

# Double Tension Band Osteosynthesis in Supracondylar Distal Humerus Fractures in Osteoporotic Adults.

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## ABSTRACT

**Background:** It is a challenge for orthopaedic surgeons to fix osteoporotic supracondylar distal humerus fractures rigidly for early mobilization because the holding power of the plate and screw fixation is low in osteoporotic bone fractures and have a higher failure rates for internal fixation. To achieve a stable, mobile and pain free joint requires appropriate preoperative planning, systematic approach obtaining an anatomic reduction and rigid construct to tolerate early mobilization. **AIM:** To evaluate the effectiveness of double tension band wiring in supracondylar distal humerus fractures in osteoporotic adults. **Methods:** 10 patients presenting with distal humerus fractures are treated with double tension band wiring technique between 2017 to 2019 were retrospectively evaluated in our orthopedic department. Fractures were classified according to AO/OTA classification. Total 10 cases with supracondylar fracture of the distal humerus were studied, 4 fractures were type A2 and 6 fractures were type A3. Patient's age averaged 65 years (range, 50–75 years). There are 4 males and 6 females. **Results:** All fractures treated with this method achieved union and rigid fixation. Radiological union was been achieved at an average of 8 weeks. DASH score at final follow-up averaged 14.4 points (range, 6–23). The analog scale of pain averaged 0.9 points (range, 0–3). Average Elbow range of motion 105° (100–120°) with maximum ROM 120° and minimum of 100° Flexion averaged 120° (115–130°) and elbow extension loss averaged 15° (range, 10–25°). There were no infections and elbow stiffness. **Conclusion:** Supracondylar distal humerus fractures can be successfully managed by Double tension band wiring and this method is a simple, reliable, faster, minimal hardware usage, less demanding and cost effective method. We recommend this technique for treating in osteoporotic patients in which two column orthogonal plate constructs are of less useful.

**Keywords:** Osteosynthesis. Supracondylar Distal Humerus Fractures.

## INTRODUCTION

It is a challenge for orthopaedic surgeons to fix osteoporotic supracondylar distal humerus fractures rigidly for early mobilization because the holding power of the plate and the screw fixation is low/weak in osteoporotic bone fractures and have a higher failure rates for internal fixating. To achieve a stable, mobile and pain free joint requires appropriate preoperative planning, systematic approach obtaining an anatomic reduction and rigid construct to tolerate early mobilization. Supracondylar Distal humerus fractures in osteoporotic adults are frequently complex and pose a considerable challenge to even most

experienced orthopaedic surgeons. Difficulty rests in the complex anatomy of the elbow and its limited amount of subchondral bone. Various methods of internal fixation have been described using single screws, single plates and multiple K-wires but these can't provide enough stability for early mobilization. The latest literatures in treatment of distal humerus fractures emphasize the fact that usage of dual plate fixation, with placement of a separate strong plate on each column, is indicated for all adult fractures involving both columns of the distal part of the humerus. Their treatment has changed over recent years, mainly due to better imaging studies and the evolution in fixation approaches, techniques and implants.

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### Aim:

To evaluate effectiveness of double tension band wiring in supracondylar distal humerus fractures in osteoporotic bones.

**MATERIALS AND METHODS**

A Retrospective study was conducted in Chalmeda Anandarao institute of medical Sciences, Karimnagar for a duration of 1 year from 2017 to 2018 which studies the effectiveness of double tension band wiring for supracondylar distal humerus fractures in osteoporotic bones. A total of 10 patients were evaluated presenting with supracondylar distal humerus fractures and were osteoporotic by using anteroposterior and lateral radiographs and classifying them according to AO Classification. After the surgery they were evaluated for radiographic union, pain, range of movement at the respective elbow joint at 3, 4, 6 weeks and then at monthly interval for 1 year. Total 10 cases with supracondylar fracture of the distal humerus were studied and are classified according to AO classification. 5 fractures were type A2, 4 fractures were type A3 and 1 fracture was type C1.

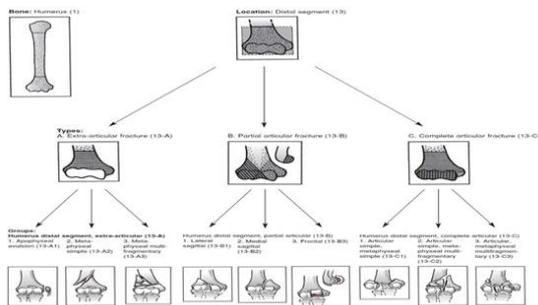


FIGURE 25-3 The AO/OTA classification of distal humerus fractures.<sup>10,11</sup>

S.NO	AGE	SEX	MODE OF INJURY	CLASSIFICATION	APPROACH (POSTERIOR)
1.	54	Female	Slip and fall on ground	A2	Paratricipital
2.	59	female	Fall from height	A3	Paratricipital
3.	64	Male	Fall from height	A2	Triceps reflecting with olecranon chevron osteotomy
4.	57	male	Road traffic accident	A2	Paratricipital
5.	64	Female	Slip and fall	A3	Triceps reflecting +olecranon osteotomy
6.	60	Female	Slip and fall	A3	paratricipital
7.	58	female	Road traffic accident	C1	Triceps reflecting with olecranon chevron osteotomy
8.	72	male	Fall from height	A2	Triceps reflecting +olecranon osteotomy
9.	63	female	Road traffic accident	A3	Triceps reflecting +olecranon osteotomy
10.	69	male	Fall from height	A2	paratricipital

**Procedure:**

Patients were placed in lateral decubitus position under regional block or general anaesthesia, the arm was placed hanging over a radiolucent support, with the elbow hanging free in 90° of flexion, a tourniquet was not used. A posterior approach was used in all cases—paratricipital as described by Alonso-Llames in 5 cases and a posterior triceps elevating approach through an extra-articular olecranon osteotomy as described by Bryan-Morrey in 5 cases. In triceps reflected cases the reflected triceps was reinserted using non-absorbable sutures placed transosseously. Ulnar

nerve identified and carefully released, mobilized and protected throughout the surgical procedure. Either 1.8- or 2-mm K-wires were used; they were placed entering through the epitrochlea and epicondyle distally to the fracture line, without detaching soft tissues. Once the K-wires were placed in the distal fragment, they were used as joysticks aiding in achieving reduction of the fractured fragment. Two or three K-wires were used for each column; they were placed exiting through the opposite cortex, proximal to the fracture line. Once the K-wires were placed, a hole with a 2.7-mm drill was performed proximal to the fracture line on each side, and a 1.6- or 2- mm wire was driven through it, then crossed to make a figure of eight, and passed through the distal soft-tissues, distally to the entry point of the K-wires. Once both tension bands were in place they were adjusted simultaneously to achieve a compression as symmetrical as possible. Once the reconstruction was tensed, elbow range of motion was checked to assess construct stability. The ulnar nerve was transposed anteriorly and subcutaneously in all cases.





### **Post-Operative Period**

Immobilized postoperatively in extension with a plaster splint and immobilized elbow in a sling for

four weeks. Controlled active and passive elbow joint motion was started between the 3rd and 4th POD; the patients were instructed on how to perform the exercises at home.

### **Followup:**

Patients were discharged on POD 5 and are followed up in OPD at 1 week (suture removal done), 3 weeks, 4 weeks and 6 weeks and then monthly up to one year. Final evaluation was performed using antero-posterior and lateral X-rays. Objective evaluation of range of motion was performed using a goniometer and pain at last follow-up was measured using an analog scale.

## **RESULTS**

All fractures treated with this method achieved union and rigid fixation. Radiological union was achieved at an average of 10.2 weeks. The analog scale of pain averaged 1.2 points (range, 0–3). Average Elbow range of motion  $105.5^{\circ}$  (100–120°) with maximum ROM 120° and minimum of 100°; Flexion averaged  $120.5^{\circ}$  (110–130°) and elbow extension loss averaged  $15^{\circ}$  (range, 10–25°). There were no infections and elbow stiffness. Overall patients had minimal symptoms related to hardware. 1 patient had 2 loose k-wires on 3<sup>rd</sup> month of followup and are removed under Local anaesthesia. 2 patients explained discomfort due to impingement of k wires and wires are removed 2 months postoperatively before they got protruded. No patient developed any nerve injuries.

S.NO	PAIN	RADIOLOGICAL UNION IN WEEKS	FLEXION IN DEGREES	LOSS OF EXTENSION IN DEGREES	ROM	COMPLICATIONS
1	1	10	130	10	120	none
2	2	8	115	15	100	none
3	0	12	120	20	100	Loosen k-wires
4	0	9	130	10	120	none
5	1	12	120	15	105	none
6	1	10	115	15	100	Missed f/u at 8 months
7	2	8	120	20	100	Impingement of k wires
8	0	12	115	10	105	none
9	3	12	130	25	105	Impingement of k wires
10	2	9	110	10	100	none

## **DISCUSSION**

Supracondylar Distal humerus fractures in osteoporotic adults are frequently complex and pose a considerable challenge to even most experienced orthopedic surgeons. Difficulty rests in the complex anatomy of the elbow and its limited amount of subchondral bone.

The osteopenia seen in elderly patients adds to the complex nature of fracture. Hastings and Engles have described a "spillover effect," in which inadequate restoration of a singularly injured joint can lead to abnormal wear and degenerative changes in an adjacent articulation. This effect can apply to the elbow

In the 1960s the Arbeitsgemeinschaft fur Osteosynthesefragen (AO) stated that the principles

of management for distal humerus fractures are anatomical reduction, rigid fixation with double plating and early mobilization, and this way of approaching distal humeral fractures remains the gold standard in most fractures and mainly when there is articular involvement. But there are certain subgroups of distal humerus fractures that might benefit from tension band osteosynthesis.

This fixation method adapts to the modern principles of fracture fixation established by the AO (flexible and biological fixation, that will allow prompt motion) as it involves less periosteal stripping and muscle damage than plate fixation, while allowing symmetrical compression, with also the advantages of being technically less demanding, faster and cheaper than plate fixation.

Tension band principle is applied here by the common extensor origin at lateral condyle and common flexor origin at medial condyle. As both muscle group contracts, the distraction forces created by them are converted into compression forces by this interosseous tension band wiring.

Early mobilization is possible because of immense rigidity, good compression and stability achieved in this technique and the tension band wiring technique acts in dynamic mode when muscles contracts.

Fractures in osteoporotic bone, where large implants can have shattering effect and screw may get loose out, this stainless steel compression gives good hold without fear of loosening and gives good hold with minimal implants.

Houben et al,<sup>[5]</sup> reported comparable results in ten patients with type C distal humerus fractures, five treated with double tension band osteosynthesis and five with double plate, for fixation of the condylar block to the shaft of the humerus. Zhao et al.<sup>[4]</sup> reported 24 patients with comminuted intra-articular fractures treated with double band osteosynthesis achieving 83 % excellent or good results. Allende et al.<sup>6</sup> reported on the use of tension bands in combination with other fixation methods for the treatment of intercondylar distal humerus fractures, concluding that they are a good alternative in comminuted distal fractures with osteoporotic bone.

Santosh et al.<sup>3</sup> had seen 80% of excellent or good results when conducted on 20 patients with distal humerus fractures with intercondylar extension treated with double tension band osteosynthesis.

Christian et al.<sup>2</sup> reported the results are comparable to the results that can be expected when using other available fixation methods when treated with double tension band wiring for transverse supracondylar humerus fractures.

In our group of patients, the average age was 70 years, all fractures got united, and the fixation achieved was adequate to allow prompt postoperative motion in all cases, as early motion was one of the main objectives in the treatment of

these injuries. In our patients the ulnar nerve was routinely transposed subcutaneously anterior to avoid contact with the tension band

Locking plates are in increasing trend and are very useful for osteoporotic fractures.

#### **But there are some drawbacks in the use of these plates:**

1. Extensive soft-tissue dissection/damage than tension band wiring;
2. They are expensive, more time consuming, and technically more demanding;
3. They do not always match precisely the anatomy of the reconstructed distal humerus;
4. Differing from 3.5-mm reconstruction plates, they do not allow being moulded to adapt to reconstruction achieved.

When using tension bands, during wire tightening symmetrical compression is achieved at the fracture site and this compression will continue postoperatively.

In osteoporotic bone even some degree of shortening might be seen, but if appropriate alignment of the articular surface is maintained this shortening can substantially enhance the stability of the fracture and does not influence negatively the final result. Tension band wiring can be useful technique in such situations that allow the surgeon to maintain the original articular congruity needed to prevent posttraumatic arthrosis, which allows for faster and progressive postoperative rehabilitation. Our series shows that supracondylar distal humerus fractures in osteoporotic adults should not be systematically treated with double plating, and double tension band fixation can be a reliable, easy and cost effective technique for the management of these particular lesions and should remain an option to be considered when planning the stabilization of these fractures.

Evaluation of literature revealed high complication rates for internal fixation in patients with osteoporosis showing the requirement of supplemental antiosteoporotic treatment<sup>8</sup>.

## **CONCLUSION**

Supracondylar distal humerus fractures can be successfully managed by Double tension band wiring. This method is a simple, reliable, faster, more biological, minimal hardware usage, less demanding and cost effective method. This technique avoids extensive soft tissue stripping and bulky hardware. We recommend this technique for treating in osteoporotic patients though locked plates are considered as gold standard for distal humerus fractures treatment.

#### **Limitations:**

The main limitations of this series are its Retrospective nature, Not having a control group, and having a small number of patients.

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