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### A clinical study of anterior bridge plating for humerus shaft fractures by minimal invasive technique

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#### Abstract

**Introduction:** Diaphyseal fractures of humerus treated with bridge plating are showing superior results in view of post-operative pain and union time. In our study we have evaluated the clinical, radiological, and functional outcome of such fractures in 15 patients, all of them were managed with dynamic compression plate over an average follow up period of 12 months. Though open reduction and plating technique of humerus shaft fracture is gold standard, this technique also gives good outcome.

**Materials and Methods:** Fifteen patients with humerus shaft fractures were managed by anterior bridge plating using Minimum invasive osteosynthesis technique between Jan 2017 and Jan 2018 were included in this study. All cases were managed with closed reduction and 4.5mm dynamic compression plate fixation over anterior aspect in bridging mode using the MIPO technique. The dominant side, gender ratio, surgery time, and fracture union time, and complications were noted. The UCLA shoulder and Mayo elbow scores were used for assessing the shoulder and elbow function.

**Results:** Out of the fifteen patients in the study, eleven were males and four were females. The mean age was 40.2 years (range 25 to 60 years). Ten out of fifteen patients (66.67%) had the dominant side fractured. Mean surgical time in minutes was 90min (range: 60–120 minutes). The mean fracture union time was 10.6 weeks (range: 10–18 weeks). However Shoulder function was excellent to good in 13 cases (86.6%), fair in 1 case (6.67%) & poor 1 case (6.67%) on the UCLA score.

**Conclusion:** In our study, small incision percutaneous anterior bridge technique for fracture shaft humerus results in good functional outcomes. It is based on relative stability which provides healing, and subsequent formation of the bone callus, and reduces the possibility of infection and non-union. It requires experience and a good assistance.

**Keywords:** Anterior bridge plate, Diaphyseal humerus fracture, minimally invasive plate osteosynthesis

#### Introduction

Fracture humerus is commonly presents in polytrauma cases especially in road traffic accidents and accounts for approximately 3% of all orthopaedic injury [1, 2, 3]. Biological fixation and relative stability has advantage over absolute anatomical reduction with compromising soft tissue and vascularity [4]. Biological fixation of fractures with soft tissue preservation and near acceptable reduction is becoming a more acceptable entity nowadays but it is still a matter of debate. For a satisfactorily outcome healing in the desired time is not the only requirement but early and acceptable functional result of the limb is the goal. Therefore concept of biological fixation was developed over a stable mechanical fixation [5]. This is development and improvement in the techniques of biological fracture fixation and stabilization systems [5, 7]. From cast and braces [8, 9] to internal fixation by interlocking nailing or plating. Researches are still going on to prove superiority of one over another [10-11]. Minimally invasive technique for humerus shaft fracture has shown promising results recently [12-14]. In our study we have evaluated the clinical, radiological, and functional outcomes of the minimally invasive technique for humerus fracture over a minimum follow-up of 12 months.

#### Materials and Methods

Fifteen patients with fractures of humerus shaft were treated with Minimum invasive Anterior Bridge plating technique in a case series of study between Jan 2017 and Jan 2018 at our

hospital. These cases were followed for a period of 12 months. Patients who had fractured at in the middle third of shafts humerus were included in study. These fractures were reduced and fixed with 4.5mm dynamic compression plate (DCP). Institutional Ethical Committee approved the study. The inclusion criterion included all fracture of humerus middle one third shafts between 25 and 60 years with written consent of study and follow up. The patients were operated within 3 to 5 days of the injury after pre anesthetic checkups. Exclusion criteria were fracture on bilateral limbs, compound fractures, poly trauma patients. A preoperative clinical examination of the affected arm was done in all aspects like abrasions, swelling, contusion, and neurovascular deficit (mainly Radial nerve status). Antero posterior (AP) and lateral (Lat) skiagrams of the humerus, of the patient were evaluated (Fig no1). Functional outcome where analyzed by UCLA shoulder score and Mayo elbow score (table no 1&2).

### Surgical technique

The patients were positioned supine and operated in either brachial block or general anesthesia. Tourniquet was not applied for this procedure. After preparing the arm, arm was kept in 90 abduction and supination. A 3 cm incision between the proximal biceps and the medial border of deltoid, 6 cm distal to the acromion process was made. Dissection was carried to the humerus. Distally, 3 cm incision was made along the lateral border of biceps, approximately 5 cm proximal from the flexion crease. Retraction of biceps was done to expose the musculocutaneous nerve, overlying the brachialis muscle. The nerve is then retracted and brachialis muscle was split till bone. The lateral half of brachialis muscle then protects radial nerve. A sub-brachialis, extra-periosteal tunnel was created with long stripper. Then 4.5-mm dynamic compression plate is passed through the incision on the anterior surface of the humerus from distal incision. Length, rotation and angulations are restored by traction under fluoroscopic guidance. Then two proximal and two distal screws were placed antero-posteriorly. Care was taken to pass the tunneling instrument anteriorly and anteromedially to avoid the chances of injury to radial nerve. Good assistant with proper knowledge of fracture anatomy makes the surgery easy. The operative time (Skin incision to closure) and duration of radiation exposure (In seconds) was recorded. Postoperatively, shoulder immobilizer was applied.

### Results

Arm was immobilized in a neck wrist sling or broad arm pouch for pain control in the first 5 days if necessary, mainly at night while sleeping. Stitches were removed on 12<sup>th</sup> post-operative day. The patients were advised to perform passive gentle limb range of motion exercises as their pain control permits. Immobilizer was removed after stitch removal. However they were informed to take out the limb and perform informed exercise for 8 to 10 times a day. Post-operative x-ray (fig 1) and 6 weeks x-ray (fig 2) and 3 month x-ray where take in follow up. After 6 weeks they were allowed active gentle exercises and light work as per radiological signs of healing. The aim was to gain full mobility, muscular strengthening soon as possible. The final goal is to restore pain free functional to full range of motion and strength. The union time and complications were noted. Follow ups were done after 6 weeks, 3months, 6 months and 12 months. The patients shoulder and elbow function were analyzed using the UCLA shoulder score and the Mayo elbow performance score (MEPS). The UCLA shoulder score was graded into excellent

to good (>27 points), fair to poor (< 5° of varus/ valgus angulation intra operatively and on following these patients up<sup>[16, 17]</sup>, in 1 case implant failure (fig.6) was noted and one case post operatively radial nerve palsy was occurred which recovered totally within 3 month. On determining the functional outcome of other cases, 13 cases had excellent to good, one with fair outcome and another with poor outcome.



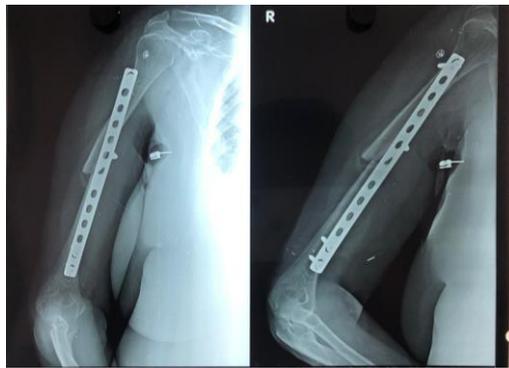
Fig 1: Pre-op xray



Fig 2: Post op xray



Fig 3-5: Range of motion at 6 months follow up



**Fig 6:** Implant failure at first follow up UCLA shoulder rating scale

**Table 1:** UCLA Shoulder Rating Scale

Measure	Finding	Points	
Pain	no pain	10	
	occasional and slight pain	8	
	pain with heavy or particular activities only; uses salicylates occasionally	5	
	none or little at rest; occurs with light activities; salicylates frequently	4	
	constant but bearable; strong medications occasionally	2	
Function	constant, unbearable; strong medications frequently	1	
	normal activities	10	
	slight reduction in function; able to work above shoulder level	8	
	most housework, washing hair, putting on brassiere, shopping, driving	5	
	light housework or most daily living activities (ADL)	4	
muscle power and motion	very light activities only	2	
	unable to use arm	1	
	normal muscle power; motion near normal	10	
	muscle power good or normal; elevation 140°; external rotation 20°	8	
	muscle power fair to good; elevation 90°; internal rotation 90°	5	
	muscle power poor to fair; elevation less than 60°; internal rotation < 45°	4	
	ankylosis with good functional position	2	
	ankylosis with deformity	1	
Score for Each Measure	Interpretation		
10 (> 8)	Excellent		
8 (> 6)	Good		
4 or 5 (> 4)	Fair		
1 or 2 (< 3)	Poor		

**Table 2:** Mayo elbow performance score (MEPS)

1	Pain	0-45(no pain –sever pain)
2	Stability	0-10(grossly unstable-stable)
3	Morbidity	0-20(<500,1000)
4	Daily functional activity	0-25(none possible-normal function for 5 different
	Excelllect	>90
	Good	75-89
	Fair	60-74
	Poor	<60

**Discussion**

In 1996, Tschern and Krettek first reported minimal invasive osteosynthesis for fractures [18-19]. Since then MIPO is used for treatment of many fractures in human body. As described

by Sarmiento *et al.* [20] the humerus bone has a wide range of acceptability criteria in its reduction and is highly amenable to conservative management or closed reduction as done in our study by MIPO technique.

Despite the requirement of high surgical expertise and time taken for adaptation of the procedure, the MIPO technique seems to be reproducible and applicable in almost all types of shaft humeral fractures. Lower rates of iatrogenic nerve injury with minimal bone vascularity disruption, and soft tissue dissection are all the advantages over conventional plate technique. Although the reduction and plating were difficult procedure initially. Whole construct becomes elastic and allows micro motion at fracture site, which favors union. Excellent to good results have been achieved with interior bridge plating with no major soft tissue problems and with functional results as per other methods [21]. Open technique of plating compromises with the local vascularity because of periosteal stripping, leading to osteonecrosis underneath the plate, which may cause delayed healing to non-healing [22]. Other fixation modalities have many drawbacks associated with the technique of fixation and the implant itself. The potential for rotator cuff damage during conventional antegrade nailing makes it an unattractive option for patients with higher work demands. The posterior plating involves greater soft tissue stripping and larger incisional scars. Union fractures in this study presents good results with fixation through indirect reduction aims at maintaining bone alignment through small incisions and replacing absolute stability by relative stability. The MIPO technique causes less tissue dissection and periosteal stripping which makes a promising modality of treatment. In conclusion, this minimally invasive technique presents newer, effective, minimal post-operative scarring) and acceptable modality of treatment for close middle 1/3<sup>rd</sup> shaft humerus fractures. While this technique requires good surgical skills with good assistant. The learning curve of MIPO is long. However more studies have to be done to standardize the protocol. To conclude, MIPO is definitely a newer and acceptable modality of treatment.

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