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A study of tension band wiring in patella, olecranon and malleolar fractures in adults

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Abstract

Background: Fractures of the eccentrically loaded bones like patella, olecranon, and medial malleolus are one of the most common fractures encountered by an orthopaedic surgeon. They continue to pose vexing problems as these being intra-articular are being subjected to continuous deforming forces from muscles.

Objectives: To evaluate the clinical results of the tension band wiring in patella, olecranon and malleolar fractures in adults.

Material & methods: Study Design: A prospective hospital based observational study.

Study area: Department of Orthopaedics, Government General Hospital, Mahbubnagar.

Study Period: May 2022 – Jan 2023 [9 months].

Study population: Cases of fractures of Patella, Olecranon, Malleoli treated by tension band wiring.

Sample size: study consisted of 30 subjects.

Sampling Method: Purposive sampling technique.

Study tools and Data collection procedure: As soon as the patient was admitted, a detailed history was taken and a meticulous examination of the patient was done. The required information was recorded and proforma was prepared. Radiographs were taken in approximate views and diagnosis was established by clinical and radiological means. Then splinting of fractures was done with above knee POP slab for patellar fractures above elbow POP slab for olecranon fractures and below knee POP slab for medial malleolar fracture. All patients were taken for elective surgery as soon as possible after necessary blood, urine and radiographic preoperative work-up.

Results: In our study, best results were obtained in fracture of patella 60%, olecranon fracture 42.8%, and medial malleolus 46.15%. In total of 30 cases, 15 (50%) had excellent results, 8 (26.66%) had good results, 3 (10%) had fair and poor result is 4(13.33%).

Conclusion: It was concluded from the present study that, Tension band wiring by principle overcomes the distractive force, achieves compression at the fracture site and maintains the alignment by minimum hardware. By achieving compression at fracture site, the fracture heals faster and the patient is back to work earlier.

Keywords: Tension band wiring, patella, olecranon and malleolar fractures

Introduction

The tension band principle was initially described and used in the fixation of fractures and non-unions by Pauwels (1935) ^[1]. CURTIS created the Pyrford Technique, which improves fixation by utilising a cerclage wire and a second tension band wire through the tendon ^[2]. DE PALMA, MULLER, and SMILLE all advocated screw fixation ^[3]. The cerclage wiring method suggested by the A.O. GROUP of Switzerland is the one that is accepted worldwide. One plate or wire that can sustain the tensile stresses is required for tension band fixation. A bone with compression resistance. The opposite cortex's buttress is still intact. The plate will bend repeatedly, become worn down, and eventually break if the medial buttress (the opposing cortex) is weak.

In this era, fracture of Patella, Olecranon and Medial malleoli are on an increasing note mainly resulting from road traffic accidents with lesser force of impact and hectic working schedule of a common man. Fractures of the eccentrically loaded bones like patella, olecranon, and medial malleolus are one of the most common fractures encountered by an orthopaedic surgeon.

They continue to pose vexing problems as these being intra-articular are being subjected to continuous deforming forces from muscles. It is also difficult to restore the desired anatomical continuity and congruity of their articular surfaces after reduction and thereby causing complications like osteoarthritis, stiffness of joints, non-union etc.

Hence, with better operative techniques, internal fixation of these fractures with tension band wiring has become an accepted mode of treatment with its outcome results enabling the patient to smoothly resume his work without hampering his day-to-day life.

Internal fixation of fractures speeds up the healing and rehabilitation. It also allows for early mobilization of the joint thereby preventing stiffness of joints and other complications related to immobilization.

Objectives: To evaluate the clinical results of the tension band wiring in patella, olecranon and malleolar fractures in adults.

Material & methods

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Sample size: study consisted of 30 subjects.

Sampling method: Purposive sampling technique.

Inclusion criteria

- Age more than 18years.
- Includes both sex groups.
- Fresh fractures of patella, olecranon and medial malleoli.
- Patient willing to give consent.

Exclusion criteria

- Age less than 18years.
- Infected fractures.
- Pathological fractures.

Ethical consideration: Institutional Ethical committee permission was taken prior to the commencement of the study.

Study tools and Data collection procedure

As soon as the patient was admitted, a detailed history was taken and a meticulous examination of the patient was done. The required information was recorded and proforma was prepared. Radiographs were taken in approximate views and diagnosis was established by clinical and radiological means. Then splinting of fractures was done with above knee POP slab for patellar fractures above elbow POP slab for olecranon fractures and below knee POP slab for medial malleolar fracture. All patients were taken for elective surgery as soon as possible after necessary blood, urine and radiographic preoperative work-up.

Patient's attenders were explained about the nature of injury and its possible complications and the need for surgery. Written and informed consent was obtained. Preoperative intravenous cephalosporin antibiotics were given and continued at 12 hourly intervals postoperatively for five days and then switched to oral form till suture removal.

Patella: A midline longitudinal incision approximately 12.5 cms long was taken. The skin and subcutaneous tissue were reflected medially and laterally to expose the anterior surface of patella. Fracture surfaces were cleaned of blood clot and small fragments. Thorough lavage was given. Fracture fragments were reduced anatomically with towel clips or bone holding forceps restoring smooth articular surface. 2 mm Kirschner wires were drilled from inferior to superior parallel to each other. These wires were placed 5 mm deep to anterior surface and protruding beyond the patella and quadriceps tendon attachments to the inferior and superior fragments.

An 18-gauge stainless steel wire was passed transversely through the quadriceps tendon attachment deep to the protruding Kirschner wires. Then over the anterior surface of patella, then transversely through patellar tendon attachment on the inferior fragment and deep to the protruding Kirschner wires, then back over the anterior surface and tightened at upper end. The reduction was checked by palpating the under surface of patella. The upper ends of the two Kirschner wires were bent anteriorly and cut short and rotated embedding posteriorly.

After surgery: The limb was placed in extension in a posterior splint. Isometric exercises were started on first postoperative day. Check dressing was done on 2nd postoperative day to know condition of operative wound. Following dressing, check x-ray in AP and lateral views were done. Active exercises were started after 2 weeks when wound was healed. Suture removal was done on twelfth postoperative day. Weight bearing was started after 6 weeks.

Olecranon: An incision 2.5 cm proximal to the olecranon and parallel with its lateral border was taken and carried distally for 7.5 cm. The fracture was exposed and fragments freshened. The fracture was reduced with a towel clip and a drill hole was made from side-to-side in the distal fragment. Two parallel Kirschner wires were passed perpendicular to fracture from proximal fragment into the medullary cavity. A 18-gauge stainless steel wire was passed through hole in distal fragment and then crossed in figure of eight over the posterior surface of olecranon and passed beneath the protruding Kirschner wire and aponeurosis of triceps muscle. The wire was tightened to achieve reduction and Kirschner wire bent and buried.

After Surgery: The limb was immobilized in posterior splint at 90° of flexion. Check dressing was done on 2nd postoperative day to know condition of operative wound. Following dressing, check x-ray in AP and lateral views were done. Sutures were removed on twelfth postoperative day and gentle active assisted exercises were started. The splint was continued for four weeks.

Medial Malleolus: An anteromedial incision was taken 2 cms proximal to fracture line and extended distally approximately 2 cm distal to tip of medial malleolus. The fracture site was exposed and freshened. Any interposed fold of periosteum was removed and loose fragments debrided. With a towel clip, the fracture was reduced. A transverse hole was drilled in proximal tibia about 2 cms from the fracture. Two parallel Kirschner wires were passed perpendicular to fracture site from distal fragment into the proximal fragment. A 18-gauge stainless steel wire was passed through the transverse hole and then over the medial surface and then beneath the protruding Kirschner wires. The wire was tightened to

achieve reduction. The Kirschner wires were bent, cut and buried.

After Surgery: Below knee POP slab was applied in neutral position. Check dressing was done on 2nd postoperative day to know condition of operative wound. Following dressing, check x-ray in AP and lateral views were done. Sutures were removed on twelfth postoperative day and active range of movements started. Weight bearing was allowed after 6weeks.

Discharge: Patient was discharged on 12th postoperative day

Follow up: Follow up was done on OPD basis at 4th, 8th and 12th week postoperatively with clinical and radiological evaluation and the results were assessed based on:

Pain Swelling Tenderness at fracture site Movements of related joint Radiological union.

Observations & results

Table 1: Relative incidence

Fracture	Number of patients	Percentage (%)
Patella	10	33.33
Olecranon	7	23.33
Medial malleolus	13	43.33

The incidence of patellar fracture was 33.33%, olecranon fracture was 23.33% and medial malleolus fracture was 43.33%.

Table 2: Age incidence

Sl. No.	Range of Age	Patella (10%)	Olecranon (7%)	Medial malleolus (13%)
1	11 – 20	1 (10%)	-	2 (15.38)
2	21 – 30	-	1 (14.28%)	-
3	31 – 40	2 (20%)	5 (71.4%)	8 (61.52%)
4	41 – 50	2 (20%)	-	1 (7.69)
5	51 – 60	5 (50%)	1 (4.28%)	2 (15.38%)

The age of patient in the study ranged from 20 years to 60 years and statistical average being 40.4 years. The average age for patellar fracture was 45.9 years, olecranon 33 years and medial malleolus 36.5 years.

Table 3: Sex Incidence

Sl. No.	Fracture	Total	Male (%)	Female (%)
1.	Patella	10	7(70%)	3(30%)
2.	Olecranon	7	6(85.71%)	1(14.28%)
3.	Medial malleolus	13	9(69.23%)	4(30.78%)
	Total	30	22 (73.33%)	8(26.67%)

The fractures of patella, olecranon and medial malleolus were

more common in male individuals, approximately 70:30 ratios in male vs female.

The incidence of patellar fracture was more common on left side, olecranon fracture on right side, malleolar fracture on right side. Overall fractures were same on right side and left side.

Indirect trauma accounted for 70% of total injuries in our study and was the most common mode of injury in patellar, olecranon and medial malleolus fracture.

50% of injuries were due to domestic in nature and RTA was second most common mode of injury accounting for 40%.

Three patients had compound injury, which were of type I, two olecranon and one medial malleolus.

Table 4: Type of fracture

Sl. No.	Fracture	Total	Transverse (%)	Oblique (%)	Comminuted (%)
1	Patella	10	6 (60%)	2 (20%)	2 (20%)
2	Olecranon	7	4(57.14%)	2(28.57%)	1(14.28%)
3	Medial malleolus	13	8(61.54%)	5 (38.46%)	-
	Total	30	18(60%)	9(30%)	3(10%)

Incidence of various types of fractures: In our study, 60% of fractures were transverse, 30% were oblique and 10% were comminuted.

48 hrs and remaining within 1 week in our study, more than 90% of fractures of patella, olecranon, and medial malleoli were operated within period ranging from 2 – 10 days.

Table 5: Incidence of various types of fracture in Ankle

Sl. No.	Lauge Hansen classification	Total case	No. of fractures (%)
1	Supination adduction	1	7.70
2	Supination external rotation	6	46.15
3	Pronation abduction	3	23.07
4	Pronation external rotation	2	15.38
5	Vertical compression	1	7.7

In our study, supination external rotation was the most common type accounting for 46.15% following pronation abduction of 23.07%. Most of the cases were operated within

Associated injuries: In our study, 3 patients had bimalleolar fracture of ankle and 1 patient had ipsilateral femoral shaft and patella fracture. No dislocation of joints was noted in our study.

Postoperative period: One patient with diabetes mellitus had superficial infection, 96.66% of patients had uneventful postoperative period.

Hospital stay: The hospital stay ranged from 5 days to 30 days, Average being 17.5 days.

Table 6: Pain

Sl. No.	Fracture	Total	4 weeks		8 weeks		12 weeks	
			No. of patients followed	persistent pain	No. of patients followed	persistent pain	No. of patients followed	persistent pain
1	Patella	10	9	7(77.77%)	9	3(33.33%)	10	2(20%)
2	Olecranon	7	7	6(85.71%)	7	3(42.85%)	7	1(14.2%)
3	Medial malleolus	13	11	9(81.81%)	11	4(36.36%)	13	5 (38.46%)

Pain and tenderness declined with progress of postoperative period but persisted in 26% of cases after 12 weeks. In most of patients pain persisted for 4 weeks, which decreased after 8 weeks.

Table 7: Movements – Patella

Sl. No.	Duration (week s)	No. of patients	Range of motion – Knee flexion	No. of patients (%)
1	4	9	Full Range	-
			Restriction of last 10 ⁰ -20 ⁰	2 (22.22%)
			Restriction of 20 ⁰ -50 ⁰	3 (33.33%)
			Restriction >50 ⁰	4 (44.44%)
2	8	9	Full Range	4(44.44%)
			Restriction of last 10 ⁰ -20 ⁰	2(22.22%)
			Restriction of 20 ⁰ -50 ⁰	2(22.22%)
			Restriction >50 ⁰	1(11.11%)
3	12	10	Full Range	8(80%)
			Restriction of last 10 ⁰ -20 ⁰	1(10%)
			Restriction of 200-500	1(10%)
			Restriction >500	-

In our study about 83% of cases had full range of movements at 12 weeks.

Table 8: Olecranon

Sl. No.	Duration (weeks)	No. of patients	Range of motion – Knee Flexion	No. of patients (%)
1	4	7	Full Range	-
			Restriction of last 10 ⁰ -20 ⁰	4(57.14%)
			Restriction of 20 ⁰ -50 ⁰	3(42.85%)
			Restriction >50 ⁰	-
2	8	7	Full Range	4(57.14%)
			Restriction of last 10 ⁰ -20 ⁰	2(28.57%)
			Restriction of 20 ⁰ -50 ⁰	1(14.28%)
			Restriction >50 ⁰	-
3	12	7	Full Range	4(57.14%)
			Restriction of last 10 ⁰ -20 ⁰	2(28.57%)
			Restriction of 20 ⁰ -50 ⁰	1(14.28%)
			Restriction >50 ⁰	-

Table 9: Medial malleolus

Sl. No.	Duration (Weeks)	No. of patients	Range of motion – Knee flexion	No. of patients (%)
1	4	11	Full Range	1(9.09%)
			Restriction of last 10 ⁰ -20 ⁰	9(81.81%)
			Restriction of 20 ⁰ -50 ⁰	1(9.09%)
			Restriction >50 ⁰	-
2	8	11	Full Range	6(54.54%)
			Restriction of last 10 ⁰ -20 ⁰	3(27.27%)
			Restriction of 20 ⁰ -50 ⁰	2(18.18%)
			Restriction >50 ⁰	-
3	12	13	Full Range	9(69.83%)
			Restriction of last 10 ⁰ -20 ⁰	4(30.17%)
			Restriction of 20 ⁰ -50 ⁰	-
			Restriction >50 ⁰	-

In our study 80% of radiological union of fracture was seen by 8 weeks.

Table 10: Complications

Sl. No.	Complications	Patella	Olecranon	Medial malleolus
1	Joint stiffness	1 (10%)	-	2(15.38%)
2	Superficial infection	1 (10%)	-	-
3	Deep infection	-	-	-

4	Osteoporosis	-	-	-
5	Migration of K-wire	-	-	1(7.7%)

One patient developed superficial infection. Joint stiffness was seen in 1 patient of patellar fracture and 2 patients with malleolar fracture, which recovered after physiotherapy. In

one patient there was skin necrosis with exposure of bent tips of K-wire at ankle, which were removed at 12weeks.

Table 11: Evaluation of results

Sl. No.	Fracture	Total	Excellent	Good	Fair	Poor
1	Patella	10	6(60%)	2(20%)	1(10%)	1(10%)
2	Olecranon	7	3(42.8%)	2(28.57%)	1(14.29%)	1(14.29%)
3	Medial malleolus	13	6(46.15%)	4(30.76%)	1(7.69%)	2(15.38%)
	Total	30	15(50%)	8(26.66%)	3(10%)	4(13.33%)

In our study, best results were obtained in fracture of patella 60%, olecranon fracture 42.8%, and medial malleolus 46.15%. In total of 30 cases, 15 (50%) had excellent results, 8

(26.66%) had good results, 3 (10%) had fair and poor result is 4(13.33%).

Table 12: Relation between type of fracture and results in ankle injuries

Sl. No.	Fracture	No. of cases	Excellent	Good	Fair	poor
1	Supination –Adduction	1	-	1(100%)	-	-
2	Pronation-Adduction	3	2(66.33%)	1(33.33%)	-	-
3	Supination-external rotation	6	4(66.67%)	2(33.33%)	-	-
4	Pronation – External	2	1(50%)	1(50%)	-	-
5	Vertical compression	1	-	-	1(100%)	-

Excellent results were seen in supination - external rotation and pronation - abduction.

Discussion

The aim of treatment of fracture is not only achieving union but also to preserve the optimum function of adjacent joints. In intra-articular fractures of patella, olecranon and medial malleolus it is important to maintain perfect anatomical reduction of fragments to obtain articular congruity by rigid fixation. The treatment of choice for these fractures is tension band wiring. Tension band wiring was made use in our 30 cases. It has given favorable results in our experience.

In present study of 30 cases of fractures of patella, olecranon and medial malleolus, medial malleoli fracture is the most common constituting 43.33%, next is fracture patella 33.33%, followed by medial malleolus 23.33%. High incidence of patella fracture (56%) was reported by Maini and Kochar in their series of 107 cases^[4].

The average age in present series was found to be 45.9 years for patella fracture, 33 years for olecranon and 36.5 years for medial malleolus fracture. The statistical average range (mode) in our series was found to be 31-40 years (50%), which was in accordance with Bostman^[5] and Gary Wolfgang⁶ studies. In present study, fracture incidences are more in males (73.33%) and females (26.67%). Similar sex incidence was found in study made by Pandit and Shah^[7], Maini and Kochar⁴. This indicates males are more exposed to trauma.

In present study, right side (50%) was involved same as that of left side (50%). Other series (Maini and Kochar⁴, Gary Wolfgang)^[6] have reported higher incidence of fracture on left side. It may be due to the fact that the left non-dominant side makes vulnerable for trauma. Indirect trauma was more common in our study (70%), the common mode of injury being domestic in nature. Simple injuries (90%) were more common than compound injuries (10%) in our series. Gary Wolfgang⁶, Pandit and Shah^[7] reported high incidence of compound injuries in their series.

In present study related to tension band wiring, we noted

difficulty in maintaining reduction of fragments while introducing “K” wires, passing K wires through bone, soft tissue, bending ends of K- wires. Skin necrosis with exposure of bent ends of K-wires was seen at medial side of ankle in one case due to migration of “Wires. Many workers (Macko and Szabo⁸, Maini and Kochar⁴) have met with similar complications.

In present study, pain persisted in 26% of cases postoperatively after 12 weeks, 2 cases of patella, 1 case of olecranon and 5 cases of medial malleolus. Pain could be due to periarticular adhesions, superficial necrosis, and bursitis over protruding K wires. It was more seen in cases of medial malleolus due to subcutaneous nature of the bone. Maini and Kochar⁴ study revealed 15% of study population had persistent olecranon pain. Srinivasulu, Dave⁹ study showed 20% persistent pain patella and medial malleolus each in the study population. After 12 weeks 4 (13.33%) cases had restriction of movements up to 25%. It was due to late seeking of medical advice, migration of K wires, superficial infection and periarticular adhesions.

In our series, we came across superficial infection in one case of patella (3.33%), joint stiffness in one case of patella and two cases of medial malleolus (10%) and migration of K-wire in one case of medial malleolus (3.33%). Complications were noted more in medial malleolus because of less soft tissue coverage. Pandit and Shah⁷ study had 15% of infections as complications in the study population. Maini and Kochar⁴ study had 11% infections as complications but in Gary Wolfgang⁶ study only 2.5% of the study population had onfection.

According to criteria outlined in methodology, best results in our study were obtained in fracture of patella 70%, olecranon fracture 57.14%, and medial malleolus 53.85%. In total of 30 cases, 15 (50%) had excellent results, 8 (26.66%) had good results, 3 (10%) had fair and poor result is 4(13.33%).

Table 13: Results comparison

Series	Patella				Olecranon			
	Excellent (%)	Good (%)	Fair (%)	Poor (%)	Excellent (%)	Good (%)	Fair (%)	Poor (%)
Dudani, Sancheti ^[10]	93.3	-	-	-	-	-	-	-
Mainiand Kochar ^[4]	36.6	38.4	15	10	46.2	46.2	7.6	-
Pandit, Shah ^[7]	-	-	-	-	75	25	-	-
Gary Wolfgang ^[6]	-	-	-	-	73	15	-	-
Mathewson ^[11]	-	-	-	-	90.48	9.52	-	-
Levack ^[12]	-	50	35.7	14.3	-	-	-	-
Present study	60	20	10	10	42.8	28.57	14.29	14.29

Conclusion

It was concluded from the present study that, Tension band wiring by principle overcomes the distractive force, achieves compression at the fracture site and maintains the alignment by minimum hardware. By achieving compression at fracture site, the fracture heals faster and the patient is back to work earlier. The fixation enables early active movements of joints as early as four weeks when the fracture is healing, which reduces joint stiffness. The long-term complications of prolonged immobilization like joint stiffness, muscle wasting, pressure sores, and osteoporosis are avoided. Hence, it was concluded that tension band wiring is a simple, inexpensive technique and effective means of fixing fracture based on biomechanical principle with minimum complications.

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