Percutaneous versus conventional tension band wiring in olecranon fractures: a randomized prospective study

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Background
Displaced olecranon fractures are the commonest fractures in the elbows of the adults that require operative treatment. The second most encountered complication was skin breakdown, which may lead to infection, either superficial or deep.
Patients and methods
A total of 64 patients were prospectively studied in this research and were divided randomly into two groups. All patients were treated with tension band wiring (TBW) technique: in group A, percutaneous method was used for fixation, and in group B, the conventional one was used.
Results
None of the study population in both groups developed wound infection or wound breakdown postoperatively. There were no recorded cases of nerve injury or deep infection. The overall rate of reoperation in our study was 32.8% (21 patients out of 64 in both groups). A significant relationship was found between the two groups regarding the time of operation and healing time, in favor of the group of percutaneous wiring. Moreover, the rate of reoperation shows a statistically significant difference between both groups, where group A showed lower percentage of reoperation cases.
Conclusion
Percutaneous tension band wiring (TBW) of olecranon fracture gives good results in terms of fixation and healing and possess a lower rate of complications in comparison with traditional TBW.

Keywords:
olecranon fractures, percutaneous, tension band

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Introduction

Fractures of the eccentrically loaded bones like patella, medial malleolus, and olecranon are one of the common fractures encountered by orthopedic surgeon. Many fixing problems are posed during treatment, as they are intraarticular and subjected to deforming forces from the muscles attached to it.

Rambold [1] was the first surgeon to use facial strips to repair displaced olecranon fracture. From 1884, many surgeons started to use wire loops, with continuous modifications till 1963 when Weber and Vasey and others suggested the use of two parallel intramedullary K-wires and figure of eight loop of steel wire with tension band principles in fixation of displaced fracture of olecranon [2–6]. The second most encountered complication was skin breakdown, which may lead to infection, either superficial or deep. Successful functional outcome correlates directly with accuracy of anatomic joint reduction, restoration of mechanical stability that allows early motion, respect for the soft tissues, and maintenance of the extensor mechanism.

The technique used in this work is percutaneous through 1-inch incision at the fracture site proximally and distal 1 cm incision for wire tunnel. A small incision is advantageous from esthetic point of view [7], but is it more beneficial than conventional more than or equal to 10 cm incision regarding operative time, healing, rate of complications, and finally, regarding the functional outcome.

Patients and methods

The study was started in June 2013 and finished in June 2016, at Suez Canal University Hospital. A total of 64 patients were prospectively studied in this research and divided randomly into two groups. All patients were treated with tension band wiring (TBW) technique: in group A, percutaneous method was used for fixation, and in group B, the conventional one was used. Male predominance was obvious in our population (45 males, equaling 70.31% of the population, in comparison with 19 females). In the 64 cases, the mean age was 35.03±13.31 years (range, 18–67

years). The minimum follow-up period was 6 months, and the maximum was 39, with an average of 21.78 ±10.76 months.

Percutaneous technique was done as follows: under general anesthesia and using an air tourniquet, a longitudinal radial curved 1-inch incision was made avoiding the tip of olecranon (Fig. 1), the fracture site was exposed, anatomical reduction was performed using compression forceps clamp, and two K-wires (diameter, 2 mm; length, 70–100 mm) were inserted parallel to the proximal surface of the proximal fragment in the intramedullary canal of the ulnar shaft to fix the fracture. A bone tunnel was made for passage of the cerclage wire through the 15-mm distal incision (Fig. 1). Then, a perpendicular drill hole to ulnar shaft was made by 2-mm drill bit. The wire was passed through it and then curved and slided subperiosteally or submuscularly adherent to the ulnar shaft, and then placed as a figure of eight harness for compression on fracture site.

One-knot technique was used in both groups, and the end of bended wires were positioned deep in the triceps tendon fibers just above the olecranon tip (Fig. 2).

The population was divided into the following groups: 29 patients in group A, and 35 patients in group B. All patients had isolated closed olecranon fracture. Operations were performed in supine position and arm resting on the patient chest.

The operated side in all patients was put in long arm sling postoperatively for 2 weeks, and they were instructed to start gentle elbow exercises after this.

Outcome evaluation

Union was assessed radiologically. Any complications that occur were recorded in detail, as well as the time of occurrence (like, prominent hardware, skin breakdown, wire migration, and infections).

Final functional outcome was assessed by Mayo Elbow Performance Index (MEPI). It takes into account pain, motion, stability, and the ability to perform daily living activities. The score ranges from 5 to 100, with higher scores indicating better function. A total score is excellent between 90 and 100, good between 75 and 89 points, fair between 60 and 74 points, and poor at less than 60 points [8].

Statistical analysis

SPSS, version 21 (SPSS Inc., Chicago, Illinois, USA) was used for descriptive and frequency analyses. Mean and SD scores were performed. Paired samples *t* test and one way analysis of variance were performed. *P* values of less than 0.05 were considered significant, and 95% confidence intervals were considered to assess the degree of precision.

Ethical considerations

This study had been approved by the local university review board, and all patients consented to participate in our study.

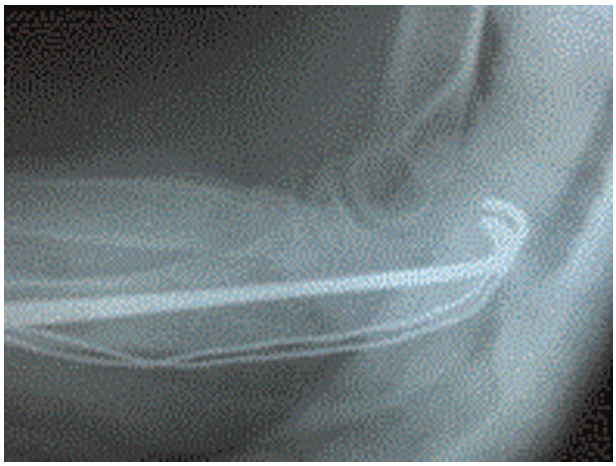
Results

None of the study population developed wound infection or wound breakdown in both groups postoperatively. There were no recorded cases of nerve injury or deep infection. The overall rate of reoperation in our study was 32.8% (21 patients out of 64 in both groups).

Figure 1

Intraoperative, the 1-inch proximal incision and the small distal one.

Figure 2



Postoperative radiograph of reduction and position of wires and tension band in percutaneous technique.

Group A

A total of 29 patients were included in group A, comprising 20 males, equaling 69%, and nine females, representing 31%. The mean age was 35.44 years (±14.36). The average operative time was 30.9 min (±6.9). All fractures united within an average of 7.68 week (±1.36). In group A, no single case of nonunion was seen. Six (20.68%) patients required metal removal. The average follow-up time was 24.31 months (±10.27). MEPI at the final follow-up was 82.86 (±5.11), and it did not differ even in patients who underwent removal of the metal work.

Group B

A total of 35 patients were included in group B, comprising 25 males and 10 females (71.4 and 28.6%, respectively). The mean age was 34.68 years (±12.57). Operative time was 41.4 min (±5.32). Only one patient needed reoperation owing to nonunion, and the other 34 patients united within an average time of 8.68 weeks (±1.76). Overall, 15 patients required reoperation to remove wires (42.85%). The average follow-up was 19.68 months (±10.85). MEPI of patients in group B was 83.42 (±5.77). (Table 1).

A significant relationship was found regarding the results between the two groups in the time of operation and healing time, in favor of the group of percutaneous wiring. Moreover, the rate of reoperation shows a statistically significant difference between both groups, where group A showed lower percentage of reoperation cases (Table 1).

Final functional scoring system (MEPI) showed no poor results in both groups, and majority of the study population in groups A and B represented good and close to excellent results (89.65 and 80.64%, respectively).

Table 1 The results of the two groups regarding age, operation time, duration of follow-up, and Mayo Elbow Performance Index

	Groups	*N*	Mean	SD
Age	Group A	29	35.4483	14.36659
	Group B	35	34.6857	12.57161
Time	Group A	29	30.8966	6.87306
	Group B	35	41.4000	5.32585
Healing	Group A	29	7.6897	1.36548
	Group B	35	8.6857	1.76187
Reoperation	Group A	29	1.2069	.41225
	Group B	35	1.4286	.50210
Follow up	Group A	29	24.3103	10.27168
	Group B	35	19.6857	10.85404
MEPI	Group A	29	82.8621	5.61073
	Group B	35	83.4286	5.77666

MEPI, Mayo Elbow Performance Index.

Within the same group, the significant difference between sex and age representations had no relation to the final follow-up, either healing or MEPI (Fig. 3).

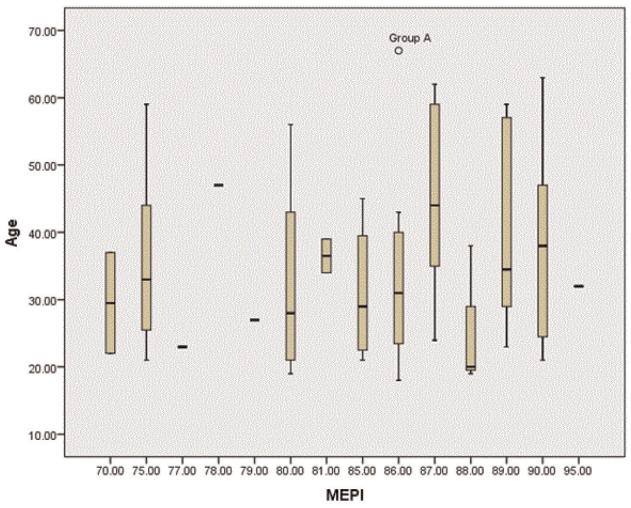
Discussion

In the emergency rooms, displaced olecranon fractures are the commonest fractures in the elbows of the adults that require operative treatment. Hamer *et al*. [9] published a review about current methods for the management of transverse displaced olecranon fractures; of 1483 papers, only 63 were relevant. Several complications were recorded postoperatively, like prominent hardware, skin breakdown, wire migration, and infections. They concluded that TBW is still the most widely used method to manage olecranon fracture.

Comparing configurations and techniques of TBW and K-wires was the common consensus of most of the works done on this method of treatment, but trying to improve the traditional technique was not mentioned. Percutaneous TBW in our study shows less operative time, less reoperation rate, and rapid union with no skin problems, when compared with the traditional open technique. However, the functional outcome in both groups shows nonsignificant difference.

Minimally invasive TBW for olecranon fractures using Ring-Pin through a 2-cm incision was published in a study in 2013. The pins were fixed using a dedicated cable wire that does not back out unless the cable wire breaks or slips out of the metallic clamp. The authors found this method useful, and the small incisions are advantageous from an esthetic point of view [7]. In our

Figure 3



Functional outcome in relation to age distribution.

work, we used the usual wires and band. We also compared it with the traditional method. Moreover, our results showed better operative time and better healing time, not only better scar. Rate of reoperation in the previously published literature ranged from 9 to 91% [10–15]. Our overall rate according to the number of our population was considered better than many published results, and also the percutaneous technique carries better results in this rate (? 21%). Haddad *et al.* [16] used two percutaneous compression screws as a simple solution; there results were comparable to ours but their study group number was nine patients only with short follow-up and no comparative group.

Conclusion

Percutaneous TBW of olecranon fractures give good results in terms of fixation and healing, and possess a lower rate of complications in comparison with traditional TBW.

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Conflicts of interest

There are no conflicts of interest.

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