

CASE SERIES

Suture tape osteosynthesis for Mayo IIA olecranon fractures: a safe, effective alternative to metal implants

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Summary

Background: Olecranon fractures are common upper-extremity injuries, and tension band wiring is the most frequently used fixation method for simple transverse fractures. Despite reliable fracture union, this technique is associated with a high rate of hardware-related complications and secondary surgical procedures.

Objective: To describe a novel metal-free suture-based fixation technique for Mayo Type IIA olecranon fractures and to evaluate its clinical and functional outcomes.

Methods: This study included twelve patients with displaced, non-comminuted Mayo Type IIA olecranon fractures treated using a high-strength suture tape osteosynthesis technique. The method uses FiberTape sutures passed through longitudinal transosseous tunnels and crossed posteriorly to replicate the biomechanical principles of tension band wiring without metallic implants. Patients were followed for six months. Clinical outcomes were assessed using the Mayo Elbow Performance Score (MEPS) and the Oxford Elbow Score (OES), while radiographic evaluation was performed to assess fracture healing.

Results: Radiographic union was achieved in all patients by the eighth postoperative week. At final follow-up, 83% of patients regained full active range of motion. The mean MEPS was 97.5/100, and the mean OES was 47.33/48, indicating excellent functional outcomes. No post-operative complications, including infection, fixation failure, suture migration, or soft tissue irritation, were observed.

Conclusion: The described metal-free suture tape fixation technique provides stable fracture fixation, excellent functional recovery, and eliminates hardware-related complications in the treatment of Mayo Type IIA olecranon fractures. This method represents a safe and effective alternative to traditional metallic fixation techniques.

Keywords: olecranon fracture, Mayo classification, suture tape fixation, metal-free osteosynthesis, elbow fractures.



INTRODUCTION

Olecranon fracture is a common upper limb injury, accounting for approximately 10% of all upper extremity fractures (1) and 40% of all fractures around the elbow joint (2). In most cases, the fracture mechanism involves a direct impact to the posterior aspect of the elbow, typically occurring with the elbow in 60°–110° of flexion. Fracture patterns depend on bone quality, patient age, and the point of impact, with the most common mechanisms being simple falls and road traffic accidents (3,4). Seventy percent of olecranon fractures are simple transverse fractures. More complex fracture patterns may involve varying degrees of articular comminution, ulno-humeral instability, and associated osseoligamentous injuries (5).

Three main classification systems exist for olecranon fractures: the Mayo, Schatzker, and AO classifications. The Mayo classification, which is the most commonly used, was described by Morrey (6) and is based on fracture displacement, comminution, and elbow stability. Type I fractures are nondisplaced, type II fractures are displaced with a stable elbow, and type III fractures are displaced with elbow instability. Each type is further subclassified into groups A and B based on comminution (6).

Surgical fixation of an olecranon fracture is indicated in cases of extensor mechanism insufficiency, intra-articular displacement, or ulno-humeral instability. The goals of operative management are to provide stable fixation, restore the extensor mechanism, and achieve anatomic reduction to restore articular congruity. Numerous operative techniques have been described in the literature, including suture fixation, tension band wiring (TBW), screw fixation, and plate fixation, depending on patient factors, fracture configuration, and surgeon preference (7–10).

Tension band wiring remains the most commonly used fixation method and is appropriate for transverse fractures with minimal articular comminution and no evidence of ulno-humeral instability. Although this technique is associated with reliable fracture union, it carries a high rate of reoperation to remove prominent or symptomatic hardware, reported to be as high as 70% in the literature (7). Other techniques, such as plate fixation and intramedullary fixation, reduce wire migration but introduce their own complications and higher implant costs compared with TBW (11).

Several suture-based fixation methods have been described, including suture bridge fixation, bone tunnel fixation, suture anchor fixation, transosseous high-strength fixation, and flat-braided suture techniques, all of which have demonstrated encouraging results (12). Therefore, there is a clear need to explore alternative fixation techniques that minimize complications. Building on existing methods and aiming to address the most common complications of current operative techniques, we developed a novel fixation technique using high-strength suture tape without metallic implants.

This study aimed to describe a novel metal-free FiberTape osteosynthesis technique for displaced Mayo Type IIA olecranon fractures and to evaluate its radiographic, clinical, and functional outcomes in a consecutive series of patients treated with this method.

MATERIALS AND METHODS

Study Design

This retrospective case series included twelve consecutive patients with displaced, noncomminuted Mayo Type IIA olecranon fractures treated using the described FiberTape fixation technique at our institution. All patients underwent surgical treatment by the same operative team and were followed for at least six months postoperatively.

Inclusion criteria

Patients were included if they presented with a displaced, noncomminuted olecranon fracture classified as Mayo Type IIA according to the Mayo classification. Only skeletally mature patients who required operative treatment and who completed a minimum follow-up period of six months were eligible for inclusion in the study. (**Figure 1**).



Figure 1. Mayo Type IIA fracture. Preoperative radiograph. Source: Authors' clinical archive. The image contains no patient-identifiable information.

Exclusion criteria

Patients were excluded from the study if they had comminuted olecranon fractures (Mayo Type IIB), fractures associated with ulnohumeral instability (Mayo Type III), open fractures, pathological fractures, previous surgical procedures involving the affected elbow, or multiple

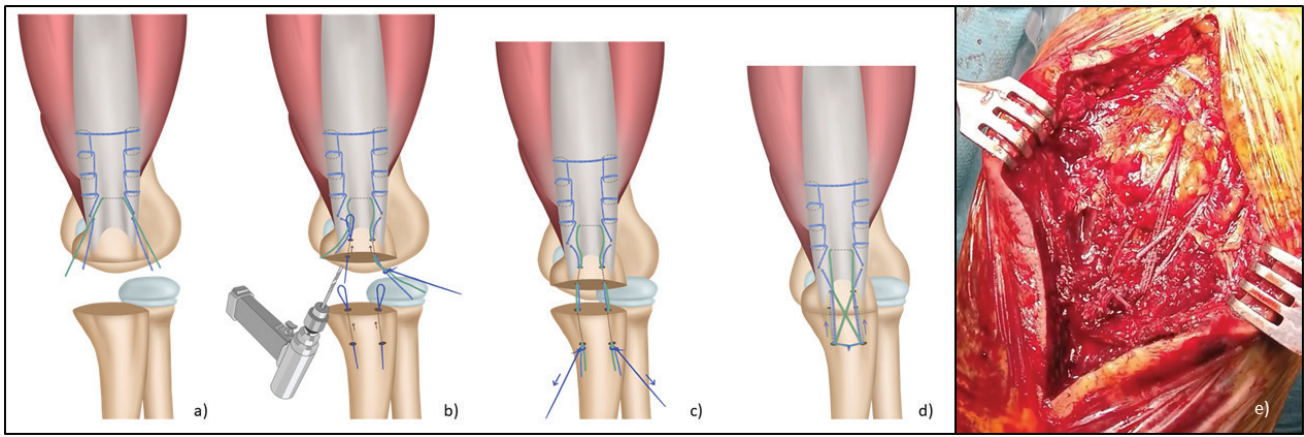


Figure 2. Illustrations of operative technique steps drawn by: Bozinovic Natalija (“Tape A” is colored blue, and “Tape B” is colored green). a) The position of Tape A and Tape B suture. b) The position of transosseous tunnels and suture passer loops. c) The path of tapes and their passing through transosseous tunnels. d) Illustration of the X-shaped construct formed after tape repassing (Tape A through ipsilateral, and Tape B through contralateral tunnel). e) X-shaped tape construct, intraoperative photograph. Source: Authors’ clinical archive. The image contains no patient-identifiable information.

traumatic injuries requiring simultaneous treatment of other skeletal regions. These exclusion criteria were applied to ensure a homogeneous patient population and to allow accurate assessment of the described fixation technique in simple displaced olecranon fractures.

Surgical technique

This technique utilizes the following instruments and materials: a 2.5-mm drill bit, a Hall PowerPro modular drill (Conmed, Largo, Florida, USA), pointed reduction clamps, two FiberTape sutures (Arthrex, Naples, Florida, USA), two Vicryl sutures (Ethicon, Bridgewater, New Jersey, USA), a suture passer, free needle, needle driver, and suture scissors.

The patient is positioned in the lateral decubitus position. A high arm tourniquet is applied to the operative limb and inflated after induction of general anesthesia. The injured arm is placed on an elbow positioner attached to the end of the operating table, and the surgical field is prepared and draped in a sterile fashion.

A standard posterior midline skin incision is made over the tip of the olecranon. The skin and subcutaneous tissue are dissected to expose the fracture site, which is then cleared of hematoma, debris, and any interposed soft tissue.

Using the Krackow technique, the first FiberTape suture (Tape A) is passed through the distal portion of the triceps tendon, from medial to lateral. Four suture throws are placed on the medial side, running distally to proximally over a span of 20 mm, and then mirrored on the lateral side. The second FiberTape suture (Tape B) is passed once through the triceps tendon near its insertion on the olecranon (Figure 2-a).

Two parallel longitudinal 2.5-mm bone tunnels are then drilled through the proximal fracture fragment. The tunnel entrances are located in the cancellous bone at the fracture line, and the exits are on the dorsal surface of the

fragment, aligned with the ends of the FiberTape sutures (Figure 2-b). The spacing between the tunnels corresponds to the distance between the midlines of the triceps tendon sutures to ensure even distribution of tensile forces.

The distal fracture fragment is prepared similarly, with two parallel longitudinal tunnels. The entrances are at the fracture line, and the exits are located approximately 4 cm distal to it on the posterior cortex of the proximal ulna. This positioning helps prevent suture migration toward the skin surface after knotting.

The ends of the FiberTape sutures are passed through the corresponding bone tunnels using a suture passer, along with the ends of the Vicryl sutures, which serve as shuttle sutures during repassing (Figure 2-c). Next, the medial end of Tape A is repassed through the medial tunnel, accompanied by the lateral end of Tape B, which has been passed through the contralateral tunnel. The same process is repeated on the lateral side (Figure 2-d).

This configuration creates an X-shaped construct that mimics the biomechanical principles of tension band wiring. The fracture is reduced using pointed reduction clamps with the elbow in full extension. The sutures are manually tensioned and tied using a simple non-sliding knot. The crossed and uncrossed ends are tied separately on the medial side of the proximal ulna to ensure the knots are adequately covered by soft tissue (Figure 2-e).

Intraoperative assessment of elbow range of motion is performed to confirm stability. The wound is irrigated with saline and closed in layers. Sterile dressings are applied, and the patient is placed in a posterior elbow splint at 90 degrees of flexion.

Postoperative protocol and follow-up

All patients followed a standardized postoperative rehabilitation protocol. A posterior elbow splint was applied and maintained for two weeks to protect the fracture site during the initial healing phase. During this period,

patients were instructed to perform hand and wrist range-of-motion exercises to prevent stiffness and maintain mobility in adjacent joints.

At two weeks postoperatively, patients were referred to physiotherapy to begin gentle, progressive elbow mobilization using a continuous passive motion (CPM) device. The primary focus during the first 12 weeks was to restore full range of motion. A physiotherapist monitored patients weekly until satisfactory joint mobility was achieved.

After restoring motion, rehabilitation progressed to strengthening exercises aimed at improving functional recovery and muscle endurance. Patients continued physiotherapy sessions under supervision to ensure safe and effective return to daily activities.

Clinical outcome assessment

Functional outcomes were assessed at the final follow-up using the Mayo Elbow Performance Score (MEPS) and the Oxford Elbow Score (OES).

The MEPS is a physician-based scoring system evaluating pain, range of motion, stability, and daily function, with a maximum score of 100 points. Scores are categorized as excellent (90-100), good (75-89), fair (60-74), and poor (< 60).

The OES is a patient-reported outcome measure consisting of 12 questions assessing elbow function, pain, and psychosocial impact. The maximum score is 48 points, with a higher score indicating better clinical outcomes.

Radiographic assessment

Standard anteroposterior and lateral radiographs of the elbow were obtained at every follow-up visit. Fracture union was defined as the presence of bridging trabecular bone across the fracture site together with the absence of secondary displacement or fixation failure.

RESULTS

This study enrolled twelve patients (six female and six male), aged 26 to 76 years (median age: 47), all treated with the previously described suture tape fixation technique. Each patient sustained a Mayo Type IIA olecranon fracture resulting from a low-energy fall on a level surface. No additional skeletal injuries or skin abrasions were present.

Patients were monitored through five scheduled outpatient visits over a six-month follow-up period. At the first postoperative visit, two weeks after surgery, the posterior elbow splint was removed, and wound healing was assessed. If local findings were satisfactory, skin sutures were removed. Subsequent follow-ups at four, eight, and twelve weeks focused on evaluating the range of motion of the operated elbow.

At the final six-month follow-up, patients completed a questionnaire assessing functional outcomes using the Mayo Elbow Performance Score (MEPS) and the Oxford Elbow Score (OES) (13,14). Standard radiographs were obtained at each visit to monitor fracture healing and fragment alignment (**Figure 3**). By the eighth postoperative week, radiographic evidence confirmed fracture healing in all patients. By the twelfth week, 10 out of 12 patients (83%) had regained full active range of motion.

Throughout the six-month follow-up, no postoperative complications were observed. Specifically, there were no cases of wound infection, suture migration, fragment malposition, suture rupture, or soft tissue irritation. Patients reported no discomfort or mechanical limitations. At the final follow-up, the average MEPS was 97.5/100, and the average OES was 47.33/48, indicating excellent clinical and functional outcomes.



Figure 3. Postoperative X-ray. The X-ray shows the adequate position of the fracture fragments and the congruence of the elbow joint. Source: Authors' clinical archive. The image contains no patient-identifiable information.

DISCUSSION

Simple displaced transverse fractures of the olecranon are common injuries that typically require surgical intervention. Tension band wiring (TBW) remains the most widely used and traditionally accepted method for treating these fractures. It is considered the gold standard because of its simplicity and minimal need for specialized equipment. TBW is particularly effective in achieving fracture reduction and fixation, as it converts the tensile forces generated by the triceps into compressive forces at the articular surface.

However, TBW is associated with a high rate of postoperative complications and secondary surgical procedures. Midtgaard et al. reported that 42% of patients treated with TBW required reoperation, most commonly due to symptomatic hardware, hardware failure, or infection (15). In a randomized controlled trial by Duckworth et al., 50% of patients treated with TBW underwent

Table 1. Demographic characteristics and clinical outcomes of the patients included in the study

Patient	Sex	Age (years)	Preop. MEPS	Preop. OES	Time to union (weeks)	Full ROM at 12 weeks	Final MEPS	Final OES	Complications
1	F	26	30	12	7	Yes	100	48	None
2	F	33	35	14	7	Yes	100	48	None
3	F	38	25	10	8	Yes	95	47	None
4	F	45	40	16	8	Yes	95	47	None
5	F	52	30	13	8	Yes	100	48	None
6	F	61	35	15	8	No	85	45	None
7	M	29	25	11	7	Yes	95	47	None
8	M	37	40	16	8	Yes	100	48	None
9	M	44	35	14	8	Yes	100	48	None
10	M	49	35	16	8	Yes	95	48	None
11	M	67	25	13	8	No	90	47	None
12	M	76	30	10	8	Yes	95	47	None

hardware removal due to symptoms, and some studies have reported complication rates as high as 70% (16,7).

Plate fixation (PF) has been shown to result in significantly lower rates of hardware removal compared to TBW (15). Additionally, several studies have shown that PF provides greater compressive force across the fracture site, particularly at the articular surface, than TBW (17,18). Wilson et al. highlighted the superior holding power of plate fixation and reduced soft tissue irritation caused by the implant (17). Despite these advantages, the higher cost of implants has limited the widespread adoption of PF for simple transverse olecranon fractures. Interestingly, a cost analysis by Powell et al. revealed that when factoring in complication rates and the need for reoperation, locking plates were ultimately more cost-effective than TBW (19).

To address the limitations of traditional fixation methods—including complications, reoperations, and cost—numerous suture-based techniques have been introduced. In a systematic review, Nazifi et al. described five suture fixation methods, all of which showed favorable outcomes in fracture reduction, functional recovery, and lower complication rates, including fewer returns to the operating room (12). A comparative study evaluating TBW, PF, and suture fixation for Mayo Type I and II olecranon fractures found a significantly higher reoperation rate in the TBW group compared to both the suture and plate groups. Notably, there was no significant difference in reoperation rates between the plate and suture groups, and no patients in the suture group required reoperation for suture removal or prominent knots (20).

Nazifi et al. also recommended a modified technique described by Phandis and Watts (21), which utilizes SutureTape (Arthrex, Naples, Florida, USA)—a flat-braided suture similar in structure to FiberWire but with greater resistance to tissue pull-out (12,21). Compared to wire sutures, braided tape sutures offer nearly double the bone pull-through strength and provide sufficient mechanical stability for displaced olecranon fractures (22).

In our technique, we used FiberTape, a high-strength suture composed of an ultrahigh-molecular-weight polyethylene multifilament core and a braided polyester jacket. FiberTape has demonstrated three times greater stiffness and ultimate load to failure compared to FiberWire (23). A biomechanical study by Borbas et al. comparing various high-strength sutures and tapes—including SutureTape, FiberTape, and FiberWire—identified FiberTape as having the best mechanical properties across multiple parameters. However, it also had the largest knot size (24).

Knot size can influence the risk of migration toward the skin surface. To mitigate this, we placed the knots on the medial side of the proximal ulna, where they are better covered by soft tissue. Importantly, we observed no complications related to knot prominence or soft tissue irritation in our patient cohort.

Additionally, unlike the Phandis and Watts technique, which utilizes transversely oriented bone tunnels, our method employs longitudinally positioned tunnels. Our technique involves double threading of the suture tapes and crossing them at the posterior aspect of the bone, creating a loop that provides both repositioning and a distraction-compression effect. Triceps contraction tightens the loop, generating compression at the fracture site—mimicking the biomechanical principles of TBW.

The economic advantage of suture-based fixation should also be noted. Nazifi et al. reported that the average cost of suture tape fixation was \$8,734 AUD, compared to \$8,830 AUD for TBW, including implant costs (12).

Considering the stable fracture reduction and fixation achieved, the compression effect at the fracture site, and the potential to reduce postoperative complications and reoperations, our technique using high-strength suture tapes presents a viable and effective alternative to traditional fixation methods for simple olecranon fractures.

CONCLUSION

The novel suture tape osteosynthesis technique for Mayo Type IIA olecranon fractures presents a promising alternative to traditional hardware-based fixation methods. By utilizing high-strength FiberTape sutures and a longitudinal transosseous tunnel configuration, this method achieves stable fracture reduction and fixation while mimicking the biomechanical principles of tension band wiring. Importantly, it eliminates the need for metallic implants, thereby reducing the risk of hardware-related complications and the need for secondary surgical interventions.

Clinical outcomes from our study demonstrated excellent fracture healing, restoration of elbow function, and high patient satisfaction, with no reported complications over a six-month follow-up period. The technique also offers economic advantages, with comparable or lower costs than TBW when factoring in reoperation rates.

Given its effectiveness, safety profile, and cost-efficiency, this suture-based approach may be a viable and

reliable alternative for treating simple displaced olecranon fractures, particularly in cases where minimizing hardware use is desirable.

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Guarantor: MG

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OSTEOSINTEZA TRAKOM ZA ŠAVOVE KOD MAYO IIA PRELOMA OLEKRANONA: BEZBEDNA I EFIKASNA ALTERNATIVA METALNIM IMPLANTATIMA

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Sažetak

Uvod: Prelomi olekranona predstavljaju česte povrede gornjeg ekstremiteta. Tenziona bandaža žicom je najčešće korišćena metoda lečenja jednostavnih poprečnih preloma, ali je povezana sa visokim procentom komplikacija vezanih za implantate i potrebom za reoperacijama.

Cilj: Prikaz nove, metal-free tehnike fiksacije šavnim trakama kod preloma olekranona tipa Mayo IIA i procena kliničkih i funkcionalnih ishoda lečenja.

Metode: U studiju je uključeno dvanaest pacijenata sa dislociranim, nekominutivnim prelomima olekranona tipa Mayo IIA, lečenih tehnikom osteosinteze pomoću visokootpornih šavnih traka (FiberTape). Šavne trake su postavljene kroz longitudinalne transosealne tunele i ukrštene posteriorno, čime se postiže biomehanički efekat sličan tenzionoj bandaži, bez upotrebe metalnih implantata. Pacijenti su praćeni tokom šest meseci. Funk-

cionalni ishodi su procenjivani pomoću Mayo Elbow Performance Score (MEPS) i Oxford Elbow Score (OES), dok je radiografski praćeno zarastanje preloma.

Rezultati: Kod svih pacijenata postignuto je radiografsko zarastanje preloma do osme postoperativne nedelje. Na završnoj kontroli, 83% pacijenata je povratilo pun aktivni obim pokreta. Prosečna vrednost MEPS iznosila je 97,5/100, a prosečna vrednost OES 47,33/48. Nisu zabeležene postoperativne komplikacije, uključujući infekciju, neuspeh fiksacije, migraciju šavova ili iritaciju mekih tkiva.

Zaključak: Prikazana metal-free tehnika osteosinteze pomoću šavnih traka omogućava stabilnu fiksaciju preloma, odlične funkcionalne rezultate i eliminiše komplikacije povezane sa metalnim implantatima u lečenju preloma olekranona tipa Mayo IIA. Predstavlja bezbednu i efikasnu alternativu standardnim metodama fiksacije.

Ključne reči: prelom olekranona, Mayo klasifikacija, fiksacija šavnim trakama, metal-free osteosinteza, prelom lakta.

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