

Original Research Article

Anterior inferior plating versus superior plating for middle 1/3rd clavicle fracture: a prospective comparative study

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ABSTRACT

Background: Fractures of the clavicle are common injuries that may result from direct blow or transmitted forces. Deformities are shortening and depression of lateral fragments. Various techniques are performed out of which superior and anteroinferior plating are widely used with each having its own merits and drawbacks. Our study compares the outcome between above mentioned techniques.

Methods: We conducted a prospective comparative study of 60 patients who has met inclusion criteria and out of which 30 patients were treated with anteroinferior technique and 30 patients were treated with superior plating technique. Outcome measure were assessed through constant and murley score.

Results: The demographic analysis of our study showed that the incidence of fracture is predominant among males (63.3%) with RTA being the most common mode of injury. AO/OTA classification which was used in our study revealed A1 as the most frequently involved group. Each group had 2 patients with infection post operatively which was managed with appropriate antibiotics. Increased incidence of delayed union was found in anteroinferior group (13.3%) with decreased hardware prominence in comparison with superior plating.

Conclusions: There were no significant differences in functional outcome between both the groups except the fact that superior plating had higher chances of plate prominence. So either of the surgical technique can be employed depending upon the feasibility of surgeon.

Keywords: Clavicle fracture, Anteroinferior plating, Superior plating, Constant and murley score, Plate prominence

INTRODUCTION

Clavicle is the most commonly fractured bone, accounting for about 2.6%–4% of all fractures and 34%–35% of shoulder girdle injuries.^{1,2} In the clavicle fractures, middle third ones are the most common fractures with an incidence of about 69%–81%.^{2,3} Conservative treatment has remained the standard for managing these fractures until recently where the trend is moving towards operative method.³

Various methods of open reduction and internal fixation with plate and screws or nailing are used for clavicle

fracture, and the plate and screw constructs is the most common methods.⁴ Among the plate and screw construction, the anterior inferior plating and superior plating were two techniques which are used.⁵

Zlowodzki et al presented that superior plating was associated with more symptoms.⁵ Robertson study showed that compared with the anterior inferior plating, the superior plating was preferred because of an advantage in fracture fixation, which could be seen in routine activity.⁶ Because of these contradictory results, we conducted this study to provide an overview and quantitative estimate of

the two different plating methods for clavicle fracture based on the current evidence.

Aim and objectives

Aim

Compare the outcome between antero-inferior and superior plate osteosynthesis in fractures of middle one-third of clavicle.

Objectives

To compare post-operative complications in both the groups (surgical site infection, delayed union, plate prominence, and neurovascular injury). To compare overall functional outcome in both plating the groups by using Constant and Murley score.

METHODS

This is a prospective comparative study was carried out on 60 patients who sustained clavicle mid-shaft fractures and meet inclusion criteria were treated surgically with open reduction and internal fixation from August 2019 to August 2020 and followed up for one year at sathagiri institute of medical sciences and research centre (Bangalore).

Inclusion criteria

Mid shaft clavicle fracture Allman Group I (middle one-third clavicle fracture). Closed Fractures of clavicle. Patient willing for surgery. Patient above 18 years of age.

Exclusion criteria

Open fractures of clavicle. Fractures of Proximal or Distal third. Un-displaced fractures of Clavicle. Fractures associated with Acromio-clavicular joint dislocation. Fracture associated with fracture of ipsilateral humerus, poly-trauma, adhesive capsulitis, floating shoulder.

There are several classification schemes for fractures of the clavicle ranging from the simple to complex. In our study we have used the AO classification for diaphyseal fracture of the clavicle.

Operative technique

All patients were operated under general anaesthesia. After minimal soft tissue and periosteum dissection, fracture fragments were reduced and hold with bone clamps and then plate was applied over the superior or anteroinferior aspect of the clavicle, lag screw was put wherever possible and then plate in neutralization mode was applied. While drilling from superior to inferior direction, a periosteal elevator was inserted inferiorly to prevent the drill from damaging the important neurovascular structures inferiorly. The medial and lateral fracture fragments were

fixed with the contoured S shaped plate with 3.5 mm cortical and locking screws. At least three screws were put on either side of the fracture. Once the hemostasis is achieved, wound was closed in layers and sterile dressing was applied and arm pouch or broad arm sling was given.

Postoperative rehabilitation

Post operatively arm was immobilized in arm pouch or broad arm sling with shoulder held in adduction and internal rotation. Elbow was maintained at 90° of flexion. Rehabilitation protocol was planned depending upon the stability of fixation.

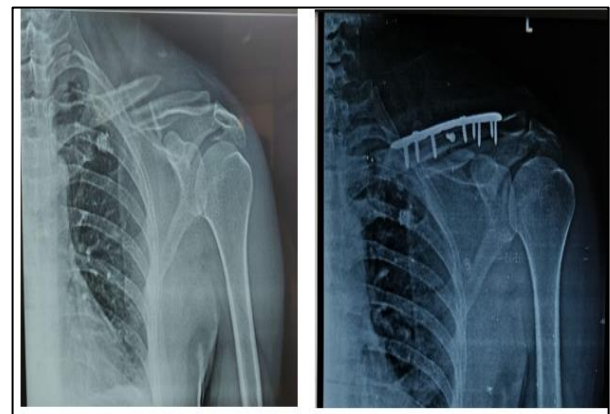


Figure 1: Clavicle fracture fixed with superior plating.

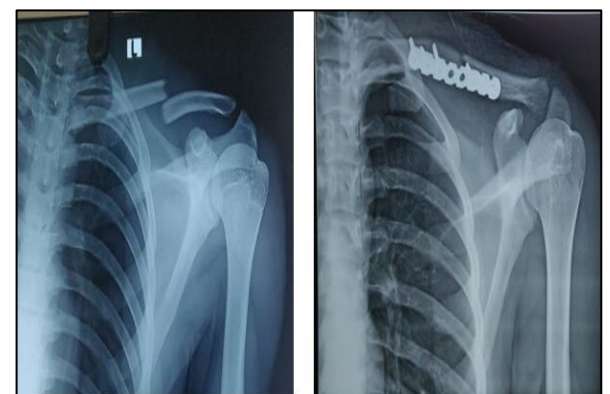


Figure 2: Clavicle fracture fixed with anteroinferior plating.

For well-fixed and stable fixation, active assisted range of motion of shoulder joint was allowed up to 90 degrees of abduction and flexion, 45 degree of external rotation. At post-op 6 weeks, patient was reassessed with X-ray and active range of motion in all planes was done. At post-op 9 to 12 weeks, isometric and isotonic exercises were advised for the shoulder muscles. In comminuted fractures and fractures which were not rigidly fixed, range of movement exercises were delayed. Patients were followed on outpatient basis with X-ray after 6 weeks, 3 months, 6 months and 1 year from the date of surgery. Clinical evaluation was be done by Constant and Murley scoring system.⁹

RESULTS

In our study total 60 patients were enrolled, among them 30 (50%) patients underwent to antero-inferior plating surgery and 30 (50%) patients underwent to superior plating surgery. In our study both antero-inferior and superior plating number of male patient were 19 (63.3%)

and female patient were 11 (36.7%). So, out of the population in our study male patients were predominant.

The mean age of Antero-inferior plating was 33.55±9.94 and mean age of Superior plating was 32.6±10.50, p value is 0.74, statistically not significant differences between two groups.

Table 1: Patient distribution according to sex in a both technique.

Sex	Antero-inferior palting N (%)	Superior plating N (%)	Total N (%)	P value
Male	19 (63.3)	19 (63.3)	38 (63.3)	1.00
Female	11 (36.7)	11 (36.7)	22 (36.7)	1.00
Total	30	30	60	1.00

Table 2: Comparison of age in both the technique.

Type of surgical procedure	Age Mean±SD	P value
Antero-inferior palting	33.55±9.94	0.74
Superior plating	32.6±10.50	0.74

Table 3: Patient distribution according to OA classification in a both technique.

OA Classification	Antero-inferior palting N (%)	Superior plating N (%)	Total N (%)	P value
A1	15 (50)	9 (30)	24 (40)	0.09
A2	3 (10)	14 (45)	17 (28)	0.09
A3	6 (20)	6 (20)	12 (20)	0.09
B1	3 (10)	0 (0)	3 (5)	0.09
B2	3 (10)	1 (5)	4 (7)	0.09
Total	30	30	60	0.09

Table 4: Patient distribution according to infection in both the technique.

Infection	Antero-inferior palting N (%)	Superior plating N (%)	Total N (%)	P value
Yes	2 (6.7)	2 (6.7)	4 (6.7)	1.00
No	28 (93.3)	28 (93.3)	56 (93.3)	1.00
Total	30	30	60	

Table 5: Patient distribution according to delayed union in both the technique.

Delayed union	Antero-inferior palting N (%)	Superior plating N (%)	Total N (%)	P value
Yes	4 (13.3)	2 (6.7)	6 (10)	0.54
No	26 (86.7)	28 (93.3)	54 (90)	0.54
Total	30	30	60	

Table 6: Patient distribution according to plate prominence in both the technique.

Plate prominence	Antero-inferior palting N (%)	Superior plating N (%)	Total N (%)	P value
Yes	0 (0)	6 (20)	6 (10)	0.03
No	30 (100)	24 (80)	54 (90)	0.03
Total	30	30	60	

Table 7: Patient distribution according to neurovascular injury in both the technique.

Neurovascular injury	Anteroinferior plating N (%)	Superior plating N (%)	Total N (%)	P value
Yes	0 (0)	2 (6.7)	2 (3.35)	0.31
No	30 (100)	28 (93.3)	58 (96.65)	0.31
Total	30	30	60	

Table 8: Patient distribution according to constant and murley score functional outcome in both the technique.

Functional outcome	Anteroinferior plating N (%)	Superior plating N (%)	Total N (%)	P value
Excellent	23 (76)	14 (47)	37 (62)	0.13
Good	4 (13)	12 (40)	16 (26)	0.13
Fair	3 (11)	4 (13)	7 (12)	0.13
Total	30	30	60	

In our study among 60 patients classified according to OA classification, 24 (40%) were A1 followed by 17 (28%) were A2, 12 (20%) were A3, 4 (7%) were B2, 3 (5%) were B1. In antero-inferior plating group 15 (50%) were A1 followed by 6 (20%) A3, 3 (10%) were A2, B1 and B2. In superior plating group 14 (45%) were A2 followed by 9 (30%) were A1, 6 (20%) were A3 and 1 (5%) were B2. Overall patient were predominant in A1 24 (40%) group in our study.

In both anteroinferior and superior group infection rate was same 6.7%, p value is 1, statistically not significant, so both groups are equally at risk of developing the infection.

In our study among 60 patients, 54 patients (90%) there was no delayed union was seen, but 6 (10%) patients presented with delayed union. In Antero-inferior plating group 4 (13.3%) patients had delayed union and in Superior plating group 2 (6.7%) patients had delayed union. In our study P value was 0.54 not significant, both groups has the same risk for delayed union.

In our study among 60 patients, 54(90%) patients did not show any plate prominence and 6 (10%) patients showed plate prominence. In antero-inferior plating group no patients were observed with plate prominence. In Superior plating group 4 (20%) patients were observed with plate prominence. In our study p value was 0.03 and is significant and superior plating group had higher chances of plate prominence when compared with anteroinferior plating group.

In our study anteroinferior plating group had no neurovascular injury, but in superior plating group 2(6.7%) patients were reported with neurovascular injury. In our study p value was 0.31 which was statistically not significant.

In our study population in anteroinferior plating group, 23 (76%) patients outcome was excellent followed by 4 (13%) patients outcome was good, and 3 (11%) were fair. In Superior plating group 14 (47%) patients had excellent outcome followed by 12 (40%) patients had good outcome and 4 (13%) had fair outcome and p value was 0.13 which was statistically not significant.

DISCUSSION

Most orthopaedicians still prefer non-operative treatment for un-displaced middle 1/3rd clavicle fracture, using a sling or arm pouch with shoulder immobilizer or figure 8 support. The treatment of choice for displaced middle 1/3rd clavicle fracture remains controversial.⁵ Although most middle 1/3rd clavicle fractures unite without any complications, conservative management has higher rates of nonunion and patient noncompliance with the outcome.¹⁰ A prospective randomized controlled trial by Altamimi SA et al compared operative (plate and screw fixation) with non-operative treatment for displaced middle 1/3rd clavicle fractures. The results in these study union rate was faster in the operative group compared to non-operative group; and also, operative management of a displaced clavicle fracture showed better functional outcome and lower rates of mal-union and nonunion compared with non-operative treatment after 1 year of follow-up.¹¹

Among the various operative methods used for clavicle fracture, and the plate and screw fixation is the most common method.¹² Among the operative methods of plate and screw fixation the anterior inferior plating and superior plating are most commonly used in plate and screw fixation and some studies have been performed to compare the two different methods for clavicle fracture. But however, the position of plate is still remains controversial. Zlowodzki et al presented that superior plating was associated with more symptoms.¹³ In addition, evidences in other studies indicated that the anterior inferior plating

may reduce the risk of underlying neurovascular injury and plate prominence. However, Robertson et al demonstrated that compared with the anterior inferior plating, the superior plating was preferred because of an advantage in fracture fixation, which can be seen in daily basis.⁶

In our study population among 60 patients, 50% patients underwent Antero-inferior plating surgery and 50% patients underwent superior plating surgery, ratio between two groups is 1:1. Similar percentage of patient were enrolled into other studies like Cao et al, Qiu et al and Xiao et al.

In our present study 63.3% were male patients and 36.7% were female patients. Similar percentage of sex distribution were seen in other studies like Deng et al, Formaini et al, and Zhao et al.

The mean age of antero-inferior plating group was 33.55 ± 9.94 and mean age of Superior plating group was 32.6 ± 10.50 , and p value was 0.74, no statistically difference between two groups. Similar age group was seen in other study like Zheng et al, Formaini et al and Hulsmans et al.

In our study among 60 patients classified according to OA classification, 24 (40%) were A1 followed by 17 (28%) were A2, 12 (20%) were A3, 4 (7%) were B2, 3 (5%) were B1. In antero-inferior plating group 15 (50%) were A1 followed by 6 (20%) A3, 3 (10%) were A2, B1 and B2. In superior plating group 14 (45%) were A2 followed by 9 (30%) were A1, 6 (20%) were A3 and 1 (5%) were B2. Overall patient were predominant in A1 24 (40%) group in our study.

In our study, in both groups infection rates was same (6.7%), p value is 1, statistically not significant. In other studies Hulsmans et al, Sohn et al, Qiu et al, Formaini et al, had reported the infection, but there were no significant difference were observed between two groups in those studies.

In our study among 60 patients, 54 patients (90%) there was no delayed union was seen, but 6 (10%) patients presented with delayed union. In antero-inferior plating group 4 (13.3%) patients had delayed union and in Superior plating group 2 (6.7%) patients had delayed union. In our study p value was 0.54 not significant, both groups has the same risk for delayed union. In other by Sohn et al, Li et al and Zhang et al, showed that there was no difference in union rate between the two groups.

In our study plate prominence was seen in superior plating group 6 (20%) patients were reported with plate prominence and p value was 0.03 and is significant and superior plating group had higher chances of plate prominence when compared with antero-inferior plating group.

In our study antero-inferior plating group had no neurovascular injury, but in superior plating group 2 (6.7%) patients were reported with neurovascular injury. In our study p value was 0.31 which was statistically not significant.

In our study population in antero-inferior plating group, 23 (76%) patients outcome was excellent followed by 4 (13%) patients outcome was good, and 3 (11%) were fair. In superior plating group 14 (47%) patients had excellent outcome followed by 12 (40%) patients had good outcome and 4 (13%) had fair outcome and p value was 0.13 which was statistically not significant so the functional outcome was same in the both groups.

CONCLUSION

There were no significant differences in functional outcome between both the groups except the fact that superior plating had higher chances of plate prominence. So either of the surgical technique can be employed depending upon the feasibility of surgeon.

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