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Fixation of Olecranon Fractures and Osteotomies Using Compression Screws: A simple Solution to a Common Problem. A Study of Cases

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SUMMARY

Olecranon fractures are common skeletal injuries accounting for approximately 10% of upper extremity fractures in adults. Simple non-comminuted fractures are traditionally fixed using the tension band wiring technique. This technique, however, has several complications, most commonly prominence of the metalwork frequently requiring surgery for removal. We describe a retrospective review of a new method of fixation for these fractures using partially threaded screws in an attempt to avoid these complications.

We used two 3.5 and/or 4 mm partially threaded screws to fix seven simple olecranon fractures and two olecranon osteotomies. Notes and clinic letters of all nine patients were reviewed for demographic data, operation details and complications. Radiographs were reviewed at final clinical follow-up. The Mayo Elbow Performance Score was completed during a telephone consultation.

One patient injured her elbow postoperatively, which resulted in fragmentation of the proximal segment and loss of fixation. In one patient the tip of the screws broke after a fall but this did not result in loss of fixation. There were no problems with metalwork prominence or skin irritation in any of the patients. Two patients had low scores due to loss of fixation, and severely comminuted supracondylar fracture of the humerus. Six patients had good scores.

We believe that use of AO compression screws is a valid method for the fixation of simple fractures of the olecranon. It is a safe technique and has several advantages over tension band fixation. There is minimal tissue dissection and operating time is decreased. There is minimal risk of metalwork prominence as screws obtain good purchase in the anterior cortex of ulna. Good interfragmentary compression is achieved as screws are perpendicular to the fracture line and two screws provide good rotational stability. Protection of fixation for 10-14 days does not result in significant loss of range of motion. Further clinical and biomechanical studies are suggested to compare this technique with other methods of fixation of olecranon fractures.

Key words: olecranon, fracture, lag screw, screw, fixation

BACKGROUND

Olecranon fractures are common skeletal injuries, accounting for approximately 10% of upper extremity fractures in adults [1]. Patients usually present after a fall on the affected arm. Swelling and tenderness is present at the fracture side. With displaced fractures inability to move the forearm against gravity is noted. The Mayo classification is based on whether these fractures are stable or unstable, comminuted or non-comminuted, and displaced or undisplaced [2]. Operative fixation is usually recommended for displaced fractures to restore the function of triceps muscle and allow for smooth movement of the trochlea in the trochlear groove of the olecranon. Type I (undisplaced) fractures with no displacement after 90 degrees of flexion can be treated by splinting and symptomatically. Type II (Non-comminuted displaced stable) fractures are treated surgically. Chevron olecranon osteotomies performed for access to the distal humerus are similar to type II fractures. Several operative methods have been described for surgical treatment of olecranon fractures. Wadsworth [23] originally described the use of a single lag screw perpendicular to the fracture line and gaining purchase in the anterior cortex of the ulna. This method is rarely used nowadays. Currently, these fractures are fixed with tension band wires [4,5,6,7-9,10] or a 6.5-7.3 millimetre AO (Synthes, Switzerland®) cancellous bone screw [11]. Intramedullary nails have also been described for the treatment of olecranon fractures. [12,13,14,15]. Type III (comminuted) fractures are usually treated with plates and screws [16].

Tension band wiring is a commonly used method for fixation of Type II olecranon fractures with no comminution at the articular surface. It was introduced with the aim of earlier post-operative mobilization. It is designed to transform the tensile forces produced by the triceps mechanism to compression forces at the fracture site. To achieve this goal his technique relies on an intact cortex on the articular side. This limits its use for fractures with comminution at the articular (concave) surface. Complications are not uncommon with this technique. Prominent metalwork, skin breakdown and loss of fixation (due to pull out or breakage of the wires) have all been described in the literature [9]. In an attempt to avoid such complications we used a new technique for the fixation of simple non-comminuted fractures.

We describe use of two 3.5 and 4 millimetre cancellous screws which are used to achieve compression across the fracture site in a series of 9 patients (7 fractures and 2 olecranon osteotomies) and discuss the advantages and disadvantages of this technique.

MATERIALS AND METHODS

Data was collected retrospectively for patients who had undergone screw fixation for olecranon fractures and osteotomies between 2008 and 2012. Patient notes and clinic letters were reviewed. Demographic data, mechanism of injury, operation details and complications were recorded. Pre and post-operative radiographs were reviewed. Patients were also asked to complete the Mayo Elbow Performance Score during a telephone consultation by the first author (BH).

All patients were treated on the day or next day after the injury. Open reduction and internal fixation was performed for most fractures. Standard posterior approach to the elbow was used. Fracture haematoma was removed. Minimal surgical dissection was performed as necessary to evaluate the amount of comminution and ensure accurate fracture reduction. The reduction was held using a large clamp. Two parallel k-wires were drilled through the olecranon across the fracture/osteotomy site, directed to engage the anterior ulnar cortex, distal to the coronoid process. Cannulated 3.5 mm of 4 mm partially threaded cannulated screws (AO Synthes, Switzerland®) with washers were inserted to achieve compression at the facture site. Intraoperative imaging was used to ensure adequate reduction and proper length of the screws. Closure was performed in layers. Three cannulated screws were used in one case (case 5) as it was felt that extra rigidity was needed. The fixation was protected with an above elbow back-slab for 2 weeks. All patients had follow ups in the outpatients and clinical and radiological assessments were performed. Gentle mobilization was allowed as comfortable.

RESULTS

Nine patients were operated using this technique. There were seven male patients and two females. Age range was 23 to 82 years (mean 59.7 years). The mechanism of injury was a simple fall in five patients, fall playing football in one patient, fall off a pushbike in one patient and road traffic accidents in two patients. Follow-up ranged from 4-54 months (mean 15.2 months). Eight fractures/osteotomies had clinically and radiographically healed without loss of fixation by 12 weeks.

Seven patients (78%) had Mayo Elbow Performance Scores of 80 and over. Of the other two patients, one patient had a low score due to loss of fixation after a fall and the other patient had a low score and reduced range of motion due to the severity of the initial injury (comminuted distal humerus fracture). With regards to complications, one patient had failure of fixation following additional injury. There was

Fig. 1. Preoperative and postoperative AP and lateral views of olecranon fracture fixed with 2 compression screws

Fig. 2. Preoperative and postoperative AP and lateral views of olecranon osteotomy fixed with 3 compression screws

Tab. 1. Summary of Olecranon fractures and osteotomies treated with compression screws

	Age Sex	Injury	Mechanism of injury	Operation Date	Medical problems	Complications	LOFU	ROM (degrees)	Mayo Elbow Performance Score
1	27/M	Comminuted # distal humerus	Fall from push bike	ORIF June 2012	Nil	Nil	4	30-100	70*
2	78/M	Olecranon #	Fall on floor	ORIF June 2012	Prostate Cancer, renal stones	Nil	4	5-130	100
3	77/M	Olecranon #	Fall on floor	ORIF March 2011	Nil	Nil	18	10-130	95
4	66/M	Open Olecranon # with some comminution	Motorbike-car accident	ORIF Dec 2011	Nil	Nil	9	5-140	100
5	79/M	Comminuted # distal humerus	Car accident	ORIF May 2011	IHD and AF on warfarin	Nil	16	5-140	95
6	30/M	Olecranon #	Fall on floor	Percutaneous Nov 2009	Nil	Nil	12	10-130	85
7	76/F	Olecranon #	Fall on floor	ORIF June 2012	Nil	Nil	4	20-110	80†
8	23/M	Olecranon #	Fall playing football	Percutaneous March 2008	Nil	Fracture tip of one screw after fall but was asymptomatic	54	5-140	100
9	82/F	Olecranon #	Fall on floor	ORIF May 2011	AKI, UTI, PE postoperatively treated with warfarin	Fall and loss of reduction 4 weeks postoperatively	16	30-120	65£

LOFU=length of follow up, Shoulder and Hand, M=Male, F= female, NA=not applicable, ORIF, IHD, AF,
*Patient had high score mainly due to the high energy nature of the injury, no problems with healing of the olecranon osteotomy.
†Patient had concomitant shoulder injury and main disability is due to shoulder pain which is under investigation by a shoulder specialist. No complaints with regard to the elbow injury.
£ Patient had multiple comorbidities and sustained a fall which resulted in fracture of the proximal segment.

no loss of fixation or prominence of metalwork. Metalwork did not need to be removed in any of the patients.

The summary of cases is presented in Table 1.

DISCUSSION

We report nine cases of fixation of olecranon using two compression screws with good and excellent outcomes with only one case of failure of fixation and no need for removal of implants.

Advantages

We believe this is a safe technique and has several advantages over fixation by previously described methods. It is a minimally invasive technique and needs minimal tissue dissection. We have used this technique percutaneously in two cases with good outcome. The learning curve is not steep as the steps are very similar to the well-known tension band wiring technique. The surgical time is also decreased using this technique as compared to the tension band wiring technique. The time needed for opening and closure, the assembly of tension band wires and passing the wires underneath the triceps tendon are omitted. The use of two screws provides excellent rotational stability.

Symptomatic implant

Rates as high as 46 and 75% of prominent metalwork have been reported with TBW technique [9, 10]. In our series there was no need for removal of the screws in any of the cases. Purchase in the anterior cortex of the olecranon minimises the chance of screw pull-out.

Several methods have been used to solve the problem of prominent metalwork. Van der Linden et al [17] showed the tension band wire technique provides a better stability if the wires are engaged in the anterior cortex of the ulna as compared to the intramedullary position of the wires. Although engaging the screws in the anterior cortex of the olecranon has the potential disadvantage of injuring the volar neurovascular structures in the proximal forearm [18], this risk also exists in the tension band wiring technique. Non-sliding (threaded) pins [8], combined screw and tension bands [7,19] and long intramedullary wires

[6] have been used to avoid this complication but still need for removal of 7.7 to 33.3% was reported [6]. FiberWire tension bands in place of metal wire tension bands were used as well to reduce prominence of metalwork postoperatively [4]. Coles et al. [20] used intramedullary screw and supplemental dorsal ulnar wiring and plates and screws for fixation of olecranon osteotomies. They reported 8% rate of symptomatic implant removal. None of our patients had a problem with prominence of metalwork.

Jeopardizing the integrity of the proximal fragment and rehabilitation

The downside of this technique might be increased chance of jeopardizing the integrity of the proximal fragment by inserting two screws in a relatively small fragment. Although one of the patients developed this complication, she had a subsequent injury. In the rest of our patients this did not seem to be a problem if injuries are avoided and gentle progressive rehabilitation is used. The senior author uses back-slabs for protection of fracture fixation with the tension band wiring technique as well. A biomechanical study did not confirm the effect of compression at fracture site and the authors suggested passive range of movement in the postoperative period with tension band wiring as well [11]. Brink et al. [21] showed that tension band wiring principle only exists during active extension in a range of 30-120 degrees of elbow flexion. The protection of fixation for 10-14 days did not affect the final outcome in terms of stiffness and range of movement in our series. We believe that early protection and gentle mobilization provides an acceptable outcome as compared to tension band wring as excellent range of movement can be achieved and there are no problems with prominence of the hardware. In comparison to a single 6.5 mm screw (which gives a surface area of 33.18 mm^2), two 4 mm screws (with cumulative surface area of 25.13 mm^2) have a considerably lower surface area and at least theoretically lower chance of jeopardising the proximal fragment. It is important to avoid inserting the screws too close to each other to avoid this complication. Use of washers also reduces the pressure on the near cortex by increasing the surface area.

Direct fracture compression

Using this technique one can insert the screws perpendicular to the fracture line and achieve excellent interfragmentary compression. As the fixation does not rely on the compression at the articular surface (unlike the tension ban wiring technique), fractures with mild comminution at the fracture site can be fixed reliably with this method. The use of plates and screws is a considerably more invasive procedure and is also associated with prominent metalwork.

We believe that use of AO compression screws is a valid method for the fixation of simple and minimally comminuted fractures of the olecranon. We have also shown that this technique can be used for fixation of olecranon osteotomies for fractures of distal humerus. Further biomechanical and clinical comparative studies are needed to compare this technique with other method of fixation of olecranon fractures.

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