

Modified Tension Band Wiring Technique by Safely Inserting K-Wires in Olecranon Fracture Osteosynthesis

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Abstract

Aim: The present study presents the results of a modified tension band technique by surgically inserting K-wires to treat olecranon fractures.

Materials and methods: The modification includes inserting the K-wires from the olecranon's upper tip and directing them to the ulna's dorsal surface. Twelve patients (three males and nine females) from 35 to 87 years of age were operated for olecranon fracture. After the standard approach, the olecranon was reduced and fixed with two K-wires from the tip to the dorsal ulnar cortex. Then the standard tension band technique was carried out.

Results: The average operating time was 17.25 ± 3.08 min. No image intensifier was used since the wires' discharge was either visible, penetrating the dorsal cortex, or palpable through this area's skin. The time needed for the bone union was six weeks. In one female patient, the wires were cut out. This patient showed a satisfactory painless range of motion (ROM) of the elbow but did not achieve full ROM. However, this particular patient had a previous removal of the radial head, and she spent some time in the ICU intubated. The modified technique used here is as stable as the classic operation, and it is safe since there is no risk of injuring the nerves and vessels of the olecranon fossa. There is less or no need for an image intensifier.

Conclusion: The outcomes of the present study are entirely satisfactory. However, many patients and randomized studies are needed to establish this modified tension band wiring technique.

Keywords

K-wires, olecranon fracture, osteosynthesis, tension band wiring

INTRODUCTION

Olecranon is a vital component of the elbow joint that is related to elbow instability. The word olecranon comes from the compound Greek words *olene* (ulna) and *cranion* (head). About 10% of all elbow fractures occur at the olecranon.^[1] Although manipulative reduction and external

fixation can be applied to patients with olecranon fractures, most patients need surgery with internal fixation. There are several internal fixation methods of olecranon fractures, with the tension band wiring (TBW) being the most popular, followed by plate fixation (PF). Some researchers are convinced that PF is superior to the TBW method due to minimal complications. However, the literature results

showed no significant difference between these two methods.^[2] Recently, a significant number of surgeons have used the TBW method due to its low cost making this method very popular.

Nevertheless, some complications with the TBW technique exist, resulting in a high risk of neurovascular injury.^[3,4] Turning the K-wires to the ulna's opposite (dorsal) surface, you can get pretty substantial support^[5], and it seems a safer technique. The present study aims to present the insertion of K-wires safely for internal fixation of modified tension band technique in treating olecranon fractures.

AIM

The present study aims to present the results of a modified tension band technique by surgically inserting K-wires to treat olecranon fractures.

MATERIALS AND METHODS

Twelve patients (three males and nine females) aged 35 to 87 years were operated on for olecranon fracture. All fractures were recent, with an average waiting time between 24 hours to 5 days. The main reasons for this delay were the patient's medical status and clopidogrel intake. All patients used nasal bactroban for nose decolonization and consequently reduction of the surgical site infection. All patients received intravenous antibiotics within an hour from the surgical incision for 3-4 days. A tourniquet was applied with a pressure of up to 200 mmHg. After the standard approach, the fracture was reduced and held by a reduction forceps.

Two K-wires were introduced from the olecranon's tip (triceps insertion) to the ulna's dorsal surface. Then the standard tension band technique was carried out. The elbow moved passively throughout the whole ROM, and the

stability of the fixation was checked. No image intensifier was used since the wires' discharge was either visible, penetrating the dorsal cortex, or palpable through this area's skin. Then the wound was closed, and an above-elbow cast was placed. Subsequently, the cast was removed after ten days, and the patient was encouraged to active elbow movements. The patients were followed up for 3 and 6 weeks, three and six months, and finally for a year. The DASH score was used to evaluate the upper extremities' function and monitor the patients' functionality over time.

Ethical considerations

The present study followed all ethical principles such as the complete confidentiality of the individuals who participated in the research, the material's safety, and the individuals' anonymity. Informed consent was obtained from the individuals that participated in the study. Furthermore, this research complied with the Helsinki Declaration and was approved by the Hospital's Ethical Committee.

RESULTS

The average operating time was 17.25 ± 3.08 min. No image intensifier was used since the extrusion of the wires was visible towards the dorsal cortex. The patients were followed up for six weeks, three, six, and twelve months postop. The time for the fracture to union was six weeks (Fig. 1). All patients, except one, achieved a full range of motion (ROM) within the first six months. In one female patient, the K-wires were cut out (Fig. 2). This patient had had a previous removal of the radial head. She was involved in a road traffic accident where she sustained an olecranon fracture and spent some time in the ICU intubated. In the six-month follow-up, she had a very satisfactory and painless ROM of the elbow (Fig. 3). This patient did not achieve

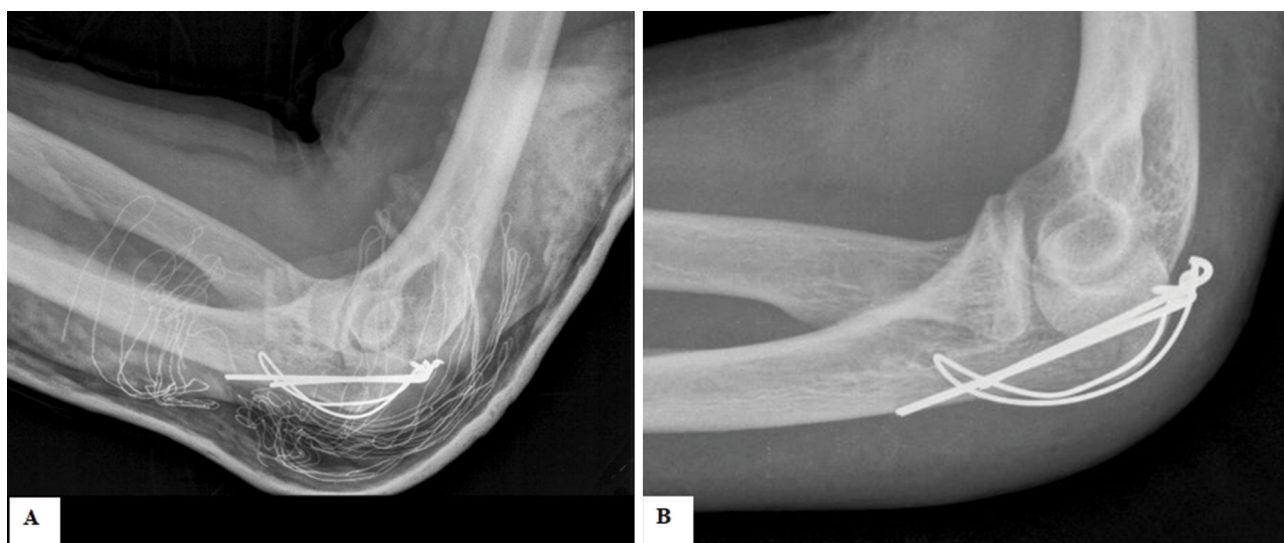


Figure 1. Roentgenograms of the olecranon fracture in an above-elbow cast. (A) next postoperative day; (B) the same fracture six weeks postoperatively.

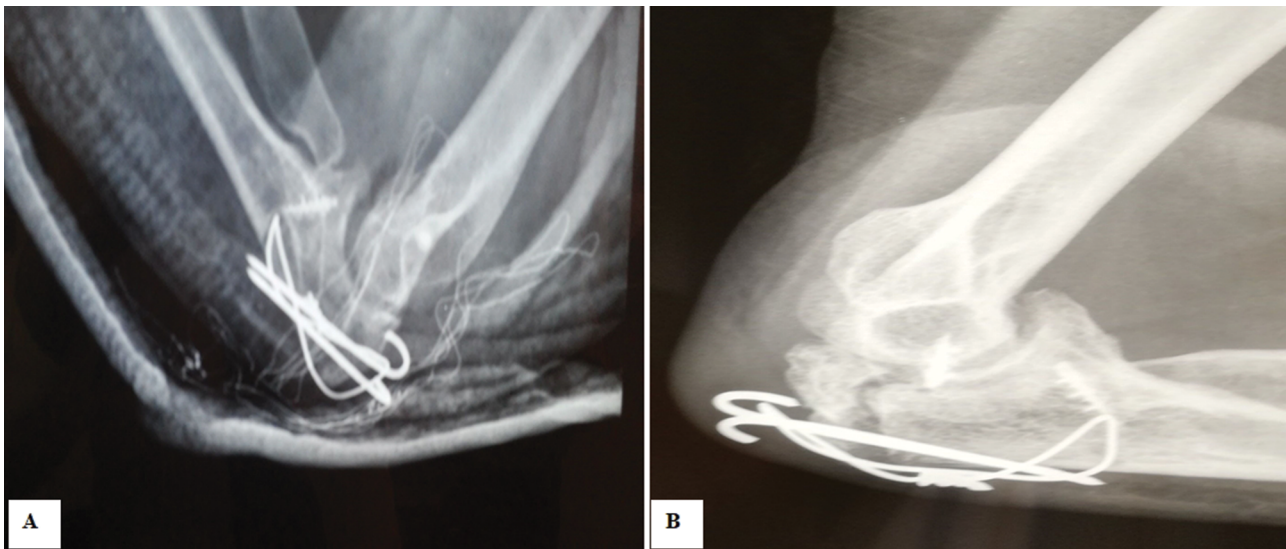


Figure 2. This patient had an elbow operation ten years ago. She sustained an olecranon fracture after the RTA and was intubated in ICU. **A)** Immediate postop roentgenogram; **(B)** Kirschners cutting out after two months.

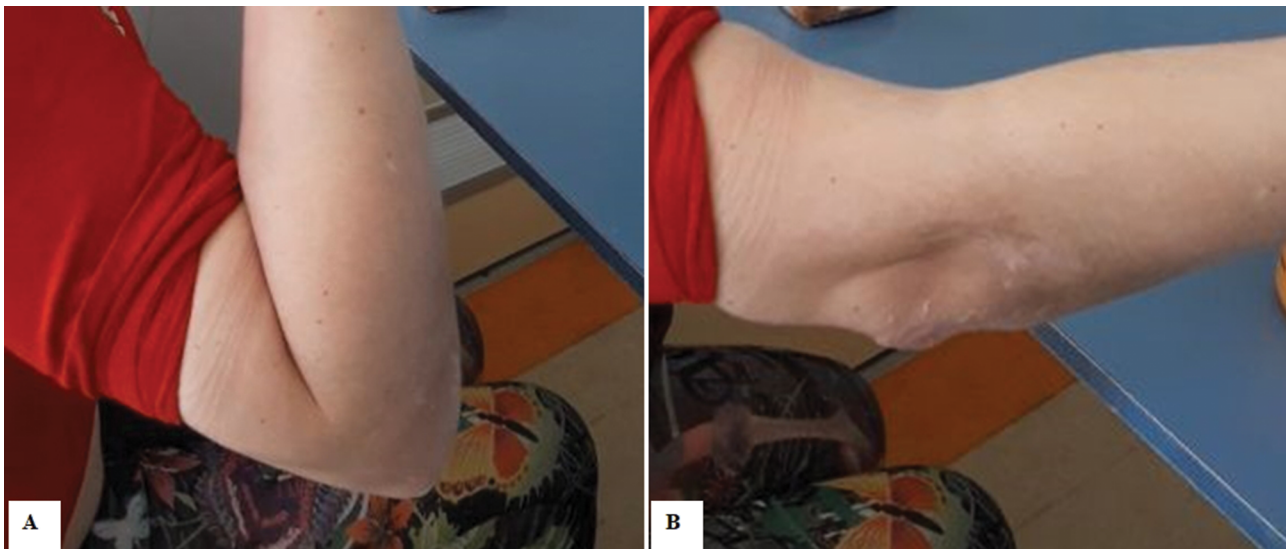


Figure 3. Despite the cutting-out of K-wires, the patient finally achieved **A)** a satisfactory flexion, and **B)** an elbow extension.

a full ROM. Since she reported of a previous elbow operation, the authors did not know if this stiffness was pre-existent. She referred to some minimal elbow problems in the past. The average DASH score of all patients was 12.1 (5.1–18.8). No skin problems or infections were observed in all patients.

DISCUSSION

Olecranon is a vital issue for elbow stability, and internal fixation is crucial to retain its biomechanical role.^[6] Concerning the type of fixation, there is still a debate about Tension Band Wire (TBW), the most commonly used technique, and plate fixation (PF). Still, it seems that there are no significant differences in DASH, improvement rate, ROM, oper-

ation time, and blood loss between them.^[2] However, there is insufficient evidence to support the superiority of TBW over PF, mainly due to poorly evidence-based studies.^[7]

It seems that correctly performed TBW in transverse olecranon fracture is relatively stable biomechanically, regardless of the length and the articular surface involved in such fixation.^[8]

In the classic TBW technique, initially, the fracture was reduced, and two K-wires passed from the tip of the olecranon either intramedullary or pushed until support was obtained to the opposite cortex into the olecranon fossa. Intramedullary, K-wires do not stabilize the fracture satisfactorily, and they should be exceeded at least beyond the ulnar bone.^[9] This seems to be quite tricky in everyday practice and demands several attempts and an image intensifier.

Anchoring the wires into the opposite cortex seems to be a stronger fixation of the fracture^[10], although several complications involve the elbow's vessels and nerves.^[3,4]

In a biomechanical thesis, Philipp Suter^[5] tested several types of fixation. He showed that by placing the K-wires in the opposite direction towards the palmar but onto the ulna's dorsal surface, the stability was not significantly different compared to other methods. Purchasing the wires that way, you can get more proximal bone on the tip of the olecranon, and even if the tip of the wire exceeds well beyond the opposite cortex, there are no vessels or nerves to entangle.

According to the present study, the insertion system failed only in one patient, partly due to the wrong technique used since the wires should have been started much higher at the tip of the olecranon and partly due to a previous elbow operation or difficulties in communicating with the patient due to a history of alcoholism. She was intubated for some time and did not quite understand the native language.

CONCLUSIONS

The modified technique presented here is as stable as the classic operation, and it is proved safe, since there is no risk of injuring the nerves and vessels of the olecranon fossa. Furthermore, there is no need for an image intensifier. Thus, the modified TBW technique is safe, easy to perform, and can safely replace the classic TBW technique. However, many patients and randomized studies are needed to establish this modified tension band wiring technique.

Conflict of Interest

The authors have declared that no competing interests exist.

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REFERENCES

1. Rommens PM, Kuchle R, Schneider RU, et al. Olecranon fractures in adults: factors influencing the outcome. *Injury* 2004; 35(11):1149–57.
2. Ren YM, Qiao HY, Wei ZJ, et al. Efficacy and safety of tension band wiring versus plate fixation in olecranon fractures: a systematic review and meta-analysis. *J Orthop Surg Res* 2016; 11(1):137.
3. Thumroj E, Jianmongkol S, Thammaroj J. Median nerve palsy after operative treatment of olecranon fracture. *J Med Assoc Thai* 2005; 88(10):1434–7.
4. Lee SH, Han SB, Jeong WK, et al. Ulnar artery pseudoaneurysm after tension band wiring of an olecranon fracture resulting in Volkmann's ischemic contracture: a case report. *J Shoulder Elbow Surg* 2010; 19(2):e6–8.
5. Suter P. Tension-band wiring of olecranon fractures – Biomechanical analysis of different fixation techniques [PhD Thesis]. Lausanne (Switzerland): Universite de Lausanne, Faculte de Biologie et de Medecine, 2012: p. 31.
6. Bell TH, Ferreira LM, McDonald CP, et al. Contribution of the olecranon to elbow stability: an in vitro biomechanical study. *J Bone Joint Surg Am* 2010; 92(4):949–57.
7. Matar HE, Ali AA, Buckley S, et al. Surgical interventions for treating fractures of the olecranon in adults. *Cochrane Database Syst Rev* 2014; 2014(11):CD010144.
8. Hammond J, Ruland R, Hogan C, et al. Biomechanical analysis of a transverse olecranon fracture model using tension band wiring. *J Hand Surg Am* 2012; 37(12):2506–11.
9. Huang TW, Wu CC, Fan KF, et al. Tension band wiring for olecranon fractures: relative stability of Kirschner wires in various configurations. *J Trauma* 2010; 68(1):173–6.
10. Saeed ZM, Trickett RW, Yewlett AD, et al. Factors influencing K-wire migration in tension-band wiring of olecranon fractures. *J Shoulder Elbow Surg* 2014; 23(8):1181–6.

Модифицированная техника фиксации натягивающей петлѐй путѐм безопасной установки К-спиц при остеосинтезе перелома локтевого отростка

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Резюме

Цель: В настоящем исследовании представлены результаты применения модифицированной методики натяжения с помощью хирургической установки К-спиц для лечения переломов локтевого отростка.

Материалы и методы: Модификация включает введение К-спиц от верхнего конца локтевого отростка и направление их к дорсальной поверхности локтевой кости. Двенадцать пациентов (три мужчины и девять женщин) в возрасте от 35 до 87 лет оперированы по поводу перелома локтевого отростка. После стандартного доступа локтевой отросток репонировали и фиксировали двумя К-спицами от кончика до дорсальной коры локтевой кости. Затем применялась стандартная методика натягивания петли.

Результаты: Среднее время операции составило 17.25 ± 3.08 мин. ЭОП не использовался, так как установка спиц была либо видна, проникая в дорсальную кору, либо пальпировалась через кожу этой области. Время, необходимое для сращения костей, составляло шесть недель. У одной пациентки спицы были перерезаны. Этот пациент показал удовлетворительный безболезненный объѐм движений в локтевом суставе, но не достиг полного объѐма движений. Однако у этой конкретной пациентки ранее была удалена головка лучевой кости, и она провела некоторое время в отделении интенсивной терапии с интубацией. Используемая здесь модифицированная методика столь же стабильна, как и классическая операция, и безопасна, так как отсутствует риск повреждения нервов и сосудов локтевой ямки. Необходимость в усилителе изображения незначительна или отсутствует.

Заключение: Результаты настоящего исследования полностью удовлетворительны. Тем не менее, необходимо большое количество пациентов и рандомизированные исследования, чтобы рекомендовать данный модифицированный метод фиксации с натягивающей петлѐй.

Ключевые слова

К-спицы, перелом локтевого отростка, остеосинтез, фиксация натягивающей петлѐй