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ORIGINAL STUDY

Posteromedial approach to the distal humerus for fracture fixation

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The authors report their experience with the posteromedial surgical approach of the humeral shaft for internal fixation of fractures by plating. Sixteen patients were treated for humeral shaft fractures (14 for recent fractures and two for nonunion) below the mid-diaphysis, all without injury of the radial nerve. Patients were operated in the prone position. Plate and screw fixation on the medial side was used in all cases. Fourteen fractures healed without delay, and two after revision with bone grafting. There were no surgical complications. The posteromedial approach allows the surgeon to avoid dissection of the radial nerve, and is an interesting alternative to lateral approaches especially in cases of re-operation or nonunion. Preoperative lesion of the radial nerve is however a relative contraindication to selecting this posteromedial approach, as it does not give access to the radial nerve.

Keywords : humerus ; diaphyseal fracture ; posteromedial approach.

INTRODUCTION

Fractures of the humeral diaphysis are common ; they represent about 60 new cases per year in an orthopaedic trauma centre which serves a population of 600,000 people (*8*). Even though conservative treatment is favoured by many authors except under some specific conditions, surgical treatment is often used (multiple trauma, open fracture, patients at risk for nonunion) (*6*). This allows for rehabilitation of the adjacent joints without delay, whereas it is difficult to stabilise distal humeral shaft fractures using closed means without compromising the range of motion of the elbow. Plate fixation seems to be the most reliable means to achieve bone union (*6*). Plate fixation in the middle and distal third of the diaphysis poses a problem due to the presence of the radial nerve. Medial surgical approaches, away from the radial nerve, are rarely used (*3-5*). The so-called vascular surgical approach between the ulnar nerve posteriorly, and the median nerve and the humeral vessels anteriorly, is a good surgical alternative. Due to complications with the median nerve and the intra-operative surgical discomfort, we have discontinued using this surgical approach, and have used instead a posteromedial approach between the ulnar nerve anteriorly and the triceps muscle posteriorly (*5*).

MATERIAL AND METHODS

Patients

Sixteen displaced fractures of the humerus shaft below the mid-diaphysis in sixteen patients were treated

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Table I. — Clinical experience with the postero-medial approach

Case number	Age (years)	AO type	Time to union (months)	Elbow range of motion (°)	Comment
1	49	B1	3	0/15/125	Iliac crest bone graft (nonunion after nonsurgical treatment)
2	38	B2	4	0/10/120	Iliac crest bone graft (nonunion after external fixator)
3	21	B1	2	0/0/150	
4	17	A3	3	0/0/150	
5	17	B3	3	0/0/145	
6	72	A3	10	0/5/130	Septic nonunion. Fusion achieved after bone graft and plating through anterolateral approach
7	80	A3	3	0/0/145	
8	27	B3	3	0/0/145	
9	29	B2	8	0/5/135	nonunion. Fusion achieved after bone graft and plating through same approach
10	15	B1	2	0/0/140	
11	62	A3	3	0/0/145	
12	48	A2	3	0/0/145	
13	37	A2	3	0/0/145	
14	22	A1	3	0/0/150	
15	81	A1	4	0/0/150	
16	17	B2	4	0/5/150	

by two surgeons in the orthopaedic departments of Meaux Hospital between January 1, 2000, and January 1, 2005 (table I), using a posteromedial approach for open reduction and internal fixation. There were eight male and eight female patients. The average patient age was 39 years (range : 17 to 82). Eight patients were injured in a motor vehicle accident, six had falls, one had a direct shock over the arm (pedestrian in a road traffic accident) and one had a torsion injury (arm wrestling).

Two patients had multiple injuries ; the other fourteen patients had an isolated humeral fracture. All fractures were closed and none was complicated by a neurovascular lesion. The fracture site was in the portion of the humerus shaft extending from the middle to the distal third, on average 11.6 cm (range : 8 to 17) from the elbow joint. Four fractures were in the middle third and twelve in the distal third. There were no distal fractures involving the elbow. Based on the AO classification (*7*), there were A1 type fractures in 2 patients, A2 in 2, A3 in 4, B1 in 3, B2 in 3 and B3 in 2. There was a medial butterfly fragment in nine patients. Fourteen patients presented with an acute fracture and two with a delayed union : one of these had undergone external fixation 5 months before, and the other had been treated conservatively with immobilisation in a thoracobrachial cast 4 months before.

Surgical technique

The patient was positioned prone with the injured arm resting on a short arm support, with the shoulder in abduction and neutral rotation, the elbow flexed at 90°, and the hand hanging freely (fig 1). The whole upper limb was in the operative field, without a tourniquet, allowing rotation of the shoulder and flexion-extension of the elbow. The incision was medial, extending if necessary to the lower limit of the latissimus dorsi proximally and to the medial epicondyle distally (15 to 25 cm). Distally, the ulnar nerve was identified behind the medial epicondyle. The humerus was then approached between the medial epicondyle and the medial head of the triceps muscle. The ulnar nerve was displaced ventrally and the humerus exposed below the triceps muscle (fig 2). The reduction was obtained avoiding the use of bone forceps and spiked retractors to avoid injury of the radial nerve on the opposite side of

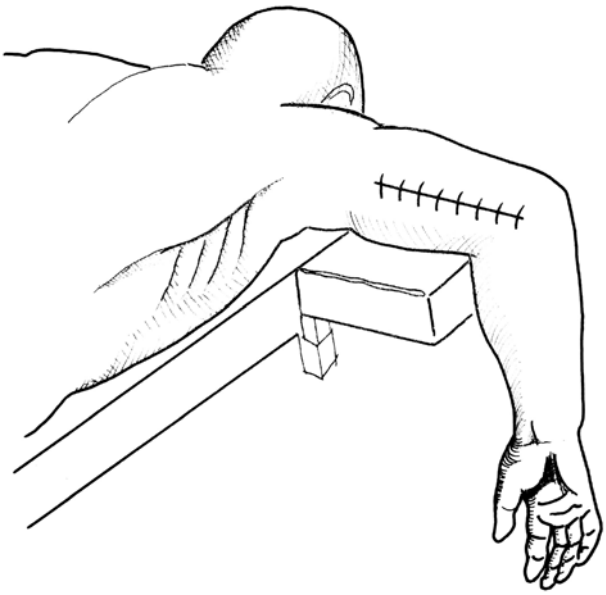

Fig. 1. — Patient positioned prone, the skin incision is medial

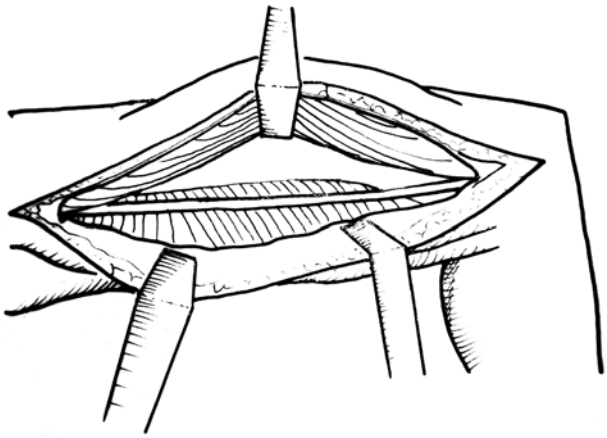

Fig. 2. — During this approach, the ulnar nerve is identified and protected.

the shaft, and to limit disruption of the osseous blood supply. Butterfly fragments, which typically are present medially, were reduced and stabilised first if possible. The major fracture was then fixed using a humeral (3.2 mm narrow) or a tibial compression plate (3.8 mm narrow) with at least three screws on either side of the fracture (3.5, 4.0 or 4.5 mm) (fig 3). The distal portion of the plate was bent to create a gentle curve to fit the medial aspect of the shaft. For fractures of the most distal portion, plating the humerus on the medial side is difficult because of the medial epicondyle. To address this problem, the plate was placed along the posterior aspect of the medial column, and the ulnar nerve was transposed anteriorly : dissection of the nerve was from proximal to distal, starting 6 to 8 cm above the medial epicondyle, and then for 5 cm into the flexor pronator muscle group distal to the medial epicondyle. After dissection, the nerve was placed subcutaneously anterior to the medial epicondyle, free from any pressure. For the non-united fractures, the humerus was approached by osteomuscular decortication, followed by freshening of the bone edges, then autologous bone grafting from the posterior iliac crest was performed. The wound was closed by allowing the triceps to fall into its natural bed, resulting in coverage of the plate.

Postoperatively, patients were immobilised in a sling, with the elbow against the trunk for 45 days. Wound dressing changes were done in the seated position, the trunk tilted forwards, the arm hanging and the shoulder in internal rotation so as to free the medial side of the arm without causing external rotation. Passive and active range of motion exercises of the shoulder and the elbow were initiated on the first postoperative day, avoiding external shoulder rotation.

RESULTS

The patients were evaluated at a mean of 16 months (range : 12 to 36) after the surgical procedure. There were no operative complications : no sensory or motor deficit in the ulnar nerve territory and no postoperative radial nerve palsy. The fracture healed in fourteen cases. The mobility of the elbow and the shoulder was good except in two patients (range : 5° to 135°) (table I). The patients were happy with the cosmetic appearance of the medially placed scar.

Two patients developed nonunion. In one case, the patient had presented with a severely displaced transverse fracture (B2 type) after a high-energy trauma. It healed in 7 months, after revision with removal of the plate, osteomuscular decortication, autologous bone grafting from the posterior iliac crest and new plate fixation using the same surgical approach. In the other case, the patient developed an infected nonunion due to *Staphylococcus aureus*. The fracture healed in 3 months after removal of the plate, debridement, autologous bone

Fig. 3A. — Patient n° 4 (table I) : Anteroposterior radiograph of the right humerus.

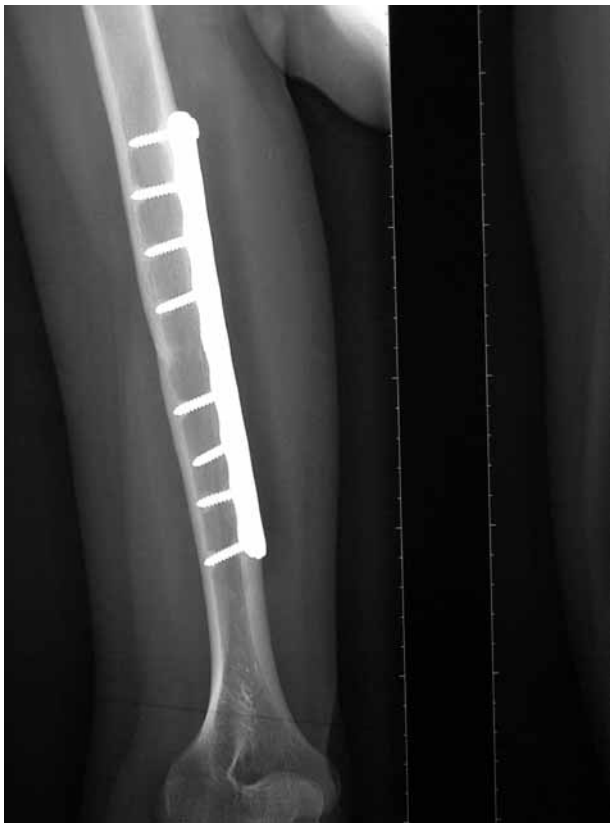

Fig. 3B. — Same patient : Postoperative radiograph – Humeral fixation was done 5 years before with a 3.2 mm 9-hole plate and 8 screws.

grafting, plating through an anterolateral approach and antibiotics.

DISCUSSION

Medial approaches are rarely used for internal fixation of humeral shaft fractures. Since these approaches were described by Judet *et al* (*3*), few publications have explored the results of plate fixation using the medial approach for fracture (*5*) or nonunion (*4*).

There are several advantages to the medial approach : no dissection of the radial nerve, the humeral shaft allows for easy adaptation of the plate except the distal portion because of the medial epicondyle, the butterfly fragment which is usually medial is easily accessible for reduction under direct view and for fixation ; the surgical scar is hardly visible. However, this approach is not recommended in cases with pre-operative radial nerve injury, as it does not give access to the radial nerve. In such cases, the lateral approach is considered the "gold standard" (*1*). However, the lateral approach gives poor access to the upper half of the diaphysis, and exposes to injury of the radial nerve, which crosses the posterior aspect of the humerus from an average of 20.7 +/- 1.2 centimeters proximal to the medial epicondyle to 14.2 +/- 0.6 centimeters proximal to the lateral epicondyle (2). The posteromedial approach is not possible in multiple-injured patients who cannot be positioned in the prone position. In cases with shoulder stiffness, the installation is difficult but is possible thanks to the scapulo-thoracic mobility (case number 1 ; table I).

The "vascular approach" (*3*) is easily performed but is uncomfortable especially to control the

fracture reduction, which in some cases is achieved in internal rotation of the shoulder : the superior edge of the incision and the biceps muscle tend to block the shaft. It then becomes necessary to use spiked retractors on the anterior aspect of the humerus with a high risk of stretching the median nerve (*5*), of injuring a humeral vessel, or of compressing the radial nerve on the opposite side of the diaphysis.

For this reason, we have preferred an approach of the humerus that passes behind the ulnar nerve, in the prone position. We fix the plate on the medial aspect of the humerus, avoiding to trap muscle fibres. One possible criticism of the medial approach may be a perceived risk to the ulnar nerve. In distal fractures or in fractures with intra-articular involvement, the plate is placed posteriorly, at a 5° angle relative to the long axis of the humerus, and the distal screw can be anchored on the medial epicondyle. In this case transposition of the ulnar nerve anteriorly is done to avoid a post-operative conflict with the plate. Contrary to the radial nerve in the lateral surgical approaches, the ulnar nerve is never stretched because it displaces forwards in the ventral decubitus ; we did not observe any lesion of this nerve. The prone position helps to obtain fracture reduction : the flexed position of the elbow relaxes the biceps, the humerus is put under traction by the weight of the forearm hanging freely, and the rotations are free. If need be, a traction can be used intra-operatively using a trans-olecranon pin.

Based on these results, it appears that displaced fractures and nonunions below the mid-point of the humerus shaft can be managed efficiently via a postero-medial approach in cases without pre-operative radial nerve palsy.

REFERENCES

1. **Alnot J, Osman N, Masmejean E, Wodecki P.** Lesions of the radial nerve in fractures of the humeral diaphysis. A propos of 62 cases. *Rev Chir Orthop* 2000 ; 86 : 143-150.
2. **Gerwin M, Hotchkiss RN, Weiland AJ.** Alternative operative exposures of the posterior aspect of the humeral diaphysis with reference to the radial nerve. *J Bone Joint Surg* 1996 ; 78-A : 1690-1695.
3. **Judet R, Patel A, Demeulenaere C.** Trois voies d'abord de l'extrémité supérieure de l'humérus et de la diaphyse humérale. *Presse Méd* 1968 ; 76 : 1961-1963.
4. **Jupiter JB.** Complex non-union of the humeral diaphysis. Treatment with a medial approach, an anterior plate, and a vascularized fibular graft. *J Bone Joint Surg* 1990 ; 72-A : 701-707.
5. **Laporte C, Jouve F, Jegou D, Saillant G.** Medial approaches to the distal humerus for fracture fixation. *Rev Chir Orthop* 2002 ; 88 : 177-181.
6. **McCormack RG, Brien D, Buckley RE *et al.*** Fixation of fractures of the shaft of the humerus by dynamic compression plate or intramedullary nail. A prospective, randomised trial. *J Bone Joint Surg*.2000 ; 82-B : 336-339.
7. **Müller ME, Nazarian S, Koch P, Schatzker J.** *The Comprehensive Classification of Fracture of Long Bones*. Springer-Verlag, Berlin, etc, 1990.
8. **Tytherleigh-Strong G, Walls N, McQueen MM.** The epidemiology of humeral shaft fractures. *J Bone Joint Surg* 1998 ; 80-B : 249-253.