Original Article

Fixation of Diaphyseal Fracture Humerus with Compression Plate in a Tertiary Care Hospital

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Abstract

Purpose: *To describe the beneficial effects of compression plate in diaphyseal fracture humerus.*

Background: *Management of humeral shaft fractures has (HSF) historically been largely conservative. A significant body of literature, dating back to the 1970s, has shown that functional bracing may achieve greater than 90 % union rates and acceptable functional outcomes. But the implant use in diaphyseal fracture is a choice of good and early recovery.*

Meterial and methods: *The Study was made based over 244 patients in the time period of 2017-2019, three-year period at Jahurul Islam Medical College Hospital.*

Selection Criteria: *We selected trials based on following inclusion criteria: 1) randomized controlled trials; 2) a target population of adults over 16-year old with humeral shaft fractures; 3) trials only the surgical procedures, Open Reduction & Plate fixation (ORPF) & Minimally invasive plate osteosynthesis (MIPO) technique. Excluded from the study 1) non- randomized controlled trials; 2) trials that enrolled children with humeral shaft fractures; 3) trials that enrolled adults with pathological or periprosthetic fractures; and the other fixator like Intra medullary interlocking (IMIL) and Enders nailing in children.*

Result: *In this study, 244 fractures cases are seen with various patterns. Among these 114 male (46.7%), 130 female (53.3%). And pattern of fractures are comminuted fractures (13.9%), oblique (7%), spiral fracturs (13.1%), Simple transvers fractures (66%). All these fractures treated with compression plate. The average open reduction time was 10.6 days. On this study overall union rate is 86.5%. Although various complications arise like non-union and delayed union in respect to patient condition and the fracture pattern.*

Keywords: Humeral shaft, Fracture, *Nonunion, Surgical approaches, Operative management, Plate fixation.*

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Introduction

Humeral shaft fractures (HSF) are relatively common, representing approximately 1% to 5% of all fractures[1, 2, 3]. The annual incidence ranges from 13 to 20 per 10,000 persons and has been found to be higher with age[4, 5, 6]. HSF have a bimodal age distribution with the first peak seen in men aged 21 to 30 years following high-energy trauma, commonly resulting in comminuted fractures with associated soft tissue injuries[7]. The second peak is witnessed in women aged 60 to 80 years, typically following lowenergy trauma[7].

Anatomical considerations: The humerus itself is a cylinder proximally, which provides strength and resistance to both torsional and bending forces, and distally it tapers to a triangular shape. It is enveloped in muscle and soft tissue, hence the favorable prognosis for healing in uncomplicated fractures. Muscles originating on the humeral shaft include the brachialis, brachioradialis, and the medial and lateral heads of the triceps brachii. The deltoid, pectoralis major, teres major, latissimus dorsi, and coracobrachialis all insert on the humeral shaft and depend- ing on the location of the fracture, all will have specific deforming forces acting on the fracture fragments. The blood supply to the humeral shaft is provided predominantly by the nutrient artery that should be protected during surgical dissection[8].

Management of humeral shaft fractures has historically been largely conservative. A significant body of literature, dating back to the 1970s, has shown that functional bracing may achieve greater than 90 % union rates and acceptable functional outcomes. More recently, however, with the advent of new surgical techniques and implant options, less tolerance for acceptable deformity and functional deficits. The objectives of this study is to review the evaluation of patients presenting with HSF was treated with the compression plates, summarize treatment related outcomes and complications, and to provide some technical parts to facilitate management. Paediatric and periprosthetic fractures are beyond the scope of this study due to some limitation of the studies and thus will not be addressed. This article reviews the current recommendations for treatment of humeral shaft fractures, including operative intervention. It also discusses the current thinking and operative trends in humeral shaft fracture fixation.

Material and Method

The Study was made based over 244 patients in the time period of 2017-2019, three-year period at Jahurul Islam Medical College Hospital.

Only above 16 years and below 60 years of age was our main concern of this study. Open Reduction & Plate fixation (ORPF) & MIPO technique are used. 4.5 millimetre low contact dynamic compression plate is used.

Surgical Management: Several options are possible for the management of HSF: open reduction and internal fixation (ORIF) with a plate. However rarely indicated un-displaced or minimally displaced HSF are routinely treated with MIPO technique. In fact, anterior angulation of 20°, a varus or valgus of 30°, 15° of malrotation and 3 cm of shortening have been shown to adequately maintain the upper limb function[9,10]. For this reason, fractures that are displaced within these values following immobilization are good candidates for conservative management.

Regarding surgical indications these are divided into three groups:[10, 11]

1) Local conditions: [soft tissues] i.e. burns, open fractures Gustilo III, obese patient (these conditions preclude the use of a brace) or [fracture configuration] i.e. pathological fracture, segmental fracture

2) Associated injuries: polytrauma (for general care, ambulation, use of crutches), bilateral HSF, floating elbow, arterial injury, brachial plexus (conservative treatment with brace requires active muscle contraction, i.e. shoulder and elbow function to be intact).

3) Conservative treatment failure: patient not comfortable in the brace, unmanageable pain, secondary dis-placement or absence of an acceptable alignment, and delayed or nonunion.

It is important to highlight the fact that there is an increased tendency to choose surgical management of HSF as an option although this is not supported by the literature. The trend towards a more operative approach could be explained by the increased demand of patients and achievement of earlier mobilization. Innovations in surgical techniques may also play an important role.

Figure1: showing the comminuted diaphyseal fracture of humerus (Left)

Operative procedure: Approaches to the humeral shaft should be dictated by the location of the fracture. The anterolateral exposure utilizing the deltopectoral interval with extension down the arm through a brachialis split provides excellent exposure to the proximal diaphysis. Distal extension is limited by the radial nerve piercing the lateral inter-muscular septum[12].

Posterior approaches facilitate exposure of distal third fractures and can be extended proximally with mobilization of the radial nerve from the spiral groove. Variations include the triceps split, paratricipital release, and triceps slide. The triceps split interval is between the lateral and long heads of the tricep and then splits the medial triceps.

Figure 2: Open reduction of the comminuted diaphyseal fracture of the humerus by the 8 hole rigid compression plate and cortical screw.

The paratricipital approach involves elevating the triceps off the lateral and medial intermuscular septae. The triceps slide utilizes the posterior antebrachial cutaneous nerve to identify the radial nerve and then elevates the tricep from lateral to medial. Described by Gerwin and Hotchkiss, this approach allows extensive exposure to the humeral shaft and is limited proximally by the axillary nerve[13]. Medial approaches are rare and often necessitated by accompanying vascular injuries requiring repair. A straight lateral approach utilizing the posterior compartment of the arm and lifting the lateral tricep off the intermuscular septum can also be used and has the advantages of being extensile in either direction and affording direct visualization of the radial nerve[14]. Minimally invasive approaches are now being used in conjunction with anterior humeral plating. This utilizes the proximal and distal limbs of the anterior approach.

The proximal incision is made 5 cm distal to the anterior acromion along the medial border of the deltoid tuberosity and utilizes the interval between the bicep and deltoid. The distal incision is placed lateral to the biceps tendon and 5 cm proximal to the elbow flexion crease. Upon developing the interval between the bicep and brachioradialis, the brachialis is split at its medial two-third and lateral one-third junction facilitating protection of the musculocutaneous and radial nerves[15].

Result

From 2017 to 2019, 267 adults with displaced fracture of shaft of humerus was treated in Jahurul Islam Medical College hospital with ASIF compression plates. 23 of these patients are lost of follow-up in the first three months. Leaving it 244, who were followed for more than 3 months to 3 years. In this study 244, 114 male (46.7%),130 female (53.3%), among these 244 fractures there are various pattern of fractures in seen, 34 of 244 comminuted fractures (13.9%), 17 of 244 oblique (7 .0%), 32 of 244 spiral fractures(13.1%), 161 of 244 comminuted fractures(66.0%). All these fractures treated with the compression plate, 4.5 mm limited contact plates with combination holes to accommodate cortical or locking screws. (Fig: 1, 2) The operative technique used to manage all these fractures.

In all of the open fractures internal fixation has delayed 1 to 3 weeks. To certain that infection was not present. The average period of delay prior to open reduction was 10.6 days. In this study period overall union rate 221 out of 244 (86.5%).

Most common complication of the diaphyseal fractures is nonunion seen during the study, non-union observed 16 of 244 (6.6%) over 24 weeks observation. Some cases union occurs after 12 weeks, 17 of 244 (7.0%). The patient was allowed to keep immobilized by the non-functional brace throughout the follow-ups. Though it is tough to control the infection rate, in this study 9 of 244(6.6%) infected cases treated with the antibiotic according to the culture sensitivity and regular dressing and monitoring.

Discussion

Humeral plating has been the predominant mode of fixation due to its reliable union rate, lower reoperation rate, and avoidance of adjacent joint discomfort[16]. There is substantial variability in plating that allows the surgeon to modify the construct to the personality of the patient and fracture. Simple fractures are best treated with compression plates, comminuted fractures are often bridge plated, and osteopenic or torsionally unstable fractures are candidates for locked or hybrid plate fixation[17]. Contemporary plates used in humeral shaft fractures are 4.5 mm limited- contact plates with combination holes to accommodate either cortical or locking screws. These plates come in Narrow and broad varieties. Both have holes at the plate ends that allow use of an articulating tensioning device to provide fracture site compression. The broad plate has staggered holes to improve screw density and limit the development of stress risers. These robust plates allow early weight-bearing[18,19]. Fractures in the more proximal and distal humeral shaft benefit from use of precontoured periarticular plates that provide multiple points of fixation in small seg-ments of bone. These holes utilize smaller screws with greater thread density and often permit use of compression or locking screws. In the distal-third of the humerus, “90– 90” degree dual plating with a malleable lateral reduction plate and a more stout posterolateral extraarticular plate has been shown to lead to good alignment and union[20]. When plating fractures with far cortex bone loss or severe osteopenia, placement of a cortical strut allograft can be consid-ered to augment the far cortex and provide purchase for the screws at that level[21].

Traditional plate fixation has the drawback of requiring larger incisions, violation of the fracture hematoma, and higher incidence of iatrogenic radial nerve palsy[18, 22]. In an effort to avoid these drawbacks, Minimally Invasive Plate Osteosynthesis (MIPO) has been developed for humeral shaft fractures. Indicated for fractures 6 cm below the surgical neck and 6 cm above the olecranon fossa and using the two-incision approach described earlier, a 10 to 12 hole narrow 4.5 mm plate is inserted submuscularly and provisionally stabilized through each incision[23].

Having union rate after plating ranges from 87% to 96% [24-29], with an average time to union of 12 weeks. The complication rate ranges from 5% to 25%[30-35], most commonly found to be non-specific complications such as infection, nonunion and malunion. Iatrogenic RNP is a risk with most approaches to the humeral shaft, and I closely reviewed 261 HSF treated with ORIF, finding iatrogenic RNP* occurred in 7.1% of anterolateral, 11.7% of triceps-splitting and 17.9% of triceps-sparing approaches. For this reason, it is vital that the radial nerve is identified and protected in all open dissections. *[*RNP= Radial Nerve Palsy]*

Conclusion

In conclusion of the study, management of the diaphyseal fracture humerus has a versatile option, among them the rigid fixation of plate has the best outcome depend upon the patient factors are receiving greater consideration and leading to doctor-patient discussions weighing the benefits of early full motion, rapid return to therapy and work, and pain control versus the risks of iatrogenic radial nerve palsy, infection, bleeding, nonunion, reoperation, and anesthetic risk.

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