



Minimally Invasive Plating of Fractures Ulna

Taher Nasser Abd-Elkader*, Abd-Elhakim Abd-Allah Massoud, Galal Mohammed Mansour Hegazy

Department of Orthopedic Surgery, Faculty of Medicine, Al-Azhar University
email: tahnasser70@yahoo.com

Abstract: Background: Minimally invasive internal fixation is also called “biological internal fixation”. This concept is used widely in the treatment of various fractures but to date, there have been few reports about such application in the repair of ulnar bone fractures. **Aim of the Work:** The study was targeting at the evaluation of radiographic and functional outcome after minimally invasive plating for fractures of the ulnar shaft. **Patients and Methods:** This is a prospective study on 15 patients with fractures ulna (According to AO classification as following; 7 patients were 2U2A3, and 5 patients were 2U2A2, 2 patients were 2U2A1, one patient was 2U2B2), were treated by minimally invasive plating technique with the aim of minimizing soft tissue damage. The study was conducted on 15 cases aged from 18 – 60 years, Mean age was 39 years. Out of the 15 studied patients, 12 were males and 3 were females. The study was carried out from June 2017 to February 2019 in El-Mabarrah hospital and Samalout general hospital. **Results:** The mean follow up in our prospective study was 12 months, Fractures union at an average of 11 weeks with good to excellent clinical outcomes. There were no complications such as implant failure or neurovascular injuries except one case that had hypertrophic nonunion. **Conclusions:** MIPO seems to be advantageous for soft tissue and bone biology. Good union was seen and fracture complications were also prevented by early mobilization.

[Taher Nasser Abd-Elkader, Abd-Elhakim Abd-Allah Massoud, Galal Mohammed Mansour Hegazy. **Minimally Invasive Plating of Fractures Ulna.** *N Y Sci J* 2019;12(9):85-88]. ISSN 1554-0200 (print); ISSN 2375-723X (online). <http://www.sciencepub.net/newyork>. 14. doi:[10.7537/marsnys120919.14](https://doi.org/10.7537/marsnys120919.14).

Keywords: Dynamic compression plate (DCP), closed reduction, ulnar bone fracture, minimally invasive plate osteosynthesis (MIPO).

1. Introduction

Fracture of the ulna is a common injury usually caused by direct trauma. Ulnar shaft fractures have been extensively studied and various treatments such as open reduction and internal fixation, plaster cast immobilization and a functional brace have been recommended. The perception is that ulnar shaft fractures treated by nonsurgical means frequently fail to unite; there are recommendations for internal fixation in preference to cast stabilization as even the above-elbow cast does not provide sufficient immobilization to facilitate healing^(1,2).

Brakenbury noted an increased non-union rate in the fractures located at the distal third of the ulna, where circulation may be compromised due to the lack of muscle coverage and termination of the nutrient artery proximal to this site so most patients with sustained fractures at the distal third of the ulna, indicated a need for surgical intervention. Stern suggested that the high rate of ulnar non-union in forearm fractures might be due to torsional stresses applied to a relatively stationary ulna during pronation and supination of the forearm^(3,8).

The traditional method of open reduction and plate fixation requires wide exposure of the fracture

site with stripping of the soft tissues, which may in turn devascularize fracture fragments. This may contribute to necrosis caused by trauma and consequently increase the risks for delayed healing and infection. Open techniques entail a larger incision, more bleeding and a need for periosteum stripping during surgery. Postoperative recovery is also protracted⁽⁴⁾.

Minimally invasive plate osteosynthesis (MIPO) have been described for some fractures of lower and upper extremities. This technique was developed to avoid extensive exposure of the fracture site and to minimize soft tissue damage, and entails a smaller incision resulting in a smaller scar and recovery of the soft tissue occurs more rapidly. To date, there are no reports of adaptations of this approach for fractures of the ulna. The ulna is a subcutaneous bone, and it is relatively easy to fix fractures of the ulna using the MIPO technique⁽⁵⁻⁷⁾.

Does minimally invasive plating technique of fixation of fractures ulna could achieve better results of healing as well as less complications than open technique?

The purpose of this prospective study was targeting at the evaluation of radiographic and

functional outcome after minimally invasive plating for fractures of the ulnar shaft.

2. Materials and Methods

From June 2017 to February 2019, 15 patients who sustained closed displaced fractures of the ulna were enrolled in this study after giving informed consent. All patients at the Department of Orthopedics and Trauma Surgery of EL-Mabarrah hospital and Samalout hospital during this time period were treated with of MIPO technique.

The cause of injury was the predominant mechanism of the injury in 9 patients was direct injury, 4 patients road traffic accident and 2 patients were falling from height, the fracture type according to AO classification as following; 7 patients were 2U2A3, and 5 patients were 2U2A2, 2 patients were 2U2A1, one patient was 2U2B2. The mean follow up period was 12 months (range; 6 – 18m). The age of patients ranged from 18 to 60y (mean; 39y); there were 12 male and 3 female patients, ten of whom had injured their dominant RT forearm. Five patients had fractures at the distal third of the forearm and the other ten fractures were at the mid shaft of the forearm, 4 patients were associated with ipsilateral fracture radius. Patients who included in this study were adult, fracture shaft ulna and recent fractures. And who aged above 65y or had infection or Fracture of proximal ulna associated with fracture of head radius were excluded from this study.

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 23.

Anteroposterior (AP) and lateral radiographic views of the affected forearm were obtained in all cases. Preoperative planning was done.

Surgical technique:

Under general anaesthesia, well padded pneumatic control all patients were operated upon while lying in a supine position with the injured upper limb placed on the chest of the patient's body, Intraoperative Fluoroscopic imaging was a pre-requested and was used for all cases throughout the procedure. 2-cm long incisions were made 4 cm proximal and 4 cm distal to the fracture site between the extensor carpi ulnaris (ECU) and flexor carpi ulnaris (FCU).

A sub-muscular extra-periosteal tunnel was prepared between the ECU and FCU and the underlying periosteum with a narrow periosteal elevator inserted first from the proximal incision distally and then from the distal incision proximally. By helping of the assistant and using bone clamp, which was inserted one on each side of the bone and we did distraction method (By traction and counter-traction) for achieving satisfied functional reduction.

Fracture was reduced through the indirect method under close observation via C-arm fluoroscopy. Inserting the plate (8-10 holes, 3.5 AO locking compression plate [LCP] in one case and small Dynamic compression plate [DCP] in 14 cases due to financial reasons) through the tunnel on the medial side gliding the plate over the bone. The plate was mounted on the medial side of ulna sub-muscular extra-periosteal. Fixation of the plate proximally and distally by three screws were applied via stab incisions on each end, then closure of the skin, then using image intensification carefully check for correct reduction and fixation. In all cases above elbow slab was done for two weeks and Postoperative x-rays were done for all patients before discharge. ⁽¹⁰⁾

Postoperative follow up:

A follow up protocol including clinical evaluation of the pain, patient satisfaction, scar and wound problems, local tenderness, range of motion as well as to early identify and manage any uprising complications. Routine plain radiographs lateral and postero-anterior X-rays were taken immediately post-operative, every two weeks for the first month then every one month till radiographic union occurs.

3. Results

The surgical procedure for ulna ranged from 40 minutes to 70 minutes with average of 55 minutes. The fluoroscopy time ranged from 50 seconds to 150 seconds with average 100 seconds. The final follow up examinations took place at an average of 12m (range; 6 – 18m) after surgery. The average time to union was 11 weeks that ranged from (6-16 weeks) and no major complications such angulation at the fracture, deep infection, compartment syndrome or nonunion were seen except one case that had hypertrophic nonunion. Supination and pronation of the injured forearm was almost equal when compared to the normal contralateral side. There was no loss of grip strength of the affected hand or forearm muscle wasting. Superficial skin infection was seen in 2 patients and was treated with oral Antibiotic and daily dressing. Deep infection was not seen. Two patients reported with keloid scar with pain during movement of forearm and that resolved after scar massage. Two patients with local tenderness but all patients had satisfaction post-operative. There was one patient had minimal displacement due to insufficient functional reduction. One patient had tourniquet palsy that was resolved later on.

Discussion

In this prospective study 15 patients with fractures shaft ulna were treated using MIPO technique, four patients had associated with fractures

radius that managed at the same time using open reduction and internal fixation.

According to Anderson score, we reviewed the results of this technique of fixation with 15 patients, where union was achieved in 14 cases (93.34%), results were denoted to be satisfactory, in 11 (73.34%) patients whom eventually had excellent score, 3 patients (20%) good score and one patient (6.66%) poor score.

This study reviewed on 15 patients; 12 males and 3 females with the tourniquet time for the surgical procedure ranged from forty minutes to 70 minutes with the mean was 55 minutes, and fluoroscopy time that ranged from 50 seconds to 150 seconds with the mean was 100 seconds, some patients had easy reduction and short time of operation and others were done fracture ipsilateral radius fixation so had long operative time that cause temporary tourniquet palsy in one case that resolved later on. The union ranged from 6 weeks to 16 weeks with the mean was 11 weeks, union was occurred in 14 cases and only one case that had hypertrophic nonunion that was later on undergo removal of the plate and ORIF with grafting, there is no deep infection or compartment syndrome were seen.

In all united cases, Supination and pronation of the injured forearm was almost equal when compared to the normal contralateral side, Range of motion of the wrist and elbow were almost equivalent to the normal side. There was no loss of grip strength of the affected hand or forearm muscle wasting.

Routine internal fixation by ORIF with plates and screws or otherwise by IM nailing which were considered the gold standard of operative treatment of forearm fractures, however, may be associated with complications such as nonunion, delayed union, infection, limitation of motion, refracture of the bone following removal of the plate, synostosis, or peripheral nerve injury.⁽³⁾

In the present series, most patients sustained fractures at the distal third of the ulna or fractures shaft ulna, indicating a need for surgical intervention.

Brakenbury noted an increased non-union rate in the fractures located at the distal third of the ulna, where circulation may be compromised due to the lack of muscle coverage and termination of the nutrient artery proximal to this site⁽³⁾.

Droll et al reviewed the functional outcomes of a similar cohort of 30 patients at a mean of 5.4 years after plate fixation for both-bone forearm fractures. They demonstrated statistically less (15% to 38%) forearm and wrist strength compared to the uninjured arm and 9% to 18% less forearm and wrist motion.⁽⁹⁾

Leung and Chow performed a prospective randomized study comparing the limited contact dynamic compression plate with the point contact

fixator in 125 forearm fractures. Twenty-nine of these fractures were isolated fractures of the ulnar shaft and all went on to union. The authors showed no statistical difference between the two internal fixation devices.⁽¹⁰⁾

Visna and colleagues used the same device in 78 patients with 118 forearm fractures. Seventeen patients were immobilized an average of 3.5 weeks. All fractures healed, with incomplete radio-ulnar synostosis in 2 (3%) patients, superficial infection in 1, and compartment syndrome in 1. The nails were removed in 27 (35%) patients, with no re-fractures noted.⁽¹¹⁾

Visna et al reported the results of a prospective study evaluating 80 patients with 115 forearm fractures treated with either plate or nail fixation. There was 1 re-fracture following plate removal. There were 2 cases of incomplete synostosis and 2 cases of partial migration of the interlocking screw in the nail group. No significant differences in functional outcome were detected.⁽¹¹⁾

Minimally invasive plate osteosynthesis (MIPO) was developed to avoid extensive exposure of the fracture site and to minimize soft tissue damage, and entails a smaller incision resulting in a smaller scar and recovery of the soft tissue occurs more rapidly and union occurs rapidly due to preserving fracture haematoma as described in paper of Suman K Shrestha, et al, the average union rate was 7-8 weeks, supination and pronation of the forearm was excellent and there was no elbow and wrist stiffness at the last follow-up.⁽¹²⁾

Finally the study has small number of patients with ulnar shaft fractures treated with this method, so has limited implications. Large meta-analysis series and randomized control design studies are needed to prove the superiority of MIPO technique in management ulnar shaft fractures over open technique and compare between their results.

Conclusion

In this study, MIPO was more advantageous for soft tissue, bone biology, supination and pronation motion of forearm results. Good union was seen and fracture complications were also prevented by early mobilization. In an ulnar bone fractures, MIPO seems to be a safe and effective surgical treatment method and could be a viable alternative to other open techniques.

References

1. De Boeck H, Haentjens P, Handelberg F, Casteleyn PP, Opdecam P. Treatment of isolated ulna shaft fracture with below elbow plaster cast. A prospective study. *Acta Orthop Trauma Surg* 1996; 115: 316-20.

2. Gebuhr P, Holmich P, Orsnes T, Soelberg M, Krashennikoff M, Kjersgaard AG. Isolated ulnar shaft fractures. Comparison of treatment by a functional brace and long arm cast. *J Bone Joint Surg Br* 1992; 74: 757-9.
3. Brakenbury PH, Corea JR, Blakenmore ME. Nonunion of isolated fractures of the ulnar shaft in adults. *Injury* 1981; 12: 371-5.
4. Heim U, Pfeiffer KM. Internal fixation of small fractures, 3rd Edn. Berlin: Springer, Verlag; 1987.
5. Sauder DJ, Athwal GS. Management of isolated ulnar shaft fractures. *Hand Clin* 2007; 23: 179-84.
6. Lau TW, Leung F, Chan CF, Chow SP. Minimally invasive plate osteosynthesis in the treatment of proximal humeral fracture. *Int Orthop* 2007; 31: 657-64.
7. Imatani J, Noda T, Morito Y, Sato T, Hashizume H, Inoue H. Minimally invasive plate osteosynthesis for comminuted fractures of the metaphysis of the radius. *J Hand Surg Br* 2005; 30: 220-5.
8. Stern PJ, Drury WJ. Complications of plate fixation of forearm fractures. *Clin Orthop Relat Res* 1983; 175: 25-9.
9. Droll KP, Perna P, Potter J, Harniman E, Schemitsch EH, McKee MD. Outcomes following plate fixation of fractures of both bones of the forearm in adults. *J Bone Joint Surg* 2007;89A:2619–2624.
10. Leung F, Chow SP. A prospective randomized trial comparing the limited contact dynamic compression plate with the point contact fixator for forearm fractures. *J Bone Joint Surg Am* 2003; 85: 2343–8.
11. Visna P, Beitl E, Pilny J, et al. Interlocking nailing of forearm fractures. *Acta Chir Belg.* 2008;108(3):333–338.
12. Suman K Shrestha, Pramod Devkota, Laxmi P Mainali. Minimally Invasive Plate Osteosynthesis In The Treatment Of Isolated Ulnar Bone Fractures. *Malaysian Orthopaedic Journal* 2012 Vol 6 No 4.

9/25/2019