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*ORIGINAL STUDY*

# A simple technique for double plating of extraarticular distal humeral shaft fractures

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**Plate fixation of extraarticular distal humeral shaft fracture is often difficult. Traditional techniques do not allow for stable fixation. A single DCP plate may have inadequate purchase in the distal fragment. The use of large plates extending distally over the lateral supracondylar ridge is often associated with pain and sometimes interferes with elbow range of motion. In this study, 22 patients with extra articular distal humeral fractures were managed with dual plating using a paratricipital approach. The first plate – a narrow DCP – was fixed on the dorsal surface of the humerus. The second plate – a small 3.5 reconstruction plate – was fixed on the dorsolateral surface. Elbow motion was started immediately after surgery. The average follow-up duration was 25 months. The mean elbow flexion/extension arc was 4° to 138°. Infection was reported in two cases and was managed successfully with conservative measures. Postoperative radial nerve contusion was reported in one case with complete resolution within 3 months.**

**Keywords** : humerus ; shaft ; diaphyseal ; fracture ; dual plating ; osteosynsthesis.

## INTRODUCTION

There has been much controversy regarding management of extraarticular distal humeral fractures. Conservative treatment has been used for a long time as the best method of treatment (*3,4,15-19*). Many authors have advocated managing these fractures surgically with open reduction and internal fixation with plate and screws (*1,9,10*). It is often difficult to obtain rigid internal fixation in very distal fractures of the humeral diaphysis without the plate impinging on the olecranon and affecting elbow function (*14*). Older techniques recommended a single DCP plate fixed on the posterior humeral surface. Moran used a DCP plate 4.5 mm at a 5° to 8° angle off-center from the long axis of the humerus along the lateral column to avoid the olecranon fossa and to give a chance for more distal fixation. However this resulted in a risk for a weak proximal fixation especially in the face of proximal segmental extension or comminution, as the oblique position of the plate prevents the placement of additional proximal fixation (*12*). Many newer techniques advised the use of a precontoured plate centrally placed on the posterior humerus with a flare extending distal and lateral for added fixation (*10*). The use of locked plates has also been described (*21*). In this study, we used a simple inexpensive and biological method involving a narrow DCP plate fixed on the posterior surface with only 1-2 screws in the

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distal fragment without impinging on the olecranon, with a 3.5 reconstruction plate for added stability. Both union rate and elbow function have been evaluated.

## MATERIAL AND METHODS

Between 2009-2011, 22 patients with extra articular distal humeral fractures were treated in our university trauma center with dual plating. In this prospective study, a modified posterior approach was used including medial retraction of the distal part of the triceps. There were 15 males and 7 females. Their ages ranged between 25-67 years (mean : 43.5 ± 12.03). The dominant arm was involved in 15 cases. The mechanism of injury was a simple fall in 7 patients, a motor vehicle accident in 7 patients, and a motor bicycle accident in 8 patients. Three patients presented with associated fractures : ipsilateral fracture of a femur and bilateral ankle fractures (N = 1), ipsilateral fracture of a tibia (N = 1) and contralateral fracture of the forearm bones (N = 1). Surgery was done for all patients within 1-10 days (average : 3.4 ± 1.97) after trauma (Table I). Initial closed reduction and splinting in a long posterior arm slab was done in all cases. The indication for open reduction and internal fixation was either polytrauma or presence of radiographic parameters including : greater than 15° varus/valgus angulation or greater than 3 cm shortening. Fractures included in this study were those involving the distal third of the humeral shaft with short distal segment, such that secure fixation of the distal fragment was not possible with a single posterior plate. Only four cortices could possibly be fixed in the distal fragment with the narrow DCP plate, and a low profile posteromedial reconstruction plate was inserted fixing 6 cortices distally.

Table I. — Demographic data

| Case No | Age (years) | Sex | Side affected | Fracture classification (OTA) | Time from trauma to operation (days) | Associated injury |
|---|---|---|---|---|---|---|
| 1 | 40 | M | L/ | 12-B2.3 | 2 | |
| 2 | 35 | F | R/ | 12-A2.3 | 1 | |
| 3 | 41 | M | R/ | 12-B1.3 | 1 | |
| 4 | 28 | M | R/ | 12-B1.3 | 2 | fracture femur, bilateral ankle |
| 5 | 52 | M | L/ | 12-A2.3 | 4 | |
| 6 | 49 | F | R/ | 12-B2.3 | 3 | |
| 7 | 60 | F | R/ | 12-B3.3 | 5 | |
| 8 | 25 | M | L/ | 12-A2.3 | 4 | |
| 9 | 57 | M | R/ | 12-C1.3 | 4 | fracture tibia |
| 10 | 45 | M | R/ | 12-A2.3 | 10 | |
| 11 | 29 | F | L/ | 12-B2.3 | 4 | |
| 12 | 31 | M | L/ | 12-A2.3 | 1 | contralateral bb forearm |
| 13 | 67 | M | L/ | 12-B3.3 | 4 | |
| 14 | 55 | M | R/ | 12-A2.3 | 6 | |
| 15 | 43 | F | R/ | 12-A1.3 | 4 | |
| 16 | 30 | M | R/ | 12-A3.3 | 2 | |
| 17 | 51 | M | L/ | 12-C1.3 | 3 | |
| 18 | 33 | M | L/ | 12-A1.3 | 2 | |
| 19 | 59 | F | R/ | 12-A3.3 | 4 | |
| 20 | 46 | M | L/ | 12-B2.3 | 5 | |
| 21 | 32 | F | L/ | 12-A1.3 | 2 | |
| 22 | 49 | m | R/ | 12-A1.3 | 3 | |

**Surgical Technique**

Plain radiographs of both the humerus and elbow, including two orthogonal views, were adequate for planning. The patient was positioned in the lateral decubitus position. The arm was positioned in the flexed position by the side. No tourniquet was used. A modified posterior approach was used including posterior midline incision, lateral exposure between the triceps and brachioradialis with medial retraction of the triceps. Exploration of the ulnar nerve and medial exposure between triceps and brachialis was done to allow for additional space for the second plate insertion. Two plates were used to fix the fracture. The first plate was a narrow DCP inserted posteriorly and medially above the olecranon fossa. In these distal fractures, only two screws could be inserted in the distal fragment. The second plate (reconstruction plate 3.5) was inserted mainly laterally. This second plate allowed 3 screws for fixation distal to the fracture. Bone graft was needed in two cases with severe comminution.

No external immobilization was necessary. On the first postoperative day, passive and active assisted range of motion of the elbow and shoulder was begun.

## RESULTS

The average follow-up was 25.27 ± 5.46 months (range : 17-36 months). The average time to union was 14.04 ± 2.98 weeks (range : 8-20 weeks) defined as absence of pain on physical examination, and radiographic bridging of bone on at least two views (Fig. 1 & 2). All patients had less than 5° of angulation in all planes and no appreciable shortening or rotation. The mean elbow extension/flexion arc was 4° to 138° (range : 0-5° extension, 120-150° flexion). Elbow flexion was back to normal within a period of 5-10 weeks. Recovery of extension took 5 to 8 weeks. Infection occurred in two cases and was managed conservatively with no effect on elbow motion. One patient had a postoperative radial nerve neurapraxia which completely resolved within 3 months.

## DISCUSSION

The main goal of treatment of extra-articular distal humeral fractures is to restore alignment and achieve stable adequate fixation to allow early elbow range of motion, which is important for a good functional outcome (*8,22,25*). Conservative treatment has been tried for such fractures. Good clinical results were reported using functional bracing following Sarmiento *et al* (*16*). However, braces fail to control alignment in this region with such small distal fragment and elbow function is better preserved with rigid fixation and early range of motion (*1,6*). The polytrauma patient can also benefit from adequate stabilization (*2,11,24*). It is often difficult to obtain rigid fixation in distal fractures of the humeral diaphysis without compromising elbow function. Many methods of internal fixation have therefore been suggested.

Schatzker and Tile advised plating the humerus posteriorly in order to utilize the flat posterior surface to achieve adequate distal fixation ; however, very distal fixation was problematic owing to impingement on the olecranon fossa as well as varus malreduction (*20*).

Moran used an oblique posterior plate orientation with a 5-8° angle off-center from the long axis of the humerus and directing the most distal screw proximally. He evaluated 8 cases (7 acute and one nonunion) and reported no complications. While improving distal fixation, the obliquity of the plate limited proximal fixation, which was problematic in comminuted or segmental fractures (*12*).

Pickering *et al* have managed distal humerus fractures using intramedullary devices. However, the medullary canal of the distal fragment often does not provide stable fixation, even when locked, resulting in potential malunion or nonunion (*13*). Furthermore, very distal shaft fractures may not allow intramedullary fixation.

In 2005, Levy *et al* reported excellent results in 15 patients using an alternative method of osteosynthesis with a modified lateral tibial head buttress plate. This modified Synthes plate had an angular offset of 22°, which allowed the plate to contour the posterolateral column and also to extend proximally up the humeral shaft. They included 15 cases (12 acute and 3 nonunions) with average follow-up of 6 months. The average range of elbow motion was from 11° to 112° at the last follow-up examination. The authors did not report the patient compliance with that bulky plate on the thin lateral column of the elbow and regarding postoperative pain. The use


***Fig. 1.*** — Case no 1 : a : preoperative AP radiograph ; b & c : immediate post-op radiograph ; d & e : 31 months after surgery

of such plate with 4.5 screws on the posterior aspect of the narrow lateral column and with thin soft tissue coverage may induce postoperative pain and limit elbow range of motion (*10*).

Scolaro *et al* described the use of small fragment (3.5 mm) extra-articular distal humeral locking plate for extra-articular distal humerus fractures. They proposed that the benefits of this plate are that it matches the contour of the distal humerus, does not impinge on the olecranon fossa, provides increased distal fixation, and allows for a locking construct (*21*). In a laboratory study on eight matched pairs of humeri models, Tejwani *et al* demonstrated that a double plating construct is stiffer than one single-locking plate when physiologically loaded in anterior, posterior, and lateral bending. They also concluded that with locked plates placed on the lateral column, resistance to varus stress is less than with a double plate construct especially in the absence of medial buttress. The use of a single locking plate will require the use of a thicker and wider plate on the thin lateral column (*23*).

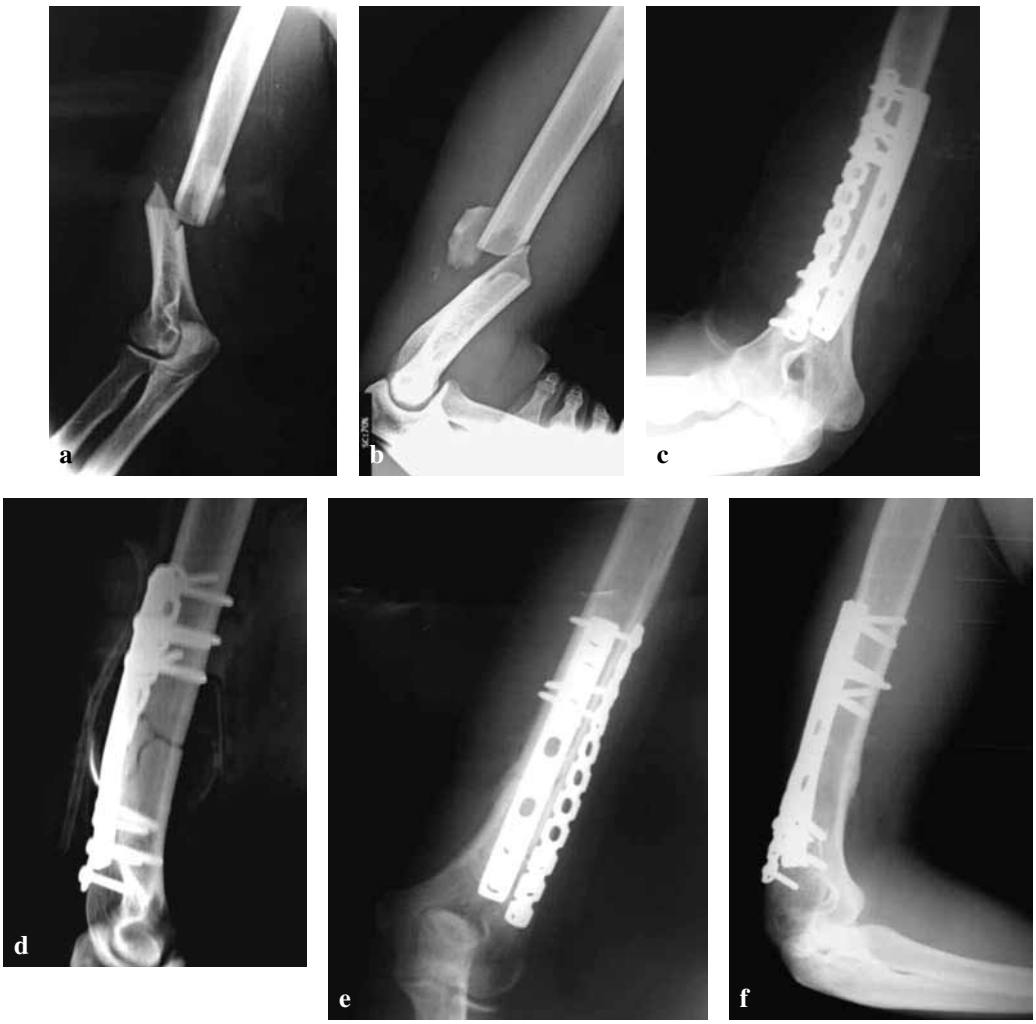


***Fig. 2.*** — Case no 4 : a & b : preoperativeradiographs ; c & d : immediate postoperative radiographs ; e & f : 26 months postoperative.

Prasarn *et al* used dual plating for fixation, including a 2.7 or 3.5 reconstruction plate laterally and a precontoured extra-articular distal humerus locking plate with a ''hockey stick'' distal configuration to fit the distal column anatomy and orientation. The range of elbow motion in 15 cases in their series was 4 to 131°.The average time till union was 11.5 weeks (range : 6-24 weeks). Their complications included pain at the incision site which required implant removal in one case (*14*).

In our study, we used double plates with almost 90-90° orientation. The first plate – the narrow 4.5 DCP – was contoured on the posterior surface of the humerus just proximal to the olecranon fossa. The second plate – a 3.5 reconstruction plate – was contoured and inserted posterolaterally extending distally over the lateral supracondylar ridge. The use of the paratricipital approach avoided damaging the triceps muscle, allowing early range of motion which was started from the first postoperative day without splinting. The plate positioning in a nearly perpendicular position is considered by many authors to be mechanically more stable than parallel plates (*5,7*). The use of a low profile 3.5 reconstruction plate extending distally allowed good fixation without much compromise to elbow motion

and soft tissue covering. Our results in this study were comparable to the results of Prasarn *et al* (*14*) with good range of elbow motion and without appreciable complications.

The paratricipital approach was utilized without exploration of the radial nerve. Using the medial access between triceps and brachialis allowed less exposure proximally on the lateral side. However, for cases with longer fracture area that will require longer plates proximally, exploration of the radial nerve will be required.

More distal fractures including the supracondylar region just proximal to the olecranon fossa where no screws can be applied to fix the distal fragment through a posteriorly inserted plate were not encountered during this study. In such cases, this technique has limited efficiency and the use of two low profile reconstruction plates on both supracondylar ridges is more appropriate.

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