

Study of radiological and clinical outcomes by using Anterior Bridge Plating (ABP) for humerus shaft fractures

Tumbal Shirish V.¹

¹Dr. Shirish V Tumbal, Associate Professor, Department of Orthopaedics, Ashwini Rural Medical College, Hospital & Research Centre, Kumbhari, Solapur, Maharashtra, India.

Correspondence Author: Dr. Shirish V. Tumbal, Associate Professor, Department of Orthopaedics, Ashwini Rural Medical College, Hospital & Research Centre, Kumbhari, Solapur, Maharashtra, India. E-mail: tumbalshirish@yahoo.com

Abstract

Background: The humerus can be considered the most versatile bone in the human body. Plating can be performed using a classic open approach or minimally invasive methods. Many humeral fractures can be successfully managed conservatively due to the wide range of acceptability. Anterior bridge plating (ABP) which utilizes the minimally invasive approach popularly known as the minimally invasive Percutaneous plate osteosynthesis (MIPPO) technique can be said to be the latest entrant in this list. The present study was undertaken to evaluate the efficacy of anterior bridge plating. **Method:** The study was carried out from April 2015 to December 2015 involving 15 patients who met the selection criteria and were operated at the tertiary care centre. Informed consent was obtained from all the patients for use of their clinical and imaging data. The assessment of the patients was done based on functional and radiological outcomes periodically. **Result:** Majority of patients belongs to age group 18-25 years (53.3%). The average age is 27.4 years. Majority of side of injury were found right side (80%). Most of cases of extent of displacement of fractures were 2-5 cms (80%). **Conclusion:** In conclusion anterior bridge plating (ABP) is very good technique in treating midshaft humeral fractures with minimal soft tissue dissection, smaller scars, and early return to overhead activities.

Keywords: Anterior Bridge Plating (ABP), Midshaft humeral fractures, Minimally Invasive Percutaneous plate Osteosynthesis (MIPPO)

Introduction

Humeral shaft fractures compose around 3% of fractures. Mildly displaced humeral shaft fractures can be treated conservatively [1, 2]. Various modalities of treatment have been described in literature each one having some advantages over the other technique right from conservatively by braces to plating and intramedullary nailing.

Fractures which are displaced extending into articular surfaces definitely need operative management in form of plating, nailing and external fixator if it is compound in nature [3-8]. Modalities of surgical treatment include locking plates, intramedullary nailing and external fixation. Although locking plates provides swift useful recovery by providing sturdy fixation [3]. Intramedullary nailing of humeral shaft fractures also has given excellent results [5-8]. The latest of all the

techniques is anterior bridge plating (ABP) which has shown very promising results in various studies [9-11]. In anterior bridge plating, there are two small incisions made one proximally and one distal to the fracture site. Anterior Bridge Plating (ABP) which utilizes the minimally invasive approach popularly known as Minimally Invasive Percutaneous plate Osteosynthesis (MIPPO) is the latest technique in the management of humeral shaft fractures. However, there is no current study to our knowledge pertaining to the study the overhead activity in manual workers and labourers. Conventional plating involved opening of the fracture site and fixation, while in nailing entry through the rotator cuff had issues in performing overhead activities. ABP has definitely advantages over both the techniques as it is minimally invasive, does not damage rotator cuff and no need to open the fracture site. Also it needs less operative time, less radiations and minimal blood loss. The present study was undertaken to evaluate the efficacy of anterior bridge plating.

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Material and Methods

Type of study: Prospective study

Study duration: April 2015 to December 2015

Place of study: Tertiary care centre

The study was carried out on 15 patients who met the selection criteria and were operated at the tertiary care centre. Informed consent was obtained from all the patients for use of their clinical and imaging data.

Selection criteria

Inclusion criteria

1. Mid-shaft humerus fractures
2. Skeletally mature
3. Minimum 3 years follow up at the time of study.

Exclusion criteria

1. Ipsilateral upper limb trauma which would hamper rehabilitation
2. Vascular injury
3. Paediatric patients (less than 12 years)
4. Open fractures

Surgical Procedure: After pre-anaesthetic fitness, patients were operated for midshaft fracture humerus. In this technique, assistants play very important role as the limb is to be held in constant traction. Usually general anaesthesia was given to achieve complete relaxation. Painting and draping was carried out and then with the skin marker, proximally biceps tendon was marked. Distally the incision was planned above the supracondylar region. Arm was abducted to 30-40 degrees, elbow flexed to 85-90 degrees and forearm was completely supinated. A long locking compression plate 4.5 mm (LCP) usually 14 hole was chosen and kept over the draped arm and seen under C-arm to get accurate length of the plate.

Proximal part of the incision lies between anterior part of the deltoid muscle and the biceps region in which a relatively avascular raphe is present and then the incision is deepened the bone. Distal incision lies in the plane between lateral border of biceps and the brachioradialis. Then the incision is deepened and the musculocutaneous nerve is identified and retracted. Then the brachialis muscle is split in the middle dividing into medial and lateral half, the lateral half protects the radial nerve. Retraction is carried out by retractors and there is no use of bone levers to avoid undue traction and nerve injury.

The plate is passed from the proximal end slowly with jig-jag movements sub periosteally till the fracture site is reached. Gentle traction and counter traction is given to achieve the alignment and the reduction of both the fragments under image intensifier. The cortical step sign and diameter difference sign described by Krettek et al was used to prevent the malrotation of the fragments. Once the reduction was acceptable, two k-wires were fixed one in proximal and one in distal hole of the plate under c arm [12].

First the proximal screw is inserted after drilling and the screw is not tightened fully. Then the distal most screw is inserted under C-arm and the proximal screw is tightened after making fine adjustments to gain acceptable reduction of the fracture site. Then the distal second screw is inserted and the second proximal screw is inserted. Distal most and the proximal most screws usually are non locking type and the remaining two screws are locking type.

Patients were allowed to start elbow and shoulder movements on the second day as per the pain tolerance capacity. Postoperatively, patients were discharged on third day with the arm pouch. Shoulder and elbow pendulum exercises were started under the supervision of physiotherapist on fifth day. Active abduction of the shoulder was started in first week and above head abduction was allowed after 3 weeks post-operatively. Patients resumed to their routine manual work after 2 months postoperatively. There was not a single case of non-union in this study.

Clinical and Radiography images of cases



Fig-1: Pre-operative X-ray



Fig-2: Immediate Post-operative X-ray

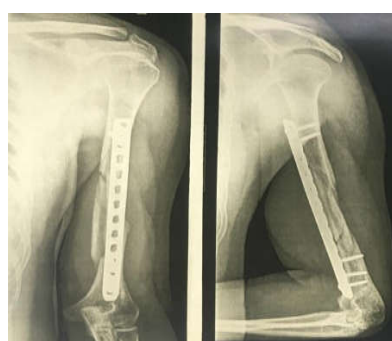


Fig-3: One and half months Post-operative X-ray



Fig-4: Three years follow up X-ray

Data collection procedure- Assessment of Outcomes: The assessment of the patients was done based on functional and radiological outcomes every month for 3 months, then every 3 months for 3 years after surgery. Radiological examinations were done after 6 weeks, 3 months, 6 months after surgery and every 6 months thereafter for 3 years postoperatively. Functional outcome was assessed using the Constant score, Mayo’s elbow score and Disabilities of the Arm, Shoulder and Hand (DASH) score. Shoulder abduction, external rotation (ER), elbow flexion, internal rotation (IR) with the arm placed adjacent to the chest and elbow flexed to 90°, and forward flexion (FE) was measured. All the muscles strength were measured and patients were asked to submit the answers to a questionnaire which consisted of “yes-no” type questions regarding quality of life, Sleep, daily activities and performance therein, discomfort and cosmetic issues. Outcome and Satisfaction was assessed and the grades were given like poor, good, very good and excellent.

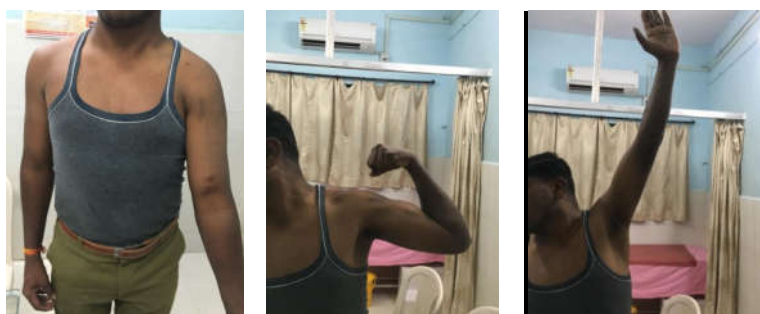


Fig-5: Functional outcome

Statistical Analysis: Data was entered in Microsoft excel after data collection. Excel was used to generate tables and graphs. Descriptive statistics such as mean, SD and percentage was used to present the data.

Result

Table-1: Age distribution.

Age	Number	Percentage
18-25	8	53.3
25-35	4	26.7
35-45	3	20.0

Majority of patients belongs to age group 18-25 years (53.3%). The average age is 27.4 years.

Table-2: Sex distribution

Sex	Number	Percentage
Male	12	80
Female	3	20

Male patients (80%) were dominant in the study.

Table-3: Distribution of side of injury.

Side of injury	Number	Percentage
Right	12	80
Left	3	20

Majority of side of injury were found right side (80%).

Table-4: Distribution of extent of displacement of fractures.

Extent of displacement of fracture (cms)	Number	Percentage
< 2	0	0
2-5	12	80
> 3	3	20

Most of cases of extent of displacement of fractures were 2-5 cms (80%).

Discussion

Anterior bridge plating is very effective in treating mid shaft fracture humerus in patients who are mainly doing the overhead activities. The strength and functional outcomes is very good as compared to other similar studies [12-16]. Tscherne and Krettek had first reported this technique of minimal invasive osteosynthesis for fractures in 1996 [17]. Many techniques have evolved since then in the minimally invasive techniques.

This technique has a high learning curve, but once mastered is definitely very easy to execute. As it is minimally invasive, the vascularity at the fracture site is well preserved which helps in faster healing of the fractures. Also it is blind procedure while inserting the plate as the incision is very small, little experience is needed to master the technique and avoid iatrogenic

nerve injuries. This technique has minimal soft tissue stripping so less chances of infection is there. Distally more care has to be taken as the split brachialis is retracted very gently to avoid radial nerve injury. There is no role of bone spikes as they are more traumatizing, so plain retractors are used. The forearm has to be supinated continuously and elbow flexed to 90 degrees to provide relaxation of the brachialis muscle.

Two proximal and two distal cortical screws are enough to maintain the reduction and it gives a stable construct. In this study one cortical and one locking screw construct was used to achieve stable construct. In the present, 80% had the right side fracture which was comparable with other study [18]. Anterior bridge plating (ABP) is also useful in comminuted shaft

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fractures humerus as it skips the comminuted region and two screws proximally and two screws distally hold the plate in good alignment. There was not a single case of non union in this study which was comparable with other study [18]. One patient had radial nerve palsy preoperatively, but we did not explore the nerve and did anterior bridge plating.

Radial nerve recovered after 6 weeks postoperatively which indicated that it was neuropraxia in nature. There was not a single case where loosening of the screws, implant breakage or loosening of plate was noticed. The union of fractures in this study would result in a good fixation by reducing the goal of minimal bone retention and absolute stabilization with stable volatility. This technique can also be used to treat humeral shaft nonunion (both atrophic and hypertrophic nonunion) [19].

The most important thing in this technique is to get good reduction with minimal varus/ valgus angulation and also in lateral view which is very important to prevent anterior or posterior angulation.

Constant imaging is needed while applications of plate as two assistants are needed to give traction and counter traction. Even slightest distraction at the fracture site is avoided while fixation of the plate to avoid non union.

The screws have to be bicortical as this prevents loosening of the screws. Locking screws are very useful in osteoporotic fractures. Excellent to good results is achieved by sub brachialis plating without soft tissue problems and with functional results by other methods [13].

Rotational alignment is very important and this is checked by comparing the medullary canal diameter of proximal and distal fragments under image intensifier. The diameters should be same which indicates that there is no malrotation of the fragments.

Conclusion

Though the technique is very promising, it has a steep learning curve involved. The greatest advantage is minimally invasive, minimal soft tissue stripping, smaller incisions, minimal blood loss, shorter operative time and early rehabilitation.

In conclusion anterior bridge plating (ABP) is very good technique in treating midshaft humeral fractures with minimal soft tissue dissection, smaller scars, and early return to overhead activities.

Study added to existing knowledge: Literature on the clinical outcomes of Anterior Bridge Plating (ABP) for Humerus shaft fractures is minimally invasive, minimal soft tissue stripping, smaller incisions, minimal blood loss, shorter operative time and early rehabilitation, which makes a meaningful adding in existing literature by conducting our study.

Contribution by authors during study process and manuscript preparation: Dr. Shirish V Tumbal, Associate Professor, Department of Orthopaedics, Ashwini Rural Medical College, Hospital & Research Centre, Kumbhari, Solapur

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