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Treatment of Non-Comminuted Olecranon Fracture using Tension Band Wiring and Crossing Screws

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ABSTRACT

Background: Olecranon fractures require open reduction and internal fixation that require anatomical reduction and early mobilization. Many methods have been described for fixation of olecranon fractures including the tension band wiring (TBW) which was the standard treatment. The aim of the present study was to comparing crossing screws fixation to the gold standard, TBW in treating isolated non-comminuted olecranon fractures by functional results as well as to assess the complications and secondary procedures. Patients and Methods: A prospective comparative study concluded 18 patients with displaced olecranon fracture Mayo's type IIA were incorporated in an interventional prospective comparative study. Patients were divided equally into two groups according to the method of treatment. A detailed history, clinical and radiological assessment were performed. The quality of the reduction, union and position of the implant will be measured. The elbow's range of motion (ROM) was measured. The functional evaluation of the surgically treated elbow will be based on the Mayo Elbow Performance Score (MEPS). At the end of the follow-up was done for one year. Results: the mean age was distributed as 30.33±9.83 and 30.88±10.05 respectively between groups with no significant difference between groups, regard sex there was no significant difference between groups. There was no significant difference detected between groups regard side. No significant difference regard follows up duration. Time of union was significantly shorter among group B. No significant difference between groups detected regard any items. Conclusion: Crossing screws for olecranon fractures provide a safe mini-invasive, that enables early healing with excellent functional outcomes and limited complications that appear to be mechanically, biologically and functionally superior to TBW.

Keywords: Crossing Screws; TBW; Olecranon Fracture; ROM

INTRODUCTION

All Olecranon fractures are intra-articular injuries so the aim of treatment, as defined by the AO group, is to restore the articular surface, achieve absolute stability of the fracture, and allow early active motion. The method of fixation depends on shape of fracture, patient comorbidities, associated injures **(1).** Majority of olecranon fractures require open reduction and internal fixation. where conservative treatment is recommended in non -displaced or displacement fracture less than 2 mm when the elbow is flexed at 90 with an intact extensor mechanism. An initial immobilization by splint for 4 weeks followed by active-assisted mobilization will ultimately lead to union and good function **(2)**. However, despite severe displacement, patients may have good functional outcomes. Veras Del Monte et al. found that only 1 patient had a bad functional outcome in a series of 13 patients treated non operatively with a mean age of 81.8 years and >5 mm displacement **(3)**.

On the other hand, displaced fractures usually require fixation. The fixation procedure depends on whether the fracture is stable or unstable. Unstable fracture includes Comminuted fractures, fracture dislocations/subluxations and displaced fractures dist al to the midpoint of the sigmoid notch, Stable fractures includes transverse, two -part and at or proximal to the midpoint of the sigmoid notch. The aim of fixation is to achieve anatomical reduction of the joint surface that allows early mobilization and rehabilitation **(4)**. There are four primary methods of operational management of olecranon fractures in use: TBW, intramedullary fixation, plate fixation and proximal fragment excision with advancement of the triceps **(5)**. Nevertheless, for intra-articular simple transverse fractures, TBW remains the AO recommended first-line therapy because it enables early mobilization, is a relatively simple technique and is low cost **(6)**.Two

1.6-mm Kirschner parallel wires (K-wires) are inserted antegrade across the site of the fracture that should penetrate the anterior distal cortex , passed as close as possible to the articular surface without penetrating the articular cartilage **(7)**.

One of the most common complications following internal fixation of olecranon fractures is painful hardware inflammation that needs removal. In up to 80 percent of cases, complaints related to essential hardware have been recorded. After TBW, a greater incidence of prominent painful hardware was recorded than compression plating **(8).**

The current study aimed to comparing crossing screws fixation to the gold standard, TBW in treating isolated non-comminuted olecranon fractures by assessing clinical, radiological and functional results.

PATIENTS AND METHODS

A prospective comparative study concluded 18 patients with displaced olecranon fracture Mayo's type IIA were incorporated in an interventional prospective comparative study. Patients were divided equally into two groups according to the method of treatment. Each of which comprised 9 patients using the crossing screws technique for the first 9 patients presented to us before moving to the traditional TBW technique for the next 9 patients. Patients' demographic data were collected using case notes There were 12 males and 6 females with 18 involved elbows (10 left & 8 right). The mean age at presentation was 30.61 years (20 – 50 years). The mean follows up period was 6.72 months (3-10 months).

Inclusion criteria:

All patients diagnosed as isolated non-comminuted type II-A fractures as per Mayo clinic classification, closed or types I &II open fractures as per Gustillo and Anderson classification, and in the age group between 20-60 years.

Exclusion criteria:

Patients with types I and III olecranon fracturesas per Mayo clinic classification, type III open fracturesas per Gustillo and Anderson classification, pathological fractures, previous proximal ulna fracture with malunion or elbow stiffness.

A detailed history, clinical and radiological assessment were performed. Pre-operative, immediate post-operative and serial follow-up of traditional radiographs of affected elbows was performed. All patients had standard antero posterior and lateral elbow radiographies.

Surgical techniques:

(A):Tension band wiring technique:

The incision is curvilinear to minimize the painful scar over the tip of the olecranon. Full thickness flaps are formed and retracted on both sides of the olecranon. A direct reduction is performed with a reduction clamp. The first 1.6 mm K-wire was medially introduced through the head of the olecranon using the drill guide. For the second K-wire, we must leave enough space on the lateral side. The K-wire was then cut 2 cm from the bone obliquely. In the same way as the first one, the second K-wire was cut. A 1.0 mm wire was prepared along its length by making a loop of approximately one third. By further twisting, the slack was then taken up and the process was repeated until the desired tension was achieved. The two fragments are drawn together by tightening the twist and the loop with two wires simultaneously, so that the fracture is put under compression.

(B): Crossing screws technique:

Patients were in lateralposition with the arm draped over a bolster attached to the operating table. We typically aim to achieve closed fracture reduction and the reduction is maintained using small point reduction forceps. A reference K-wire was inserted into the olecranon central in the AP view and in the lateral view after the reduction was achieved. in the AP view, they tend to cross so that the one that began near the medial cortex is aimed at the lateral cortex and vice versa to be parallel to the reference wire or have slight crossing in the lateral view. The reference wire will be removed after assurance of their position, and then the other wires was replaced by two partially threaded 4.0 -mm cannulated screws with washers.

Postoperative follow up and outcomes:

The elbow will be secured in a removable splint flexed to 90 ° to rest the injured zone and aid in the healing of soft tissue. An x-ray performed at 4 weeks postoperative and if the fixation remains stable without fracture gap, the rehabilitation phase was started based on passive stretching and reinforcement under the supervision of occupational therapist. AP and lateral elbow radiographs were taken directly after surgery and at 4, 8, 12 weeks, 6 and 12 months postoperatively, and finally at the end of the follow-up operation. The quality of the reduction, union and position of the implant will be measured. The elbow's range of motion (ROM) was measured.The functional evaluation of the surgically treated elbow will be based on the Mayo Elbow Performance Score (MEPS).

Statistical analysis:

Data analyzed using microsoft excel softwar and imported into Statistical Package for the Social Sciences (SPSS version 20.0) software. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD; difference and association of qualitative variable by Chi square test (X2). Differences between quantitative independent groups by t test. P value was set at <0.05 for significant results & <0.001 for high significant result.

RESULTS

We studied 18 cases of isolated non-comminuted olecranon fracture showing age was distributed as 30.33±9.83 and 30.88±10.05 respectively between groups with no significant difference between groups, regard sex there was no significant difference between groups **(Table 1)**. There was no significant difference detected between groups regard side **(Table 2)**. No significant difference regard follows up duration **(Table 3)**. Time of union was significantly shorter among group B **(Figure1)**. No significant difference between groups detected regard any items **(Table 4)**.

Table1: Age and sex distribution between studied group

			Group A	Group B	t/ X2	P
		Age	30.33±9.83	30.88±10.05	0.116	0.909
Sex	Female	N	2	4		
		%	22.2%	44.4%		
	Male	N	7	5	1.0	0.31
		%	77.8%	55.6%		
	Total	N	9	9		
		%	100.0%	100.0%		

Table 2: side distribution between studied groups

			Group		X^2	P
			Group A	Group B		
Side	LT.	N	6	4		
		%	66.7%	44.4%		
	RT.	N	3	5	2.50	0.28
		%	33.3%	55.6%		
	Total	N	9	9		
		%	100.0%	100.0%		

Table 3: follow up time distribution between studied groups

	Group A	Group B	t	P
Follow up month	8.77±1.30	8.66±1.50	0.168	0.869

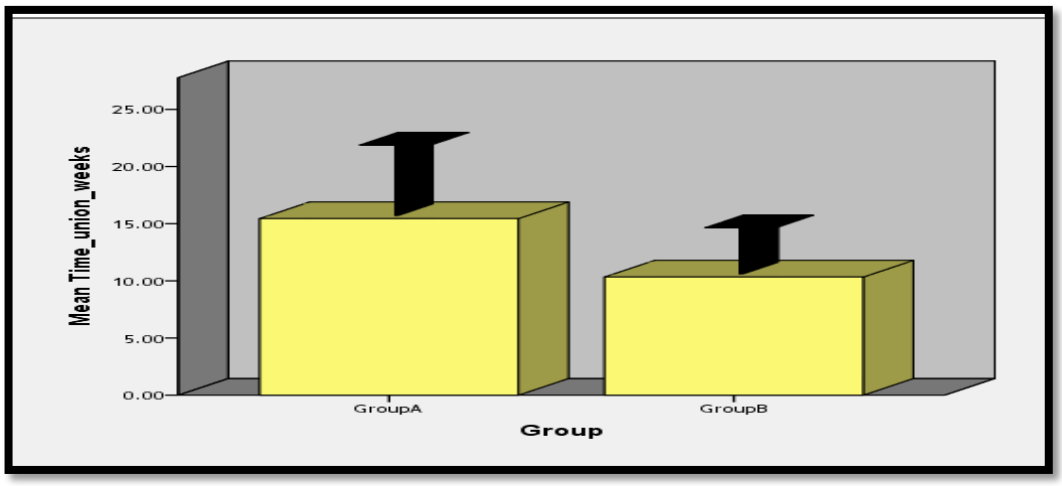

Figure 1: Union time distribution between studied groups

Table7: Adverse effect and outcome distribution between studied groups

			Group		X^2	P
			Group A	Group B		
Range deficit Flexion	No	N	8	8		
		%	88.9%	88.9%		
	Yes	N	1	1	0.0	1.0
		%	11.1%	11.1%		
Range deficit Extension	No	N	8	9		
		%	88.9%	100.0%		
	Yes	N	1	0	1.05	0.303
		%	11.1%	0.0%		
Metal ware removal	No	N	6	8		
		%	66.7%	88.9%		
	Yes	N	3	1	1.28	0.25
		%	33.3%	11.1%		

DISCUSSION

In our study, 18 patients with displaced olecranon fracture Mayo's type IIA. We compared the use crossing screws to TBW in treating isolated non-comminuted olecranon fractures by assessed the clinical, radiological, and functional results.

It is essential to consider the risk of soft tissue complications when selecting the method of fixation and the timing for surgery. This may explain the shorter time to OR in the group of patients managed with screws (11.11±3.48 versus 83.22±24.76 hours), as the PC or mini-invasive technique allowed earlier interference, which was statistically signific Plate fixation was stated to provide adequate stability and high union rates for simple and comminuted fractures and was applied to the dorsal (tension) surface of the ulna, which makes the structure the most biomechanically sound [79-80]. In addition, screws may be passed into the coronoid or inserted along the medullary canal for extra stability **(9)**.

Hume and Wiss (10) prospectively compared TBW and plate fixation. They reported that plate fixation had a lower complication rate, better clinical outcomes, less displacement of the fracture fragments, and less complain of implant problems. They found that altering the compressive forces across the fracture during contraction of the triceps, lead to reduction of fracture compression with both fixation modes, but never diminishes to zero with plates and remains several times greater than that with TBW, which showed negligible compression at the anterior part.

Moreover, **Rowland and Burkhart (11)** presented mathematical calculations, arguing that the standard configuration of TBW led to the fracture gap opening up on the articular side of the fracture and **Hutchinson et al. (12)** found that insimulated contraction of the triceps, the fragments were distracted at both the anterior and posterior sides of the ulnaFracture compression allows direct bone healing without excessive callus that may reduce the incidence of post traumatic elbow arthritis.

Wilson et al. **(13)** reported that effective compression of a transverse olecranon fracture requires a plate fixation. Also, **Ali (14)** added another option for compression that can be used also with oblique fractures as the position of the screws can be freely modified to be, or at least nearly, perpendicular to the fracture lines. However, plating seems to be an aggressive maneuver for a simple small subcutaneous fracture like this, PC or mini-invasive crossing screws appears to be a simple effective option for stable fixation with compression that was suspected to help early direct bone healing without any extra callus formation in any case till end of the follow up. The mode of fixation may alter the rehabilitation program. Stable fixation is mandatory for early postoperative rehabilitation functional recovery.

Jones et al. (15) compared the strength and stability of transcortical screw fixation with TBW for simple transverse olecranon fractures under cyclical loading. They concluded that screw fixation provided equivalent strength and less plastic deformation as compared with TBW. The main mechanical problem with these fractures is the sagittal plane bending forces. However, for non-comminuted fractures in the age group between 20 and 60 years with suspected good bone stock, a good purchase of the screws is suspected. Application of the screws in a crossing manner improves their pull-out strength and kept their main axis not in the same plane of the bending forces, which will be safely dispersed without affecting the stability of the fixation construct.

CONCLUSION:

Crossing screws for olecranon fractures provide a safe mini-invasive, that enables early healing with excellent functional outcomes and limited complications that appear to be mechanically, biologically and functionally superior to TBW.

No conflict of interest.

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