

# Osteosynthesis in Fractures of the Distal Third of Humeral Diaphysis

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## ABSTRACT

**Objectives:** To compare the clinical results of osteosynthesis with plate and screws versus antero-  
grade locked intramedullary nail in fractures of the distal third of humeral diaphysis.

**Material and methods:** 184 patients with fractures of the distal third of humeral diaphysis were  
included in a prospective study. 82 patients underwent open reduction and internal fixation with plate  
and screws (Group 1), while in 102 cases, closed reduction and osteosynthesis with locked intramedul-  
lary nail was performed (Group 2). The 2 groups were similar in terms of age and gender distribution  
and pattern of fractures. The function of shoulder and elbow were assessed using the Oxford Shoulder  
Score (OSS) and Oxford Elbow Score (OES). Operating time, duration of hospital stay, complications  
and moment of union were recorded.

**Outcomes:** 6 months after surgery the average OSS was 44.42 in Group I and 40.23 in Group II,  
while the mean OES was 40.88 in Group I and 46.54 in Group II. The average duration of the surgical  
procedure was 87 min in Group 1 and 43 min in the nail group ( $p < 0.001$ ). The mean duration of hospital  
stay was 2.6 days in Group 1 and 1.8 days in Group 2 ( $p < 0.05$ ). The rate of non-unions was 3.66%  
in the plate group and 2.94% in the retrograde nail group ( $p > 0.05$ ).

**Conclusions:** The clinical results of the 2 methods of osteosynthesis were similar, but the operating  
time and the duration of hospital stay were longer after plate osteosynthesis. Shoulder function was  
slightly impaired in the nail group but not statistically significant.

**Keywords:** osteosynthesis, compression plate, intramedullary nail, humerus

## INTRODUCTION

**M**ost distal third humeral shaft fractures can be treated by conservative methods with an overall low complication rate (especially in what infection and radial nerve palsy are concerned). In opposition to this concept some authors recom-

mend immediate surgical intervention in order to achieve a predictable and stable fixation and an early active physical rehabilitation of shoulder and elbow joints. These fractures can be fixed internally using compression plating (CPL) or intramedullary nails (IMN). CPL has been proved to provide a good and stable alignment and an early rehabilitation in despite of an extensive soft tissue exposure and the danger of

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radial nerve injury. IMN offers the advantage of a closed osteosynthesis, preserves the periosteal blood supply and distributes the load sharing all around the diaphysis but no matter if it's anterograde or retrograde it impairs the shoulder or/and elbow function.

This study aims to compare the clinical results of osteosynthesis with CPL and screws versus anterograde locked IMN in fractures of the distal third of humeral diaphysis. □

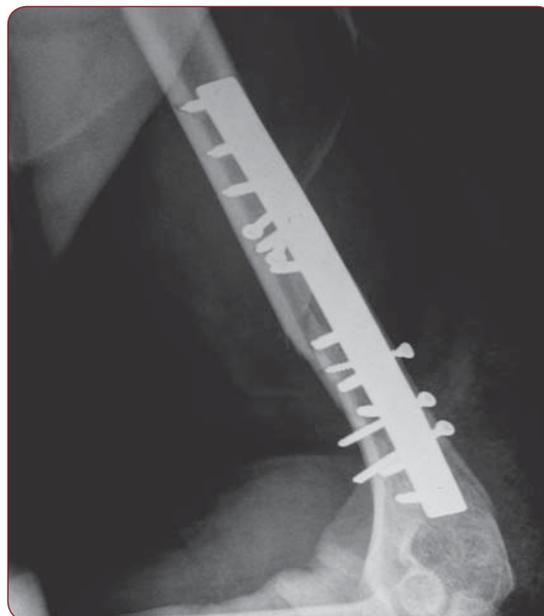
### MATERIAL AND METHODS

184 patients with fractures of the distal third of humeral diaphysis were included in a prospective study. 82 patients underwent open reduction and internal fixation with plate and screws (Group 1), while in 102 cases, closed reduction and osteosynthesis with locked intramedullary nail was performed (Group 2). The two groups were similar in terms of age and gender distribution and pattern of fractures.

All the fractures were at least five centimeters proximal to the olecranon fossa; open fractures, pathological fractures and fractures with initial nerve or vascular complications were excluded from the study.



**FIGURE 1.** Osteosynthesis with plate and interfragmentary screws – postoperative X-ray view.



**FIGURE 2.** Osteosynthesis with plate and interfragmentary screws – postoperative X-ray view.

In Group 1, during surgery, the patients were placed in a prone position with the arm in a 90 degrees lateral abduction. A median posterior approach was used and whenever the fracture was close to the middle third of the humeral shaft, we preferred to isolate and protect the radial nerve prior to osteosynthesis. A four millimeters thickness CPL with at least six holes was used in all cases. At least three bicortical screws were introduced in each fragment (Figure 1). Interfragmentary screws were used when required in order to stabilize fragments and maintain reduction (Figure 2).

In all cases undergoing IMN, the patients were placed in a supine position and a trans deltoidian (splitting fibers) approach was preferred. The entry point for the nail was situated between the articular surface of the humeral head (medially) and the greater tuberosity (laterally). The nail was made of stainless steel and locked with one or two screws in each fragment (depending on the site of fracture) (Figure 3) or with one or two screws in the proximal fragment and expandable tip in the distal one (Figure 4).

After surgery the arm was put at rest in a splint for 7 to 14 days depending on the surgical procedure and intensity of pain. Intermittent physical rehabilitation was started for both shoulder and elbow at 7 days postoperatively. Clinical and radiological check-ups were done at 6, 12 and 16 weeks after surgery. Clinical



**FIGURE 3.** Osteosynthesis with locked centromedullary nail – postoperative X-ray view.



**FIGURE 4.** Osteosynthesis with expandable centromedullary nail – postoperative X-ray view.

examination referred to shoulder and elbow range of motion and neurological examination. Radiological examination considered fracture alignment and stability and progression of fracture union.

The function of shoulder and elbow were assessed using the Oxford Shoulder Score (OSS) and Oxford Elbow Score (OES). Operating time, duration of hospital stay, complications and moment of union were recorded.

Statistical analysis was performed and the differences were considered significant if the p value was <0.05. □

**RESULTS**

At six months after surgery the average OSS was 44.42 in Group1 and 40.23 in Group II ( $p>0.05$ ), while the mean OES was 40.88 in Group 1 and 46.54 in Group 2 ( $p>0.05$ ).

The average duration of the surgical procedure was 87 min in Group1 and 43 min in the IMN group ( $p<0.001$ ). The mean duration of hospital stay was 2.6 days in Group 1 and 1.8 days in Group 2 ( $p<0.05$ ). Union was appreciated clinically and radiologically; if no sign of bone bridging was obtained until six months after surgery, that case was rated as a non-union.

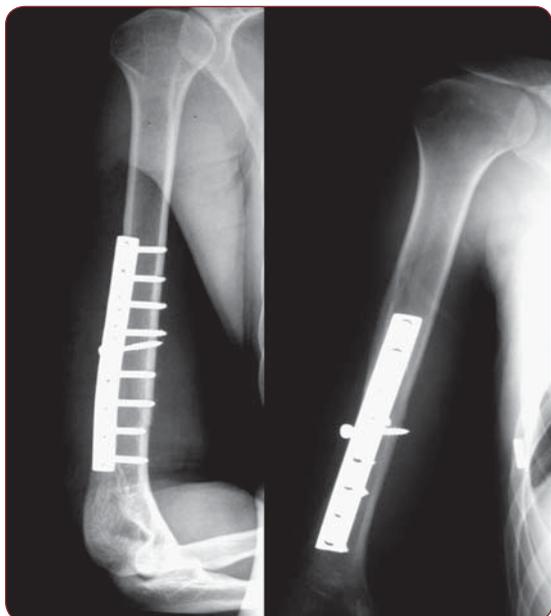
The rate of non-unions was 3.66% in the CPL group and 2.94% in the IMN group ( $p>0.05$ ). The rate of radial palsy was 2.44% (2 cases/ 82 patients) in Group 1 and 0.98% (1 case /102 patients) in Group 2 ( $p>0.05$ ). All the postoperative radial nerve palsies were transient and fully recovered at six months. Sepsis was present in 3 cases / 82 patients (3.66%) in Group 1 and 0 cases / 102 patients (0%) ( $p<0.05$ ) in Group 2. □

Type of osteosynthesis Functional scores	CPL (Group I)	IMN (Group II)	p
OSS	44.42	40.23	>0.05
OES	40.88	46.54	>0.05

**TABLE 1.** Functional results in shoulder and elbow after surgery.

Type of osteosynthesis Complications	CPL (Group I)	IMN (Group II)	p
Nonunion	3.66%	2.94%	>0.05
Radial nerve palsy	2.44%	0.98%	<0.05
Sepsis	3,66%	0	<0.001

**TABLE 2.** Rate of complications after surgery.



**FIGURE 5.** Osteosynthesis with plate and interfragmentary screw – postoperative X-ray views.

## DISCUSSIONS

In many orthopedic departments, most of the fractures of the distal third of humeral diaphysis are still treated by conservative methods, especially in some elderly patients who might present a high risk for anesthesia. Jawa et al (1) published a retrospective study, comparing the values of conservative and surgical treatment. Functional bracing can be quite uncomfortable at least at the beginning of immobilization period. In terms of bone union, most of the authors report very good results, better than after surgical treatment, even if the healing may be accompanied by a variable degree of misalignment. Up to a certain degree, misalignment will not impair the function of the upper limb or need to convert the treatment towards a surgical procedure. Stiffness of the shoulder and elbow joints is slightly common after conservative methods and may need a longer time of physical rehabilitation in order to restore their normal mobility. Infection is very rare and there is no need for a second intervention for hardware removal.

But in the last ten years, management of these fractures by surgical methods gained more and more place. The most used surgical methods of fixation are CPL and IMN and controversy still exists between the superiority of one of this procedure over the other.

Schatzker (2) advocated for CPL fixation on the posterior aspect of the distal humerus for a few reasons: on this aspect the surface of the humerus is flat enough to adapt the plate in good conditions, the olecranon fossa is well visualized and we can rationally place the distal screw in order to avoid it, this approach allows the placement of two plates on each side of the humerus.

Also, IMN fixation devices have been described by many authors (3,4). They showed that in comminuted fracture the fixation is poor, especially if the size of the diaphyseal canal doesn't fit with the nail, leading to high rates of mal- or non-union. Distal locking of the nail may weaken the humeral cortex and produce fractures. Also, biomechanical laboratory bending tests have proved superior stability of the osteosynthesis, if performed with a CPL in comparison with a IMN (5).

Different studies on CPL fixation reported a 2-10% rate of non-union, 2-5% rate of postoperative radial nerve palsy, 2-4% rate of wound infection. In our CPL group the rate of non-union was of 3.66%, rate of radial nerve palsy of 2.44% and rate of infection of 3.66%, all of them being inside the limits found in the literature.

Non-union cases in the CPL group are considered to be influenced by the insufficient fixation of the bone fragments. Three bicortical screws in each fragment seem to be inadequate, especially if the fracture pattern is unstable. In these cases some authors recommend an additional interfragmentary screw or a longer plate with eight holes and four bicortical screws in each fragment (Figure 5).

In IMN fixation, non-union is usually due to iatrogenic interfragmentary diastasis during surgical procedure. Consequently, attention must be paid not to impinge the distal fragment when the nail is hammered and to accurately size the nail to the length of humerus. □

## CONCLUSIONS

The clinical and radiological results of the 2 methods of osteosynthesis were similar, but the operating time and the duration of hospital stay were longer after plate osteosynthesis. Shoulder function was slightly impaired in the nail group but not statistically significant. Fixation with an eight holes CPL will provide a superior stability of the osteosynthesis and will

allow a more aggressive physical rehabilitation. The intramedullary nails must be of the right length and size and during hammering we must avoid creating any interfragmentary gap. All

these technical tips and tricks will decrease the rate of non-unions.

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