e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(5); 1717-1720

Original Research Article

Analysis of Functional Outcome of Pre-Contoured Olecranon Locking Plate in Fractures of the Olecranon

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Received: 10-01-2024 / Revised: 13-02-2024 / Accepted: 10-03-2024
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Conflict of interest: Nil

Abstract:

Background: Olecranon fracture can be caused by direct trauma such as fall on the elbow or by indirect trauma such as falling on partially flexed elbow, with indirect forces by the triceps muscle avulsing the olecranon. Present study aims to analysis the functional outcome of precontoured olecranon locking plate for fractures of the olecranon.

Methods: Present study was conducted at Orthopaedics department of IGIMS, Patna, Bihar from January 2014 to December 2014. This study was performed on thirty one skeletally mature patients with displaced fractures of the olecranon. Open reduction and internal fixation of displaced olecranon fracture of ulna with pre contoured olecranon locking plate. Patients were assessed by measuring the range of motion and Mayo Elbow Performance Score (MEPS) and index (MEPI). Serial radiographs were reviewed preoperatively for fracture classification and associated fractures, immediately postoperatively, and at the time of final review for adequacy and maintenance of reduction, evidence of union and arthritis.

Results: At 1 year of follow up the mean flexion of elbow was 123.7° (range 90-130°), while the mean extension was 5.64° (range 0-30°). The MEPS index showed 1patient having fair result, 6 patients having good results and 24 patients having excellent results. None of the patients had poor results. The mean MEPS were 90.65. All patients showed full radiological union.

Conclusion: 'Pre-contoured Olecranon Locking Plate' provides rigid internal fixation allowing vigorous early mobilization at the elbow, especially in comminuted fractures of the olecranon. It shows an excellent rate of radiological union. There was no case of implant failure in our study, even in comminuted fractures, which can be attributed to the use of locking compression plates. Thus it is a viable alternative to other forms of fixation of olecranon fractures and is a versatile implant which can be used in all types of olecranon fractures with minimal complication rate.

Keywords: Olecranon fracture; Pre contoured olecranon locking plate; Tension band wiring; Osteosynthesis.

Introduction

Olecranon fractures accounts for approximately 10% of fractures around the elbow and 2% of all fractures of the upper limb. Olecranon fracture can be caused by direct trauma such as fall on the elbow or by indirect trauma such as falling on partially flexed elbow, with indirect forces by the triceps muscle avulsing the olecranon.

Olecranon fractures can occur at any age but are most common in the first three decades of life while fractures of the proximal ulna occur predominantly in older patients[1]. Nowadays, operative treatment is the management of choice for all displaced olecranon fractures. Fractures of the olecranon being intra-articular, and since the olecranon effectively functions as the fulcrum of the lever arm of the elbow, it is necessary to restore precise anatomical alignment and articular congruity with rigid fixation, so that early movement can be encouraged.

For long, tension band wiring was considered the gold standard for the treatment of minimally displaced and comminuted fractures of the olecranon with low levels of pain. However in comminuted fractures with bone loss results are far from satisfactory such as initiating early movement and contraction of sigmoid notch. Subchondral bone comminution opposite the tension-band construct may cause failure in compression. According to a biomechanical study, a significantly more stable fixation was achieved by plate fixation

in comminuted osteotomies and hence allowing early mobilisation. Moreover, locking compression plates provide superior mechanical stability at the fracture line because they provide angular stability. Further, locking screws have been shown to provide excellent stability even with unicortical purchase. Recent studies have shown the pre-contoured olecranon locking plate to be more effective with a lower rate of symptomatic hardware and subsequent implant removal than tension band wiring.

The purpose of this study is to evaluate the clinical results and functional outcome, and complications of management of olecranon fractures with the Pre-contoured Olecranon Locking Plate.

Materials and Methods

Thirty one skeletally mature patients with displaced fractures of the olecranon who presented to the orthopedic emergency and the Out-Patient Department of Orthopaedics, Indira Gandhi Institute of Medical Sciences, Patna, Bihar from January 2014 to December 2014 were included in the study. Undisplaced fractures of the olecranon, patients with local infection or soft tissue defects around the fracture site and patients with poor general condition were not included in our study.

The average age of the patients was 33.68 years (range, 22 to 56 years). Out of the 31 patients in the study, 21(68%) were male, and 10(32%) were female. The most common mode of injury was fall from stairs/ height on their elbow or outstretched arm which amounted to 20 cases (64.5%). Road traffic accidents were responsible in 11(35.5%) cases. The dominant hand was involved in 19 out of the 31 patients.

The Mayo Classification was used to classify the fracture pattern. Type I fractures are undisplaced and stable, type II are displaced and unstable fractures but with intact collateral ligaments preventing dislocation and in type III fractures the elbow joint is unstable. Type II and III fractures are further subdivided into A (non-comminuted) and B (comminuted).Out of the 31 patients, 15(48.4%) had type IIA fractures while 13(42%) patients had type IIB fractures.

Type III fractures were uncommon with 1(3.2%) patient having type IIIA and 2(6.4%) patients having type IIIB fractures. Patients having type I undisplaced fractures were not included in the study.

Mayo Classification

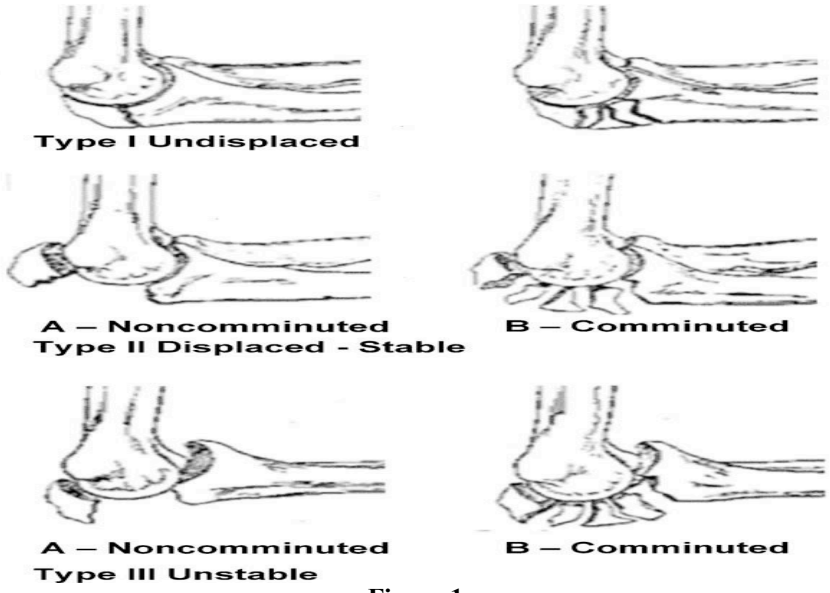

Figure 1:

The surgery was performed under regional anesthesia with sedation or general anesthesia. All patients were placed in lateral decubitus position. Under tourniquet control, a posterior midline incision was given with a slight lateral curve at the point of the elbow. The fracture was temporarily fixed with K- wires. Then, a longitudinal slit was made in the triceps tendon to allow for optimal positioning of the plate over the tip of the olecranon. The plate of appropriate size was placed in position and held with the help of clamps. The plate was then fixed with the help of bicortical locking/ non-locking screws in the distal fragment and unicortical screws in the proximal fragment. Finally, a 'home-run screw' was passed from the apex of the olecranon crossing the fracture towards the base of the coronoid. Additional K-wires were used for inter-fragmentary fixation in cases of severe comminution. The stability of the fixation checked intra-operatively. The elbow was splinted with an above-elbow plaster slab in the post-operative period. Guarded passive and assisted-

active range of motion exercises were started on the 5th post-operative day. The plaster slab was removed at suture removal on the 14th post-operative day and range of motion exercises was continued. The patients were followed up serially at 3, 6, 12 weeks, 6 months and 1 year. All patients were followed up for a minimum of 1 year.

Patients were assessed by measuring the range of motion and Mayo Elbow Performance Score (MEPS) and index (MEPI). The MEPS measures range of motion, pain, elbow stability and ability to do activities of daily living. Serial radiographs were reviewed preoperatively for fracture classification and associated fractures, immediately postoperatively, and at the time of final review for adequacy and maintenance of reduction, evidence of union and arthritis.

Observation and Results

The mean duration of surgery was 64.5 minutes (range 45-90 min). It was found that with increasing grades of Mayo classification, the duration of surgery increased. At one year of follow up, the mean flexion at the elbow at final follow up of 1 year was 123.7° (range 90-130°), while the mean extension at the elbow at 1 year was 5.64° (range 0-30°).The MEPS index at one year of follow up showed 1(3.2%) patient having fair result, 6(19.4%) patients having good results and 24(77.4%) patients having excellent results. None of the patients had poor results. The mean MEPS at 1 year of final follow up was 90.65.

A negative correlation was found between MEPS at 1 year and Mayo classification; that is higher grades of Mayo classification had lower MEPS scores compared and vice versa. A negative correlation was found between the day of surgery following injury and MEPS at 1 year; that is the later the day of surgery following injury, the lesser the MEPS at 1 year. The mean MEPS of patients operated within 10 days was 93.2 compared the mean MEPS of patients operated after 10 days which was 82.5. Reduction was maintained until union in all thirty one patients. The average time for radiological union ranged from 6 to 12 weeks with an average time of 10 weeks. Out of the 31 patients, 4(12.9%) patients had delayed union. Ultimately all patients showed full radiological union at follow up of 1 year and there was no case of non-union.

Out of the 31 patients, 1(3.2%) patient had superficial infection which was managed with wound debridement and intravenous antibiotics. The superficial infection healed uneventfully within a few days. 1(3.2%) of the patients had prominent implant causing skin impingement and may require implant removal at a later date. 1(3.2%) of the patients had chronic pain for over 6 months with restriction of motion at the elbow (ROM 30-90°). This patient had an open comminuted fracture of the olecranon and was operated 44 days after the injury.

Discussion

The aim of operative treatment of fractures of the olecranon is restoration of the articular congruity of the ulno-humeral joint with rigid fixation, so that early mobilization of the elbow and rehabilitation can be initiated.31 patients with fractures of the olecranon were treated by open reduction and internal fixation with the 'Pre-contoured Olecranon Locking Plate'. Only closed fractures were included in the study.

All the 31 fractures in the study showed radiological union at follow up. The average time for radiological union was 10 weeks with a range from 6 to 12 weeks. At 12 weeks all fractures had united except in 4 patients. Ultimately all fractures united at 1 year of follow up. In a study by Meredith L. Anderson et al, of the 32 patients treated with congruent elbow plate fixation, 30 achieved radiographic union. The average time to radiological union was 11.6 weeks. In another Seibenlist S et al, in 15 patients with fractures of the olecranon who underwent locking plate ostoesynthesis, the mean time to union was 11 weeks. In a study by Donald Macko et al, in 20 patients treated with TBW, 60% of the fractures healed by 12 weeks, 90% by 5 months and 95% by 7 months which was significantly later than our study.

The average elbow range of motion at 1 year of follow up was from 5.64° (0-30°) to 123.7° (90-130°). The average arc of motion was 118.06° at the end of 1 year of follow up. 26 of the 31 patients in our group had an extension deficit of 10° or lesser while only 5 patients had an extension deficit of more than 10°. Similarly only 5 patients had a flexion of lesser than 120°.

In a study by Meredith L Anderson et al on 32 patients with olecranon fractures treated with Mayo Congruent Elbow Plating System, the mean range of motion at final follow up was 120° which was similar to our study. The mean extension deficit was 13.6° in their study. In another study by Geert Buijze et al, the mean range of motion was 123° with an extension deficit of 13° In another study by Ramazan Erden Erturer et al, the mean range of motion was 116°. In a study by Mary C Hume et al, comparing the results of fracture fixation by TBW and One-third Tubular Plating, the mean extension deficit in the TBW group was 10° and 7° in the plating group.

The MEPS (Mayo Elbow Performance Score) was used because it emphasizes on the more important patient outcome factors such as pain, range of motion and whether the patient is able to do his

activities of daily living. In our study, the mean MEPS at 1 year of follow up were 90.65. Of the 31 patients in our study, 24(77.4%) patients showed excellent results, 6(19.4%) patients showed good results and 1(3.2%) patient showed fair result. None of the patients had poor results at final follow up. In a study by Byron E Chalidis et al on treatment of olecranon fractures with TBW, 85.5% patients had good to excellent results compared to the 96.8% in our study, with 9.7% having fair result and 4.8% having poor results. In a study by Christopher S Bailey et al on the outcomes of plate fixation, 13(52%) patients had excellent results, 10(40%) good, (4%) fair and 1(4%) poor result. Meredith L Anderson in his study reported average MEPS of 89, with 92% having good or excellent results. Seibenlist S in his study on pre-contoured locking plate osteosynthesis reported mean MEPS of 97, with excellent results in 12 patients, good results in 2 patients and fair in 1 patient. Hence, it appears that MEPS scores are better in patients who undergo plating than in patients who undergo TBW. This may be due to the more rigid fixation which permits more vigorous and early mobilization of the elbow.

Complications were observed in 3 of the 31 patients. One patient developed superficial infection which healed uneventfully with debridement and IV antibiotics. Symptomatic implant prominence was seen in 1 patient causing impingement of the overlying skin and is awaiting implant removal. Donald Macko in his study on the complications of TBW in olecranon fractures reported a high rate of hardware prominence in 16 of his 20 patients. In a study by Byron E Chalidis on TBW in olecranon fractures, hardware removal was recorded in 82% of the patients. Seibenlist S in his study on pre-contoured locking compression plates reported hardware prominence leading to implant removal in 1 of the 15 patients. Meredith L Anderson in his study on 32 patients reported hardware prominence in 3 patients. On the basis of the above mentioned results, it can be concluded that the Pre-contoured olecranon locking plate has a low rate of hardware prominence. Chronic pain was reported in 1 of our patients. This patient presented to us more than 1 month after the injury and was operated 44 days following the injury. The patient also had restriction of movement at the elbow with a mean range of 60° (30°-90°). In a study by Christopher S Bailey on 25 patients who underwent plate fixation, 3 patients reported of chronic pain at the elbow. There were no other complications in our study such as myositis ossificans, implant failure, ulnar neuropathy which have been reported in previous studies.

Conclusion

Thus, we can conclude that the 'Pre-contoured Olecranon Locking Plate' provides rigid internal fixation allowing vigorous early mobilization at the elbow, especially in comminuted fractures of the olecranon which is necessary to achieve a good and fully functional elbow. It shows an excellent rate of radiological union. There was no case of implant failure in our study, even in comminuted fractures, which can be attributed to the use of locking compression plates. There was a very minimal rate of complications in wound healing and due to implant prominence, in spite of the olecranon being a subcutaneous bone. We can conclude that, the 'Pre-contoured Olecranon Locking Plate' seems to be a viable alternative to other forms of fixation of olecranon fractures. We feel that it is a more versatile implant which can be used in all types of olecranon fractures with minimal complication rate.

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