

Comparative Analysis of the Tension Band Wiring Approach with Cancellous Screws and K Wires for Treating Olecranon Fractures

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Abstract

Background: Injuries that frequently occur in the emergency room include olecranon fractures. Open reduction and internal fixation with k-wires and figure-of-eight tension band wiring is the surgical treatment for misplaced fractures. An intramedullary cancellous screw and tension band wiring can also be used to repair it. The current study compares the outcomes of both surgical techniques and evaluates their benefits and drawbacks.

Methods: Between February 2021 and January 2022, a prospective comparative study involving 40 olecranon fractures was conducted at the Department of Orthopaedics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar. Ten of the fractures were treated with tension band wiring and Kirshner wire, and the other ten were treated with an intramedullary cancellous screw and tension band wiring.

Results: According to Colton's classification, the majority of the fractures in our study were type II B fractures. According to the Mayo elbow performance score, the cancellous screw group had excellent outcomes in 16 patients (80%), acceptable results in 2 patients (10%), and fair results in 2 patients (10%). The K wire group had outstanding results in 10 patients (50%) and good results in 6 patients (30%). Both groups did not exhibit any subpar outcomes.

Conclusions: According to the findings of this study, cancellous screws combined with tension band wiring for displaced transverse and oblique olecranon fractures produce better clinical outcomes than tension band wiring combined with K wire fixation while also avoiding costs, lost productivity, and potential complications from hard-surface removal.

Keywords: Olecranon Fractures, Cancellous Screw, Tension Band Wiring.

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Introduction

One of the most frequent orthopaedic injuries seen in the emergency room is olecranon fractures. Typically, motor vehicle or motorcycle accidents, falls, or assaults result in Ulna olecranon process fractures. Treatment for undisplaced fractures usually

involves a brief period of immobilisation followed by a slow increase in range of motion. According to several publications, conservative treatment is preferable for undisplaced fractures with displacement less than 2 mm [1]. When the elbow is dislocated,

open reduction and internal fixation are typically needed to realign the articular surface anatomically and return the elbow to normal function. The fixation must be secure, permit active elbow flexion and extension, and support fracture union [2].

Olecranon fractures were once treated with closed reduction and the placement of a plaster cast. However, prolonged immobility brought on by its own difficulties raised patient morbidity and death [3]. By forgoing any type of splinting, allowing the arm to dangle in extension, and implementing early massage, Sachs reported good results with rapid resolution of function [4]. Regardless of whether there was fibrous or bony union, Elite reported a fast restoration to relatively normal elbow flexion and extension following this treatment plan [4]. Daland presented the first comprehensive series of 48 cases of conservatively treated fractures of the olecranon.

He came to the conclusion that close reduction was highly inadequate and that open reduction is always recommended [5]. As a result, it has become crucial to intervene surgically while taking this into account. The patient will return to normal function as soon as feasible thanks to aggressive mobilisation following surgery. The quality and speed of the fracture union are significantly influenced by the early and active movement, which also shields the tissue from fracture disease.

For straightforward transverse fractures, stable internal fixation with figure-of-eight tension-band wire fixation allows for early motion to reduce stiffness [6]. Tension band wiring is most suited to pure transverse fractures without comminution, according to Robert N. Hotchkirs. To strengthen the rigidity of the attachment, Weber and Vasey recommended twisting both figure-of-eight wire limbs [7]. Cooper According to Jerald L., Robert D., and D'Ambrosia, type II (transverse or oblique) olecranon fractures

can be internally fixed using intra-fragmentary compression screws with or without a neutralising plate, tension band wiring, and related intramedullary wires or screws. They came to the conclusion that this technique converts tension pressures into compression forces across the fracture site and that it works best with parallel intramedullary Kirschner wire or a single 6.5 mm cancellous screw alone with figure-eight tension band wiring. Additionally, they chose intramedullary compression screws to stop anterior subluxation in cases of elbow fractures and dislocations [8]. Compared to just the figure of eight wire, the K-wire employed in the AO tension-band approach more effectively resists shearing force. Thus, by transferring tensile force to compressive force at the fracture site, this produces a desirable result [2,9,10].

By transforming tensile force into compressive force at the fracture site and adding additional resistance to displacement by lag screw compression, cancellous screws with wire combination is stated to have offered the increased strength of fixation [11]. This study is directed towards the clinical evaluation of results of tension band technique for olecranon fractures using cancellous screws and K wires and to compare the results.

Material and Methods

The 40 fractures of the olecranon in this study were all treated with the tension band wiring technique. Patients were randomly divided into two study groups, each of which received 20 operations using Kirshner wires or a 6.5 mm cancellous screw. The operations were performed at the Department of Orthopaedics at Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, between February 2021 and January 2022.

Adult patients with transverse or oblique fractures without significant comminution or minimal comminution, fractures with

neurovascular deficits, fractures due to extremes in age, comminuted fractures, severely contaminated and infected open fractures, and associated distal humeral fractures were excluded from this study.

Under general anaesthesia or brachial plexus block, the procedure was carried out. The site of the procedure was thoroughly sprayed with iodine and spirit and covered after a mid-arm tourniquet was applied with the patient in a supine or lateral posture. Exposure of the olecranon was done via Campbell's technique. With the use of a reduction clamp or a lengthy towel clip, precise anatomical reduction was accomplished. From the tip of the olecranon, or the proximal fragment across the fracture site to the distal fragment piercing the

anterior cortex, two K-wires are implanted parallel.

Distal to the fracture site, the ulna's shaft had its periosteum removed, and a transverse hole was bored around 3 to 5 cm away. This transverse hole was used to insert a No. 18 stainless steel malleable wire, which was then wrapped around the protruding Kirschner wires and crossed over the posterior surface of the olecranon in a figure-eight pattern before being tightened with an AO tensioner and secured with a twist. The Kirschner wires 1800 are bent at the proximal ends, and the cut ends are tapped back into the proximal segment. By moving the joint, stability and reduction accuracy were verified. The wound was dressed sterilely and given a compression bandage.



Figure 1: Tightened SS wire with K wire across the fracture.

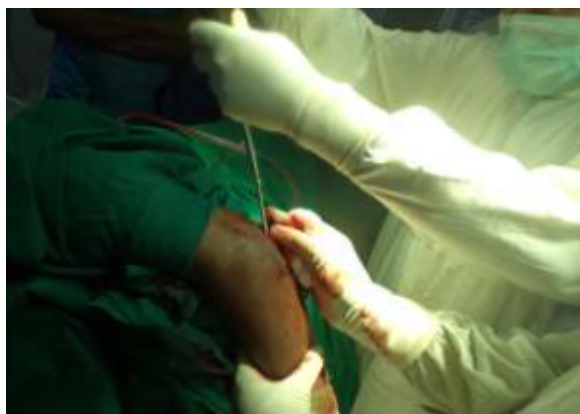


Figure 2: 6.5 Cancellous screw insertion across the fracture.

Accurate anatomical reduction was obtained and held with a reduction clamp or towel clip using comparable anaesthesia, positioning, tourniquet application, and technique. From the tip of the olecranon across the site of the fracture to the distal fragment, a 6.5 mm AO cancellous screw is inserted in a parallel fashion. The neck of the screw is wrapped with a no. 18 stainless steel malleable wire in a figure-eight pattern, tightened with an AO tensioner, and then secured with a twist. By moving the joint, stability and reduction accuracy were verified. Wound was closed in layers and sterile dressing and compression bandage provided.

Following surgery, analgesics and antibiotics were given to all patients for five days. On day 1, the patient was asked to do finger movements while the affected limb was raised. From the third postoperative day, elbow movements were advised.

Patients were checked on at 6 and 12 weeks and then every 3 months after that. Three

months following the procedure, the outcome was evaluated. At the follow-up appointment, the patient underwent a thorough clinical examination and was evaluated subjectively for symptoms including pain, edoema, and joint motion restriction. During a clinical examination, the elbow joint's swelling, tenderness, motions, prominence of the K wire and the head of the cancellous screw, as well as the strength of the muscles operating on the joint, were observed.

Patients were instructed to carry out physiotherapy in the form of, active flexion-extension and pronationsupination without loading. Check x-ray were taken at each follow-up. In all patients duration after which they returned to job was noted.

In this study, the Mayo Elbow Performance Score (MEPS) was used to assess the functional outcome, while standard radiographs were used to assess the radiological outcome (Table 1) [12].

Table 1: Interpreting the Mayo elbow performance score

Greater than 90	Score 75 to 89	Score 60 to 74	Score below 60
Excellent	Good	Fair	Poor

Results

Patients treated with a cancellous screw and tension band wiring had an average age of 39.2 years (range: 23–58 years), whereas patients treated with tension band wiring and K wire had an average age of 37.6 years (range: 23–58 years) (range 21-50 years).

14 male (70%) and 6 female (30%) patients made up an equal number in both categories.

16 patients (80%) in the group receiving treatment with a cancellous screw and tension band wiring had fractures of the right olecranon, whereas 4 patients (20%) had fractures of the left side. Six patients (60%) in the group receiving tension band wiring with K wire had fractures of the right

olecranon, while four patients (40%) had fractures of the left side.

Falling on the elbow was the most frequent mechanism of injury in both groups, affecting 16 patients (80%) in the group with TBW and cancellous screws and 14 patients (70%) in the group with TBW and K-wires. In each group, there were 4 patients who had injuries from traffic accidents (20%), and 2 patients (10%) in the TBW with K-wire group had histories of assault. Six patients (30%) had an oblique fracture and fourteen patients (70%) had a transverse fracture in the TBW with cancellous screw group. Twelve patients (60%) in the TBW with K-wire group had transverse fractures, six (30%) had oblique

fractures, and two (10%) had avulsion fractures (Table 2). In the tension band wiring with K-wire group 2, patient 2 had an isolated olecranon fracture in 18 patients (90%) and radial head fracture in one patient

(10%). The remaining 18 patients (90%) in the TBW with cancellous screw group had isolated olecranon fractures, whereas the second patient (ten percent) had ulna shaft fracture.

Table 2: Type of fractures (Colton's classification) [13].

Type of fractures	TBW with K wire n (%)	TBW with cancellous screw n (%)	Total n (%)
Transverse	12 (60%)	14 (70%)	26 (65%)
Oblique	6 (30%)	6 (30%)	12 (60%)
Avulsion	2 (10%)	-	2 (10%)
Total	20	20	40 (100%)

Chi-square = 0.39, p=0.53, NS

The mean postoperative days for tension band wiring with K-wire were 6.9 ± 1.4 days and for tension band wiring with cancellous screw group were 6.4 ± 1.2 days. Patients were operated on on an average of 3 to 4 days following the injury.

Check X-rays (both lateral and antero-posterior views) were taken immediately following surgery, at 6 and 12 weeks, and then every month until the conclusion of the follow-up period. Twelve patients (60%) were followed up for six months in the TBW with K-wire group, while in the TBW with cancellous screw group eight patients (40%) were followed up for four months, six patients (30%) had five months, and another six (30%) were followed up for six months. The length of time that each patient took before returning to work was reported. Four patients in the TBW with K-wire group (40%) experienced fracture union at 12 weeks, eight patients (40%) in 14 weeks, and the final four (20%) in 16 weeks. In contrast, 14 patients (70%) at the TBW with cancellous screw group demonstrated fracture union in 12 weeks, whereas the remaining 6 patients (30%) exhibited fracture

union in 14 weeks.

Patients' level of pain was evaluated at the conclusion of the follow-up. Eight patients (80%) in the TBW with cancellous screw group and two patients (20%) in the TBW with K-wire group reported no discomfort, while five patients (50%) in the TBW with cancellous screw group and five patients (50%) in the TBW with K-wire group reported mild aching pain.

In the current investigation, 2 patients (10%) had an arc of motion between 50° and 100° while 18 patients (90%) in the group receiving TBW with a cancellous screw demonstrated good arcs of motion more than 100° . 14 patients (70%) in the group receiving TBW with K-wire had arcs of motion more than 100° , while 6 patients (30%) displayed arcs of motion between 50° and 100° .

In the TBW with K-wire group, 2 patients (10%) experienced a superficial infection that was managed with a broad spectrum antibiotic, and 6 patients (30%) showed hardware prominence that required a second surgery to remove

Table 3: Observation

Results	TBW with K wire n (%)	TBW with cancellous screw n (%)	Total n (%)
Excellent (score >90)	10 (50%)	16 (80%)	26 (65%)
Good (Score 75-89)	6 (30%)	2 (10%)	8 (20%)
Fair (Score 60-74)	4 (20%)	2 (10%)	6 (15%)
Poor	0	0	0
Total	20	20	20 (100%)

Only 2 patients (10%) in the TBW with cancellous screw group had noticeable hardware that required a second procedure to remove.

16 patients (80%) in the TBW with cancellous screw had outstanding results, 2 patients (10%) had good results, and 2 patients (10%) had fair results. Five patients (50%) in the TBW with K-wire group had great outcomes, six (30%) had acceptable results, and four (20%) had mediocre results (Table 3). Only 2 patients (10%) in the TBW with cancellous screw group had noticeable hardware that required a second procedure to remove. However, neither group's outcomes were terrible.

Table 4: According to Mayo elbow performance score

Method	Excellent n (%)	Good n (%)	Fair n (%)	Poor n (%)
TBW with K -wire	10 (50%)	6 (30%)	4 (20%)	-
TBW with cancellous screw	16 (80%)	2 (10%)	2 (10%)	-

Discussion

Treatment for olecranon fractures has ranged from early elbow range of motion without consideration for the fracture to exact and open anatomic reduction of the fracture site.

Olecranon fractures were initially managed by immobilising the elbow in full extension for 4–6 weeks before the advent of aseptic surgery and the development of roentgenography [3].

In most cases, this led to a stiff elbow and a lack of flexion.

Later, doctors gradually started to adopt the mid-flexion position, however this commonly resulted in nonunion due to the wide separation of the fracture pieces, reducing the strength of the triceps mechanism [12].

Lister decided to treat the olecranon fracture as the first fracture to be treated by open reduction and internal fixation utilising his

technique of asepsis with a wire loop due to the conundrum of nonunion and stiffness [3]. This technique, which served as a precursor to the tension band technique supported by the AO group, has since been modified.

In addition to attaining union, the primary goal of treating olecranon fractures is to maintain the optimal function of the nearby soft tissues and joints. If early movements are to be implemented to prevent complications like traumatic arthritis and joint stiffness, a perfect anatomical reduction of the fragments to obtain articular congruity and rigid fixation of the fragments is of the utmost importance in the management of intra-articular fractures like the fracture of the olecranon. Dynamic compression occurs when forces generated at the site of the fracture when the skeleton is put under normal physiological load are harnessed in addition to the pre-stress of the implant to

further compress the pieces. Pauwel was the one who initially used the tension band fixation principle and showed how it could be used to internal fixate bone after appropriating it from industrial mechanics.

Every eccentrically loaded bone is subjected to bending strains. As a result, the stresses are distributed in a normal way, with compression on the bone's concave side and tension on its convex side. This is also the reason why when a bone of this type fractures, a gap appears on the tensile side.

An eccentrically loaded broken bone must be able to sustain axial compression as well as the tensile pressures applied by a tension band wire in order to regain its ability to support weight. Inter-fragmental compression is the effect of the device being pre-stressed in tension. This axial interfragmental compression dynamically increases as a result of the loading.

Therefore, it is accurate to say that "The implant absorbs the tension and the bone the compression," describing the tension band theory in a single sentence.

Tension band wiring was used to treat 37 cases of olecranon fractures by Patricia Villaneva, who reported that a large majority of these cases had satisfactory outcomes [15]. According to a survey of 62 patients with isolated olecranon fractures by Byron E. Chalidis *et al.*, tension band wiring technique is the "Gold standard" for treating olecranon fractures since it promotes strong elbow function and no physical capacity loss [16].

Tension band wiring with K-wire is the most common method for fixation of olecranon fractures and it works on the principle of converting tensile forces to compressive forces at fracture site, it usually gives good result but cancellous screws with tension band wiring combination provides the strength of fixation that is by converting the tensile force to a compressive force at the

fracture site with additional resistance to the displacement due to the lag screw compression.

In our study, 40 olecranon fracture cases were treated, 20 of which were fixed with tension band wire and K-wire and 20 of which were fixed with a cancellous screw and tension band wire. The outcomes of the two groups were compared, and we found that the second group produced more successful outcomes.

The following discussion will analyse and compare the findings, outcomes, and other data. In the current study, the average age incidence for TBW with K-wire is 37.6 years, and for TBW with a cancellous screw, it is 39.2 years.

Males have a higher incidence of olecranon fracture in the current study. We discovered that in the TBW with K-wire group and the TBW with cancellous screw group, 16 patients (80%) had fractures on the right side and 4 patients (20%) had fractures on the left. Right side fractures were included in 12 patients (60%) and left side fractures in 8 patients (40%) respectively. Fall on the elbow injuries were the most frequent kind of injury in both groups, accounting for 16 (80%) in the TBW with cancellous group and 14 (70%) in the TBW with K-wire group. RTA injuries accounted for 4 patients (20%) and 2 patients (10%) in the TBW with K-wire group, respectively.

In the TBW with K-wire group, 12 (60%) of the patients had transverse fractures, 6 (30%) had oblique fractures, 2 (10%) had avulsion fractures, and 2 (10%) had radial head fractures as an additional injury. In the TBW with cancellous screw group, there were 14 (70%) transverse fractures, 6 (30%) oblique fractures, and 2 (10%) concomitant ulna shaft fractures. In the current study, 6 (30%) patients in the TBW with K-wire group required a second procedure to remove the implant, while 2 (10%) patients in the TBW

with cancellous screw group had hardware prominence.

According to the Mayo elbow performance score, the results were assessed. In our study, 16 (80%) patients in the TBW with cancellous screw group had excellent results according to the Mayo elbow performance score, and 2 (10%) patients each had good and fair results, with no patient having a poor result. 14 Ten patients (50%) in the TBW with K-wire group had outstanding results, six (30%) had good results, four (20%) had fair results, and none had bad results (Table 3).

Conclusion

According to the findings of the current study, tension band wiring with K-wire fixation has a much higher re-operation rate for the removal of hardware than does tension band wiring with cancellous screw fixation. This results in higher costs, lost productivity, and potential complications from hardware removal.

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