



## OUTCOMES IN DOUBLE TENSION BAND OSTEOSYNTHESIS IN DISTAL HUMERUS FRACTURES AO TYPE C1

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### ABSTRACT

**Introduction:** Distal humeral fractures accounts for approximately 2% of all fractures and nearly one-third of humeral fractures in adults. In this regard, Double Tension Band Wiring (DTBW) technique was used for the fixation of the distal humeral fractures type C1 (AO) to evaluate the early movement and complications of the patients.

**Methodology:** This study was conducted on 38 patients of C1 (AO type) who were subjected to open reduction and internal fixation using DTBW techniques, to evaluate the incidence of complications and to evaluate intraoperative parameters and postoperative functional outcomes over a period of 12 months.

**Results:** The mean age of the participants was 43.7 years. The mean tourniquet time was 76 minutes. The mean union time was 11.4 weeks and the mean duration of the follow-ups was 13.72 months. The mean values for the lack of extension, flexion, and range of motion were 12.24°, 120.9°, and 108.2° respectively. Neuropraxia was observed in 1 patient who was treated with conservative treatment. Mean MEPS score was 80.15. 17 patients had excellent scores , 12 had good scores and 9 had fair scores. None had poor scores. Hardware prominence was observed in 1 case which was treated with hardware removal after union was achieved. Hardware removal was performed 6 months after the surgery. Moreover, patients were diagnosed with no serious complications, such as the nonunion of fracture site, malunions, and deep infection. The radiological examination of the patients revealed the success of their treatment.

**Conclusions:** Based on the obtained results, it can be concluded that DTBW is an effective technique in AO type C1 fracture fixation, which allows gentle early motion. Moreover, this cost-effective technique decreased the surgery duration, tourniquet time, and damage caused by soft tissue stripping.

### KEYWORDS :

#### INTRODUCTION

Distal humeral fractures accounts for approximately 2% of all fractures and nearly one-third of humeral fractures in adults. The incidence of distal humerus fractures is due to the high-energy trauma among the younger population or minor falls in older individuals. There are various suggested therapeutic approaches for this issue including closed reduction, external fixation, open reduction and internal fixation, and arthroplasty (1)

Open reduction and internal fixation is recommended in the case of unstable and displaced fractured in patients with good function in their upper limb. This approach aims to achieve stable anatomic reduction, which allows the early gentle range of motion (2)(3)

According to the literature, double-sided plate for fixation is biomechanically preferred, compared to other methods (4)(5)(6)

But the advantages of double tension band wiring are an easier and faster procedure, less periosteal and muscle damage, and symmetrical compression. The functional results and complications of patients treated by this method are compared with the results of patients treated with plate fixation.(7)

Although Double Tension Band Wiring (DTBW) has provided acceptable outcomes regarding the fixation of distal humeral fractures, the current study aimed to evaluate this technique in

terms of early movement and complications in the fixation of the distal humeral fractures type C1 in AO classification. This technique is technically less demanding, cost effective and utilises minimal implant which is easy to place and thus minimises the tourniquet time, an added advantage over double plate osteosynthesis.

#### MATERIALS AND METHOD

The present study was a set prospective study carried out from February 2016 to March 2021; 38 patients of supracondylar fracture of humerus with intercondylar extension were operated using this technique. All adult patients having C1 type intercondylar with fracture of the humerus were selected. Standard antero-posterior and lateral radiographs were obtained in the Emergency Department and fractures. CT scan was not done because as CT scan facility was not affordable by our patients and this study was primarily done on poor patients who could not afford locked plates or expensive radiological investigations. According to AO classification, all were C1 fractures. All patients were operated in lateral position under regional block or general anaesthesia. Non-sterile tourniquet was used and was inflated just before making the skin incision. We used posterior approach of elbow with olecranon chevron osteotomy. Ulnar nerve was identified and retracted to avoid injury. Intercondylar portion of fracture was first reduced and held with AO reduction clamp or k-wire as anatomical as possible. Then we passed a guide wire for cannulated cancellous screw from medial side to lateral aspect or vice versa in intercondylar area crossing fracture perpendicularly.

A cannulated cancellous drill bit was used to drill over the guide wire and a proper sized 4mm cannulated cancellous screw was inserted over the guide wire to secure the fragments in place. Now the condylar block was attached to the humeral shaft using double tension band. Firstly, after reducing the condylar block to the humeral shaft, two k wires were passed from the lateral condyle across the fracture to engage the medial cortex of humeral shaft and likewise two k wires were passed from the medial condyle across the fracture to engage the lateral cortex of the humeral shaft. Now a 4.5 mm cortical screw with a washer was inserted in the midline of humeral shaft just above the fracture at the level of k wire tips. An 18 gauge stainless steel wire was passed beneath the screw head and across the medial k wire tips distally in figure of 8 manner and tightened using double loop. Similarly a tension band was applied laterally. Stability of the construct was checked under vision and olecranon osteotomy was closed using tension band wiring. Again the stability of the whole construct was checked by moving the elbow through full range of motion. Ulnar nerve was transposed anteriorly when needed. Tourniquet was deflated and haemostasis achieved. Wound was closed in layers over a suction drain. Drain was removed on second postoperative day and gentle active range of motion exercises was started. Patients were discharged from the hospital on postoperative day 4 after doing 2<sup>nd</sup> check dressing and patient was called for follow up on OPD on postoperative day 10. Suture removal was done on postoperative day 14 or 15. Patient was then followed up in OPD at 4 weeks, 6 weeks and then monthly up to one year. Hardware removal was performed 1 year after the surgery.

**RESULTS**

Out of 38 C1 type fractures. Rigid fixation was achieved in all. Average tourniquet time was 76 mins with minimum of 50 minutes and maximum of 90 minutes.

Radiological union was achieved at an average of 11.4 weeks. Average arc of motion was 108.2 degrees with maximum arc of motion 140 degrees (0-140) and minimum of 60 degrees (30-90).

The mean values for the lack of extension, flexion and range of motion were 12.24 degrees, 120.9 degrees, and 108.2 degrees respectively.

The loss of arc of motion was consistent with the age of the patient and compliance of the patient with physical therapy.

One patient had ulnar nerve neuropraxia in the postoperative period which corrected over a period of 3 weeks via conservative approach. One patient had palpable k-wire tips beneath the skin which were removed after radiological union. Overall patients had minimal symptoms related to hardware. Elbow functional outcome was graded according to Mayo Elbow Performance score (MEPS)(8). Patients having score more than 90 were graded as excellent, 75-90 was graded as good , 60-74 was graded as Fair and score below 60 graded as poor. Mean MEPS score was 80.15. According to MEPS out of 38 patients, 17 patients had excellent outcomes, 11 patients had good outcomes 9 patients had fair scores. None had poor outcomes.

**Table no. 1**

Parameters	Value
Age avg	43.63
Mean MEPS score	88.18
Mean Fixed flexion deformity in degrees	12.4 degrees
Average Maximum Flexion degrees	120.9 degrees
Mean Range of Motion	108.2 degrees
Mean Time to union (weeks)	11.4 weeks
Mean Tourniquet time(mins)	76 mins

**DISCUSSION**

Distal humerus fractures remain a challenging reconstructive problem for orthopaedic surgeons due to complex anatomy of the distal humerus and difficulty in exposing the fracture. Anatomical reduction, rigid fixation and early mobilisation are required to prevent complications (9)

In general, Locking Compression Plate is a standard method for fracture fixation due to its high mechanical strength, as well as orthogonal or parallel plating. Presently, there is increasing trend towards the use of locked plates in intercondylar fractures of distal humerus. The very design of the locked plates is for osteoporotic fractures (10)(11) (12). However, this technique increases the cost of treatment, operation time, soft tissue injury, and periosteal stripping.

On the other hand, tension band wiring aims to convert tensile force to compressive force across the reduced fracture plane (13). Although various methods of fixation and limited internal fixation with screws, pins, or one plate have been introduced, these methods were not successful to maintain the early range of motion (13)(14)(15)

The DTBW is a cost-effective, strong, and secure method to allow gentle early motion regarding the fixation of distal humeral fractures type C1(AO Classification). This technique reduces the duration of the surgery, tourniquet time, and the damage caused by soft tissue stripping (commonly occurred in plate fixation). Moreover, it requires simple methods of surgery and tools.

Because of the rigidity and stability achieved in this technique and because the tension band wiring technique acts in dynamic mode when muscles contract, we can mobilise the patient very early. In fractures in osteoporotic bone where large implants can have shattering effect and screw may loosen out, this technique gives good hold without fear of loosening with minimal implants.

Hardware removal was done in one case after union was achieved.

Pin removal is more convenient than plate removal; however, in some patients plate removal is not possible and may lead to morbidity.

Double tension band wiring has been used in past with encouraging results. In a study of 10 patients, Houben et al., reported comparable results, where 5 patients were treated with double tension band and 5 were treated with double plates (7). Zhao et al., reported 83% excellent or good results in their study of 24 patients treated with double tension band wiring (16). This method can also be used in combination with other methods of fixation, as reported by Allende et al., (17), where they concluded that the method is good alternative in osteoporotic settings when combined with other methods. Dubey et al., described a modification and did transosseous fixation of intercondylar fracture of lower end humerus by tension band wiring technique, and reported excellent results (18).

Patients in the present study revealed no major complications, including non-union of fracture site, malunion, deep infection, and permanent nerve injury were observed. In our study patients had good clinical outcome using Double Tension Band osteosynthesis as is evident by Mayo Elbow Performance Score which has strong reliability(8). Our study shows that in inter-condylar fractures in adults, double tension band fixation can be a reliable, easy and cost effective technique for the management of these fractures and should remain an option to be considered when planning the stabilisation of these fractures especially the AO type C1 fractures. Our results are comparable to other studies done using locked plates.

**CONCLUSION**

Double tension band is a reliable, more biological, less surgically demanding and cost effective method of fixation of intercondylar fractures of humerus. Rigid fixation and hence, early mobilisation can be achieved with this method. This method avoids extensive soft tissue stripping and bulky hardware. Though locked plates are considered as gold standard in the treatment of fractures of the distal humerus, double tension band technique should be considered as an option while planning fixing these fractures especially AO type A2 and C1 fractures. The main limitations of this series are its retrospective nature, not having a control group, having a small number of patients and no experience with comminuted AO type C2 and C3 fractures.

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**FIGURES**



Figure 1 – preoperative Radiograph



Figure 2 – Immediate Postoperative Radiograph



Figure 3 – Postoperative radiograph- 1 year follow up



Figure 4 – Clinical outcome was excellent at 1 year follow up. Patient demonstrates elbow flexion upto 130 degrees

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