Anterior Bridge Plating with Mini Incision MIPO Technique for Humerus Diaphyseal Fractures

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ABSTRACT

Introduction: *Anterior bridge plating with minimally invasive technique in shaft humeral fractures is reported as an acceptable less traumatic and reproducible procedure by several authors. We have evaluated the clinical, radiological, and functional outcome of such fractures in eleven patients, all of which were managed with dynamic compression plate over an average follow-up period of 22 months. Though open reduction and plating technique of humerus shaft fracture is prevailing, this technique also gives favorable outcome.*

Materials and Methods: *Eleven patients with humerus shaft fractures were managed by anterior bridge plating using MIPO technique between Jan 2013 and April 2015 were included in this series. All cases were treated with closed reduction and 10-12 hole 4.5mm dynamic compression plate fixation over anterolateral aspect in bridging mode using the MIPO technique. The dominant side, gender ratio, surgery time, radiation exposure, and fracture union time, and complications were noted. The UCLA shoulder and Mayo elbow performance scores were used for assessing the shoulder and elbow function.*

Results: *Of the Eleven patients in the study, eight were males and three were females. The mean age was 34.3 years (range 20 to 53 years). Eight out of eleven patients (72.7%) had the dominant side fractured. Mean surgical time in minutes was 79.5 (range: 60–100 minutes) and mean radiation exposure, in terms of one sec for each c-arm exposure was 95 seconds (range: 70–160 seconds).The mean fracture union (radiological) time was 13.7 weeks (range: 10–18 weeks). One patient (9.1%) develops infection for which premature plate removal and debridement was done at 5 months and managed then conservatively. However Shoulder function was excellent to good in 9 cases (81.8%) and fair in 1 case (9.1%) on the UCLA score.*

Conclusion: *This study confirmed a high overall rate of union and excellent functional outcomes. Mini incision anterior bridge technique for fracture shaft humerus gives good functional results and should be considered as an effective, cosmetically advanced surgical option in the treatment of humeral shaft fractures. It is a safe and less time consuming method for simple types of humeral shaft fractures when the surgeon is experienced in the technique.*

Key words: *Anterior Bridge plate, Minimally invasive plate osteosynthesis (MIPO), Diaphyseal humerus fracture*

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INTRODUCTION

Absolute anatomical reduction by compromising soft tissue and hence the vascularity is becoming older trend now. Precise reduction and absolute stable fixation has its biological price.[1] Biological fixation of fractures with soft tissue preservation and near acceptable reduction is becoming a more acceptable entity. However 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.

Evidence shows, that a biological fixation is far more superior over a stable mechanical fixation.[2] This sensitizes the development and improvement in the techniques of biological fracture fixation and stabilization systems.[3,4] From conservative cast and braces[5,6] to internal fixation with nailing[7], plating and screw, Treatment of humeral fracture has evolved a lot with their complications.[7-10] Studies are still going on to prove superiority of one over another. Minimally invasive technique for humerus shaft fracture has shown promising results recently.[11-14] we have evaluated the clinical, radiological, and functional outcomes of this mini invasive technique for humerus fracture over a minimum follow-up of 1 year and 6 months.

MATERIALS AND METHODS

Eleven patients with fractures of humerus shaft were treated with Anterior bridge plating using minimal invasive technique in a case series of study between Jan 2013 and April 2015 at our centre. The cases were followed for a minimum period of 1 year and 6 months. All patients who had fracture at midshaft level were selected. These fractures were reduced and fixed with 4.5mm narrow Dynamic compression plate (DCP). All surgeries were done by the same surgeon. Institutional Ethical Committee approved the study.

The inclusion criterion included all those mid shaft fracture of humerus between 20 and 55 years and who consented to participate. The operative procedure was performed within 4 days of the injury. Exclusion criteria included fracture on both the limbs, higher grade of compounding, concomitant other medical illness such as malignancy, vascular insufficiency of the upper limb, poly trauma patients with an injury severity score[16] of >16 points, drug addict patients (alcohol and others).

A preoperative clinical examination of the affected arm was carried in all aspects like-abrasions, swelling, contusion, puckering and neurovascular deficit (chiefly Radial nerve status). Antero posterior (AP) and lateral (Lat) radiographs of the humerus, of the patient were evaluated. These radiographs were also used to decide the appropriate length of implant and planning the surgery.

Clinical Details of patients

S.NO.	Age (Year)	Sex	Surgery Time (Minutes)	Radiation Time (Seconds)	Dominant side fracture	Follow up. (Months)	Union (Weeks)	Active Shoulder ROM (Abduction/flexion)	Elbow Rom (Flexion/Extension)	ULCA	MEPS	Complications
1	20	M	90	70	Yes	28	10	100/160	135/0	35	100	-
2	24	M	80	90	Yes	26	12	100/165	140/0	34	95	-
3	33	F	80	82	Yes	26	12	90/150	130/5	30	90	5 degree varus
4	39	M	90	63	Yes	24	14	110/165	135/0	35	95	-
5	26	F	100	163	No	24	16	90/100	90/0	23	65	Infection(plate removal)
6	29	F	90	102	Yes	20	11	110/160	140/5	33	100	-
7	35	M	70	93	No	20	14	100/145	120/0	30	90	-
8	43	M	60	106	Yes	20	12	100/160	130/5	33	95	-
9	40	M	80	110	No	18	16	120/145	110/0	27	70	4 degree varus
10	53	M	75	92	Yes	18	16	90/145	130/0	31	95	-
11	35	M	60	78	Yes	18	18	110/165	130/0	33	95	-

UCLA >27 (Good / Excellent) , < 27 (Fair /Poor)

MEPS > 90-Excellent , 75- 89- Good , 60-74 -fair , < 60- poor

1st xray (Post trauma) **post operative day 1** **post operative 6 months**

Clinical picture of patient at 6th month post operatively

SURGICAL TECHNIQUE

The patients were positioned supine. Eight patients were given local brachial block, three under general anesthesia. A 2-3 cm incision between the medial border of deltoid and proximal biceps, 5 cm caudal to the acromion process was made. Distally, a 2-3 cm incision at the lateral border of the biceps, nearly 5 cm proximal to 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 and a 4.5-mm dynamic compression plate is passed through the incision on the anterior surface of the humerus. Varus/ valgus angulation, length and rotation are restored by traction. Confirmation of the reduction done. Each side of the plate is fixed with two screws in anterior to posterior direction. Tunneling was done carefully in anterior fashion to prevent iatrogenic radial nerve injury. The amount of force required to be used for manual traction for achieving proper reduction was not easy at first, but becomes easy as technique is practiced. The 'cortical step sign' as described by Krettek[17] is used to look for any rotational malalignment. One patient required bone grafting. The operative time (skin incision to closure) and duration of radiation exposure (in seconds) was recorded. Postoperatively, shoulder immobilizer was applied.

FOLLOW UP

The operative limb was kept in shoulder immoblizer till stitches were removed (12th day), there after the patients were advised to perform active gentle limb range of motion exercises as their pain control permits. The immoblizer was

continued for another three weeks. However they were informed to take out the limb and perform informed exercise for five minutes after every hour. To avoid stiffness, after four weeks they were trained by a dedicated physiotherapist to perform active range of motion exercises and were allowed to perform usual gentle activities. After radiological signs of healing, a rehabilitation program was started. The aim was to gain full mobility, muscular strengthening and proprioception as soon as possible. The total rehabilitation period depends on the individual patient's progression. The final goal is to restore ache free functional to full range of motion and strength. The union time and complications were noted. The patients were followed up by same surgeon, first after 2 weeks then monthly for the next 6 months, then once every 3 months till 1 year. The patients shoulder and elbow function were analyzed using the UCLA shoulder score[18] and the Mayo elbow performance score (MEPS)[19] The UCLA shoulder score was graded into excellent to good (>27 points), fair to poor (<27 points). Elbow function was graded on the MEPS basis into excellent (≥90 points), good (75–89 points), fair (60–74 points), or poor (<60 points). Based on the anteroposterior and lateral radiographic view Union was accepted as the presence of bridging callus in three of the four cortices and absence of pain. Also any loss of fracture reduction was analyzed in similar radiographs.

RESULTS

Of the Eleven patients followed up to a minimum of 18 months in the study, eight were males and three were females. The mean age was 34.3 years (range 20 to 53 years). Eight out of eleven patients (72.7%) had the dominant side fractured. The mean surgical time was 79.5 minutes (range: 60–100 minutes) and mean radiation exposure was 95 seconds (range: 70–160 seconds). The mean radiological fracture union time was 13.7 weeks (range: 10–18 weeks). Shoulder function based on the UCLA score was excellent to good in 9 cases (81.8%), fair in 1 case (9.1%) and one patient (9.1%) develops infection for which plate was removed prematurely at 5th month, wound was meticulously debrided and managed then conservatively. Road traffic accident (RTA) was the most common mode of injury, found in 10 cases, one patient sustained injury following direct blow by 'lathi' hit on the arm. We had used a single lag screw in one case (oblique fracture). The mean follow-up of our cases were 22 months (range: 18–28 months). Fracture union was observed at a mean period of 13.7 weeks (range: 10–18 weeks). In one case, where callus was not radio logically satisfactory at 12 weeks, we infiltrated bone marrow, and radiological union is seen at 18 weeks. We had accepted < 5° of varus/ valgus angulation intra operatively and on following these patients up, in 2 of the cases the angulation had remodeled to acceptable alignment. In the one case, 5° of varus, angulation at the end of 10months; which did not affect his functional outcome and one has 4^0 of varus with fair functional outcome. One patient who develops infection has decreased range of motion both at shoulder and elbow level and poor functional outcome. We had one case with postoperative sensory deficit over the lateral part of the forearm due to musculocutaneous nerve injury, which recovered within 8 months of surgery without any intervention. On determining the functional outcome of other cases, 9 cases had excellent to good outcome.

DISCUSSION

Tscherne and Krettek first reported minimal invasive osteosynthesis for supracondylar femoral fractures in 1996.[22] Since then this technique is used in managing various other fractures. 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. Though indirect reduction and plate placement is technically difficult and requires experience, Plates can be safely used anteriorly or anteromedially over the humeral shaft. Bridging the fracture fragment, with fixation only at either ends of the plate and bone.

Excellent to good results have been achieved with sub brachialis plating with no major soft tissue problems and with functional results as per other methods.[23] Open technique of plating interferes with the local vascularity, leading to osteonecrosis underneath the plate, which may cause delayed healing to non healing (published rate of nonunion being 5.8%).[24]

Union of the humeral shaft fractures in this series presents good results with fixation through indirect reduction aims at maintaining bone alignment through mini incision and replacing absolute stability by relative stability. This bridge-plate technique can be used even for the treatment of humeral shaft nonunion (both atrophic and hypertrophic nonunion).[25] The present technique through its less tissue dissection and periosteal stripping makes a promising modality of treatment.

In conclusion, this series demonstrates that the anterior minimally invasive bridge-plate technique for treatment of humeral shaft fractures

presents newer, effective, cosmetically advanced (minimal operative site scar) and acceptable modality of treatment for such fractures. Though the technique is complex, requiring a relatively long learning time the results are good and reproducible. However a larger multi centric metanalytical study with control groups will help us to arrive at a standardize protocol. To conclude, MIPO is definitely a newer and acceptable modality of treatment.

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