Tension band wiring fixation is associated with good functional outcome after olecranon fractures at a Togo Hospital

Anani A[1], Akouété B[3], Yaovi Edem J[1], Ekoué D[2], Atsi W[1], Assang D[1] *Affiliation:* 1-Department of Orthopaedics, Tokoin Teaching Hospital 2- Department of General Surgery, Tokoin Teaching Hospital 3- Surgical clinic of Lomé (CCL), Lomé / TOGO
Correspondence: Docteur ABALO Anani, Post Code: 7 BP: 13607 Lomé / TOGO Fax : 00228 2226119 *E-mail:* grabanl@yahoo.fr

Abstract

Background: Tension band wiring (TBW) is a widely accepted technique for olecranon fractures. Various investigators have reported a significant rate of complications especially hardware prominence. The purpose of this study was to determine the clinical and radiological outcome after tension band wiring of olecranon fractures.
Methods: Sixty three patients (42 men and 21 women) were treated for fractures of the olecranon by TBW technique. Their mean age at the time of operation was 28 years (19 to 48). The mean follow-up period was 74.5 months (35 to 121). The overall outcome was evaluated using functional rating index described by Broberg and Morrey, the Visual Analogue Scale (VAS) subjective pain score (10 = unbearable pain) and patient satisfaction score (10 = complete satisfaction).
Results: Wound infection developed in six patients (09.5%). No non-unions, malunion or ulnar nerve palsies complicated the postoperative period. Hardware removal was recorded in 45 patients (71.4%) due to pin prominence, localized pain or direct complaint. Removal was not significantly affected by pin position (p = 0.201). Elbow pain persisted in 12 patients. Four patients (06.3%) had significantly reduced flexion arcs affecting the functional outcome. None of the patients had objective evidence of instability of the elbow.
The mean range of elbow flexion, pronation and supination was 135°, 70° and 79° respectively. 29 patients (46%) had an excellent functional result while four (6.4%) had poor result. The poor results were significantly associated with fracture type (p = 0.001) and the duration of immobilization (p = 0.003). The average satisfaction rating was 9.1 out of 10 (range, 5–10).
Conclusion: Tension band wiring fixation for isolated olecranon fractures leads to good elbow function and minimal loss of physical capacity.

Introduction

Olecranon fractures commonly occur after slips, falling onto the arm or in high energy trauma (1,2). The fractures are usually isolated but associated lesions can occur in complex injuries and polytrauma cases. Due to the intra-articular extension of fractures, anatomic reduction and early mobilization should be achieved in each case (3,4). Open reduction and internal fixation for displaced fractures allows early mobilization and reduces postoperative elbow joint stiffness (1,5). Of the various methods of internal fixation including wires, intramedullary screws and screw and plate fixation (1,2,6-8), tension band wiring (TBW) is the widely accepted technique (5,7). However, while TBW has been shown to be rigid under biomechanical testing, various investigators have reported significant rates of complications, most frequently hardware prominence (8,9). Helm et al (10) reported that 82% of patients in their series needed removal of hardware following TBW.

The purpose of this study was to determine the clinical and radiological outcomes in patients treated for olecranon fractures by tension band wiring technique in our hospitals

Materials and Methods

Between 2000 and 2007, we treated 63 patients (42 men and 21 women) with fractures of the olecranon. Their mean age was 28 years (19 to 48). The mechanism of injury included motor vehicle crashes (31 patients), industrial accident (13 patients), and fall (19 patients). Six of the fractures were open (type I in four patients and type II in two (11).

The fractures were classified according to the Mayo classification (4) (Figure 1). There were 4 (6.4%) type IB, 29 (46%) type IIA, 7 (11.1%) type IIB, 19 (30.1%) type IIIA, and 4 (6.4%) type IIIB. There were no associated neurovascular injuries. The mean interval between injury and operation was 12 days (2 to 21). The six patients with open fractures were treated by débridement, primary wound closure, and delayed internal fixation.

Fracture osteosynthesis was achieved with the insertion of two parallel 1.8 mm Kirschner wires from the tip of the olecranon into the shaft of the ulna. Sometimes we

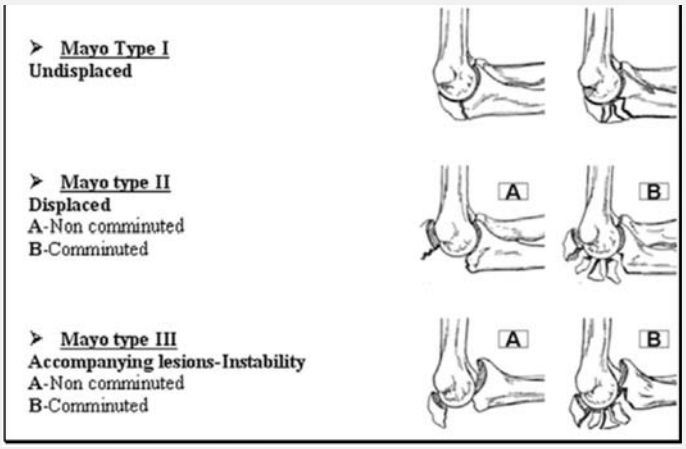

Figure 1. The fracture pattern was assessed using the Mayo classification which takes into account the degree of fracture displacement and comminution as well as the stability of the elbow joint.

Figure 2: A 34-years-old male sustained an olecranon fracture type IIIB in a traffic accident. 2a: Olecranon fracture type IIIB

2b: Anteroposterior and lateral radiographs of the elbow showing the use of three Kirschner wire for the TBW.

2c: Union of the olecranon fracture and material removal at 17 months post-operation.

used three Kirschner wires (figure 2). 0.8mm cerlage wire was passed round the K wires and tightened to create compession. Grafting with autogeneous bone was performed in seven patients.

The elbow was immobilised in a long-arm splint for a mean of 6.4 days (3 to 35) after operation, after which active exercises were started.

The mean follow-up period was 74.5 months (35 to 121). Evaluation at follow-up consisted of assessment of the stability, muscle strength, the active range of flexion and extension of the elbow, and rotation of the forearm. Anteroposterior and lateral radiographs were taken to assess bony union, articular congruity and post-traumatic degenerative changes. The overall outcome was evaluated using functional rating index described by Broberg and Morrey (12), the Visual Analogue Scale (VAS) subjective pain score (10 = unbearable pain) and VAS patient satisfaction score (13) (10 = complete satisfaction). The SPSS program 8.0 (SPSS Inc, Chicago, IL, USA) was used for data management. Statistical analysis was conducted using Chi-square test and Student's t-test as appropriate. P values less than 0.05 were considered to be statistically significant.

Results

Wound infection developed in six patients (09.5%). They resolved after intravenous antibiotics and surgical débridement. No nonunions, malunion or ulnar nerve

Tension band wiring fixation is associated with good functional outcome after olecranon fractures at a Togo Hospital Anani A, Akouété B, Yaovi Edem J, Ekoué D, Atsi W, Assang D

Figure 3. A 47-years-old female who sustained an opened (Goustilo type 1) olecranon fracture type IB in a domestic accident. 3a. Fixation by TBW at 13 days post traumatic.

3b. Union of the fracture at four months post operation.

Figure 4. A 27-years-old male who sustained a closed olecranon fracture type IIA in a traffic accident. A lateral radiograph of the elbow showing a symptomatic hardware.

palsies complicated the postoperative period (figure 3).

The anterior ulnar cortex was perforated by both Kirschner wires in 19 fractures (30.2%), by one in 13 fractures (20.6%). They were placed intramedullary in 31 fractures (49.2%).

Hardware removal was recorded in 45 patients (71.4%) due to pin prominence, localized pain or direct complaint (figure 4). The above event was not affected by pin position (p = 0.201). Pain persisted in 12 patients (19%) after metal work removal (VAS 1–2).

The mean range of flexion was 135° (95 to 145). The mean pronation was 70° (60 to 80), and the mean supination was 79° (70 to 90). Four patients (06.3%) had significantly reduced flexion arcs affecting the functional outcome. The rest of cases had some degrees of flexion or extension deficit without being functionally disabled. There was mild loss of the strength of flexion and extension in seven patients. The strength of pronation and supination was almost normal in all patients. No patients had objective evidence of instability of the elbow.

According to the functional index of Broberg and Morrey, 29 patients (46%) had an excellent result, 22 patients (34.9%) good result, eight patients (12.7%) fair result, and four patients (6.4%) poor result. The poor results were significantly associated with fracture type III (p = 0.001) and the immobilization period up to one week (p = 0.003). The average satisfaction rating was 9.1 out of 10 (range, 5–10) with 56 patients (73%) stating complete satisfaction of the final result. Degenerative changes were found in 20 elbows (31.7%) but no correlation with the final outcome was identified (p = 0.026).

Discussion

Open reduction and rigid internal fixation has become the accepted method of treatment for displaced fractures of the olecranon in order to allow early mobilisation, and the prevention of contracture of the elbow (1,2). The goals of fixation are realignment of the longitudinal axis of the olecranon, the provision of sufficient stability for mobilisation, preservation of the coronoid process, and anatomical restoration of the articular surface of the trochlear notch (13). At present, tension band wiring is the widely accepted technique (5,7). A tension band converts the tensile forces at the fracture site created as a result of muscle action into compressive forces (14-16). In 1963, Weber and Vasey (17) introduced the concept of combining the tension band with Kirschner wires to increase the stability of the fixation. This technique was further modified by the AO group by placing the Kirschner wires obliquely to engage the anterior cortex of the ulna in order to increase the stability of the fracture fixation and to prevent the wires from backing out. A biomechanical analysis of this technique showed a significant increase in fracture stability when compared to the original Weber-Vasey technique (18). Other authors had suggested various modifications in order to improve the biomechanical properties of the technique (19,20).

While tension band wiring has been shown to be rigid under biomechanical testing, there are have reports of significant rates of complications, most frequently hardware prominence (5,8,9,21). Helm et al (10) reported that 82% of patients in their series needed removal of hardware following tension band wiring.

In the randomized study by Hume and Wiss (8), eight patients (42%) in the tension band group had symptomatic hardware compared to one in the plate fixation group.

Rommens et al (21) stated that suboptimal pins placement (Kirschner wires which are not inserted parallel or do not transverse the opposite cortex of the proximal ulna) was not correlated with increased rate of implant loosening or secondary procedures. The above finding was also evident in our study. We have reported a rate of 71.4% of pins prominence. To avoid hardware problems with TBW technique, some authors have recommended plating osteosynthesis for fracture stabilization (2,8,13). Bailey et al (13) reported high patient satisfaction (9.7/10) with a low pain rating (1/10) after plate fixation in Mayo types II and III fractures.

Since this study, the policy in our department is to use one-third tubular plate fixation when fracture comminution (Types IIB and IIIB) couldn't support compression with the TBW technique.

Various degrees of postoperative elbow stiffness and deficit of range of motion have been reported in literature after surgical treatment of olecranon fractures (21,22). Degenerative changes are not uncommon after olecranon fractures and they have been related to the length of follow up (23). Karlsson et al (24) found that with a mean of 19 years after isolated olecranon fractures 50% of the patients developed degenerative changes. However, these patients did not report any substantial symptoms and no correlation could be found between radiographic findings and patient subjective outcome. In

31.7% of our patients, degenerative changes were identified after an average of 6.2 years postoperatively. Nonunion, ulnar nerve palsy and wound infections have been described in approximately 2–10% of olecranon fractures (4,10). Even though the subcutaneous position of the Kirschner wires and their subsequent migration may be responsible for secondary displacement and wound healing problems, careful operative technique and appropriate soft tissue management are of greatest importance in order to minimize these complications.

Conclusion

Tension band wiring fixation for isolated olecranon fractures leads to good elbow function and minimal loss of physical capacity.

References

1. Colton CL. Fractures of the olecranon in adults: classification and management. Injury 1973;5:121-9.
2. Anderson ML, Larson AN, Merten SM, et al. Congruent elbow plate fixation of olecranon fractures. J Orthop Trauma 2007; 21:386–393.
3. Morrey BF: Current concepts in the treatment of fractures of the radial head, the olecranon, and the coronoid. Instr Course Lect 1995, 44:175-185.
4. Cabanela H, Morrey BF. The elbow and its disorders. 3d edition. Philadelphia, Saunders; 2000:365-379.
5. Horne JG, Tanzer TL: Olecranon fractures: a review of 100 cases. J Trauma 1981, 21(6):469-472.
6. Gordon MJ, Budoff JE, Yeh ML, et al. Comminuted olecranon fractures: a comparison of plating methods. J Shoulder Elbow Surg 2006; 15:94–99.
7. Hak DJ, Golladay GJ. Olecranon fractures: treatment options. J Am Acad Orthop Surg 2000; 8:266–275.
8. Hume MC, Wiss DA. Olecranon fractures. A clinical and radiographic comparison of tension band wiring and plate fixation. Clin Orthop Relat Res 1992; 285:229–235.
9. Macko D, Szabo RM. Complications of tension-band wiring of olecranon fractures. J Bone Joint Surg [Am] 1985; 67-A:1396-1401.
10. Helm RH, Hornby R, Miller SWM: The complications of surgical treatment of displaced fractures of the olecranon. Injury 1987; 18(1):48-50.
11. Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analysis. J Bone Joint Surg [Am] 1976;58-A:453-8.
12. Broberg MA, Morrey BF. Results of delayed excision of the radial head after fracture. J Bone Joint Surg [Am] 1986;68-A:669-74.
13. Bailey CS, MacDermid J, Patterson SD, et al. Outcome of plate fixation of olecranon fractures. J Orthop Trauma 2001,15(8):542-548.
14. Hotchkiss RN. Fractures and dislocations of the elbow. In: Rockwood CA, Green DP, Bucholz RW, Heckman JD, eds. Rockwood and Green's fractures in adults. Vol. 1, 4th ed. Philadelphia: Lippincott- Raven, 1996:929-1024.
15. Fyfe IS, Mossad MM, Holdsworth BJ. Methods of fixation of olecranon fractures. An experimental mechanical study. J Bone Joint Surg Br 1985, 67(3):367-372.
16. Horner SR, Sadasivan KK, Lipka JM, et al. Analysis of mechanical factors affecting fixation of olecranon fractures. Orthopedics 1989, 12(11):1469-1472.
17. Weber BG, Vasey H: [Osteosynthesis in olecranon Fractures.]. Z Unfallmed Berufskr 1963, 56:90-96.
18. Prayson MJ, Williams JL, Marshall MP et al: Biomechanical comparison of fixation methods in transverse olecranon fractures. J Orthop Trauma 1997; 11(8):565-572.
19. Hutchinson DT, Horwitz DS, Ha G, et al. Cyclic loading of olecranon fracture fixation constructs. J Bone Joint Surg Am 2003, 85-A(5):831-837.
20. Rowland SA, Burkhart SS: Tension band wiring of olecranon fractures. A modification of the AO technique. Clin Orthop Relat Res 1992:238-242.
21. Finsen V, Lingaas PS, Storro S: AO tension-band osteosynthesis of displaced olecranon fracture. Orthopaedics 2000; 23(10):1069-1072.
22. Rommens PM, Kuchle R, Schneider RU, et al. Olecranon fractures in adults: factors influencing outcome. Injury 2004, 35(11):1149-1157.
23. Villanueva P, Osorio F, Commessatti M, et al. Tensionband wiring for olecranon fractures: analysis of risk factors for failure. J Shoulder Elbow Surg 2006, 15(3):351-356.
24. Karlsson MK, Hasserius R, Karlsson C, et al. Fractures of the olecranon: a 15- to 25-year followup of 73 patients. Clin Orthop Relat Res 2002:205-212.