MANAGEMENT OF COMMINUTED FRACTURES OF THE OLECRANON BY TENSION BAND WIRING

Shahid Sultan, Alam Zeb Khan

Department of Orthopaedic Surgery, Ayub Medical College, Abbottabad.

Background: Open reduction and rigid internal fixation has become the generally accepted method of treatment for displaced fractures of the olecranon in order to allow early mobilisation and to prevent contracture of the elbow. Comminuted fractures of olecranon are unstable, therefore, bone graft and tension band wiring are supposed to give good stability. Here we give an account of our experience with this procedure. **Methods:** We treated ten patients with comminuted fractures of the olecranon by multiple tension-band wiring and a graft from the iliac crest between 1999 and 2002 at Ayub Teaching Hospital, Abbottabad. After initial immobilization strengthening and endurance exercises were started. The patients were followed up for stability, muscle strength, active range of flexion and extension at elbow and rotation of forearm. **Results:** The time to union of the fractures was 3 to 7 months. No patient reported difficulties with activities of daily living or symptoms of instability of the elbow. The median flexion was up to 135° (125° to 145°) with a median flexion contracture of 15° (range10° to 30°). The median pronation was 70° (60° to 80°) and median supination 79° (70° to 90°). Only three patients had mild pain and loss of strength. Five patients had excellent and 5 good results with a median Broberg and Morrey index score of 94.5 points (84 to 100). **Conclusion:** Our results are in accordance with those reported from other centres and the technique is thought to be a practical alternative to plate fixation of olecranon fractures with extreme comminution.

Keywords: Olecranon; comminuted fracture; tension band wiring

INTRODUCTION

A comminuted fracture of the olecranon is a difficult injury to treat. Since it is intra-articular and the olecranon effectively functions as the fulcrum of the lever arm of the elbow, it is necessary to restore precise anatomical alignment with rigid fixation so that early movement can be encouraged. Although tension-band wiring is the standard technique for fixation[1-5], yet it can be difficult to carry out adequately when there is comminution and bone loss. Under these circumstances the compressive force of the wiring may cause the fragments of bone to collapse displacing the fracture and shortening the ulna. Fixation by a plate, in combination with bone grafting is an alternative method used to maintain reduction of comminuted fracture after reconstruction of the joint surface.[6-10] It does not, however, consistently provide enough stability to allow early mobilisation especially when the proximal fragment is small and thin.[4]

Alternatively comminuted cortex of olecranon is replaced by iliac crest bone graft and fixed with tension band wiring. This provides good stability and rigid fixation to the fracture and early movements of the elbow can be started.[11]

We describe the operative technique employed and the results of treatment in ten patients with comminuted fractures of the olecranon using multiple tension-band wiring in combination with a bone graft from iliac crest.

MATERIALS AND METHOD

We kept complete record of all the patients treated for comminuted fractures of the olecranon between 1999 and 2002 at Ayub Teaching Hospital, Abbottabad. We used a proforma to record the relevant data. The fractures were graded according to the criteria of Gustilo and Anderson.[11] All fractures were classified according to the Mayo classification.[5] Associated neurovascular injuries and fractures were also noted. Patients with open fractures were treated by irrigation, debridement, primary wound closure, and delayed internal fixation.

The patient was placed in the supine position under general anaesthesia. We used a standard posterior approach after inflation of a tourniquet. The goal was to replace the comminuted section of the mid portion of the olecranon with a bone block from the iliac crest while preserving the anatomical curvature of the notch of the trochlea. The comminuted posterior section was initially removed but the length of the ulna was maintained. The bed for the graft was prepared and bone taken from the iliac crest to fill the defect. The posterior cortex of the fractured olecranon was preserved to provide stability for the graft. Two parallel 1.8 mm Kirschner wires were inserted from the tip of the olecranon through the bone block into the shaft of the ulna. After radiological assessment of the length of the ulna and the contour of the trochlear notch, two 0.8 mm wires were anchored to the bone block and to the shaft of the ulna separately, passed around the Kirschner wires and twisted in a figure-of-eight. In the patient with a large fragment of the coronoid process around the Kirschner wires, and twisted in a figure-of-eight fashion over the bone block.

The elbow was immobilized in a long arm splint after operation after which active exercises were started. Dynamic flexion and extension splints were used after three or four weeks and strengthening and endurance exercises after three months.

The follow up evaluations consisted of assessment of the stability, muscle strength the active range of flexion and extension of the elbow, and rotation of the forearm. Antero-posterior and lateral radiographs were taken to assess boney union, articular congruity and post traumatic degenerative changes. The overall outcome was determined using the functional rating index described by Broberg and Morrey.[12]

RESULTS

Between 1999 and 2002, we treated ten patients with comminuted fracture of olecaranon. The injury was caused by a high energy injury, including eight motors vehicle accidents and two falls from a height. Six of the fractures were open and were graded according to the criteria of Gustilo and Anderson as type I in 4 patients and type II in 2.[11]

All fractures were classified according to the Mayo classification[5]; 6 were IIB and 4 type IIIB. Three patients had type IIIB fractures involving the coronoid as the major fragment and also had a Monteggia fracture associated with a fracture of the distal radius. There were no associated neurovascular injuries.

The interval between injury and operation was from 2 to 15 days. Six patients with open fractures were treated by irrigation, debridement and primary wound closure, and delayed internal fixation. The elbow was immobilized in a long arm splint for up to 5 days after operation, after which active exercises were started. Dynamic flexion and extension splints were used after three or four weeks and strengthening and endurance exercises after three months.

The follow up period was from 15 to 36 months. At follow up evaluations the range of flexion was 125° to 145° with mean flexion contracture of 10° to 30°. The pronation range was 60° to 80°, while the supination was 70° to 90°. Seven patients had no pain and 3 had mild pain during heavy manual labour. There was mild loss of the strength of flexion and extension in 3 patients. The strength of pronation and supination was almost normal in all patients. None had objective evidence of instability of the elbow.

The time to union of the fractures was from 3 to 7 months. There were no operative complications. No patient reported difficulty with activities of daily living or symptoms of instability of the elbow.

The radiographs at the final follow up showed no steps in the articular surface or gaps in the trochlear notch, despite the fact that 5 patients had a gap in the articular surface of less than 2 mm on the final films taken at operation. According to the functional index of Broberg and Morrey there were 5 excellent and 5 good results with a mean score of 94.5 points (range 84 to 100).[12]

Table-1: Range of movements (degree) at final follow up evaluation

Case	Ext./Flex.	Pron./Sup.	Result
1	-15/125	80/80	Good
2	-10/130	80/90	Excellent
3	-15/135	80/80	Excellent
4	-10/135	60/70	Excellent
5	-30/125	60/70	Good
6	-10/140	80/80	Excellent
7	-10/135	70/80	Excellent
8	-15/145	60/80	Good
9	-15/135	70/80	Good
10	-20/135	60/70	Good

DISCUSSION

The goals of fixation of comminuted fracture of olecranon are realignment of the longitudinal axis of the olecranon, provision of sufficient stability to allow early mobilisation, preservation of coronoid process and anatomical restoration of the artricular surface of the trochlear notch[4]. Tension-band wiring is a widely used technique for stabilising this fracture[1-5,7,14-16]. This particular construct counteracts the tensile forces from the triceps muscle and converts them to a compressive force at the site of the fracture. Where there is marked comminution with bone loss, tension-band wiring

may lead to collapse of the fragments with shortening of the articular surface of the olecranon, dyscongruity of the joint impingement, loss of movement and degenerative osteoarthritis.[4]

In the presence of comminution plate fixation has been used with supplementary Kirschner wires, screws or bone grafting[6-9,17,18]. In some circumstances the proximal bone fragment may be small and thin making fixation with a plate difficult. Severe comminution of mid portion of the olecranon may occasionally make satisfactory reconstruction impossible and excision of the comminuted section with shortening of the olecranon may be the only option.[1]

Several classification systems have been used for comminuted fractures of the olecranon but there have been few outcome studies. Teasdall *et al* [6] reported that 69% (11 of 16) of patients with comminuted fractures treated by fixation using a plate and wires had excellent or good results with a mean range of movement of 25^0 to 110^0. Ring *et al*[10] found that 88% (15 of 17) of patients with transolecranon fracture-dislocation treated by plate fixation had an excellent or good result, with a mean range of movement of 14^0 to 127^0. Excision of the proximal fragment with reinsertion of the triceps tendon into the proximal ulna is an alternative technique[4,5,19]. There are very few indications for this procedure since it is contraindicated in the presence of damage to the anterior soft tissue[5], fractures involving the coronoid process and with anterior dislocation of the radial head or ulna shaft[4,5]. A single intramedullary screw may be combined with tension-band wiring[4,14-16]. This does not function as well as parallel Kirschner Wires when fixing a small proximal fragment.

Our series of 10 patients included 4 who had a Mayo type IIIB unstable comminuted trans-olecranon fracture-dislocation and 3 also with considerable involvement of the coronoid process. All patients had an excellent or good result, with a mean range of movement between 15^0 and 135^0. These results compare favourably with others previously described.

The early active movement allowed by rigid fixation is an essential factor in postoperative management and we believe that the rigid stability obtained with this technique is related to the replacement of the comminuted section with a tricortical bone block from the iliac crest and multiple tension band wiring. The aggressive resection of the comminuted position may leave a defect requiring a substantial bone graft. Impaction of the graft between the tip of the olecranon and the shaft gives some inherent stability, allowing immediate active mobilisation. Realignment of the longitudinal axis of the ulna and preservation of its length ensures a normal anatomical relationship to the head of the radius.

A further advantage of this technique is that a large fracture fragment of the coronoid process can be fixed securely to the shaft of the ulna by figure of eight wiring. The stability of the fracture is tested during the operation through a full range of passive movement of the elbow. In one case a small residual gap in the articular surface of the trochlear notch which was seen at operation was not apparent on the radiographs at the final follow up.

The indications for multiple tension band wiring with a graft from the iliac crest to treat fractures of the olecranon are comminution, especially affecting the mid portion of the olecranon process, with or without transolecranon dislocation (Mayo type IIB and IIIB), of the coronoid process.[11] This technique is an alternative to plate fixation in fractures with extreme comminution. It allows anatomical alignment of the fragments and the bone graft and reestablishment of the normal relationship between the olecranon and coronoid process with early postoperative mobilisation and a good functional outcome.

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Address for correspondence:

Dr. Shahid Sultan, Assistant Professor, Department of Orthopaedics, Ayub Medical College, Abbottabad, Pakistan.