

Sami ROUKOZ<sup>1,2</sup>, Wael BAYOUD<sup>1,2</sup>

Roukoz S, Bayoud W. Wireless tension band wiring for olecranon fractures. Case series. J Med Liban 2016; 64 (3): 160-163.

**ABSTRACT** • This retrospective study evaluates the results of wireless tension band wire (WTBW) which is a modified technique of tension band wires (TBW) for Mayo type II A and III A olecranon fractures. In this technique the K-wires of the TBW are replaced by a cerclage wire while keeping the figure of eight wiring. **Material and Methods:** We reviewed retrospectively our WTBW cases done between 2000 and 2015 where we replaced the K-wires by a cerclage wire. In this technique no hardware migration is possible. Patients were evaluated clinically, radiographically and a DASH score was measured. **Results:** Seventeen patients were reviewed with a mean age of 58.5 years. The mean follow-up period was 58.5 months. The mean DASH score was 12 with 7 patients having a DASH score of zero. Joint mobility was near normal compared to the other side with loss of a mean of 4° in elbow extension and a mean of 3° in elbow flexion. In comparison with other series, in addition to good results, hardware removal for medical reasons was the lowest in our technique. It was needed in three patients for pain on elbow contact and in one with ulnar nerve irritation. This represents a rate of 23.5%. **Conclusion:** Undesirable events related to the use of K-wires in standard tension band wiring, such as wire migration, wire protrusion through the skin and wire impingement, are absent in the wireless tension band wiring. The high rate of patient satisfaction, good clinical results as well as low rate of needed hardware removal make this technique preferable for fixing Mayo Type II A olecranon fractures.

Keywords : olecranon fracture; tension band wire; cerclage fixation

## INTRODUCTION

Tension band wiring (TBW) is the goal standard for simple non comminuted olecranon fractures. Wire migration and elbow pain related to the use of the K-wires in this technique reduce the optimal results that can be achieved in the treatment of this type of fractures.

We reviewed retrospectively our case series of Mayo type II A and III A olecranon fractures treated with a wireless tension band wiring (WTBW) where we re-

<sup>1</sup>Orthopedic Department, Hôtel-Dieu de France University Hospital, Beirut, Lebanon.

<sup>2</sup>Faculty of Medical Sciences, Saint Joseph University, Beirut, Lebanon.

Corresponding author: Roukoz Sami, MD.  
e-mail: samiroukoz@gmail.com

Roukoz S, Bayoud W. L'utilisation du cerclage avec haubanage sans broche pour fixer les fractures de l'olécrane. J Med Liban 2016; 64 (3): 160-163.

**RÉSUMÉ** • **Contexte :** Étude rétrospective pour évaluer le résultat d'une technique modifiée en double cerclage de l'haubanage des fractures olécraniennes type II A selon la classification de Mayo. La modification étant le remplacement des broches de Kirchner par un cerclage circulaire tout en gardant le cerclage en huit. **Matériel et Méthodes :** Nous avons revu rétrospectivement tous nos patients opérés par double cerclage entre 2000 et 2015. Dans cette technique où les broches sont remplacées par un cerclage aucun déplacement secondaire du matériel d'ostéosynthèse n'est possible. Les patients ont été évalués cliniquement, radiologiquement et selon le DASH score. **Résultats :** Dix-sept patients ont été revus avec un âge moyen de 58,5 ans. Le recul moyen était de 58,5 mois. Le DASH score moyen est de 12 avec 7 patients ayant un score de zéro. Le déficit moyen en extension est de 4° et le déficit de la flexion du coude est de 3°. Seulement trois patients ont eu besoin d'une ablation de matériel pour prééminence sous-cutanée du matériel et un patient pour syndrome irritatif du nerf ulnaire. Ceci représente un taux de 23,5%. **Conclusion :** La technique de double cerclage évite les complications liées aux broches dans la technique classique d'haubanage telles que migration, protrusion à travers la peau et conflit avec la fossette olécranienne. Le taux élevé de satisfaction des patients, de bons résultats cliniques ainsi que le très bas taux d'ablation de matériel pour cause médicale font que nous recommandons l'utilisation de cette technique de fixation dans les fractures type II A de Mayo de l'olécrane.

placed the K-wires by an additional wire cerclage keeping the figure of eight wiring. Our hypothesis is that WTBW will improve the results of these fractures.

## MATERIAL AND METHODS

This is a retrospective descriptive study that was approved by the ethics committee of our institution. We looked in our charts for olecranon fracture operated between the 1<sup>st</sup> of January 2000 and the 1<sup>st</sup> of July 2015.

Patients older than 18 years old, operated by wireless tension band wiring for their type II A olecranon fracture (according to Mayo classification) were included in this study. Patients younger than 18 years old or with comminuted fracture or with olecranon osteotomy for treating distal humerus fractures were excluded.

### Wireless wiring surgical technique

The procedure is performed under general or regional anesthesia. The patient is positioned in lateral decubitus on the operating table with the upper arm supported by a padded post and a pneumatic tourniquet on the proximal arm. Verification of a 100° free arch of motion of the elbow is then performed. If no allergy, one dose of antibiotics (cefazolin) is given at induction. The incision is started few centimeters proximal to the tip of the olecranon, and extended distally as needed to provide access to the injured area. The flexor carpi ulnaris as well as the anconeus tendons are detached medially and laterally as far as necessary to expose the involved bone fragments and to make anatomical reduction and stable fixation possible. After removing all interposed tissues between both fragments of the fracture, the reduction of the transverse olecranon fracture is held with small pointed reduction forceps. A hole is drilled through the ulna with a 2.5 mm drill approximately 40 mm distal to the fracture line and 5 mm away from the posterior cortex. A 1 mm wire is passed through this hole, then beneath the triceps tendon or through another hole drilled in the proximal fragment [if large enough] in a figure-of-eight shape. Another 1 mm wire is passed in a circle-shape. The knots are tightened and buried towards the ulna to avoid soft-tissues irritation afterwards (Fig. 1). Stability and reduction are checked peroperatively and immediately postoperatively with fluoroscopy. The wound is closed layer by layer over a suction drain. The elbow is put in a sling for 1-2 weeks and early active and passive mobilization of the elbow is started in the immediate postoperative setting. Usually the patient is discharged on the day following the removal of the suction drain.

The included patients were contacted and followed up in the clinical setting. In every patient, bilateral elbow active flexion/extension, as well as bilateral forearm pronation and supination and bilateral flexion and extension of the wrist were evaluated. Circumference of both arms and forearms is assessed with a measure in centimeters. Every patient answered the DASH (Disabilities of the Arm, Shoulder and Hand) questionnaire. Complications were looked for and noted.

Elbow and wrist extension and flexion arcs were performed for both limbs using the same goniometer. Pronation and supination of both forearms were assessed by asking the patient to hold a pen with his fist closed, elbow to body, in neutral position and to perform a pronation and a supination. The angle that the tip of the pen draws is measured by a goniometer. We compared the injured limb to the uninjured limb to highlight any significant difference.



**FIGURE 1.** Per-operative picture showing the wireless wiring of a type II A olecranon fracture before closure of the wound and after fluoroscopy verification of the reduction.

### RESULTS

Twenty patients met the inclusion criteria, but three passed away before the final follow-up, giving a total of 17 patients with a mean age of 58.5 years ranging between 31 and 88 years.

There were 10 females (mean age 60.1) and 7 males (mean age 56.4). All patients were right handed, and 8 out of the 17 fractures occurred in the right upper limb. All fractures were closed fractures except for two (12%) that were both treated as closed fractures. The mean follow-up reached 6 years (0.3 to 14 years).

The analysis of the motion of the operated limb, when compared to the uninjured extremity, showed a mean loss of 4° (0-15) of elbow extension, 3° (0-10) of elbow flexion, 4° (0-10) of forearm supination and 2° (0-10) of wrist flexion. There was no loss in wrist extension. The mean forearm and arm circumferences showed no difference between both extremities on the last follow-up. These results are detailed in Table I.

**TABLE I**

RESULTS of the STATISTICAL COMPARISON of the EVALUATED CLINICAL VARIABLES BETWEEN the INJURED and NON-INJURED EXTREMITIES

	Elbow		Forearm		Wrist		Forearm	Arm
	Extension	Flexion	Pronation	Supination	Flexion	Extension	Circumference	Circumference
Injured arm	4°	143°	79°	80°	66°	60°	24 cm	28 cm
Non-injured arm	0°	146°	82°	84°	68°	65°	24 cm	28 cm

The mean DASH score reached 12, ranging from 0 to 55. It is of note that 7 patients out of the 17 had a DASH score of 0.

While reviewing complications, we found no infections, and no loss of reduction (mal union or non-union). However, six patients underwent hardware removal:

- Two patients had no symptoms and were only operated because their physician asked them to.
- Two patients were operated because they had minimal pain on elbow contact.
- One patient had numbness in the ulnar nerve territory and was operated on for hardware removal and ulnar nerve neurolysis.
- One patient was operated because of residual flexum (10°), and regained full extension after surgery.

Concerning functional recovery, only four patients requested postoperative physical therapy. No cases of elbow arthritis were reported.

Figure 2 shows the case of a patient with a type II A olecranon fracture treated with the wireless tension band wiring, the immediate postoperative setting and the last follow-up.

#### DISCUSSION

Tension band wiring (TBS) remains the gold standard for treating Mayo type II A, non-comminuted olecranon fractures [1]. Comminuted fractures and fracture dislocations are treated by plate fixation or other techniques [1].

Although this technique gives a high rate of satisfaction many drawbacks remain to be solved like wire migration and pain related to the use of this type of fixation. Wire migration is the most commonly reported complication of TBW fixation. This leads to prominence of the K-wires at the insertion site into the olecranon leading to pain and sometimes skin breakdown [2]. This situation will lead to a less than optimal result as the

patient will reduce his activity and sometimes will need immobilization until bone healing and hardware removal [3, 4]. Many authors addressed this problem advising the proper positioning of the K-wires. Huang *et al.* in a retrospective study assessed three configurations of the K-wires in TBW [5]. They concluded that the K-wires should be fixed distally in the anterior cortex of the ulna and not in the medullary canal [5]. Newman *et al.* advised to bend the proximal end of the K-wires through two 90° bent and impact it in the proximal cortex of the olecranon [6]. Kim *et al.* recommend the use of K-wires with eyelets [7]. The figure-of-eight wire will go into the eyelet preventing the wire migration [7]. This type of K-wire is not easily available [7]. Karlson *et al.* proposed fixation without the K-wires, keeping only the figure-of-eight wiring [8]. This type of fixation was not stable enough and they reported a high rate of implant removal (43%) as well as 16% of radiographic osteoarthritis with a follow-up of 18.2 years [8]. This seems related to the inability of the figure-of-eight to stabilize rotation by itself [8].

In our wireless tension band wiring (WTBW) no K-wires were used. Instead, they were replaced by adding a cerclage wire to the figure-of-eight wiring. The wire passes proximally into the anterior part of the triceps tendon or inside the proximal bone fragment if its size allows to drill a whole of 2.5 mm. Distally, both wires go into the posterior cortex of the distal fragment either in the same hole or in two different holes. The added cerclage inhibits rotation and gives stability to the fixation system allowing early postoperative mobilization as no wire migration is possible. This explains the good final results in our series.

The reported frequency of hardware removal in TBW for olecranon fractures ranges from 20 to 100% [1]. Baecher and Edwards in their review report a 65% incidence of hardware removal [1]. The absence of K-wires in WTBW explains the very low rate of extension lag as the proximal tip of the K-wires may impinge on the ole-



**FIGURE 2.** Type II A olecranon fracture treated with WTBW  
a. Preoperative X-ray    b. Immediate postoperative X-ray  
c. Last follow-up X-ray 4 years later

cranon fossa when the elbow is in extension. This also explains the low incidence of hardware removal for medical reasons (one case of ulnar nerve irritation) in our series (23.5%).

In WTBW, the absence of wire migration, the absence of impingement in the olecranon fossa with the tip of the K-wires and the very early postoperative active mobilization explain the good results of this technique. The mean extension lag leveled 4° and the flexion lag reached 3° with a mean follow-up of 58.5 months. The mean DASH score was 12 with 7 patients having a DASH score of zero.

The incidence of other complications in TBW in Mayo type II A olecranon fractures, such as non-union, infection, heterotopic ossification are low, and they happen in less than 1% of cases. In our patients no such complications occurred.

#### CONCLUSION

Wireless tension band wiring – a technique where the K-wires in the classical tension band wire are replaced by a cerclage wire keeping the figure-of-eight wire – is a reliable procedure, simple to use and gives very good results. We recommend it for Mayo type II A olecranon fractures instead of the classical tension band wire fixation.

#### REFERENCES

1. Baecher N, Edwards S. Olecranon fractures. *J Hand Surg Am* 2013; 38A: 581-90.
2. van der Linden SC, van Kampen A, Jaarsma RL. K-wire position in tension-band wiring technique affects stability of wires and long-term outcome in surgical treatment of olecranon fractures. *J Shoulder Elb Surg* 2012; 21 (3): 405-11.
3. Catalano LW, Crivello K, Lafer MP, Chia B, Barron OA, Glickel SZ. Potential dangers of tension band wiring of olecranon fractures: An anatomic study. *J Hand Surg Am* 2011; 36 (10): 1659-62.
4. Schneider MM, Nowak TE, Bastian L et al. Tension band wiring in olecranon fractures: The myth of technical simplicity and osteosynthetic perfection. *Int Orthop* 2014; 38 (4): 847-55.
5. Huang TW, Wu CC, Fan KF, Tseng IC, Lee PC, Chou YC. Tension band wiring for olecranon fractures: relative stability of Kirschner wires in various configurations. *J Trauma* 2010; 68 (1): 173-6.
6. Newman SDS, Mauffrey C, Krikler S. Olecranon fractures. *Injury* 2009; 40 (6): 575-81.
7. Kim JY, Lee YH, Gong HS, Lee SL, Lee SK, Baek GH. Use of Kirschner wires with eyelets for tension band wiring of olecranon fractures. *J Hand Surg Am* 2013; 38 (9): 1762-7.
8. Karlsson MK, Hasselius R, Besjakov J, Karlsson C, Josefsson PO. Comparison of tension-band and figure-of-eight wiring techniques for treatment of olecranon fractures. *J Shoulder Elb Surg* 2002; 11 (4): 377-82.