OLECRANON FRACTURE AND TENSION BAND WIRING

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SYNOPSIS

Tension band wiring, an excellent technique of internal fixation developed by the AO group, counteracts tensile forces that act across the fracture site and converts them into compressive forces. It achieves good union and also allows early active mobilization, thus minimising the incidence of postoperative stiffness.

Between 1982 and 1986, 32 patients (22 males and 10 females, ages from 18-85 years) with olecranon fractures and associated complications were seen in the Department of Orthopaedic Surgery, Alexandra Hospital and treated with open reduction and internal fixation by tension band wiring. All 32 patients had, in addition, 2 parallel Kirschner wires introduced across the fracture site to improve alignment and stability.

Post operative results were assessed over a period of 6-18 months. Union was achieved in 31 cases by 12 weeks. 23 cases (71.9) had already united by 8 weeks. 25 patients recovered full range of movement of the elbow. All these were mobilished 2-3 weeks after the injury. Out of 31 patients interviewed, 24 reported that they were satisfied with their post operative recovery.

KEYWORDS: *Olecranon fracture, tension band wiring, early mobilisation.*

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INTRODUCTION

Tension band wiring technique is a method of internal fixation developed by the Arbeitsgemeinschaft Fur Osteosynthesefragen group. The basic prinicple is to conteract the tensile forces that act across the fracture site and convert them into compressive forces.

In order to accomplish this, the wire is passed in figure of eight fashion around the insertion of the triceps tendon and then distally beyond the fracture site into a transverse drill hole on the posterior border of the olecranon.

Improved alignment and greater stability can be provided by introducing 2 parallel Kirschner wires across the fracture site before applying the tension band (Weber & Vasey 1963.) They serve to neutralise the shearing and torsional forces. The counter pressure of the trochlea under tension by the triceps muscle causes a compression force across the fracture site sufficiently strong to allow immediate active range of motion.

Mechanism of tension band wiring

Pauwels borrowed (1935) from mechanics the principle of tension band fixation and demonstrated its application in internal fixation of bone. He used a 1.2 mm wire as tension band.

Every eccentrically loaded bone, eg olecranon is subjected to bending stresses. This results in a typical distribution of stresses with tension on the convex and compression on the concave side of bone. The fracture will displace with a gap on the tension side.

In order to restore the load bearing capacity of an eccentrically loaded fractured bone, the tensile forces have to be absorbed by a tension band and the bone itself has to be able to withstand axial compression. The prestressing of the wire in tension results in axial interfragmental compression. Loading results in a dynamic increase of this axial interfragmental compression.

In order to achieve an increase in interfragmental compression we must place the wire wherever we have maximal tensile forces, ie furthest from the load axis.

MATERIALS & METHOD

32 patients seen in the Department of orthopaedic Surgery, Alexandra Hospital for olecranon fracture and treated with open reduction and internal fixation by tension band wiring and 2 Kirschner wires from 1982 to 1986 were selected for this study.

There were 22 males and 10 females with ages ranging from 18-85. Average age was 33.3 years.

These patients were followed up for 6 months to 18 months. Average period of follow up was 8.2 months. 22 patients underwent removal of implants 3 months to 1 year later. (Mean = 4.5 months).

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Their preoperative occupations were given in Table 1.

Heavy manual labourer	9
Light manual labourer	14
Sedentary worker	2
Housewife	7
Total	32

Details of Procedure

The patients is in the supine position with the elbow flexed at 90° and the forearm across the patient's abdomen.

A slightly curve incision is made across the posterior aspect of the olecranon process and approximately 6 cm distally along the lateral aspect o the olecranon.

The skin and its thin layer of subcutaneous tissue are retracted together to expose the fracture site. The fracture site is inspected and any irregular fragments that might prevent anatomic reduction of the fracture are reorientated.

Any loose fragments of bone within the elbow joint are removed.

The olecranon fracture is reduced and held with reduction clamps.

2 Kirschner wires are drilled through the olecranon across the fracture site along the long axis of the ulna.

Next a hole is drilled transversely through the distal fragment just below the subcutaneous border of the ulna. A 1.2 mm thick wire is used for the tension band. This wire is threaded through the transverse hole in the distal fragment, then crossed and passed around the protruding ends of the Kirschner wires.

The wire is placed under tension and secured so that tension will be maintained. The Kirschner wires are bent to form little hooks over the tension band wire.

Security of the internal fixation may be checked by passively moving the elbow. The wound is closed with a well padded bandage.

Post-operative Management

Immediate mobilisation is allowed if th fixation is stable. However, if the nature of the fracture or fixation appears to be unstable, a period of immobilisation in a long arm backslab may be warranted.

The postoperative results were assessed by

1) Objective assessment

a) Union

Clinical criteria:

i) The fracture site was mildly tender.
ii) The bone moved in 1 piece.
iii) Pain only when we attempted angulation,

Radiological criteria

i) Xrays showed visible fracture line with fluffy callus around it.

b) Range of flexion, extension, pronation and supination of forearm.

All these patients were mobilised 2-6 weeks (mean = 2.91 weeks) after the opeation. Maximum range of flexion, extension, pronation and supination of forearm were assessed.

C) Period of Incapacity.

The period of incapacity was from the time of injury to the time when patient was able to perform light duties.

2) Subjective assessment

31 patients were interviewed by phone.

The 85 year old lady passed away 2 years ago and was assessed from the records.

They were asked the following questions:

a) Was he satisfied postoperatively?

Yes

No Reasons:

b) Was he able to perform preoperative duties?

Yes

No Reasons:

RESULTS

20 patients were involved in road traffic accident. 5 patients were involved in industrial accident. 5 patients had a fall. 2 patients were assaulted.

The mechanisms of injury and the types of olecranon fracture are given in Table II.

Types of Fracture Mechanisms	Oblique	Transverse	Comminuted	Fracture Dislocation	Total
Fall on elbow	2	13	14	0	29
Direct blow to Olecranon	0	0	2	0	2
Fall on outstretched hand	0	0	0	1	1
Total	2	13	16	1	32

There were 4 compound fractures. Emergency wound debridement and internal fixation were done.

There were 28 closed fractures. 19 were fixed on the day of injury, 9 were fixed electively 2 to 7 days after the injury.

6 patients (18.75%) had associated elbow injuries

2 had displaced fracture head of radius and had excision of radial head done. 2 had undisplaced fracture head of radius. 1 had fracture lateral condyle of humerus and was internally fixed with a screw. 1 had fracture ulnar shaft and was fixed with plate and screws.

Postoperative results

1) Objective Assessment

a) Union

Table III indicates the period of time taken for the fracture to show both clinical and radiological signs of union.

Period of Interval	No of Patients
6 weeks	5
8 weeks	18
10 weeks	2
12 weeks	6
1 year	1
	32

One out of 32 had delayed union. Delayed union rate was 3.125%. 31 patients showed clinical and radiological union 6 — 12 weeks after the operation. Union rate was 96.875%. Mean time to union was 9.94 weeks.

b) Range of movement

25 patients achieved full range of flexion, extension supination and pronation of forearm. 20 were mobilized 2 weeks and 5 were mobilized 3 weeks after the operation. One patient had limited elbow flexion ranging from 95° to 105°. He was mobilised 6 weeks after the operation.

One patient with malunion of olecranon fracture had a range of 50°-90° of elbow flexion. He was mobilized 6 weeks after the operation.

5 patients with associated injuries showed limited ranges of movement.

Table IV shows the maximum range of flexion. extension, supination and pronation of forearm according to associated injures.

	Extension & Flexion	Supination	Interval between injury and mobilisation
Displaced fracture nect of radius with excision of radial head	30° — full	0° — 60°	6 weeks
Undisplaced fracture neck of radius.	20° — full	Full	4 weeks
Fracture dislocation	0 — 120°	Full	4 weeks
Fracture lateral condyle	80 — 100°	Full	6 weeks
Displaced fracture neck of radius with exclusive of radial head	40 — 110°	Full	6 weeks

c) Period of Incapacity

Table V shows the period of incapacity for the 25 working patients.

Period of Incapacity	No of Patients
6 weeks	6
8 weeks	6
12 weeks	6
14 weeks	3
16 weeks	1
20 weeks	3
	25

Mean period of incapacity was 10.96 weeks.

2) Subjective Criteria

31 patients were interviewed by telephone.

24 patients were satisfied postoperatively. All regained full range of movement. They were able to perform preoperative duties.

5 patients were not satisfied because they had stiff elbows. However, they were able to perform duties which they were doing before the injury.

2 patients had stiff elbows and weakness of arm muscles. Both had difficulties in performing preinjury duties. One of them had changed his job.

Postoperative complications

One compound fracture developed Stapylococcus aureus abscess 4 months later and required removal of implants and incision and drainage. Infection rate was 3.125%.

2 patients (6.25%) had ulnar nerve neuropraxia. Both recovered 4 months after the injury.

1 patient (3.125%) had malunion of fracture. There was 20° of angulation.

DISCUSSION

The goal of open reduction and internal fixation of the olecranon fractures is to rigidly fix the fracture fragments, to anatomically restore the joint surface and to allow early movement.

The technique of tension band wiring seems to fulfil these requirements.

The method is a relatively simple technique and does not require any special equipment.

It achieves good union in 31 cases by 12 weeks and also allows early active mobilization, thus minimising the incidence of postoperative stiffness and muscles atrophy. It also allows a more rapid restoration of movement.

25 patients were mobilized early and able to achieve full range of movement without affecting union. 7 patients were mobilized late and developed elbow stiffness.

Overall good functional results were achieved. 25 working patients were able to return to work early. 29 patients were able to perform the same preinjury duties without any limitation. 24 patients were satisfied postoperatively because they were able to regain full range of painless movement.

Fig 1

A 28 years old man sustained a closed transverse fracture of the right olecranon. The fracture displaced with a gap on the tension side.

Fig 2

The tension band counteracts tensile forces that act across the fracture site and converts them into compressive forces.

This Xray was taken 8 weeks after the operation and showed good union.

Infection developed in one compound fracture. It was a badly contaminated open wound and operation was done 5 hours after the injury.

However, this technique is not free from drawbacks.

Gradual sliding of the K wires causing skin problems was reported by Wenzel (1968), Delivannies (1973), Schorplatz and Allgower (1975), Horne & Tanzer (1981), Jensen & Olsen (1986).

The K wires are not rigidly anchored in the bone and the tension on the tension wires varies during active mobilization of the joint. This constitutes a considerable risk of sliding of the K wires which may result in skin problems and/or deterioration of the stability for the fracture fixation.

This complication can be overcome by forming a loop at the prominent end of the K wire instead of a simple hook (James 1972) or by replacing the K wires with specially designed non sliding Netz pins. The pins are firmly anchored by the tensioned wire running through the hole in the distal end of the pin (Netz & Stomberg 1982.)

Penetration of a K wire through the cortex of the ulna in one out of 11 patients was reported by S B Deliyannis (1973). This complication can be prevented by the use of blunt ended K wires.

Skin problems may also be due to faulty positioning of the sharp cut ends of the tension wires. This complication can be avoided by carefully burying the ends, preferably under the muscle on the radial side of the ulna.

The above drawbacks were not reported in this study.

CONCLUSION

Tension band wiring is an ideal method for internal fixation of olecranon fractures.

Early mobilization allows return to full range of motion without affecting union.

It achieves our aim in the management of olecranon fractures.

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