Olecranon Fractures Treated With AO Screw and Tension Bands

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ABSTRACT: Twenty-eight patients averaging 36.4 years of age underwent open reduction and internal fixation of olecranon fractures. The AO cancellous screw was used alone in 16 and with tension banding in 12. Banding was used when the bone was soft or severely comminuted. The fractures were clinically healed at an average of nine weeks and roentgenographic healing with obliteration of the fracture line occurred at 13 weeks. Sixty-seven percent acquired full motion by the ninth postoperative week. All but two patients regained full supination and pronation. No patient lost greater than 30° of extension and only two lost greater than 30° of flexion. There were few operative difficulties or postoperative complications.

We found the AO cancellous screw alone and in severely comminuted cases in combination with tension band wiring to be an excellent fixation device for olecranon fractures. It allows for early range of motion in young patients with excellent healing prospects by 16 weeks.

Introduction

The treatment of olecranon fractures remains controversial. Treatment alternatives include immobilization alone, excision of the proximal fragment with triceps repair, and open reduction with internal fixation. Fixation in the younger patient is desirable because it restores elbow anatomy and allows early mobilization preventing stiffness.

Various forms of internal fixation for olecranon fractures have been described. These include plates, tension-band wiring, bicortical screw fixation, and intramedullary screw fixation. An acceptable internal fixation device should provide solid fixation to permit early mobilization without fear of fragment displacement, anatomic reduction to lessen the likelihood of post-traumatic arthritis, should be relatively easy to use, reliable, and widely available. The AO cancellous screw with or without tension-band wiring meets these criteria.

Methods and Materials

Between March 1975 and December 1983, 28 patients underwent open reduction and internal fixation using the AO cancellous screw with or without tension-band wiring for a fractured olecranon. Fourteen were left, 14 right. The average age was 36.4 years with a range of 16 to 78. Sixteen were male averaging 31 years, range 17 to 58. Twelve were female averaging 44 years with a range of 16 to 78 years.

The fracture mechanisms were comparable to those of Retig. Twelve (42.9%) were due to falls either on the elbow or on the outstretched hand. Automobile accidents caused seven (25%); blunt trauma was responsible for three (10.7%) and one (3.5%) fracture resulted from a motorcycle accident. The remaining five (17.9%) fractures were in unreliable patients and the circumstances under which they occurred were unclear. All operations were performed in a teaching hospital by residents under staff supervision.

Our operative technique is similar to that of MacAusland. After general anesthesia the arm was placed at 90° of flexion across the patient’s chest and a tourniquet inflated. An incision was made 4 cm above the olecranon and slightly lateral to it and carried distally 4 cm below the olecranon. The elbow joint was examined and cleared of loose bone fragments. The fracture was reduced and held with a towel clip. The triceps tendon was then incised at the tip of the olecranon to permit the introduction of a 4.5 cm drill bit. The placement of the hole in the proximal fragment at the tip of the olecranon must be in line with the intramedullary canal of the ulna. Medial or lateral alignment was not a problem. Accurate positioning of the hole in the olecranon in the anterior or posterior plane as seen on the lateral x-ray is the most important technical point that needs emphasis. The tendency is to place the hole closer to the olecranon articular surface which is out of alignment of the ulnar medullary canal. With excessive screw tightening the olecranon fragment will displace.

The intramedullary canal was tapped with a 6.0 tapper and a cancellous 4.5 mm screw was inserted. The length of the screw was judged adequate if there was firm resistance to turning in the final 1 cm to 2 cm. If this did not provide adequate fixation a longer screw or tension-band wiring was used to supplement the fixation. Wiring was used sparingly since they were almost always symptomatic because of the superficial position, especially when the arm was resting on a table or armchair. If there was a fracture of the radial head, this was treated before olecranon fixation.

The fractures were immobilized in a splint for an average of four weeks with a minimum of two days and a maximum of six weeks. Supervised rehabilitation consisted of active and active assistive range of motion for four weeks after immobilization was.

Nine (37.5%) regained full extension and flexion defined as 140°. Seven (29.2%) recovered extension and flexion within 15° of normal. Two (8.3%) lost more than 30° of flexion, and the remaining four (16.7%) had combined losses in both extension and flexion totaling more than 15°. Only two (8.3%) patients did not regain full supination and pronation.

Intraoperative complications arose in two patients (7.1%).
discontinued. All but four patients were followed until healing was evident and range of motion was either normal or showed no further increase.

We modified Colton’s classification for our study as follows: type A: transverse fractures (may be mildly comminuted); type B: oblique fractures (may be mildly comminuted); type C: fracture-dislocations; type D: olecranon fractures with associated elbow injuries (Figure). We noticed that transverse and oblique fractures are occasionally accompanied by mild comminution consisting of a small central fragment. As a result, we modified Colton’s classification so that types A and B would include mild comminution which is defined as the presence of no more than three fracture fragments. Severe comminution, the presence of more than three fragments, would put the fracture in type D. Colton pointed out that varying degrees of comminution may result from an oblique fracture such as a separated central fragment that may be comminuted or a split in the sagittal plane of the proximal fragment. Although the fracture may be primarily oblique, the resulting severe comminution would place it in type D. Type D was adapted from Delitannis who believed that associated injuries, such as supracondylar fractures of the humerus or a fracture of the radial head, in conjunction with the olecranon fracture can have a compound deleterious effect on the elbow joint.

Using our classification, 17 (60.7%) had a type A or transverse fracture, type B: four (14.3%), type C: two (7.1%), and type D: five (17.9%). Two (7.1%) fractures were open. One of these was a type D fracture sustained in an automobile accident and the other was also a type D fracture resulting from blunt trauma.

Involvement of the trochlear notch as measured along the radius of the trochlear notch distally from the proximal tip of the olecranon to the distal extent of the fracture on the articular surface, ranged between 26% and 64.6% with an average of 43.9%.

The AO cancellous screw was used alone in 16 (57.1%) of the cases and tension-band wiring was added in the remaining 12 (42.9%) cases. Tension-band wiring was added if the bone was of poor quality, the screw did not gain adequate purchase, or if the fracture was severely comminuted and could not be securely fixed with the screw alone. This decision was made at surgery.

Results

The fractures were clinically healed at an average of nine weeks. That is, there was no pain with motion or uncomfortable tenderness present. Complete roentgenographic healing with obliteration of the fracture line average 13 weeks. This closely corresponds to healing times reported by others.

Four patients were not followed long enough to determine a stable range of motion. Of the 24 remaining patients, 16 (66.7%) regained full range of motion within 15° by the ninth postoperative week. None of these patients complained of any noticeable limitation. No patients lost more than 30° extension and only two (8.3%) lost more than 30° flexion.

One had the fragment displaced by the screw and in the other the olecranon fragment split when the screw was tightened. Neither complication influenced the final result.

Postoperative complications were infrequent and easily managed. One patient was readmitted for wound cellulitis that developed during the first postoperative week. She was treated with antibiotics and the infection subsided with no sequelae. Ulnar nerve irrigation was seen in another but resolved spontaneously. There were only four (14.3%) complications with respect to the operative technique. One had poor reduction, one had loss of compression, one had fixation failure and in the other the screw bent.

All but one patient in this series healed within 16 weeks. This patient had immobilization for eight weeks for a fragment that displaced postoperatively. The poor reduction was accepted. She returned to work at eight weeks. Five years later she was seen for another orthopedic problem at which time we took the opportunity to take elbow x-rays which showed the fracture had healed satisfactorily.

The patient with loss of compression also posed no problem. In accord with Rettig, the fracture went on to heal painlessly at six weeks. The fixation failure was the result of the screw not engaging the distal ulna. The displaced fragment was treated conservatively. The bent screw held fixation and, along with the others, there was no ill effect on the final outcome.

Finally, 14 (50%) had complaints of minimal pain and tenderness over the hardware. Eight of these complaints came from patients who had the AO screw supplemented by tension-band wiring. Six (21.4%) patients eventually had the screw, wire, and washer removed although one of these felt most of the symptoms came from the pins used to fix an associated fracture of the humeral condyles.

Discussion

We found that the AO cancellous screw is an excellent fixation device for olecranon fractures. This screw transfixed the fracture and engages the ulnar medullary canal. The use of a screw was first proposed by Macauland in 1942 and was subsequently advocated by Harmon. Callahan, Colton, and Rettig. Colton noted it could easily be used to fix any type of fracture whereas both excision and the Weber-Vasey technique are limited in that they are not satisfactory when treating fracture dislocations.

Rettig showed the AO cancellous screw to be virtually failsafe for two reasons. First, the device itself is trustworthy, unlike its
frequently used counterpart, the Leinbach screw, which Rettig showed to have a 60% failure rate due to breakage at the thread-shank junction. Second, all of Rettig's cases using the AO cancellous screw that had delayed union experienced no pain and went on to spontaneously unite. He reasoned, and our results confirm, that even though the screw may lose compression, it provides sufficient fragment immobilization and fixation against the pull of the triceps as well as good alignment thus allowing the fracture to unite. In addition, the AO screw may be combined with tension-band wiring for added fixation and compression in certain cases such as those with severe comminution or poor bone stock.

MacAusland points out that in many cases of comminution, once the main fragment is reduced, the smaller fragments fall into place easily.

Our results show that in all but one case in which the wrong length screw was chosen, the AO screw provides strong fixation to allow early range of motion without the fear of displacement. None of the patients experienced any problems with these exercises, and, except in our case of a single technical failure, no instances of fragment displacement occurred.

The low intraoperative complication rate and the simplicity of both the device and the technique underscore the surgical ease of the procedure. Potentially the most common complication during surgery is either displacement by a poorly placed hole in the olecranon or further comminution of the olecranon by excessive compression. If these occur, it can be salvaged either by the addition of tension-band wiring or, as a last resort, excision of the fragments. The latter was not necessary in any of our patients. We avoid tension-band wiring if at all possible since the wires often produce symptoms when the arm is resting on a table or armchair. Seventy-five percent of those treated with supplemental tension-band wiring eventually complained of pain from the wire on the superficial ulna whereas only 38% of those with the screw alone had symptoms from the screw head or washer.

We are aware that both olecranon excision and the Weber-Vasey technique (multiple K-wires and figure of eight wiring or the traction absorption device) are two other methods that have received acceptance. Excision was first suggested by Fiolle in 1918 and later advocated by Dunn, Wainwright, McKeever and Buck, Adler, Fay, and MacAusland, and Rowe with uncertain, diverse, and inconsistent criteria. When using excision, Rettig and Gartsman showed they could get good results with fewer complications compared with the Weber-Vasey technique. Their claim is that excision eliminates the possibilities of fixation device failures and an incongruent articular surface that can lead to post-traumatic arthritis. However, many authors advise excisions only if there is no other choice since questions remain regarding elbow stability, triceps strength, and extensor power.

The Weber-Vasey technique is based on the tension-band principle which was first defined by Pauwels in 1935 and further modified by Weber and Vasey in 1963. The Kirschner wires have been found to migrate causing Netz to further modify the technique recently with the advent of non-sliding pins. Deliyanis, Mathewson, Kiviluoto, and Rettig all report good results with the Weber-Vasey technique. These authors and Colton advocate its use although Rettig has pointed out that delayed union with this type of fixation can be painful. Deliyanis noted that the wires, being subcutaneous, sometimes produce symptoms. The procedure is difficult and requires extensive exposure of the fracture site. Colton stated it should not be used in the face of fractures associated with dislocation.

Although Gartsman showed there is no statistical difference by dynamometric testing between the operated and non-operated elbows in those that have the fracture excised and those that have internal fixation, it is important to emphasize that these authors were dealing with a population much older than ours. We do not feel excision is indicated in the young adult.

The device proved reliable with no breakage and only one instance of bending with no effect on the result. As in Rettig's series as long as the screw held the fragments, compression loss did not affect the outcome.

We feel the AO cancellous screw is a good option in treating olecranon fractures. It is simple to utilize and remove, not susceptible to hardware failure, and complications with its use are minimal. Even with loss of compression and reduction it can maintain sufficient immobilization for healing. It allows confident use of early motion exercises. We feel it satisfies the criteria for a satisfactory fixation device and is indicated for the treatment of all but the most comminuted olecranon fractures.

References