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# Functional outcome assessment of olecranon fracture treated with locking compression plate: A prospective study

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**Abstract**
**Background:** The olecranon process of the ulna enhances stability and strength of the elbow joint but it is susceptible for fracture because it lies subcutaneously. Multiple options exist for the management of this fracture. This study was aimed to evaluate the functional outcome of olecranon fracture treated with precontoured locking compression plate which provides adequate stability and achieves fracture union in case of both simple and comminuted olecranon fractures.
**Material and Methods:** It was a prospective cohort study of 32 cases of olecranon fracture who were treated with open reduction and internal fixation with precontoured locking compression plate in Bokaro General Hospital in between July 2017 to June 2019. Evaluation of functional outcome were done by Mayo elbow performance score and serial radiographs in follow-up.
**Results:** All fractures are united**.** Out of 32 patients, 20 (62.5%) were males and 12(37.5%) were females. Average age was 47.90 years. According to Mayo classification 8 cases (25%) were of mayo type 2A, 11cases (34.37%) were of mayo type 2B, 10 cases (31.25 %) were of mayo type 3A and 3 cases (9.38%) were of mayo type 3B of olecranon fractures. patients with excellent results were 21 (65.62%), 6 cases (16.75%) with good results, fair results was noticed in 4 cases (12.5%) and 1 case (3.13%) seen with poor result.
**Conclusion:** Precontoured LCP provides good stability by its precontoured shape and thus helps in early mobilization, specially in communited fractures where other modes of fixation often tend to delay the process of mobilization because of lack of stability.

**Keywords:** Precontoured locking compression plate, olecranon fracture, LCP

## Introduction

Previous studies reported that olecranon fractures are one of the most common injuries of the upper extremities [1] which account for approximately 10% of all fractures of the upper extremities [2, 4]. Before the days of asepsis, the olecranon was immobilised in full extension for 4-6 weeks but this resulted in stiff elbow in absolutely Non Functional position, so later on immobilisation in mid flexion was given. In this position non-union became fairly common owing to the wide separation of fractured fragments. Now a days the treatment method for displaced olecranon fractures are open reduction and internal fixation (ORIF), with two standard methods including tension band technique or plating [2, 7, 9].The choice of surgical intervention technique depends upon many factors, including the site of fracture line, the amount of comminution, the stability of the joint and the ability to reduce the articular surface [9]. The purpose of surgical treatment for olecranon fractures is to re-establish normal anatomy and function of the elbow joint in such a manner that the re-constituted regular intra-articular and extra-articular relations become stable and are fixed properly. Then only these operative treatments can provide a good functional outcome which leads to early mobilization of the elbow joint and also decreases post-traumatic stiffness of this particular joint. From last few decades Tension band wiring (TBW) a surgical method for displaced transverse intra-articular olecranon fractures have been considered as the gold standard [10]. Now a days, plate fixation has gradually becomes popular globally. Plating techniques have been used for both comminuted and non comminuted fractures of the olecranon [2, 7, 9]. It is reported that Plate fixation provides adequate stability and achieves fracture union in case of both simple and comminuted olecranon fractures [7]. In our study we are trying to observe the functional outcome of locking compression plate fixation surgical technique as a treatment of Olecranon fractures. We hypothesize that functional outcomes of this surgical intervention of olecranon fractures with a Precontoured Locking Compression Plate Fixation will be analogous to other available plating systems.

## Materials & Methods

This was a prospective cohort study conducted in Orthopaedics Department, Bokaro General Hospital, Bokaro, Jharkhand, India from July 2017 to June 2019 after getting approval from institutional ethical committee. Thirty two (32) patients with olecranon fractures who underwent locking compression plate fixation surgery were recruited for this study. Patients were classified on the basis of MAYO classification which is based on the fracture's displacement, degree of stability and comminution [5].This can be simple undisplaced fracture to complicated fracture which leads to dislocation of the elbow joint [6].

### Inclusion criteria

- Mayo Classification of olecranon fracture IIA, IIB, IIIA and

IIIB types are included.
- Patients 18 to 70 years of ages were taken for this study.
- Patients with olecranon fractures who were underwent open reduction and internal fixation with compression locking plate surgery
- Patient having co-morbidities were taken.
- Patients with concomitant osseous injuries of the elbow were taken also.
- Patients who were co-operate to participate for research purpose as well as follow up.

**Exclusion criteria**
- Open fractures
- Mayo Classification of olecranon fracture IA and IB. (undisplaced fracture)
- Non co-operative and not willing to participate in this study.
- Age less than 18 year or more than 70 years

Surgery was done within 2-3 Days. Appropriate sized locking compression Plate was placed after cutting tab (most proximal screw hole). Then one cortical screw was inserted in elongated hole of the plate which helps in adjustment and proper fitting of plate over the bone. Then one longitudinal locking screw was inserted of size not more than 30mm because beyond this size longitudinal screw hits the central middle screw for coronoid process. In cases of comminution, longitudinal screw was used of size as long as it purchases beyond the fracture line, in these cases that central middle screw was not inserted which interrupts its course. Average hospital stay duration was 4-5days. After surgical intervention (Precontoured Locking Compression Plate Fixation) final functional outcome was assessed during 6$^{th}$ month of follow up. Postoperative limb immobilization was done for 3 weeks by above elbow plaster of paris slab. Functional outcome of physical capability was assessed by measuring range of motion. Patients' functional outcome was also evaluated by using Mayo Elbow Performance Score. Radiographs were evaluated preoperatively, immediate postoperatively and during the time of follow up i.e. 3 weeks, 6 weeks, 3months, 6 months postoperatively.

**Result**

Over all 32 patients were selected for this study purpose among them 20 (62.5%) were male and12 (37.5%) were female. Average patients' age was 47.90 ±11.34 years (Mean± SEM).From Radiograph we evaluated that bone union was achieved in all cases.

Table one shows Patients' profile and fracture related history like Age group wise incidence of olecranon fracture, nature of Trauma/ mode of injury, side of fracture, type of fractures according to MAYO classification, concomitant osseous injury among the patients of olecranon fracture of Bokaro General Hospital, Jharkhand from July 2017 to June 2019.

**Table 1:** Demographic Details Of Olecranon Fracture Patients

| Patients' Profile and Fracture Related History | Over All N=32 | Male n =20 | Female n =12 |
|---|---|---|---|
| Age Incidence | | | |
| Age group | | | |
| 18-30 yrs | 5(15.62%) | 3(15%) | 2(16.67%) |
| 31-40 yrs | 8(25%) | 7(35%) | 1(8.33%) |
| 41-50 yrs | 10(31.25%) | 6(30%) | 4(33.33%) |
| 51-60 yrs | 7(21.86%) | 3(15%) | 4(33.33%) |
| 61-70 yrs | 2(6.25%) | 1(05%) | 1(8.33%) |
| Nature of Trauma/Mode of Injury | | | |
| FFH | 13 (40.62%) | 6(30%) | 7(58.33%) |
| RTA | 19 (59.38%) | 14(70%) | 5(41.67%) |
| Fracture Side | | | |
| Right | 25(78.12%) | 16(80%) | 09(75%) |
| Left | 07(21.88%) | 04(20%) | 03(25%) |
| Type of Fracture(As per Mayo classification) | | | |
| IIA | 8(25%) | 4 (20%) | 4(33.33%) |
| IIB | 11(34.37%) | 6 (30%) | 5(41.67%) |
| IIIA | 10 (31.25%) | 9 (45%) | 1(8.33%) |
| IIIB | 3 (9.38%) | 1(5%) | 2(16.67%) |
| Concomitant Osseous Injury | | | |
| Present | 6 (18.75%) | 4(20%) | 2(16.67%) |
| Absent | 26 (81.25%) | 16 (80%) | 10(83.33%) |

SEM= standard error of mean, FFH= fall from height, RTA= Road traffic accident.

Table two represent patient rated outcome measures and MEPI of affected side after surgery during 6$^{th}$month of follow up.

**Table 2:** Patient rated outcome measures and MEPI of affected side.

| Patient rated outcome measures and MEPI | Over all (Mean±SEM) | Male (Mean±SEM) | Female (Mean±SEM) |
|---|---|---|---|
| According to Mayo Elbow Performance Score | | | |
| Pain | 38.43± 3.61 | 39±3.01 | 37.5±3.22 |
| Range of Motion | 19.09±1.32 | 19.5±1.45 | 18.33±0.94 |
| Stability | 10±0.0 | 10±0.0 | 10±0.0 |

| | | | |
|---|---|---|---|
| ADL | 23.44±1.83 | 23.5±1.72 | 23.33±1.33 |
| Elbow range of motion | | | |
| Flexion | 124.25±11.30 | 125.05±11.35 | 122.91±12.76 |
| Flexion contracture | 8.37±1.01 | 8.3±0.88 | 8.5±1.04 |
| Supination | 68.09±3.22 | 68.05±4.45 | 68.17±3.57 |
| Pronation | 76.56±6.11 | 76.5± 5.43 | 76.67± 6.11 |
| MEPI Total Score | 91.09± 11.09 | 92.5± 11.53 | 88.75±11.37 |

SEM= standard error of mean, ADL=Activity of daily Life

Table three shows comparison of patient rated outcome measures and MEPI between of affected side and unaffected side after surgical intervention during 6$^{th}$month of follow up by using student's *t* test. We did not found any significant difference of Elbow Range of Motion between affect and unaffected side at the significance level of 0.05 but In case of Supination our result shows a significant different between affected and unaffected side at the significance level of 0.10 which is statistically consider as very less significant difference.

**Table 3:** Comparison of Patient Rated Outcome Measures and MEPI between Of Affected Side and Unaffected Side.

| Parameter | Affected Side (Mean ± SEM) | Unaffected Side (Mean ± SEM) | *T Score* | *p* value (S/NS) |
|---|---|---|---|---|
| Elbow Range of Motion | | | | |
| Flexion | 124.25±11.30 | 132.55±8.34 | 0.016 | p>0.05(NS) |
| Flexion Contracture | 8.37±1.01 | 9.22±2.01 | 0.073 | p>0.05(NS) |
| Supination | 68.09±3.22 | 79.82±4.45 | 1.736* | P<0.10(S) |
| Pronation | 76.56±6.11 | 80.34± 8.46 | 0.000 | p>0.05(NS) |

S= significant difference, NS= non-significant difference.

After interpreting the Mayo elbow performance score we found over 65.62% (21 patients) with Excellent score followed by 18.75% (6 patients) good, 12.5% (4 patients) fair and 3.31%(1 patient) poor Score. In case of Male patients result shows 70% (14 patients) Excellent Score, 15% (3 patients) Good, 15% (3 patients) Fair Score and no patient with poor Score but in case of female patients 58.33% (7 patients), 25% (3 patients), 8.33% (1 patient) and 8.33% (1 patient) with Excellent, Good, Fair and Poor Score respectively.

We observed some post-Surgery complications like Symptomatic hardware prominence among patients 7 patients (21.88%) in which 5 patients were male and 2 were female, Superficial infection in case of 3 patients (9.38%) among them 2 were male and 1 was female, Deep infection among 2 patients (6.25%) both were male patients. Implant removal was done for 9 (28.12%) patients among the 6 were male and 3 were female patients.


**Fig 2:** Immediate post-operative x-ray


**Fig 1:** Pre-Operative x-ray

**Fig 3:** 4 Weeks Post-operative x-ray

**Fig 4:** 3 Months Post-Operative X-ray

**Fig 5:** 6 Months Post-Operative X-ray

**Fig 6:** Flexion extension movements after 6 months

**Fig 7:** Pronation supination movements after 6 months

**Fig 8:** Surgical scar mark right elbow

**Discussion**

The main aim of the treatment of fracture is not only achieving union but to preserve the optimum function of the adjacent soft tissues and joint. In the management of intra articular fracture like fracture of the olecranon, a perfect anatomical reduction of the fragment to obtain particular congruity and rigid fixation of the fragments is utmost important, if early movement are to be instituted to prevent complications like traumatic arthritis and joint stiffness. Previous study report shows Locking compression plate provides the strength of fixation. By good rigid fixation and good anatomical reduction that facilitate early range of motion.

In our study duration selected 32 cases of fractures of the olecranon treated with locking compression plate among them 20 (62.5%) were male and 12 (37.5%) were female with average age was 47.90 ±11.34 years and This is well in accordance with the pervious authors (Bailey CS. *et al* (2001) [7]. is his study average age was 54 years and De Giacomo A. F. *et al* (2016) [11]. average age was 50 years [7, 11] But In the study report of Singh N. K. *et al* (2019) [12]. showed less average age of the patients which was 37years [12] Actually this fractures happen less common in children than adults as the paediatric olecranon is short, thick and comparatively stronger than the distal humerus [13].

Pervious study reports also reveal that higher percentage of male were affected by olecranon fractures than female but the study of Bailey C. S. *et al* shows just opposite scenario [7, 11, 14].

We evaluate that the most common cause for injury is Road traffic Accident (59.38%)in overall patient and in case of male patients but female patients were most affect by fall from the height but pervious study reports disclosed that most common cause of injury can be vary.

In this study the involvement of right side (78.12%) was seen more frequent than left side which is similar with the study Bailey C. S. *et al* (2001) [7]. and other previous studies but the studies of Singh N. K. *et al* (2019) [12]. and Singhal S K *et al* (2018) [14]. both were done in northern part of India shows left side involvement was more common than right side [7, 12, 14].

The aspiration of any surgical intervention for olecranon fractures not only for achieving reunion of that bone but also for an early functional re-establishment of elbow join and repairing of all structures. Mayo elbow performance score (MEPS) was used to know the functional outcome, as it depicts the most of the patient outcome factors including pain, range of motion and ability to perform routine activities and all patients returned to pre-injury daily activities.

According to Mayo Elbow Performance Score (MEPS) we found that mean score for pain, range of motion, Stability, Activity of Daily life (ADL) were 38.43, 19.09, 10 and 23.44 respectively. We observed that mean elbow range of motion that is flexion, flexion contracture,

supination and pronation were $124.25^0$, $8.37^0$, $68.09^0$ and $76.56^0$ respectively in case of effected side during 6th month of follow up. We also compare the range of motion between affected and unaffected side we did not found any statistical significant difference between both sides at the significant level of 0.05.Our case series of olecranon fractures resulted mean MEPS of 91.09 with overall 65.62% excellent and followed by 18.75% good, 12.5% fair Score. This Patient rated outcome measures by using MEPS also comparable with pervious study of Bailey C. S. *et al* (2001) [7]. Singh N. K. *et al* (2019) [12]. And Singhal S K *et al* (2018) [14]. [7, 12, 14]. So Locking compression plate can be a good fixation system for olecranon fractures particularly displaced comminuted type. The device provides good angular stability by its precontoured shape and thus helps in early mobilization, even in communited fractures where other modes of fixation often tend to delay the process of mobilization because of lack of stability. Perhaps one of its greatest applications, is in osteoportic fractures where it may provide a solution to the old age problems of screw back out, late collapse, and mal alignment since the stability of the construct does not entirely depend on the quality of the bone.

Thus, locking compression plate is an optimal tool for olecranon fractures. It provides rigid fixation in the region of olecranon, where cancellous bone and frequently poor bone stock make fixation difficult. Orthopedic surgeons experience with locking compression plating technique will find it a useful technique. However careful understanding of its basic principles, identification of appropriate fracture patterns for use of LCP is essential to avoid complications like non-union, compromised range of motion and hardware prominence.

The main complications of internal fixation of olecranon fractures are related to irritation caused by hardware followed by superficial infection and Deep infection. The subcutaneous nature of the plate has led to concerns about the prominence of the hardware. Our result shows21.88% of Symptomatic hardware prominence, 9.38% superficial infection and 6.25% Deep infection among patients. However the incidence of symptomatic hardware protrusion is lower in plate fixation than tension band wiring [15, 16] with 0–20% of cases requiring plate removal [7, 17]. In our case 28.12% of Implant removal was done.

However a more comprehensive study with longer follow up periods is essential to throw more light into the advantages, complications and possible disadvantages of the use of Locking Compression Plate with special attention to the long term outcomes. The olecranon- locking compression plate is a good implant to use for fractures of olecranon. However, accurate positioning and fixation are required to produce satisfactory results. We recommend use of this implant in Mayo Type IIa, IIb, IIIa and IIIb, oblique fracture, longitudinal fracture and osteoporotic fractures. Our early results are encouraging but long term studies are needed to prove definitively acceptable outcomes so that the technique can become part of the armamentarium of the orthopaedic surgeon.

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