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Anterior bridge plating with mini incision MIPO technique for type a humerus diaphyseal fractures

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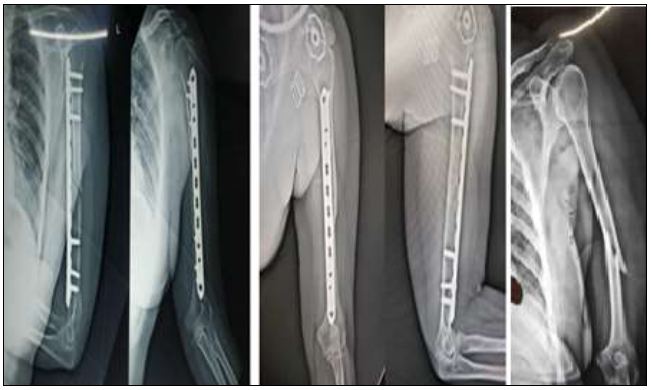
Abstract
Introduction: Anterior bridge plating with minimally invasive technique for type A shaft humeral fractures is reported as an acceptable less traumatic and reproducible procedure by several authors. We have evaluated the clinical, radiological, and functional outcome of such fractures in twenty patients, all of which 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 prevailing, this technique also gives favorable outcome.
Materials and Methods: Twenty patients with type a humerus shaft fractures were managed by anterior bridge plating using MIPO technique between March 2017 to November 2019 were included in this series. All cases were treated with closed reduction and 10-12 whole 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 performance scores were used for assessing the shoulder and elbow function.
Results: Of the Twenty patients in the study, ten were males and ten were females. The mean age was 34.3 years (range 18 to 85 years) twelve out of twenty patients (60%) had the dominant side fractured. Mean surgical time in minutes was 88.98 (range: 50 to 150 minutes). The mean fracture union (radiological) time was 14.3 weeks (range: 10–16 weeks) and clinical union time was 10.4 week. However Shoulder function was excellent in 20 cases (100%) on the UCLA score.
Conclusion: This study confirmed a high overall rate of union and excellent functional outcomes. Mini incision anterior bridge technique for type A fracture shaft humerus gives good functional results and should be considered as an effective, cosmetically advanced surgical option in the treatment of type A humeral shaft fractures. It is a safe and less time consuming method for type a humeral shaft fractures when the surgeon is experienced in the technique.

Keywords: Anterior bridge plate, minimally invasive plate osteosynthesis (MIPO), diaphyseal humerus fracture

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 2 year and 8 months. Our study is about AOOTA type a shaft humerus fracture.

Materials and Methods

It is a retrospective study. Twenty patients with fractures of humerus shaft were treated with Anterior Bridge plating using minimal invasive technique in a case series of study between marches 2017 to November 2019 at our centre. Out of twenty patients 60% are male, 40% female, 60%right 40% left. According to OAOOT 45% A2, 25%A1, 30% A3 types of fractures. The cases were followed for a minimum period of 2 year and 8 months. All patients who had fracture at mishit 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 18 and 88 years and who consented to participate. The operative procedure was performed within 4 to 5 days of the injury.



Post op Final union Pre-OP

Fig 1: 35 Year old lady having ho fall down and injury to left arm

Case 1

Pre Op Post Op Final union

Fig 2: Clinical

Surgical technique

The patients were positioned supine with affected arm on radiolucent arm board with 90 abduction. twelve patients were given local brachial block, Eight under general anesthesia.

Fig 3: Pre-Opdrape

A proximal incision 2-3 cm between the medial border of deltoid and proximal biceps, 5 cm caudal to the coraciod 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 medial side & deltoid with cephalic vein retracted to expose the musculocutaneous nerve, overlying the brachialis muscle. The nerve is then retracted and brachialis muscle was split at its lateral 3rd -medial 3rd junction to reach anterior surface of humerus. The lateral half of brachialis muscle then protects radial nerve. A sub-brachialis, extra-periosteal tunnel was created and a 4.5-mm narrow dynamic compression plate,lcdcp or lcp(usally 12 or more) 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 withtwo 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[15] is used to look for any rotational misalignment. 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 (15th 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 two 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 [16] and the Mayo elbow performance score (MEPS) [17] 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.

Fig 4: Incision markings

Results

Of the Twenty patients followed up to a minimum of 12 months in the study, ten were males and ten were females. The mean age was 34.3 years (range 18 to 85 years) twelve out of twenty patients (60%) had the dominant side fractured. The mean surgical time was 88.98 minutes (range: 50–150 minutes). The mean radiological fracture union time was 14.3 weeks (range: 10–14 weeks). Shoulder function based on the UCLA score was excellent to good in 20 cases (100%). Road traffic accident (RTA) was the most common mode of injury, found in 20 cases, The mean follow-up of our cases were 32 months (range: 18– 38 months). Fracture union was observed at a mean period of 14.3 weeks (range: 10–14 weeks).

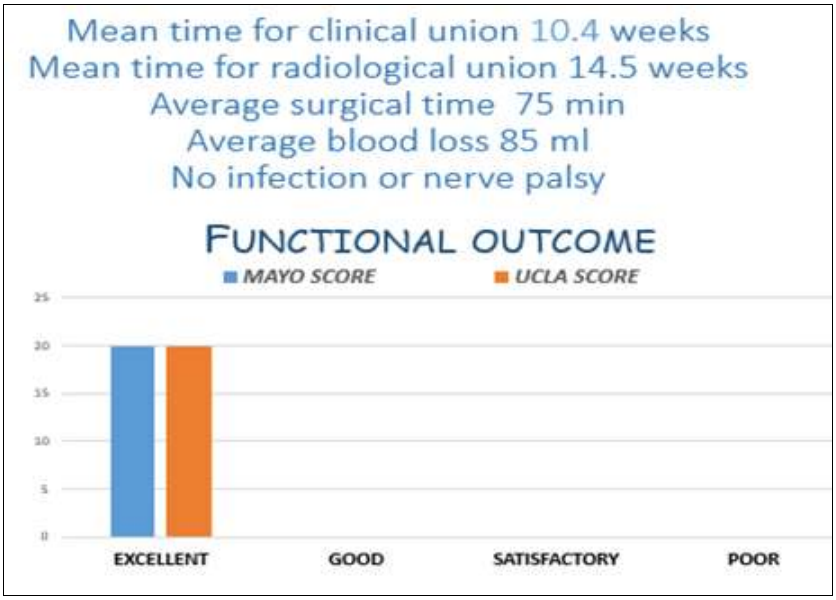


Fig 2: Result and analysis

Clinical

Pre op Post Op Final union

Discussion

Tscherne and Krettek first reported minimal invasive osteosynthesis for supracondylar femoral fractures in 1996 [18]. 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, high union rate, excellent functional recovery, less chances of complications 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 [19]. 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%) [20].

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 anterior bridge- plate technique can be used even for the treatment of humeral shaft nonunion (both atrophic and hypertrophic nonunion) [21]. 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 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. William Dias el at studies 23 for transverse shaft humerus fracture treated with MIPPO ABP, his

union rate is 11.4 wks comparable to our study. Their conclusion was ABP can be considered as safe & effective technique for transverse humerus fractures. To conclude, MIPO is definitely a newer and acceptable modality of treatment.

Take home messages

It combines the advantage of both conservative & conventional open reduction plating method & avoid disadvantage of both method. It is relatively safe & easily reproducible method for treating all types of shaft humerus fractures. Its giving faster functional recovery, it has relatively simple learning curve, less complications & can give excellent functional outcome as compared to conventional methods. Although our study is short term, we need large, long term study to evaluate the results.

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