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## Does anatomic locking compression plate play a vital role in maintaining length of clavicle in comminuted fracture & enhance good functional outcome

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### Abstract

Deformity following un-united and mal-united adult clavicle fractures is being increasingly recognised as the indications for operative treatment of displaced fractures of the clavicle. Various options include low contact dynamic compression plates, which are strong, but difficult to contour and cause soft tissue irritation. Recon plates are easier to contour, but lack sufficient mechanical strength. Anatomical Pre-contoured locking plates are now available, matching the shape of the adult clavicle. The purpose of this study is to assess the clinical and radiological outcome of a pre-contoured clavicle plate in the treatment of acute, displaced, mid-shaft clavicle fractures. This study presents the results of 26 patients treated with an anatomical congruent clavicle plate for acute displaced, mid-shaft fractures of the clavicle at a tertiary referral centre. All patients were managed with a precontoured clavicle plate. The fracture united in all cases with no complication and high patient satisfaction on the Disability of the Arm and Shoulder (DASH) score and Pain Visual analogue score (VAS). The results were comparable with other published studies, and the pre contoured clavicle plate represents one of the best operative management of these fractures.

**Keywords:** clavicle fracture, pre contoured plate

### 1. Introduction

Clavicle fractures are common, accounting for 5 to 10% of all fractures and up to 44% of all injuries to the shoulder girdle [1, 2]. Majority of these fractures (roughly around 80-85%) occur in the middle third of the clavicle [1, 3, 4]. Most of these fractures have been treated conservatively suggesting that only 0.1% of fractures, treated non-operatively, will fail to unite [1]. Recent studies indicated mid shaft fractures with 2 cm shortening have a 15% non-union rate [5]. Mal-union of clavicle fractures can occur upto 50% of cases [5, 6]. Primary cause for poor outcome with conservative management include weakness, pain, displacement, or a bump [6]. Some indications for fixation of clavicle fracture include compound fractures, skin denting, damage to neurovascular structures and floating shoulder [7, 8, 9].

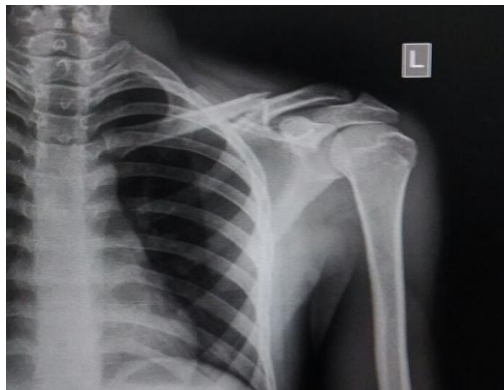
Many controversy exists on the modality of fixation used for middle third clavicle fractures [1, 10]. Various treatment options include intramedullary fixation [11, 12] internal fixation with plates [9, 13, 14, 15], and external fixators. Wires fixation carries risk of migration which may cause damage to vital structures [16, 17]. Reconstruction plates are weak, but easy to contour to the anatomy of the clavicle and often cause little soft tissue irritation. LCDCP (limited contact) plates, on the other hand, are bulky, difficult to contour, but offer more mechanical strength [18]. Anatomic pre-contoured plates have the advantage of not requiring further bending, having a lower profile causing fewer soft tissue problems whilst retaining the mechanical strength of the stronger plates.

The purpose of this study is to assess the clinical and radiological outcome of the precontoured Anatomic Clavicle Plate in the treatment of acute, comminuted mid-shaft clavicle fractures. Advantages of precontoured Anatomic Clavicle Plate are low profile plates which are pre-contoured to match the anatomy of clavicle and made from indian stainless steel. These plates are side specific and different shaped curves for the level of fracture.

### Material and Methods

The study was conducted at Rajah Muthiah Medical College & Hospital, Annamalai University, Chidambaram between May 2016 to October 2017. This study is a prospective study with a total of 34 patients with acute, displaced, mid-shaft fractures of the clavicle are treated with an anatomical contoured clavicle plate. Proper anesthetic assessment followed by detailed informed written consent from all patients were obtained. All cases were Allmann Type 1 fractures [19]. Twenty six patients with Allmann Type 1 were included in the study & were followed up for a period of twelve month. Four patients were lost in follow up and of the remaining twenty two, there were 14 male and 8 female patients. The Pre-operative assessment included an AP view of the fracture (Figure 1).

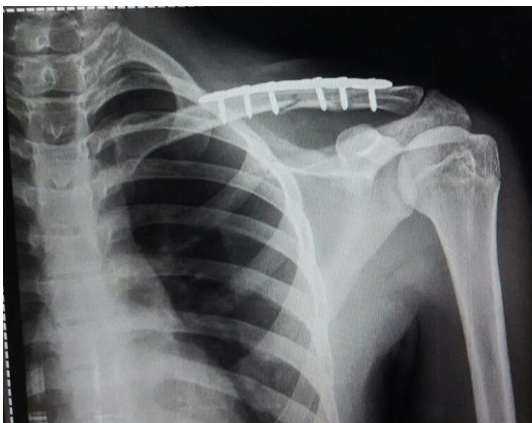
### Pre op X rays



These X rays are useful to assess of the amount of medio lateral shortening and extent of displacement. All patients were put on rehab protocol to perform passive and active assisted exercises in the initial 4 weeks.

Weight lifting, sports & recreational activities, overhead abduction of the arm above head were discouraged for atleast 8-12 weeks or until signs of fracture union were seen. Both clinically and radiological (AP radiograph) assessments were used to assess the outcome (Figure 2).

### Post op X rays



Fracture union was defined clinically as pain free use of the arm/shoulder and radiological without evidence of delayed fracture union. Outcome assessment was performed at 12 (range 4 to 18 months) post operatively. Disabilities of the Arm Shoulder and hand questionnaire (DASH) scoring system & Pain Visual Analogue scoring system was used on all 22 patients [20].

### Operative Technique

Under inter scalene block & local infiltration with tumescent solution (solution of ringer lactate & Lignocaine with soda bicarbonate & adrenaline) the patients were placed supine with a small sand bag along the medial border of scapula. A subcutaneous infraclavicular approach was utilized with careful periosteal stripping. Special care was taken to protect the supraclavicular nerves & vessels. Minimal soft tissue stripping was done & the fracture was reduced, fixed with precontoured plate applied to the superior surface of the clavicle & held with 3.5mm screws (both locking & cortical screws used). Unlike the recon plates contouring of the plate was not required.

### Intra Operative Images



### Results

Twenty two patients with displaced, mid shaft fractures were treated with pre contoured anatomical clavicle plate. The mean age was 38.2 years (range from 18 to 44 years). 8 happened while involving themselves in sport cum recreational activities, 7 were as a result of road traffic accidents (RTA) and 7 due to self-fall. All fractures were in the middle third and displaced more than 20mm. Two patients had an associated fracture of the upper limb which required open reduction and fixation (one proximal humerus & other scapula) while two patients had additional rib fractures which were managed conservatively.

The mean time from injury to operation was 5.4 days (range from 1 to 7 days).

At mean follow up at 10.4months (3-18 months) the mean DASH score was 12.4 and the mean VAS score was 1.4 (0-8). Active range of motion was regained in all patients who were available for examination (22 out of 22 patients).

At a mean of 11.8 weeks (range 6 to 24 weeks) there was a 100% (22 of 22 patients) healing rate. Restoration of medio lateral length compared to the normal patient was achieved in almost all cases.

### Post-operative images-Restoration of length



### Discussion

Fracture clavicle middle third are common injuries. Results of conservative management of fractures of the clavicle have been variable. A non-union rate of 0.1% for conservatively treated fractures was reported by Neer<sup>[1]</sup>, and non-union rate of 4.6% for operatively treated fractures. Unsatisfactory shoulder function due to nonunion with conservative treatment led to shortening<sup>[5, 6]</sup>.

This shortening of clavicle resulted in abnormal biomechanical stress on the shoulder as result of altered anatomical relationships<sup>[21]</sup>. Shortening of 10mm was shown to decrease shoulder function by atleast 50% of cases and with shortening > 20mm there was considerable deterioration. The position of glenoid fossa may also be altered which may affect glenohumeral mobility and scapular rotation which may lead to poor results especially in young and active patients<sup>[6]</sup>. Multiple controversy exists with regard to the techniques used for fixation of displaced middle third clavicle fractures and the implant used<sup>[1, 10]</sup>. Operative management has its own pros & cons and a complication rate as high as 27.3% has been quoted<sup>[18]</sup>. Most common among them is irritation due to hardware with dynamic compression plating and plate

removal being a common reason for re-operation<sup>[18]</sup>.

In our case series we haven't done any implant exit & found that routine plate removal is not mandatory as the implant is low profile and caused minimal irritation. Functional outcome of conservative and operative management in mid shaft clavicle fractures showed better function, a lower rate of non-union, and a lower incidence of mal-union in the operative group by the Canadian Orthopaedic Trauma Society. From other studies it was evident that the most common reason for re-fracture being implant removal after union the primary cause for removal being soft tissue irritation. Multiple studies by researchers changed the actual practice towards pre contoured plate and preliminary results indicated a markedly reduced prevalence of soft tissue irritation<sup>[22]</sup>.

Plate contouring takes time, and experience is required to accurately contoured to match the patient's anatomy. Manipulating the implants can lead to structural failure. Huang *et al* compared the anatomy of the clavicle with the shape of the pre contoured plate with digital mapping. The results showed that the plate fitted the S-shaped contour of the superior surface of the clavicle in majority of the cases. Huang *et al* study concluded that the plate was adequately shaped for fixation of fractures in the medial three-fifths of clavicles<sup>[23]</sup>. In our study we found that the plates could be reversed and used for the contralateral side which actually provided an increased range of choice.

Our paper described a series of 22 patients with acute, displaced, mid-shaft fractures which were followed for a minimum of 3 months to a maximum of 18 months. But the limitation of our study being no control group and hence it provides no basis for firm conclusions, or statistical analysis.

However our study clearly demonstrates that the pre contoured locking plate appears to be an effective way of fixing mid shaft clavicle fractures and due to its low profile nature, routine plate removal is not required.

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