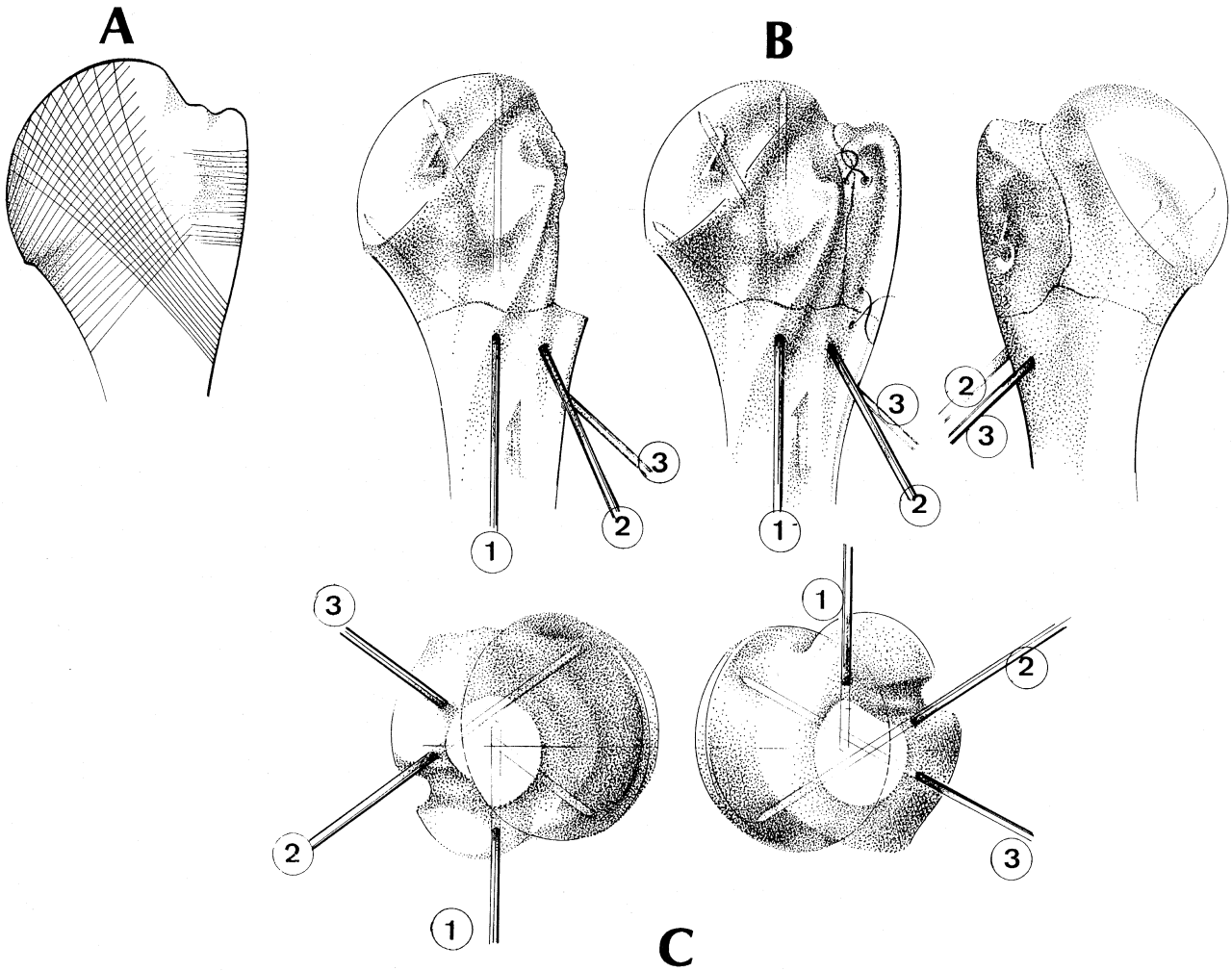

Fig. 1. — ***A.*** Schematic drawing of the trabecular structure of the proximal humerus.
B. Anteroposterior and posteroanterior views of the osteosynthesis construction.
C. Coronal view of the osteosynthesis construction.

the cephalic articular fragment. Finally, the third K-wire is introduced through the lateral aspect of the metaphysis towards the anteroinferior portion of the articular fragment (fig. 1). The K-wires are introduced using a power drill first, and once near subchondral bone, they are anchored by light blows from a small hammer (200 g.). This is a better way to feel penetration into subchondral bone and appropriate localization of the pins.

Finally, the greater tuberosity is reduced and fixed with two transosseous sutures. The reduction is checked with fluoroscopy, and the stability of the osteosynthesis is tested by passive abduction and rotation of the arm before closing the wound over a suction drainage leaving the K-wires subcutaneous.

Postoperative management

The operated limb is immobilized in a foam support which maintains the arm in 45 ° abduction, 15 ° flexion and 30° external rotation.

On the second postoperative day, the drain is removed, and the patient starts pendulum exercises. On the seventh and 21st days an xray is taken to rule out secondary displacements. The K-wires are removed after four weeks under local anesthesia.

Analysis of the results

At final follow-up, the patients were evaluated with regard to pain, range of motion, and quality of anatomic reduction by two surgeons, working independently, who applied the Neer (11) evaluation scales for the shoulder.

RESULTS

All fractures healed after an average time of 6.3 weeks (range : 4 to 10 weeks).

The overall functional ratings based on the Neer (11) scales are presented in table I with the rest of the epidemiological data of the series. At final follow-up, 74.3% of the cases were rated as satisfactory or excellent. Only three patients (10.3%) showed a poor functional rating noted as a “failure”.

The average postoperative mobility and the incidence of residual pain are detailed in table II. Eighteen patients (62.1%) in the series had no pain or only slight and occasional pain, not interfering with daily activities. Two patients (6.9%) suffered severe pain.

There was a 10.3% rate of postoperative complications : one avascular necrosis of the humeral head, one osteitis and one severe loss of reduction due to K-wire migration which required new K-wire osteosynthesis on the tenth postoperative day.

Ten patients (34.5%) presented pin migration between the third and fourth postoperative week, but in no cases did this result in loss of reduction .

There were no cases of nonunion. Nonanatomical reductions, but without articular incongruence, were noted in six patients (20.7%). These imperfect reductions were obvious on the immediate postoperative xray and were not a result of secondary failure of the osteosynthesis. In the three patients classified as failures, the latter were related to osteitis, avascular necrosis of the humeral head and insufficient reduction, respectively.

DISCUSSION

Although the majority of proximal humerus fractures may be adequately treated with nonsurgical methods, approximately 20% are displaced fractures and fractures dislocations which may not be treated conservatively (9, 18). As other authors (1, 5, 12, 16), we have performed surgical

Table II. — Clinical postoperative results distribution concerning pain and range of motion. EXT.ROT : External rotation

PAIN		MOBILITY					
	Patients	ABDUCTION	Patients	ELEVATION	Patients	EXT. ROT.	Patients
None	15	180°	0	180°	1	60°	0
Mild	3	170°	3	170°	8	30°	24
Moderate	9	130°	12	130°	15	10°	3
Severe	2	100°	10	100°	2	< 10°	2
Incapacitating	0	80°	2	80°	1		
		< 80°	2	< 80°	2		

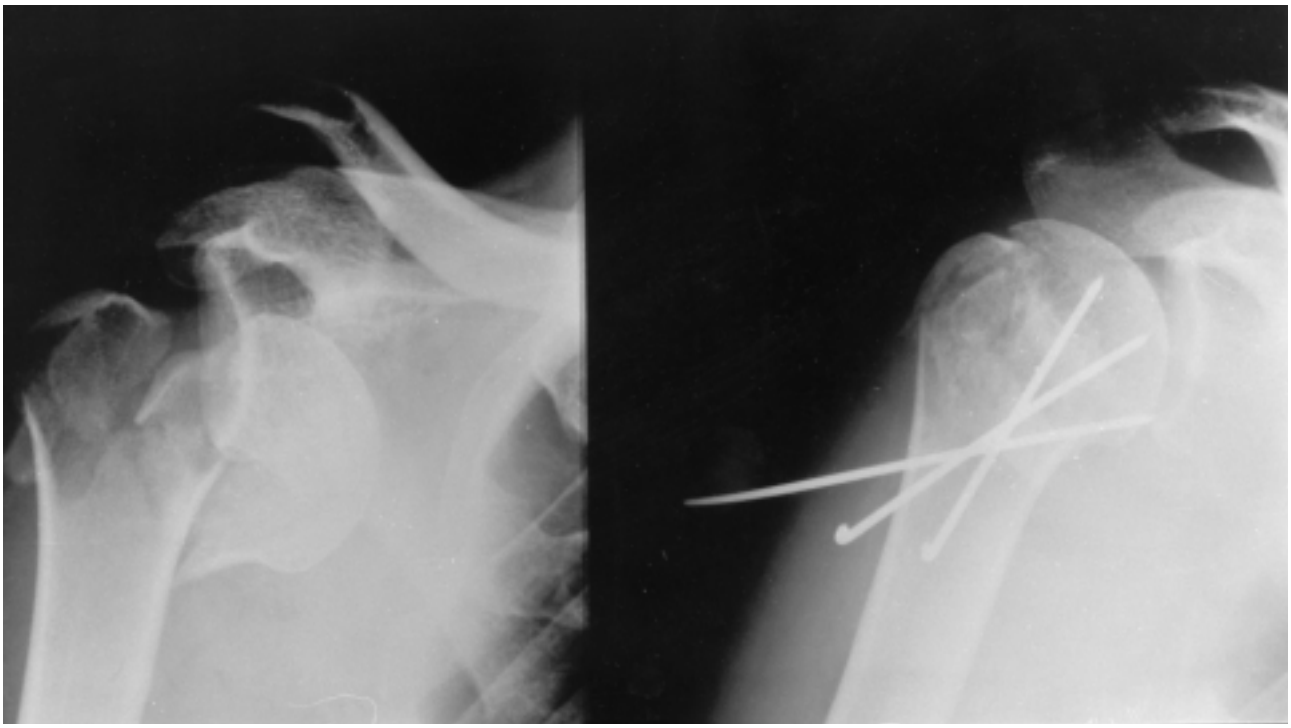

Fig. 2. — Three-part fracture with marked displacement before and after surgery

treatment for three-part fractures and fracture dislocations with satisfactory results.

The conservative attitude of many authors is supported by the analysis of nonhomogenous series in which they have included nondisplaced and benign injuries, which certainly do well without surgery. On the other hand the allegedly high rate of complications (3, 7, 17) of open reduction and internal fixation methods may reinforce a conservative approach, and it is argued that operative treatment does not guarantee adequate reconstruction of the proximal humerus anatomy (13).

However, fracture healing in a varus position results in limited abduction and subacromial impingement by the greater tuberosity, (17) and extension deformity of more than 20 to 30° reduces elevation of the arm. Therefore treatments which do not achieve adequate reduction lead to poor functional results.

When we opt for surgical treatment, the selection of the fixation technique may be a dilemma. These injuries usually affect elderly postmenopausal females. The weak osseous architecture of the proximal humerus in osteoporotic elderly patients entails a risk of failure for classical techniques of internal fixation (3, 7, 17), especially screws and plates, which are also associated with a high incidence of avascular necrosis and subacromial impingement (4, 17). It cannot be overlooked that bone of appreciable density in the humeral head extends no deeper than 1 cm beneath the articular surface, and the anchorage of fixation material is therefore usually insufficient.

This simple fixation technique is based on stable reduction of the cephalic fragment on the metaphysis giving support, contrary to fixation with tension bands (5) or screwed plates (7), which claims to achieve stability by compression and thereby fails when the medial cortical bone is comminuted.

Our method provides greater stability to the reduction of the cephalic fragment above the metaphyseal one in any plane of motion including rotation. It also shares the advantages of the Hawkins (5) technique in minimizing dissection of the soft tissues and suturing of the greater tuberosity at the level of the union of tendon with bone,

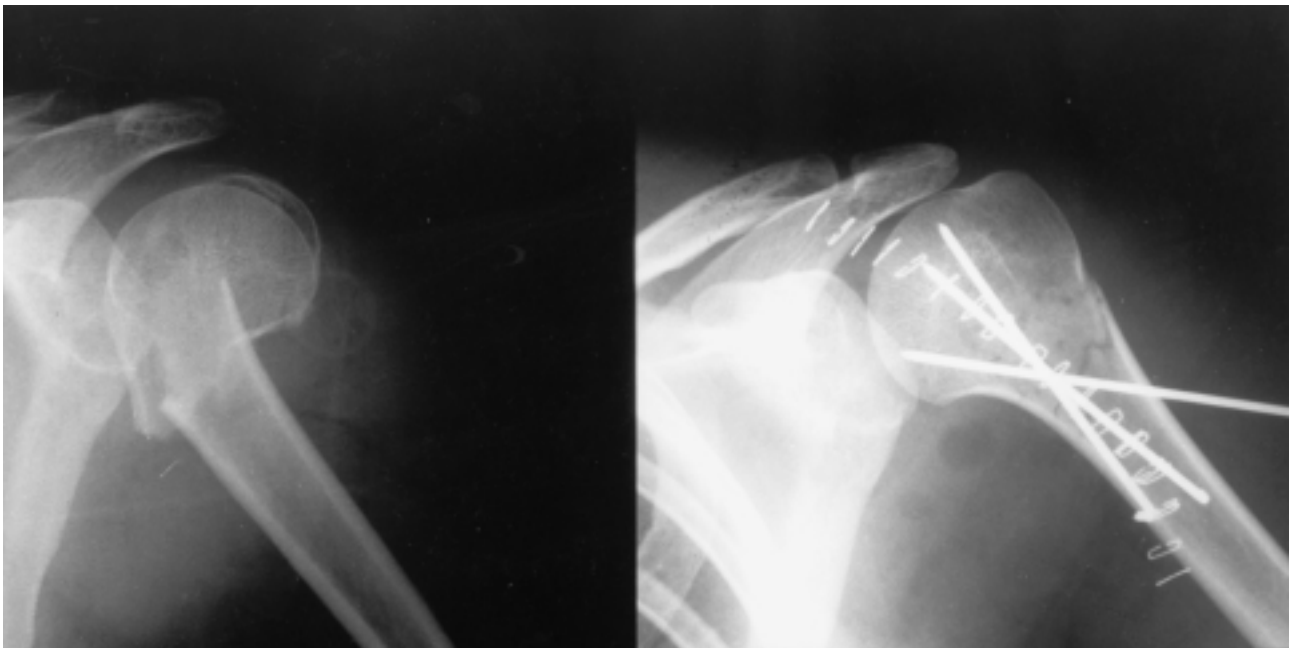

Fig. 3. — Fracture displaced into valgus before and after surgical treatment

where the latter is always more dense (15). Resch *et al.* (14) recommended percutaneous reduction and minimal osteosynthesis with cannulated screws with a similar fixation concept. This change in fixation philosophy explains the low incidence of complications in our series. No nonunions were noted ; there was only one avascular necrosis and one reintervention due to loss of reduction and displacement of material.

The rate of satisfactory or excellent results obtained is comparable to that in Hawkins' (5) series. Besides reestablishing the normal anatomy, it is important to achieve a stable fixation permitting early postoperative rehabilitation. Otherwise, a good anatomical reconstruction may be associated with a useless limb due to a frozen shoulder. For this reason we do not recommend surgery in patients with psychological difficulties or in those who are not likely to cooperate adequately in the physiotherapy program. In this sense the technique used has withstood the progressive rehabilitation program from the second postoperative day with only one case of secondary displacement.

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SAMENVATTING

J. DE LA HOZ MARÍN, P. HERNÁNDEZ CORTÉS, J. TERCEDEOR SÁNCHEZ. Heelkundige behandeling van driedelige humeruskopfracturen.

De meeste humeruskopfracturen kunnen conservatief behandeld worden. Voor de verplaatste driedelige fracturen echter dringt een ingreep zich op, om een anatomische reductie en voldoende stabiliteit te bekomen. Deze laatste om vroegtijdige revalidatie toe te laten. De auteurs beschrijven een eenvoudige osteosynthesetechniek met behulp van Kirschnerpinnen. Negenentwintig opeenvolgende driedelige fracturen, behandeld volgens deze methode, worden retrospectief beschreven. Na een minimum follow-up van 12 maanden werden, volgens de criteria van Neer, 79,3% zeer goede of aanvaardbare resultaten genoteerd. Achttien patiënten (62,1%) waren pijnvrij, of hadden slechts een lichte last zonder problemen in het dagelijkse leven. Vierentwintig schouders (75,9%) hadden een actieve abductie van meer dan 130°, en 15 (51,7%) raakten tot 130°. Er waren drie verwikkelingen : één ischemische necrose, één osteitis, en één secundaire verplaatsing waarvoor een wederingreep nodig was. De auteurs raden deze ingreep aan wegens zijn eenvoud en zijn gunstig effect.

RÉSUMÉ

J. DE LA HOZ MARÍN, P. HERNÁNDEZ CORTÉS, J. TERCEDEOR SÁNCHEZ. Traitement chirurgical des fractures à trois fragments de l'extrémité supérieure de l'humérus.

La plupart des fractures de l'humérus proximal peuvent être traitées de façon conservatrice. Cependant, le traitement chirurgical s'impose pour les fractures à trois fragments déplacées, pour obtenir une réduction anatomique et une stabilité suffisante pour permettre la rééducation précoce. Les auteurs présentent une technique simple d'ostéosynthèse au moyen de broches de Kirschner, qui s'applique au traitement des fractures à trois fragments de l'humérus proximal. Une série continue de 29 fractures à trois fragments de l'humérus proximal traitées par cette technique a été étudiée de façon rétrospective. Avec un suivi minimum de 12 mois, et sur base des critères de Neer, des résultats excellents ou satisfaisants ont été obtenus dans 79,3% des cas. Dix-huit patients (62,1%) n'avaient aucune douleur ou n'avaient qu'une douleur légère sans interférence avec la vie quotidienne. Vingt-quatre épaules (75,9%) avaient une élévation active supérieure à 130° et 15 (51,7%) avaient au moins 130° d'abduction active. Il y a eu trois complications : une nécrose avasculaire, une ostéite et une perte de réduction qui a exigé une reprise de l'ostéosynthèse. Les auteurs recommandent cette technique pour le traitement chirurgical des fractures à trois fragments de l'humérus proximal, en raison de sa simplicité et de ses bons résultats.