Section: Orthopaedics

Original Research Article

FUNCTIONAL OUTCOME OF 'J' PLATING FOR CLAVICLE 'Z' FRACTURES

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ABSTRACT

Background: Clavicle fractures make up about 3-5% of all adult fractures. The vast majority of fractures, approximately 80%, is located in the midshaft of the clavicle and more than half of these fractures are displaced. In comminuted fracture with single or multiple (segmental or butterfly) pieces in the middle which gets aligned vertically, which given the appearance of 'Z' in X-ray. **Objective:** This study aims to know the functional outcome in comminuted clavicle Z fractures treated with locking contoured J-plate.
Materials and Methods: This study was conducted in our institute between January 2016 to January 2023 on 29 patients of mid-third clavicular fracture. Closed comminuted middle third clavicular fracture patients aged between 20 to 60 years were included in the study.
Results: Twenty-nine isolated closed comminuted clavicle middle third fracture patients were included in our study as per the inclusion criteria. Their mean age was 32.8 years. All fractures united at a mean duration of 13.2 weeks with more than 90% patients having excellent to good results and none of the patients had poor outcome.
Conclusion: We conclude that fixation of comminuted clavicle fractures with contoured locking J – plate gives excellent results, maintaining the length and alignment of the clavicle. Consider 'Z' fracture as a separate entity and we advised to manage it surgically to get good functional outcome and early functional recovery.
Keywords: Clavicle, J – plate, Comminuted, Z – fracture.

INTRODUCTION

Clavicle fractures make up about 3-5% of all adult fractures with higher incidences reported more recently.[1-3] The majority of fractures, approximately 80%, is located in the midshaft of the clavicle and more than half of these fractures are displaced.[4,5]

Clavicle fractures may be treated either nonoperatively or operatively, with differing potential benefits and complications, depending on patient characteristics, such as age and occupation, as well as fracture characteristics, such as displacement, comminution.[5]

Non-operative treatment with a sling or figure of eight bandage or shoulder immobilizer.[6,7] which has the benefit of avoiding surgical intervention and the associated risks of surgery, can allow for fracture healing and a return of function. More recent studies, however, suggest higher malunion and nonunion rates up to 40% following nonoperative treatment in particular for patients with displaced midshaft clavicle fractures.[8-13] Some of the displaced clavicle fractures, there is soft tissue interposition which is not suitable for conservative management. In addition, shortening of clavicle, non-union residual pain, disappointing cosmesis and shoulder dysfunction also present.[11,13] Indications for surgery include complete displacement, shortening >2 cm, floating shoulder, compound fracture, complex fracture, and established nonunion.

In clavicle fracture – distal fragment is displaced inferiorly by the weight of the upper limb and proximal fragment displaced superiorly leading to gap in the fracture site. In comminuted fracture with

single or multiple (segmental or butterfly) pieces in the middle gets aligned vertically, which gives the appearance of 'Z' in the X-ray. 'Z' deformity is well visualised when it is malunited in that position. A recent report identified comminution of fracture as an independent predictive factor for nonunion of midshaft clavicle fracture after nonoperative treatment.[14]

Advantages of surgical fixation over nonoperative treatment of these unstable Z fractures include anatomic reduction of the bone to get back the length and alignment and original shape of the clavicle, expedite healing, reducing the risk of nonunion, quicker rehabilitation or return to daily activities and allowing for long term improvement in function.[15-17]

Many studies have confirmed early good functional recovery after operative management of clavicle fracture.[12,13,15,18]

There are two commonly performed surgical techniques used to repair displaced midshaft clavicle fractures: (1) open reduction and plate fixation and (2) intramedullary nailing.[19–21]

The optimal method to treat displaced midshaft clavicle fractures remains a continued topic of debate. Despite the large number of individual studies published on the topic, it is still relatively unknown as to which surgical intervention provides better long-term functional outcomes and reduces overall complication rates. Studies on comminuted clavicle fractures are less but have shown good results with plating. Recent reviews have been conducted in an attempt to determine which technique is superior, however, they have either been inconclusive due to the limited number of published studies or have lacked adequate pooling due to insufficient study reporting.[21,22]

Several types of plates and fixation methods have been described; these include pre-contoured dynamic compression plates, S-plates, hook plates or reconstruction plates.[19] Plate fixation provides immediate rigid fixation with rotational stability and may be less technique-sensitive. Although high success rates of plate fixation of displaced clavicle fractures have been shown, reported complications of plate fixation include implant failure, deep infections, damage to nerves and blood vessels, implant prominence, poor cosmesis, nonunions, and refracture as a result of removal of the plate.[23-25]

On the other hand, intramedullary fixation is less invasive with comparatively reduced implant prominence and better cosmetic results. However, it has certain disadvantages, including the requirement of intra operative radiation exposure, migration of the nail and implant irritation, and need for implant removal to prevent migration.[26,27]

Studies on comminuted clavicle fractures treated with locking plate are less. This study aims to know the functional outcome in comminuted clavicle Z fractures treated with contoured locking J-plate.

MATERIAL AND METHODS

This study was conducted in our institute between January 2016 to January 2024 on 29 patients of mid-third clavicular fracture, attending our emergency or OPD department. Informed written consent from all the patients was obtained. Closed comminuted middle third clavicular fracture patients aged between 20 to 60 years were included in the study. Skeletally immature patient, open or pathological fracture and associated with other fractures were excluded from the study. Plain radiograph of clavicle along with shoulder in antero-posterior view, special views when required was taken to assess the site and type of fracture, Routine investigations were done and fitness for surgery was obtained.

All patients were operated in beach chair position under general or regional anesthesia with incision over the clavicle and fixing with a locking plate which has more curve laterally than medially which resembles more of 'J' shape than S- shape and doesn't have combi holes, all are locking holes. (Figure 1) While doing surgery, dissection was done as minimal as possible preserving the soft tissue attachments, supraclavicular nerves were saved when feasible. Fragments are aligned to gain original length, contour, anatomy of the clavicle, stabilized with K-wire temporarily before definitive fixation with plate. With a minimum of three bicortical locking screws on either side except in one case where fracture was more medial, only two screws bicortical and one screw medially unicortical were used. Adequate screw length confirmed on c-arm.

If the fragment is big enough, lag screw was placed. If it is smaller it was temporarily stabilized with k-wire to achieve reduction and k-wire removed after plate fixation. In cases where two, three smaller pieces were present, attempt was made to suture the fragments back into the fracture site with no.1 vicryl, so that the gap in the fracture site was reduced to minimum. Bone grafting was done primarily in 2 cases and the rest planned for a secondary grafting. Wound closed in layers and subcuticular suture was used.

Postoperatively, analgesic and antibiotics were continued, with dressing on 2nd day and suture removal at 2 weeks was done. Operated limb was supported by shoulder immobilizer for 3 weeks but with supervised range of movements. In first week mobilisation depending on the patient tolerability and the rigidity of fixation, in the second week passive and active movements was done, from third week complete ROM allowed at shoulder joint but no weight bearing or straineous activities was advised, complete return to the previous level activity only after confirming radiological union was allowed, the delay in mobilization was in accordance with comminution at the fracture site.

Patients were followed regularly at 2, 6, 12 and 24 weeks. Patients were assessed clinically as well as radiologically. X rays were taken at each follow-up to see progressive fracture union and implant position. The functional outcome was assessed by DASH score.

RESULTS

Figure 1: J – Shape locking plate

Figure 2: Comminuted clavicle 'Z' fracture

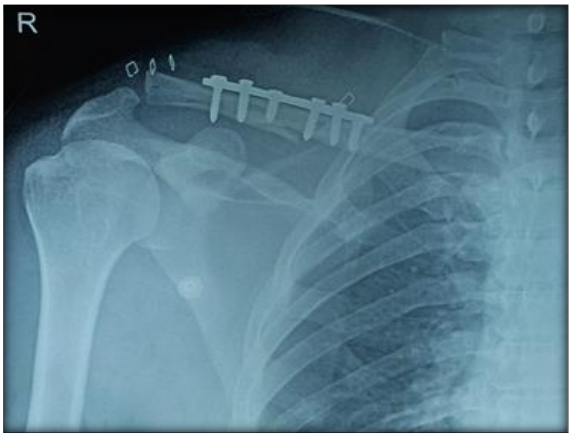

Figure 3: Operated with J-plate

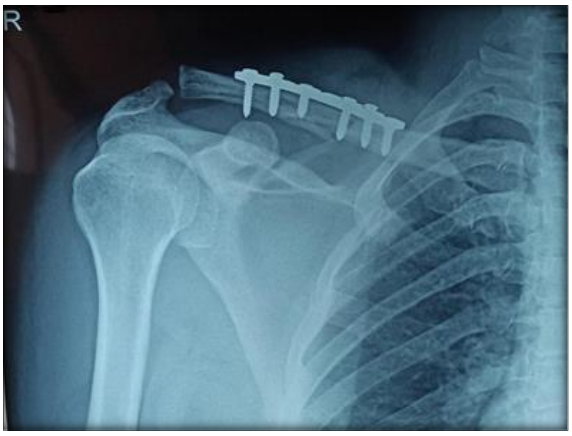

Figure 4: Follow-up after 1 month

Figure 5: Clinical photo of surgical scar

Twenty-nine closed comminuted clavicle middle third fracture patients were studied as per the inclusion criteria. Their mean age was 32.8 years (range 24 to 48), of which 22 patients were male and 7 were females. 13 patients had left-sided fractures, whereas 16 patients had right-sided fractures. [Figure 2 to 5]

All patients were operated on within 3 days after the injury except one patient was operated with a delay of 8 days after injury who presented late to us after osteopathic treatment. All fractures united at a mean duration of 13.2 weeks. As per the DASH score, the functional outcome in 21 patients had excellent functional outcomes, good in 6 patients, and fair in 2 patients. Plate prominence occurred in two patients, hypertrophic skin scar was seen in one patient, decreased sensation over upper part of the chest in one patient and one patient had plate slightly bent during follow-up in which delayed union occurred and not willing for secondary surgery eventually improved with physiotherapy. [Table 2]

Table 1: Age distribution

Age / Sex	Number of patients	Percentage
20 – 30 yrs	10	34.5 %
30 – 40 yrs	14	48.3 %
40 – 50 yrs	3	10.3%
50 – 60 yrs	2	6.9 %

Table 2: Functional outcome

	Number	%
Excellent	21	81.9%
Good	6	13.6%
Medium	2	4.5%
Poor	0	-

DISCUSSION

The most common injury mechanism of mid-clavicle fracture is a fall on to the shoulder. When the shoulder joint is subjected to an impact force from the side, the shoulder joint and clavicle absorb the bulk of the applied force leads to comminuted fracture. Given that the middle clavicle is the narrowest region, junction of change in curvature and has the least soft tissue coverage, about 85% of clavicle fractures occur in the middle of the clavicle.[28] In the past, because of the excellent remodeling properties of the clavicle, comminuted fracture in the middle clavicle were generally treated conservatively, regardless of fracture displacement or comminution. However, recent studies have shown that the incidence of complications is significantly higher after conservative treatment of comminuted fractures than if the fracture was treated surgically. Generally comminuted fractures are displaced and give the appearance of the letter Z in the x-ray and being unstable patient will have more pain. If treated conservatively, these fractures might malunite in that displaced position.[29]

There are various kinds of plate fixation for the comminuted clavicle fractures.[16] Fixation with intramedullary nailing does not control rotation, so it requires longer period of immobilization till union as compared to internal fixation methods like plate fixation.

Locking plate in various shapes and contour are generally used in pelvi-acetabular fractures. Many of the plate resembling shape of J are also used. S – plate system is used in clavicle to match the shape of the clavicle. As the curvature of lateral part of the clavicle is more than the medial part, we have used J – plate which has more curvature laterally and very little curve medially to match the shape of the clavicle.

We evaluated the results of 29 cases of comminuted mid-third clavicle fracture treated with locking J – plate.

Similar to Bostman,[30] study and Pearson et al,[31] study, we also got all fractures united at a mean duration of 13.2 weeks, with 79 % united at 12 weeks and 21% united at 15

In all 29 cases we achieved union but delayed union in one case (3.4%) compared to Mahendra panwar,[32] study, the delayed union occurred in 5% at the end of 14 weeks because of a large butterfly fragment and plate breakage. Where as in Bostman et al,[30] study delayed union occurred in 2.91%. the patient with delayed union had slightly bent plate and had denied any secondary bone grafting procedure but he eventually had no symptoms and had good DASH score.

In our study one patient had hypertrophic skin changes where as in Mahendra panwar,[32] study there was cosmetically unacceptable hypertrophic skin scar in 2 patients. Plate prominence was seen in thin individuals in 6.8% in our study where as 5% in their study.

We don't have any superficial infection in our patients which is similar to Kao et al,[33] study but in Mahendra panwar,[32] study 2% had superficial infection in the immediate postoperative period.

Complications noted in our study were hypertrophic skin scar, delayed union, plate prominence, and bent plate, all of which were successfully treated conservatively and none of the patients required second surgery.

Limitations: Our study is limited by a lack of randomized control, lower number of patients, and short-term follow-up.

CONCLUSION

Comminuted clavicle fractures are displaced in majority of cases and there is less scope for conservative management as it is unstable and may lead to 'Z' deformity. We conclude that fixation of comminuted clavicle fractures with contoured locking J – plate gives excellent results, maintaining the length and alignment of the clavicle with minimal complications.

We advocate to consider 'Z' fracture as a separate entity and advise to manage these fractures surgically to get good functional outcome and early recovery.

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