



COMPARISON BETWEEN MINIMALLY INVASIVE VERSUS OPEN REDUCTION PLATING IN MID TO DISTAL THIRD HUMERAL SHAFT FRACTURES

Orthopaedics

Dr. Ranjeet Kumar*

Assistant professor, Department of Orthopaedic, Anugrah Narayan Magadh Medical College & Hospital, Gaya, Bihar, India. *Corresponding Author

Dr. Shambhu Prasad

Senior resident, department of orthopaedics, Anugrah Narayan Magadh Medical College & Hospital, Gaya, Bihar, India.

Dr. Shailendra Kumar

Associate professor, Department of orthopedics, Anugrah Narayan Magadh Medical College & Hospital, Gaya, Bihar, India.

ABSTRACT

This study compares the functional outcomes of osteosynthesis of fracture shaft of humerus by minimally invasive plating and open reduction plating technique. 25 patients were retrospectively analysed and divided into two groups. Group A (n=13) patients were treated by MIPO and group B (n=12) by conventional plating. The mean operation time in group A was 86.63 minutes and 111.40 minutes in group B. Iatrogenic radial nerve palsy in group A was 0% (0/13) and 3 in group B 33.33% (4/12). The mean fracture union time in group A was 15.62 weeks (range 8–24 weeks), and 37.14 weeks (range 10–58 weeks) in group B. The mean UCLA end-result score in group A was 35.54 points (range 33–35), and 31.23 points (range 30–35) in group B. When compared to the conventional plating techniques, MIPO offers advantages in terms of reduced incidence of iatrogenic radial nerve palsies and accelerated fracture union and a similar functional outcome with respect to shoulder and elbow function.

KEYWORDS

INTRODUCTION

There are various methods used to treat mid-distal third humeral shaft fractures. Most of the fractures can be effectively treated conservatively [1]. Indication of operative treatment are (1) failure of closed reduction, (2) intra-articular extension of fractures, (3) neurovascular compromises, (4) associated ipsilateral forearm and elbow fractures, (5) segmental fractures, (6) pathological fractures, (7) open fractures, (8) fractures in polytraumatised patients, (9) bilateral humeral shaft fractures, (10) periprosthetic fractures and (11) transverse or short oblique fractures [2]. These fractures can be surgically treated by either using a dynamic compression plate (DCP) or intramedullary nails (IMN) [3]. The advantages of DCP over IMN include anatomical reduction of fractures and less interference to elbow and shoulder function. The major disadvantages of this technique, however, are extensive soft tissue stripping and disruption of periosteal blood supply, which increase the risk of nonunion and iatrogenic radial nerve palsies [4]. MIPO technique has advantages of less soft tissue dissection and no need to expose the radial nerve hence low risk of iatrogenic radial nerve palsies. These advantages appear to indicate that MIPO is superior to conventional plating osteosynthesis. The purpose of this retrospective study was to compare the clinical results of two groups of patients: those treated with MIPO and the other treated by conventional open reduction and plating osteosynthesis.

MATERIAL AND METHODS

Patients with closed displaced unstable middle or/and distal third humeral shaft fractures without radial nerve palsies were selected and treated by either conventional open reduction and plating or by MIPO technique were included.

Exclusion Criteria

1. Patients with mid-distal third shaft fractures associated with radial nerve injuries
2. Patients with open fractures
3. Skeletally immature patients
4. Patients with pathological fractures
5. Patients in which time lag between injury and surgical intervention exceeded three weeks

Study Period And Location

From June 2019 to March 2020, 25 cases (18 males, 7 females) of mid-distal third humeral shaft fractures, with average age of 38.6 years (19–62 years), were surgically stabilised by plating in Anugrah Narayan Magadh Medical College and Hospital, Gaya. The patients were divided into two groups: patients treated by the MIPO technique (group A) and patients treated by open reduction and plating internal fixation (group B). There were 13 cases in group A (9 males, 4 females)

with average age of 36.7 years (19–60 years). Causes of injuries were road traffic accidents in 8 patients, and falls in 5. There were 12 cases in group B (9 males and 3 females) with mean age of 36.9 years (24–62 years). Six cases were caused by injury from a fall and six by road traffic accident. 8 fractures involved the middle third humeral shaft and 4 the distal third.

Operative Procedure

The operative techniques applied in group A were similar to that previously described in literature. Obtaining closed reduction was the crucial step in the whole procedure, which was done under image guidance. Two small incisions were made on the anterior side of the arm, proximal and distal to the fracture site. A submuscular extra periosteal tunnel was prepared between the brachial muscle and underlying periosteum with a narrow periosteal elevator inserted first from the proximal incision distally and then from the distal incision proximally. Through this tunnel a straight, noncontoured, long, narrow, 4.5-mm dynamic compression plate (DCP, 10–12 holes) was inserted from the proximal incision, passing the fracture site and down to the distal incision. At least three screws and six cortices were inserted in each of the main fracture fragment. Screws were percutaneously inserted by an additional stab incision. The radial nerve was not exposed during the whole procedure. Wound closure was done in the standard fashion, no drain tube was used.

For the patients in group B, open reduction and internal fixation with a plate were performed by conventional anterolateral or posterior approaches centred on the fracture site with patients in a supine or lateral position and the arm on a radiolucent board. The radial nerve was exposed and carefully protected in both the approaches. The fractures were reduced and a straight 4.5-mm dynamic compression plate was applied to fix the fractures with at least three screws in each end of the plate. The stability of the bone-plate construction was examined by passive motion of the shoulder and the elbow. The wound was closed after placing a drainage tube sub-muscularly. 7 cases in this group were operated upon via a posterior approach and 5 by an anterolateral approach.

Postoperative treatments in both groups were the same except for removing the drainage tube in group B. The arms were immobilised with a collar and cuff sling and the patients were encouraged to move the shoulders and elbows early, usually three days after surgery in both groups. The stitches were removed two weeks after surgery. All patients were followed-up at four-week intervals for the first three months after the surgery and at eight-week intervals for the next three months after surgery. The range of motion of the shoulders and elbows were recorded. Radiographs of the injured arm were taken. More active exercises were started when callus appeared.

For data collection the operative time was defined as the time from the skin incision to skin closure. Also recorded were the fracture union time, perioperative complications, late complications, and shoulder and elbow function. Union was defined as the absence of pain and the presence of bridging callus in three of the four cortices seen on the anteroposterior and lateral radiographic views of the humerus. Shoulder function was assessed using the UCLA scoring system, the parameters including pain (10 points), motion (10 points), function (10 points), and patient satisfaction (5 points). Subjective criteria constitute 15 points of a total of 35 points, and the findings on examination comprise the remaining 20 points. The scores were further divided into excellent (34–35 points), good (29–33 points), fair (21–28 points), and poor (0–20 points) according to Ellman [9]. Elbow function was assessed using the Mayo elbow performance index (MEPI), which evaluates patients on a 100-point scale regarding pain (45 points), range of motion (20 points), stability (10 points) and function (25 points). Function of the joint is classified as excellent (>90 points), good (75 to 89 points), fair (60 to 74 points) or poor (<59 points).

RESULTS

There was no significant difference in mean age, gender, type of the fractures or associated injuries between the two groups. The mean duration of injury for group A was 5.59 ± 1.80 days (range 3–9 days), while for group B it was 6.50 ± 3.58 days (range 2–13 days). There was no statistical significance between the two groups ($t=0.933$, $P=0.358$).

The mean operation time was 86.63 minutes in group A and 111.25 minutes in group B.

The occurrence of iatrogenic radial nerve palsy in group B, 25%(3/12), was significantly higher than in group A, 0%(0/13).

The mean fracture union time was 15.62 weeks (range 8–24) in group A and 37.14 weeks (range 10–58) in group B. The mean fracture union time in group B was longer than that in group A. There was no incidence of infection or implant failures in either group. All iatrogenic radial nerve palsies spontaneously recovered with mean onset time of 22.4 weeks (range 12–52 weeks) without any surgical interference.

At the latest visit, the mean active anterior forward flexion of affected shoulder in group A was 166.7 degrees (range 150–170), while it was 165.00 (range 150–170) in group B. The mean UCLA end-result score in group A was 34.46 points (range 33–35) and 34.38 points (range 30–35) in group B.

There was no statistically significant difference in the range of motion (ROM) and MEPI between the two groups. The mean ROM was 132.7 degrees (range 100–140) in group A and 135 degrees (range 120–140). The mean MEPI was 99.4 points (range 90–100) in group A and 99.56 points (range 95–100) in group B. There were no significant postoperative deformities in either group.

DISCUSSION

In comparison with open reduction and internal fixation using a plate, one of the major theoretical advantages of MIPO with an anteriorly placed plate to treat mid-distal humeral shaft fractures is less surgical trauma to the soft tissue around the fracture site. The periosteal circulation around the fracture fragments is minimally disrupted and thus bone union is promoted and complications such as nonunion are decreased. In this study, although all the fractures treated with plating finally united without secondary surgical interference, the union time of fractures treated by the MIPO technique was 15 weeks, while the fracture union time of the patients treated by the open reduction technique was 21 weeks, much longer than patients treated by MIPO. Although there is no statistical significance between the two groups. This may be due to relatively small number of cases in the study and, with larger study groups, the results may show statistical significance.

Another advantage of MIPO is that the radial nerve does not need to be dissected, although it is very important to carefully expose and protect the radial nerve during the entire procedure of open reduction and internal plating fixation. When a plate is placed on the anterior side of humeral shaft the mean distance from the closest part of the plate to the radial nerve is 3.2 mm. The brachial muscle that covers most of the anteriorly placed plate protects the radial nerve from injury when a plate is inserted sub-muscularly through two small incisions on the anterior side of the arm away from fracture site. The incidence of

iatrogenic radial nerve palsies in the open reduction patients is 25%, higher than most series. The fact that there was no case of radial nerve palsy occurring in the MIPO group demonstrates its superiority over the conventional technique even when compared to historical control data of pre-existing literature. As with any other retrospective study, there is scope for selection bias; however, the groups were properly matched for age, sex, injured side, OTA classification, mean duration between surgery and the occurrence of injuries and associated injuries. This study is small when considered statistically.

CONCLUSION

From this retrospective comparative study, mid-distal third humeral shaft fractures could be effectively treated with the MIPO technique, with advantages of shorter fracture union time and lower incidence of iatrogenic radial nerve palsies but with similar functional outcomes to the conventional open plating technique.

REFERENCES

- Ekholm R, Tidermark J, Törnkvist H, Adami J, Ponzer S. Outcome after closed functional treatment of humeral shaft fractures. *J Orthop Trauma*. 2006;20(9):591–596. doi: 10.1097/01.bot.0000246466.01287.04.
- Schemitsch EH, Bhandari M (2003) Fractures of the humeral shaft. In: Browner BD, Jupiter JB, Levine AM, Trafton PG (ed) *Skeletal trauma: basic science, management, and reconstruction*, 3rd edn. WB Saunders Company, pp 1487–1488.
- Niall DM, O'Mahony J, McElwain JP. Plating of humeral shaft fractures—has the pendulum swung back? *Injury*. 2004;35(6):580–586. doi: 10.1016/j.injury.2003.10.021.
- Changulani M, Jain UK, Keswani T. Comparison of the use of the humerus intramedullary nail and dynamic compression plate for the management of diaphyseal fractures of the humerus. A randomised controlled study. *Int Orthop*. 2007;31(3):391–399.
- Lim KE, Yap CK, Ong SC, et al. Plate osteosynthesis of the humerus shaft fracture and its association with radial nerve injury—a retrospective study in Melaka General Hospital. *Med J Malaysia*. 2001;56(Suppl C):8–12.
- Apivatthakakul T, Arpornchayanon O, Bavornratanaavech S. Minimally invasive plate osteosynthesis (MIPO) of the humeral shaft fracture. Is it possible? A cadaveric study and preliminary report. *Injury*. 2005;36(4):530–538. doi: 10.1016/j.injury.2004.05.036.
- Orthopaedic Trauma Association Fracture and dislocation compendium. *J Orthop Trauma*. 1996;10(Suppl 1):1–55.
- Ellman H, Hunker G, Bayer M. Repair of the rotator cuff. *J Bone Joint Surg Am*. 1986;68:1136–1144.
- Ellman H. Arthroscopic subacromial decompression: analysis of 1 to 3 year results. *Arthroscopy*. 1987;3:173–181. doi: 10.1016/S0749-8063(87)80061-0.
- Gill DR, Morrey BF. The Coonrad-Morrey total elbow arthroplasty in patients who have rheumatoid arthritis. A ten to fifteen-year follow-up study. *J Bone Joint Surg Am*. 1998;80:1327–1335. doi: 10.1302/0301-620X.80B6.8658.
- Pospula W, Abu Noor T. Percutaneous fixation of comminuted fractures of the humerus: initial experience at Al Razi hospital, Kuwait. *Med Princ Pract*. 2006;15(6):423–426.