

Triceps Aponeurosis Tongue Shape Flap: A New Technique to Solve the Wound Problem in Olecranon Fracture Fixation

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Abstract Background: Internal fixations for olecranon fractures, like tension band wiring and plates, have some complications such as prominence of the devices, neurovascular injuries, superficial infection, and skin irritation. In this study, a new triceps aponeurosis tongue shape flap technique was used to solve the problem in patients with olecranon fracture fixation. **Materials and methods:** Nine patients with olecranon fractures were evaluated. After fixation by tension band wiring and plate, the free aponeurosis triceps muscle in a tongue-shaped flap was used and rotated 180° to cover the whole the pin wire or plate. The surgeon then began to suture it to the anconeus, extensor carpi ulnaris and flexor carpi ulnaris muscles, fully around, with absorbable sutures. The follow-up time was eight weeks and a Mayo elbow performance score (MEPS) was filled for all patients. **Results:** Nine patients were analysed. Two cases were male and seven was female. The meanage was 49.11±10.37 years. Extension was full in six patients and was 170 in three. Flexion was full in all patients. No complications were recorded. The MEPS results showed that it was good and excellent in all the patients (number for patients was in the range of 80-95). **Conclusion:** According to results of present study, this technique can help to surgical fixation of olecranon fractures with different devices to have fewer complications, especially prominence of fixator systems and with this method tension band wiring can be remained as a gold standard in olecranon fracture fixation.

Keywords: olecranon fracture, internal fixation, triceps, aponeurosis flap

Cite This Article: Mohamad Qoreishy, Ali Keipourfard, Alireza Manafi Rasi, Ali Tahririan, and Mehran Soleyman Ha, "Triceps Aponeurosis Tongue Shape Flap: A New Technique to Solve the Wound Problem in Olecranon Fracture Fixation." *American Journal of Medical Case Reports*, vol. 5, no. 6 (2017): 166-170. doi: 10.12691/ajmcr-5-6-9.

1. Introduction

Olecranon fractures are common because of its subcutaneous location, which makes them vulnerable to trauma. Direct and indirect traumas, especially overloading applied by triceps and hyperextension of elbow joint by extreme forces, are possible mechanisms of olecranon fractures. However, in the follow-up, the treatment of the fractures has a favourable prognosis. [1] Simple olecranon fractures occur in all age groups and include approximately 10% of upper extremity fractures. [2] These types of fractures are intra-articular injuries where, in these cases, anatomic restoration of the articular surface should be achieved. To obtain early range of motion (ROM) exercises and avoid rigidity of the elbow joint, the fracture fixation must be firmly fixed. [3] For fixation of these fractures, several techniques are used as internal fixations. Commonly used methods include plate fixation, tension band wiring, fragment excision with triceps advancement, and intramedullary screw fixation. [4] The tension band wiring (TBW) technique (by a pair

of Kirschner wires [K-wires]) was first introduced by Weber and Vasey in 1963. [5] This technique has been known as the gold standard in management of transverse olecranon fractures. [6,7,8] Plate fixation was also used by Zuelzer in 1951 for the first time, [9] and this technique was described as being safe and effective with a low rate of plate removal. [10]

According to the studies, the common complications of fixation techniques included: symptomatic prominence of the devices (K-wires or plate and screws), neurovascular injuries (especially ulnar nerve) and local complication including superficial infection and skin irritation [2,11,12,13,14]. A prominence of K-wires was observed in 80% of patients undergoing K-wire technique surgery. In some cases, local complications can lead to removal of the fixation. [12] Furthermore, in plate fixation, hardware removal was seen because of the prominence of the internal fixation in some cases. K-wire instability can lead to an increase in the fracture gap and can increase the risk of non-union of a fracture. [15] According to studies into decreasing these complications, no techniques were reported.

In orthopaedic surgeries, aponeurosis flaps are used to bridge the tendon gaps in ruptures and re-ruptures.

[16,17,18] In this situation, advancement of aponeurosis as a desired flap is its scant elasticity. [19]

In this study, the aponeurosis tongue flap was used in olecranon fractures. According to the complications after surgery, a new triceps aponeurosis tongue flap technique was used to solve wound problems in patients with olecranon fracture fixation.

2. Materials and Methods

In this study, nine patients with a simple olecranon fracture who were referred to Akhtar Orthopedic Educational Hospital – which is affiliated with Shahid Beheshti University of Medical Science, Tehran – and operated on with the new triceps aponeurosis tongue flap technique, were evaluated. Preparation approach and technique of this new method along with all of the surgical processes were performed by a single surgeon. At first, for the positioning, the patient was placed in a lateral decubitus position and their upper arm was supported by a padded post. The forearm should be in a position where it can be flexed beyond 100°. A small padded table can be placed under the forearm to support the elbow in extension when necessary. A tourniquet was used on the proximal arm.

2.1. Skin Incision

The incision was started a few centimetres proximal to the tip of the olecranon, as needed for access to the injured area before the use of this new technique for the fixation of bone with a K-wire or plate. The curve was made slightly medially around the tip of the olecranon, and distally for 7 cm, as needed to provide access to the injured area.

2.2. Surgical Dissection

Elevation of the lateral flap provided access to the lateral structures of the elbow. In the proximal portion, the subcutaneous tissue was dissected and elevated. Over the olecranon, the olecranon bursa was removed and the triceps aponeurosis incised, exposing the bone.

2.3. Reduction and Fixation

The TBW method was used for five patients, and open reduction and internal fixation with anatomical olecranon plate was used in four patients.

2.4. The New Technique

After the fixation of the fractures with one of these two methods, the skin incision was extended proximal, between 7 to 12 cm to reach the proximal third of triceps aponeurosis. The dissection deepened the fascia, and exposed the aponeurosis of the triceps as far distally as its insertion on the olecranon. When the triceps muscle was contracted by fixed extension of the elbow, the aponeurosis was freed proximally to distally in a tongue-shaped flap and retracted distally to its insertion. After this, the flap was rotated 180° and then the whole pin wire or plate covered with this flap of aponeurosis. It was ensured that no part of device existed out of the coverage of the flap, and a suture to the anconeus muscle and extensor carpi ulnaris and flexor carpi ulnaris, fully around with absorbable sutures, was made. To prevent the risk of damage of the ulnar nerve during the aponeurosis suturing to the surrounding muscles, it is preferable to use ulnar nerve exploration.

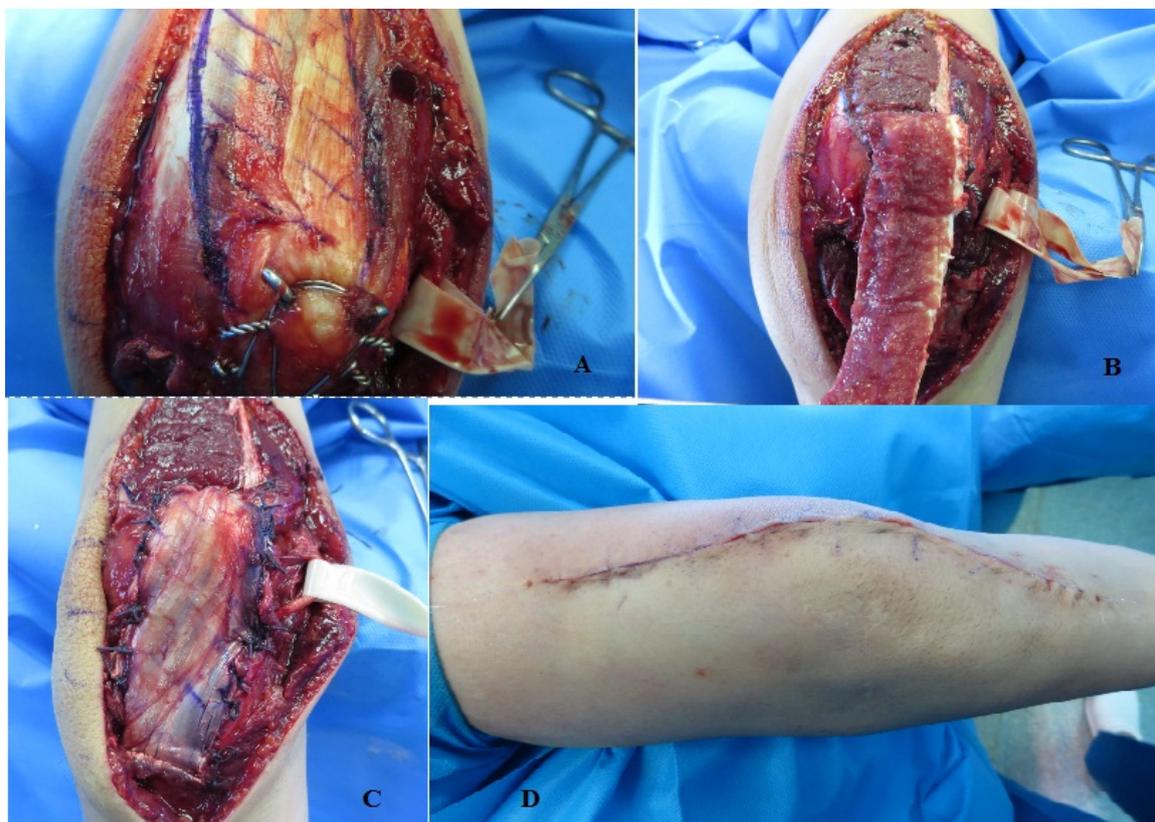


Figure 1. Skin incision, dissection and reduction and fixation by Triceps aponeurosis tongue shape flap

The follow-up time for each patient was every two weeks, and after eight weeks the joint-specific Mayo elbow performance score (MEPS) was filled and all the variables including extension, flexion and complications were evaluated for each patient. Surgery complications included prominence of the K-wires, neurovascular injury, and local complication, and cases with fixation removal were recorded. In MEPS, pain, motion, stability, and function are measured and results categorized as excellent (90), good (75-89), fair (60-74), or poor (60). [20]

3. Results

Nine patients with olecranon fractures were analysed for a new triceps aponeurosis tongue shape flap technique. Two cases were male, and seven were female. The mean age was 49.11 ± 10.37 years. The TBW method was used for five patients, and open reduction and internal fixation with anatomical olecranon plate was used in four patients. Extension of the elbow joint was evaluated in all patients: in six cases it was full, and in three it was 170° . Flexion evolution of the elbow joint in these patients was full. According to the post-operative follow-up of the patients, TBW had no complications, prominence of the hardware, or local complications (including superficial infection and skin irritation). Two cases with ulnar nerve mild paraesthesia were reported in the first series of patients (six cases). To prevent the risk of damage to the ulnar nerve, ulnar nerve exploration was used during the surgery. For all patients, for follow-up, MEPS was used after surgery. The scores showed that the results were good in four patients and excellent in five (mean score was 85.55 ± 5.83).

4. Discussion

Open reduction and internal fixation are surgical options for these fractures. [21] Several surgical techniques are used for internal fixation of olecranon fractures. Common methods of open reduction and internal fixation include tension band wiring, plate fixation, fragment excision with triceps advancement, and intramedullary screw fixation. [22] Obtaining the full range of motion in the elbow joint without stiffness and pain, and allowing the joint to have active movements, are primary goals in intra-articular olecranon fractures. The operative techniques of open reduction and internal fixation with tension band wires or a plate and screws are commonly used. [23] The bursa,

subcutaneous tissue and skin cover the olecranon directly. The fracture site is easily accessible due to the location of olecranon and implants are located subcutaneously. The site of implant in olecranon fractures is responsible for complications and elbow joint dysfunctions. [24,25] Common complications of fixation techniques are the prominence of the K-wires or the hardware of the plate fixation, neurovascular injury, and local complications (including superficial infection and skin irritation) which can lead to device removal and fixation failure. In this study, to solve the complications after surgery of olecranon fractures with TBW or plates, a new triceps aponeurosis tongue shape flap technique was used. Nine patients were evaluated post-operatively.

The complications of fixation (TBW method and plate), including prominence of the hardware, and local complications, including superficial infection and skin irritation, were not seen in the study. For follow-up, MEPS was good for all patients. Two cases of ulnar paraesthesia were reported because of aponeurosis suturing to the surrounding muscles. Ulnar nerve exploration was suggested to reduce the risk of these injuries. According to the present study, flexion in patients was improved and was full or near to full, and the Mayo elbow score was good and excellent for all patients. Villanueva et al. (2006) evaluated the risk factors of tension band wiring for olecranon fractures. According to the results, the mean flexion was 131° (range, 95° - 140°) and mean extension was 7° (range, 0° - 25°). In 17 cases the fixation was removed. Postoperative haematoma and superficial infection was recorded. Mayo elbow scores were recorded as being excellent in 22 patients, good in ten, fair in three, and poor in two. In the present study, the new aponeurosis flap technique could improve these complications.

One of the most common complications leads to removal of the K-wires in TBW, and the plate and screw system is prominent in these fixator systems. K-wire migration may also be related to secondary displacement, wound healing complications, pain and reoperation. [26] Saeed et al. (2014) evaluated the factors affecting K-wire migration in tension band wiring of olecranon fractures. According to the results some factors included bent wires, wire positioning (medullary/transcortical), proximal prominence, articular step, distance from the articular surface, and ulnar shaft angle. [27] Several modifications were described for tension bands to especially avoid the migration of K-wires. [28,29,30,31] In the present study the wires were covered by a tongue-shaped aponeurosis flap, and the migration of wires was reduced.

Table 1. The results of patients with olecranon fracture and new technique of triceps aponeurosis tongue shape flap

No	Age	Sex	Fixation technique	Extension	Flexion	MEPS	Complications
1	56	Female	TBW	Full	Full	90	No
2	36	Male	TBW	Full	Full	80	Ulnar injury
3	38	Female	TBW	Full	Full	80	No
4	59	Female	TBW	170	Full	95	Ulnar injury
5	61	Female	Plate	170	Full	80	No
6	62	Female	Plate	170	Full	90	No
7	41	Female	TBW	Full	Full	80	No
8	43	Male	Plate	Full	Full	85	No
9	46	Female	Plate	Full	Full	90	No

TBW: Tension band wiring; MEPS: Mayo elbow performance score.

For solving the complications of fixation techniques, some studies suggested different methods; however, they could not solve the problems completely. Mullet et al. (2000) passed the K-wires through the anterior ulnar cortex, showing that this technique can reduce the incidence of wires backing out. [32] However, the results of studies have shown that this technique is associated with a high risk of neurovascular injury if the wires move out of the cortex [33,34,35].

Furthermore, the AO trauma suggested the transcortical K-wire surgical technique. However, this technique may have some dangerous effects on the radial neck, radioulnar joint (proximal part), biceps tendon and supinator muscles, leading to forearm rotational problems. [36,37] Lui et al. (2012) compared the cable pin system (CPS) and TBW in a randomized prospective study. They demonstrated that internal fixation by CPS can lead to shorter healing times, better elbow functions and fewer complaints than TBW. However, this technique has some major limitations: the pin diameter is large and is unsuitable for comminuted fractures, just four lengths of pins are available (35, 40, 45 and 65 mm), and, finally, this method is the most costly, and the materials required are more expensive than those of TBW.

According to the results of the present study, this technique can help surgical fixation of olecranon fractures with different devices to result in fewer complications, especially prominence of fixator systems, and with this method tension band wiring can remain the gold standard in olecranon fracture fixation.

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