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A comparative study of stabilization of shaft clavicle fractures using intramedullary nailing vs plating

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Abstract
Background: Clavicle fractures account for approximately 2–4% of all adult fractures and about half of all fractures in the shoulder girdle. Conservative management poften leads to cosmetic deformities, complications such as axillary pressure sores, upper extremity edema and venous congestion, brachial plexus palsy, worsening of deformity and increased risk for non-union. There are two commonly performed surgical techniques used to repair displaced midshaft clavicle fractures, open reduction and plate fixation and intramedullary nailing. The present study was conducted to evaluate the end results of Mid shaft clavicle fractures treated in Tertiary Care Centre by various surgical modalities and to evaluate the effectiveness of the different modalities of the treatment and their complications.
Materials and Methods: The present study was a Randomized, Prospective study carried out from October 2016 to March 2018 among patients admitted with midshaft clavicle fractures operated with intramedullary nailing and Open reduction and internal fixation with plating, patients were selected which were operated during the study duration at Orthopaedics Department in Krishna Hospital and Medical Research Centre attached to Krishna Institute of Medical Sciences Deemed University, Karad, Satara.
Results: It was observed that majority of patients in Group P (56%) had excellent outcome followed by good outcome (44%) according to DASH Score. In group I, 15 (60%) patients had good outcome followed by fair outcome (36%).However Group I showed poor outcome (4%). The difference among outcome in both groups showed no statistical significance. (P>0.05).
Conclusion: Plate fixation for severely displaced comminuted midshaft clavicle fractures provides excellent results in terms of rigid fixation, rotational stability and maintenance of anatomical length. Intramedullary nailing of simple midshaft clavicle fractures provides a similar result in terms of quick return to activities with a very good cosmetic outcome.

Keywords: Mid shaft clavicle fracture, Plate fixation, Intramedullary nailing, communited

Introduction
Clavicle fractures account for approximately 2–4% of all adult fractures and about half of all fractures in the shoulder girdle [1, 2] The most common cause for a clavicle fracture is a direct blow to the shoulder or a fall on an outstretched arm [3, 4] The majority (69–82%) of these fractures occur in the middle third of the clavicle, or the midshaft [3, 5] Traditionally, these fractures were treated non-operatively as rates of non-union were less than 1% after conservative treatment [5, 6] Recently , however there is increasing evidence that conservative treatment of displaced midshaft clavicle fractures results in higher non-union rates and deficits in shoulder muscle strength and endurance. Good results with high union rates and low complication rates of displaced fractures of clavicle. It has therefore been suggested that surgical intervention for these fractures should be considered due to lower rates of non-union and greater patient satisfaction.
The earliest reported attempt at closed reduction of a displaced midshaft fracture of the clavicle was recorded in the “Edwin Smith” papyrus dating from the 30th century BC. Hippocrates described the typical deformity resulting from this injury, and emphasized the importance of trying to correct it. It is possible to obtain an improvement in position of the fracture fragments by placing the patient supine, with a roll or sandbag behind the shoulder blades to let the anterior displacement and rotation of the distal fragment correct with gravity,

followed by superior translation and support of the affected arm. Unfortunately, it is difficult or impossible to maintain the reduction achieved. In a prospective series of 868 patients with clavicle fractures treated nonoperatively, Robinson *et al*. reported a significantly higher non-union rate (21%) in displaced comminuted midshaft fractures [7].

In a recent study of displaced midshaft clavicle fractures two modalities of treatments were compared – Conservative Management Vs Intramedullary nailing. In conservatively treated group fractures united but they were associated with more complications and less patient satisfaction. Patient were immobilised for a longer period. Figure of 8 clavicle brace and sling is good modality of treatment in minimally displaced fractures and patient with fewer demands. Deformity was often cosmetic. Complications such as axillary pressure sores, upper extremity oedema and venous congestion, brachial plexus palsy, worsening of deformity and increased risk for non-union. Intramedullary nailing group reported to have faster union and immobilisation as compared to the conservative grou [8].

There are two commonly performed surgical techniques used to repair displaced midshaft clavicle fractures: (1) Open reduction and plate fixation and (2) Intramedullary nailing. [9-11] Although both techniques have been proven to reduce the rates of non-union and enhance functional outcomes for patients with displaced midshaft clavicle fractures, [12] they are both associated with a different set of drawbacks.

When comparing a rigid IM nail to a plate, no difference emerges in union rate or in shoulder function. Instead, it seems that the overall complication rate is higher with plate fixation than with rigid IM fixation. Several studies compare elastic stable intramedullary nailing (ESIN) to plate fixation. According to these studies, shoulder function, union rate, and complication rate all appear somewhat equal. Time to union is slightly shorter in ESIN than in plate fixation. This phenomenon is explained by favourable features of ESIN such as preserving the soft tissue envelope, the periosteum, and the vascular integrity of the fracture site [13].

Intramedullary fixation (IMF) has emerged as a promising alternative to traditional open reduction and internal plate fixation. Advantages of this minimal invasive treatment option include maintaining the fracture hematoma and keeping the periosteum intact, which positively influences bone formation, and improves cosmetics due to the small incisions used. Different techniques and examples of IMF devices have been reported and include the Hagie pin, Knowles and Rockwood pins and Titanium Elastic Nails (TEN).

In nailing major complications like bone-healing problems and deep infections requiring implant removal were reported no higher than 7%. Reported rates for minor complications, such as wound infection and implant irritation that could be resolved without further surgery, were as high as 31%. The noted rates for major complications requiring additional surgery were low, but implant related problems that also require additional surgery might present with high prevalence. Although plating of the clavicle spans the original fracture site, it rarely involves fixation along its entire length. Re-fracture secondary to additional trauma either medial or lateral to the original hardware is thus possible, and in fact is reported at rate of between 1% and 2%. Re-fracture necessitates revision Open Reduction and Internal Fixation with Plating. In a recent randomized trial, there was a wound complication rate of approximately 5% [13, 14]

Plate fixation (PF) has an advantage that PF gives immediate stability and it provides superior fixation which enables early postoperative mobilization. Several types of plates and fixation methods have been described; these include (precontoured) dynamic compression plates (DCP), or reconstruction plates. Although high success rates of Plate Fixation of displaced clavicle fractures have been shown, reported complications of PF include implant failure, (deep) infections, implant prominence, poor cosmesis, non-unions and refracture as a result of removal of the plate are some of the main disadvantages.

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. Thus, the present study was conducted to evaluate the end results of Mid shaft clavicle fractures treated in Tertiary Care Centre by various surgical modalities and to evaluate the effectiveness of the different modalities of the treatment and their complications in respect totime required for union with respect to radiological and clinical outcomes, range of movements, associated complications with respect to infection, deformity and pain, stability at shoulder joint and the results were evaluated according to DASH score.

Materials and Methods

The present study was a Randomized, Prospective study carried out from October 2016 to March 2018 among patients admitted with midshaft clavicle fractures operated with intramedullary nailing and Open reduction and internal fixation with plating, patients were selected which were operated during the study duration at Orthopaedics Department in Krishna Hospital and Medical Research Centre attached to Krishna Institute of Medical Sciences Deemed University, Karad.

The present study was conducted among total 50 cases, out of them:

- 25 cases operated with Intramedullary elastic nailing
- 25 cases treated with open reduction and internal fixation with plate synthesis

In the present study, All the displaced middle third clavicle fractures- ROBINSON TYPE 2 A & TYPE 2 B, with Obvious clinical deformity, Compliant patients of 18-60 years age who have an active lifestyle, Bilateral clavicle fractures, comminuted fractures of the clavicle, Mid shaft Clavicle fracture associated with other injury and Medically fit to undergo surgery (ASA grade 1-3) were included.

Cases with Age <16yrs, Fractures older than 4 weeks, Pathological fractures, Open fractures, Congenital anomaly or bone disease, Any medical contraindication for surgery, Patient refusal , Medically unfit (ASA Grade 4/5), Established non-union from previous fracture, Previous fractures around the clavicle, Previous operations to shoulder or clavicle, Clinically important neuro-muscular upper limb disability.

General information like name, age, sex, occupation and address were noted. Then a detailed history was elicited regarding mode of injury like fall on the shoulder, Road traffic accident, direct injury to shoulder and fall on outstretched hand. Enquiry was made to note site of pain and swelling over the affected clavicle. Past medical illness and family history were also recorded. General condition of the patients was examined for pallor, pulse rate and blood pressure. Respiratory and cardio vascular system were examined for any abnormalities.

The fractures were treated in form of:
1. Open reduction and Plate Osteosynthesis
2. Operated with Intramedullary Fixation

The affected upper limb was immobilized with the help of a Clavicle brace.
In patient to be treated operatively routine investigation like Hb%, Total count, Differential count, ESR, Blood urea, Sugar, Serum creatinine, Serum Electrolytes and ECG were done. HBsAg, HCV and HIV test were done before surgery on all patients.
All the patients were operated as early as possible once the general conditions of the patients were stable and the patients were fit for surgery as assessed by the physician.
Instruments used for plate fixation / Intramedullary nail fixation -
1. Titanium / Stainless Steel Precontoured superior and anterior locking compression plate
2. Reconstruction plate
3. Locking reconstruction plate
4. Locking and cortical screws
5. Hand drill / pneumatic drill
6. General instruments like retractor, periosteal elevator, reduction clamps, bone lever, t-handle, impactor and cutting plyer.
7. Fully functional Orthopaedic Operation theatre
8. Titanium or Stainless Steel Elastic Nails (Diametre range 2-4 mm)
9. Curved and Straight bone Awl
10. Flexible hand reamers (Diametre range 2-4mm)

Results

This was a prospective study of 50 cases of midshaft clavicle fractures who were treated surgically at Krishna medical college and hospital, Karad, Satara from Oct 2016 to March 2018. We assessed the demographic characteristics of the study population. It was observed that majority of patients in Group P (60%) and Group I (68) was in age group 21-30 years. The mean age in group P was 35.84 years and group I was 36.02 years. There was no significant difference in age distribution in two groups. ($P>0.05$)
The surgery time in Group P and Group I was 58.38 ±10.18 and 52.39 ±9.24 minutes respectively. This difference in mean surgery time in patients was statistically not significant. ($P>0.05$). The length of incision in Group P and Group I was 10.2 ±1.18 and 4.25 ±1.68 cms respectively. The length of incision in Group P patients was more compared to Group I with statistically significant. ($P<0.05$)
The average blood loss in Group P and Group I was 130.21 ±20.44 and 72.63 ±13.23 ml respectively. The average blood loss in Group P patients was more compared to Group I with statistically significant. ($P<0.05$). There were no intraoperative complications in both the groups.
The VAS score pre-operatively in Group P and Group I was 7.23 ±1.62 and 7.19 ±1.59 respectively. This difference in VAS in patients was statistically not significant. ($P>0.05$). The VAS score at 1 week, 6 weeks and 6 months decrease in Group P as in comparison to Group I, but the difference in VAS in patients was statistically not significant at 1 week, 6 weeks and 6 month. ($P>0.05$). The mean fracture union time in Group P and Group I was 6.18 ±1.43 and6.78 ±1.92 months respectively. This difference in mean fracture union time in patients was statistically not significant in both groups. ($P>0.05$)
The flexion in Group P and Group I was 165.75 ± 9.21 and 164.68 ± 8.28 respectively. This difference in flexion movement in patients was statistically not significant. ($P>0.05$). The abduction in Group P and Group I was 166.25 ±10.49 and 167.18 ±11.22 respectively. This difference in abduction movement in patients was statistically not significant in both groups. ($P>0.05$)
The internal rotation in Group P and Group I was 72.5 ±6.50 and 73.11 ± 6.23 respectively. This difference in internal rotation movement in patients was statistically not significant in both groups. ($P>0.05$). The external rotation in Group P and Group I was 74.25 ± 5.19 and 73.19 ± 5.63 respectively. This difference in external rotation movement in patients was statistically not significant in both groups. ($P>0.05$). It was observed that majority of patients in Group P (56%) had excellent outcome followed by good outcome (44%). In group I, 15 (60%) patients had good outcome followed by fair outcome (36%).However Group I showed poor one outcome (4%).
The difference among outcome in both groups showed no statistical significance by chi square test. ($P>0.05$). The above table shows distribution of patients according to complications. It was observed that majority of patients in Group P (12%) had hypertrophied scar followed by surgical site infection (8%). In group I, 2 (8%) patients had surgical site infection followed by 1 incidence of implant failure (4%). The difference among complications in both groups showed no statistical significance. ($P>0.05$)

Discussion

The majority of clavicle fractures heal with nonoperative treatment is no longer valid. Nonunion after a clavicle fracture is an uncommon occurrence. The prevalence is higher than previously reported. There are subgroups of individuals who appear to be predisposed to the development of this complication either from intrinsic factors such as age or gender, or from the type of injury sustained.
The main principles of non-operative treatment historically have included the bracing of the shoulder girdle to raise the outer fragment upward, out ward and backward, depression of the inner fragment, maintenance of reduction and the use of ipsilateral elbow and hand so that associated problems with immobilization can be avoided. Conservative management reported certain disadvantages such as it needs frequent readjustment and it causes increased discomfort. complications such as axillary pressure sores, upper extremity oedema and venous congestion, brachial plexus palsy, worsening of deformity and increased risk for non-union.
The optimal method to treat displaced mid shaft 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. Hence, the present study was conducted to evaluate the end results of Mid shaft clavicle fractures treated in Tertiary Care Centre by various surgical modalities and to evaluate the effectiveness of the different modalities of the treatment and their complications in respect to time required for union with respect to radiological and clinical outcomes, range of movements, associated complications with respect to infection, deformity and pain, stability at shoulder joint
In the present study, it was observed that the mean age in group P was 35.84 years and group I was 36.02 years. There was no significant difference in age distribution in two groups. ($P>0.05$). In a study done by Nidhi Narsaria *et al.* [15]

on surgical fixation of displaced midshaft clavicle fractures elastic intramedullary nailing versus precontoured plating observed the average age in the plating group was 40.2 ± 11.2 (range 18–64) years and in the elastic nailing group it was 38.9 ± 9.1 (range 20–62) years. Both groups showed no statistical difference in term of age (p = 0.82)

The mean injury time in Group P and Group I was 2.42 ±1.23 and 3.18 ±1.39 weeks respectively. This difference in mean injury time in patients was statistically not significant. (*P*>0.05). Nidhi Narsaria *et al*. [15] study on surgical fixation of displaced midshaft clavicle fractures elastic intramedullary nailing versus precontoured plating observed no statistical difference in term of time from injury to operation (p = 0.62).

Surgery was performed at a mean of 7.2 ± 3.2 days (range 1–14 days) of injury time in the plate group and at a mean of 6.9 ± 3.1 days (range 1–13 days) in patients in the intramedullary nail group, and there was no statistically significant difference (p = 0.62).In a study by Partha Saha *et al*. [16] on plate versus titanium elastic nail in treatment of displaced midshaft clavicle fractures observed the trauma surgery delay was 12.84 ± 5.90 days (range 3‑ 27 days) in the Plate group and 13.79 ± 5.90 days (range 4‑ 27 days) in the nail group with no statistical significance. The surgery time in Group P and Group I was 58.38 ±10.18 and 52.39 ±9.24 minutes respectively. This difference in mean surgery time in patients was statistically not significant. (*P*>0.05), and the length of incision in Group P and Group I was 10.2 ±1.18 and 4.25 ±1.68 cms respectively. The length of incision in Group P patients was more compared to Group I with statistical significant. (P<0.05).

The average blood loss in Group P and Group I was 130.21 ±20.44 and 72.63 ±13.23 ml respectively. The average blood loss in Group P patients was more compared to Group I with statistical significant. (P<0.05) There were no intraoperative complications in both the groups. In a study by Partha Saha *et al*. [16] on plate versus titanium elastic nail in treatment of displaced midshaft clavicle fractures observed, mean operative time was significantly shorter in the nail group than in the plate group (P < 0.001). The mean intraoperative blood loss was significantly lower in the nail group than in the plate group (P < 0.001) The average wound size was also much smaller in the nail group than in the plate group. Similarly, Nidhi Narsaria *et al*. [15] study on surgical fixation of displaced midshaft clavicle fractures elastic intramedullary nailing versus precontoured plating observed length of incision, operation time, blood loss and duration of hospital stay were significantly less for the intramedullary nail group.

The VAS score pre-operatively in Group P and Group I was 7.23 ±1.62 and 7.19 ±1.59 respectively. This difference in VAS in patients was statistically not significant. (*P*>0.05) The VAS score at 1 week, 6 weeks and 6 months decrease in Group P and Group I, but the difference in VAS in patients was statistically not significant at 1 week, 6 weeks and 6 month. (*P*>0.05). In a study by Silva *et al*. [17] the VAS scores for patients in the plating group were less as compared to the nailing group though statically not significant.

The flexion in Group P and Group I was 165.75 ± 9.21 and 164.68 ± 8.28 respectively. This difference in flexion movement in patients was statistically not significant. (*P*>0.05). The abduction in Group P and Group I was 166.25 ±10.49 and 167.18 ±11.22 respectively. This difference in abduction movement in patients was statistically not significant in both groups. (*P*>0.05) The internal rotation in Group P and Group I was 72.5 ±6.50 and 73.11 ± 6.23 respectively. This difference in internal rotation movement in patients was statistically not significant in both groups. (*P*>0.05) The external rotation in Group P and Group I was 74.25 ± 5.19 and 73.19 ± 5.63 respectively. This difference in external rotation movement in patients was statistically not significant in both groups. (*P*>0.05)

The clinical union time was considered as absence of tenderness at fracture site and radiographic union was defined as evidence of bridging callus or obliteration of fracture lines. The mean fracture union time with respect to radiological union and clinical union in Group P and Group I was 6.18 ±1.43 and 6.78 ±1.92 months respectively. This difference in mean fracture union time in patients was statistically not significant in both groups. (*P*>0.05). Jamal E.H. Assobhi *et al*, in their study observed that middle third clavicle fractures united at an range of 3- 9 months following conservative management.

In a similar study in Silva *et al*[17] the mean time to radiographic union was 2.7 months in the plating group and 2.4 in the nailing group but this difference was insignificant. Nidhi Narsaria *et al*. [15] study on surgical fixation of displaced midshaft clavicle fractures elastic intramedullary nailing versus precontoured plating observed the average bone union time was shorter in the intramedullary nail group (6.1 months ± 1.8; range 2.5–8 months) than in the plating group (7.4 months ± 2.7; range 3–11 months) but this difference was insignificant (p = 0.68).

It was observed that majority of patients in Group P (56%) had excellent outcome followed by good outcome (44%) according to DASH Score. In group I, 15 (60%) patients had good outcome followed by fair outcome (36%).However Group I showed poor outcome (4%).The difference among outcome in both groups showed no statistical significance.(*P*>0.05). Vikas Kulshreshtha *et al*, among their study,in conservative group observed that 3 patients hadexcellent functional outcome, 7 had good functional outcome, 3 patients had satisfactory to adequate outcomes.

In another study conducted by Silva *et al*. The six month DASH scores were 9.9 for the plating group and 8.5 for the intramedullary nailing group, similarly there was no difference at the end of 1 year in the both groups in DASH score.In another study by Zehir *et al*. Mean DASH scores were not significant in Intramedullary nailing and plating groups respectively. In a study by Partha Saha *et al*. [16] on plate versus titanium elastic nail in treatment of displaced midshaft clavicle fractures observed, the overall results using the constant score were 26 excellent, 9 good and 2 fair in the plate group; while in the nail group it was 28 excellent and 6 good results.

The mean shortening of clavicle in Group P and Group I was 3.72 ±1.22 and 6.75 ±2.34 mm respectively. This difference in mean shortening of clavicle in patients of Group I was more with statistical significance. (P<0.05). In a study by Partha Saha *et al*. [16] on plate versus titanium elastic nail in treatment of displaced midshaft clavicle fractures observed, Clavicle lengths were significantly better maintained by plating [18] (*P* = 0.001) than by nail.

The mean time to return to normal activity in Group P and Group I was 12.18 ±4.18 and 16.88 ±5.28 weeks respectively. This difference in mean time to return for normal activity of Group I patients was more compared to Group P with statistical significance. (P<0.05)

It was observed that majority of patients in Group P (12%) had hypertrophied scar followed by surgical site infection (8%). In group I, 3 (12%) patients had surgical site infection and 1 (4%) patient had implant failure. The difference

amongcomplications in both groups showed no statistical significance. (P>0.05)

In a study by Partha Saha *et al*. [16] on plate versus titanium elastic nail in treatment of displaced midshaft clavicle fractures observed, major complications in 5 patients [infection (n= 4) and nonunion (n = 1)] in the plate group, while none in the nail group. In the plate group, subjective evaluation of cosmetic results was poor in 13 patients [ugly scar (n = 6), hardware prominence (n = 9)] when compared to 12 patients in the nail group [hypertrophic callus (n = 1)]

The vast majority of clavicle fractures occur in the midshaft region with overall rates being reported as high. Although non-operative management remains a viable option for many of these fractures, internal fixation is becoming increasingly common. The indications for fixation have expanded in response to evidence that non-unions occur as often as 15% in completely displaced mid-shaft clavicle fractures [18], and poor functional outcomes occur with fractures with greater than 20 mm of shortening or medialization. Specifically, plating of such fractures remains popular amongst orthopaedic surgeons. For the physician, plating has been shown to be a reliable and relatively easy technique to learn and perform with the emergence of improved implants and better soft-tissue handling. Post-operatively, plating also provides immense stability and strength, potentially enabling earlier rehabilitation. Comparatively, intramedullary fixation of displaced midshaft clavicle fractures has also yielded good functional results and patient satisfaction. Because of the minimally invasive nature of this technique, good cosmetic results have also been indicated; as a smaller incision is required when ther one technique is superior in comparison to the other has yet to be adequately addressed. Although the results suggest the potential comparable results achieved with each method, several important considerations need to be made such as cost, length of procedure, and ease of approach, patient's functional demands.

Table 1: Age distribution group plating

Age group (Years)	Group Plating (%)	Nailing Group (%)
16-20	00 (00)	01 (04)
21-30	15 (60)	17 (68)
31-40	05 (20)	05 (20)
41-50	03 (12)	01 (04)
51-60	02 (08)	01 (04)
Total	25 (100)	25 (100)

Table 2: Distribution according to intra-operative characteristics-Plating and nailing Groups

Intra-operative characteristics	Group Plating	Group Nailing	P value
Surgery time (min)	58.38 ±10.18	52.39 ±9.24	>0.05
Length of incision (cms)	10.2 ±1.18	4.25 ±1.68	<0.05
Average blood loss (ml)	130.21 ±20.44	72.63 ±13.23	<0.05
Intra-operative complications (%)	00	00	-

Table 3: Distribution according to pain assessment-Plating Group

Pain (VAS score)	Group P	Group I	P value
Pre-operative	7.23 ±1.62	7.19 ±1.59	>0.05
1 week	3.18 ±1.62	3.24 ±1.59	>0.05
6 weeks	2.89 ±1.18	2.93 ±1.06	>0.05
6 month	1.90 ±0.78	2.03 ±0.89	>0.05

Table 4: Distribution according to range of movement assessment at 6 months

Range of movement	Group P	Group I	P value
Flexion	165.75 ± 9.21	164.68 ± 8.28	>0.05
Abduction	166.25 ±10.49	167.18 ±11.22	>0.05
Internal Rotation	72.5 ±6.50	73.11 ± 6.23	>0.05
External Rotation	74.25 ± 5.19	73.19 ± 5.63	>0.05

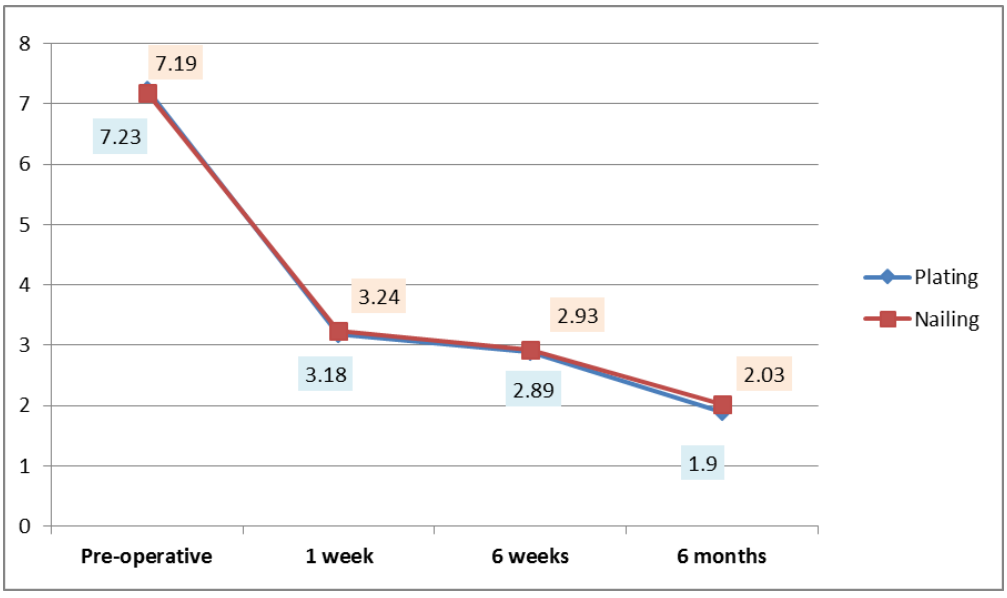


Fig 1: Distribution according to pain assessment among Plating and nailing Group

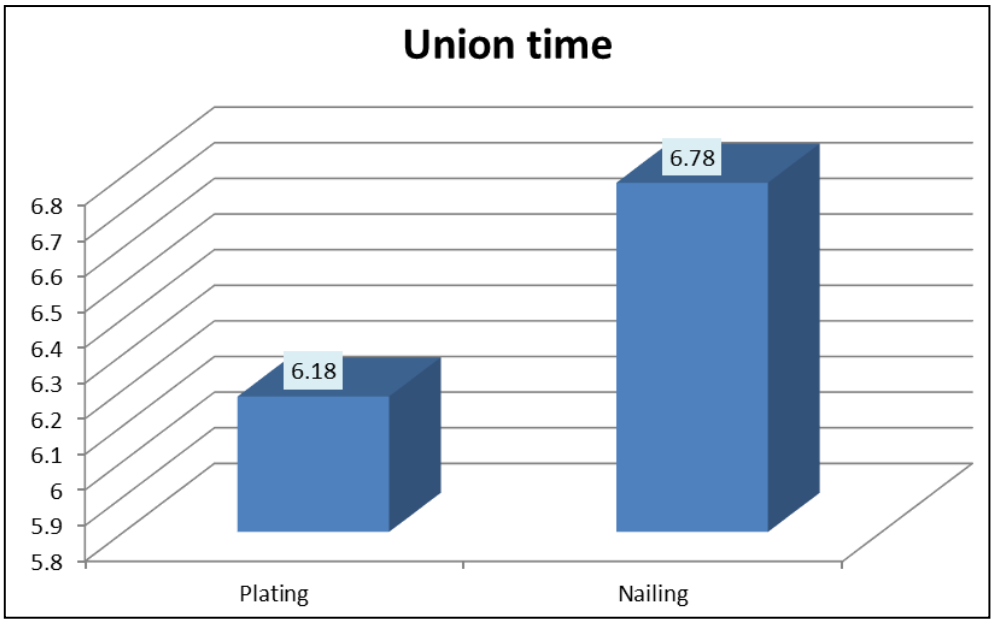


Fig 2: Union time among nailing and plating groups

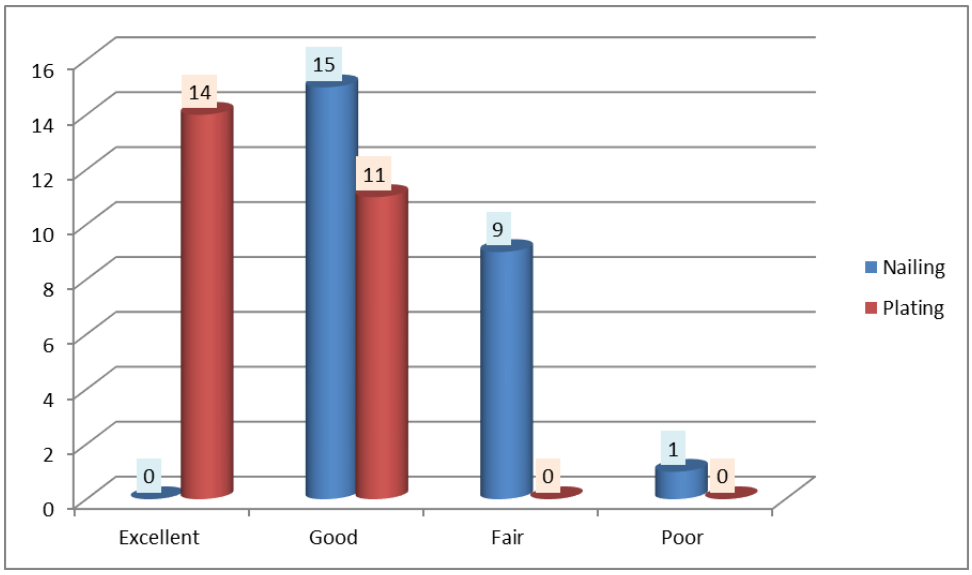


Fig 3: Functional outcome among nailing and plating groups

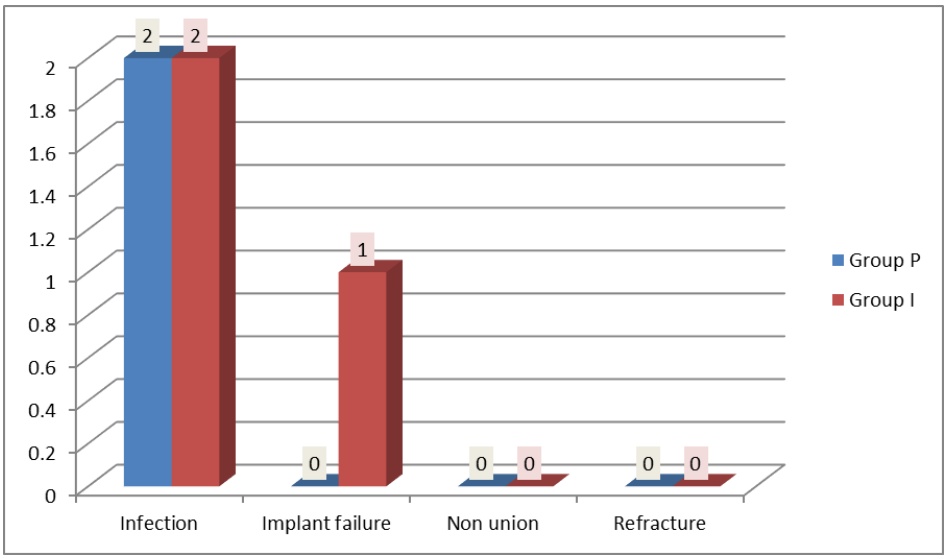
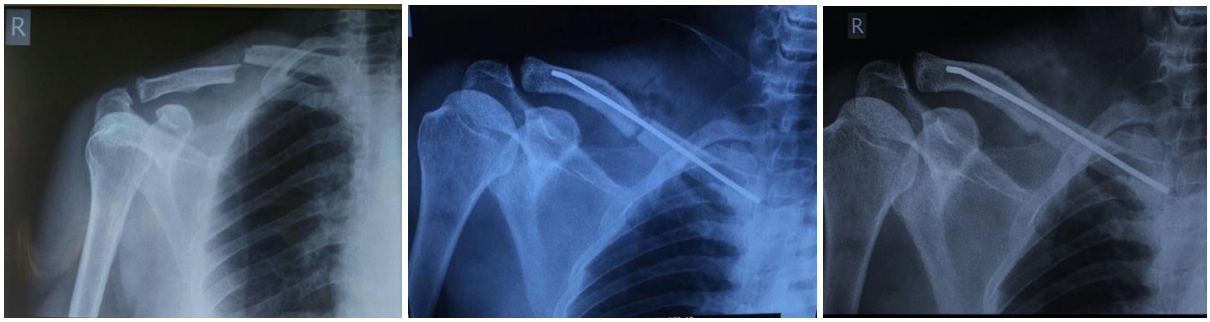


Fig 4: Distribution according to complications

Pre-operative X-ray | Post-op | 6 months post-op

Case 1: Plate fixation



Pre-Operative X-ray | Post-op 6 Months | post -op

Case 2: Intramedullary Nail Fixation

Conclusion

From the present study, we conclude that plate fixation for severely displaced comminuted mid shaft clavicle fractures provides excellent results in terms of rigid fixation, rotational stability and maintenance of anatomical length which intramedullary nailing fails to maintain. Hypertrophied scar and plate prominence are the disadvantages of plate fixation. Intramedullary fixation shows good cosmetic result and good functional results when done in a closed manner for non comminuted mid shaft clavicle fractures. In severely displaced comminuted mid shaft clavicle fractures plate fixation is the gold standard with excellent functional outcome.

Conflicts Of Interest: None to declare
Sources of Funding: None

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