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Plate fixation versus elastic nailing for displaced clavicle fractures: A comparative study

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Abstract

Background: A prospective comparative study carried out to compare the efficacy of intramedullary nailing and plate fixation, for displaced midshaft clavicular fracture, over each other.

Materials and Methods: 62 patients with midshaft clavicle fracture were randomly divided into the plating group (31 patients) and the nailing group (31 patients). Post operative assessment was done and outcomes were compared between the groups throughout the follow up period of 1 year in terms of union rate, cosmesis, functional score and complications.

Results: Incision length ($p=0.008$), operative time ($p=0.02$), blood loss ($p=0.003$) and hospital stay was significantly less for the nailing group as compared to the plating group. Implant failure, non union and hypertrophic scar was more prevalent in the plating group. The Constant Murley score was significantly higher for the nailing group ($p=0.04$) in the initial 6 months of the follow up, however there was no statistically significant difference in the DASH score ($p=0.42$) and Constant score beyond 6 month follow up.

Conclusion: Intramedullary nailing is a superior alternative to plate fixation for clavicle fracture because of less complications, less hospital stay, better cosmesis and functional outcome.

Keywords: plate fixation, elastic nailing, displaced clavicle

Introduction

Clavicle is one of the most commonly fractured bones accounting for 2.6 – 4 % of all the fractures [1]. 69 – 82% of these occur in middle third of clavicle, 73 % of which are displaced midshaft clavicular fractures) [2]. A direct blow or fall is the most common mechanism of injury [3,4].

Displaced midshaft clavicle fracture have been treated conservatively because the previous literature suggested clavicle non union to be rare and malunion to be clinically irrelevant [5, 6]. However unsatisfactory results in terms of union, cosmesis, pain, muscle strength and functional outcomes were observed in 30% of the patients treated conservatively [7, 8].

Recent literatures support surgical management of displaced midshaft clavicle fracture [9, 10] over the traditional conservative management. Various modalities for fixation of clavicular fractures like dynamic compression plate (DCP) [11], tubular plates, reconstruction plates [12], Knowles pin [13], rock wood pin [14], titanium elastic nail [15], external fixator [13-15] have been described.

Plate fixation and intramedullary nailing are the two commonly used surgical techniques [9, 10] but conflicting evidences, regarding their efficacy over each other, exists. Studies suggest that plate fixation provides more rigid stabilisation and stronger construct, facilitating early rehabilitation, as compared to nails [16] but in terms of soft tissue preservation, callus formation and infection rates, intramedullary fixation has been found more promising [17].

This prospective study was carried out to compare the functional outcomes of plate fixation and intramedullary fixation for Displaced midshaft clavicular fracture.

Materials and methods

A prospective comparative study was conducted on 62 patients between August 2013 to September 2017. The patients were divided randomly into the plating group (31 patients) and the nailing group (31 patients).

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The patients with displaced midshaft clavicle fracture of duration less than 2 weeks and age group between 20-60 years were included in the study.

Exclusion criteria: Open fracture of clavicle, associated neurovascular injuries, more than 4weeks duration, comminuted fracture, pre-existing infection.

Technique

The patient were made to lie in supine position on the table and a folded towel was placed in the interscapular region. Primary painting, draping was done and the affected limb was kept free for intraoperative manipulation.

Nailing technique: TEN (titanium elastic nail) was inserted by a technique first described by Jubel *et al.* [18] In antegrade nailing a small incision is made 6mm-10mm lateral to the sternoclavicular joint and the medullary cavity was breached using a pointed owl directed in line to the clavicle. Under the fluoroscopic guidance, the reduction was achieved and the nail was inserted. In irreducible fractures, open reduction was done through an additional incision made over the fracture site, followed by nail fixation



Fig 1: Fracture clavicle fixed with elastic nail

Anterosuperior surface plating: An incision was made transversely over the fracture site and after a careful soft tissue dissection and subperiosteal dissection, the fractured ends were reduced and fixation was done using precontoured 3.5mm dynamic compression plate.

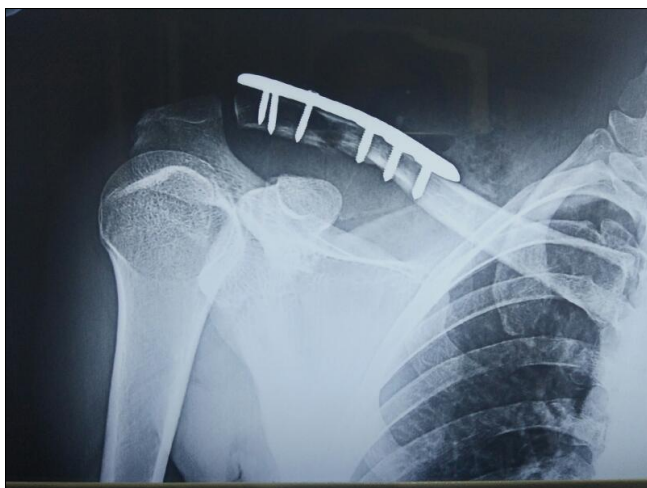


Fig 2: Fracture clavicle fixed with dynamic compression plate

In the post operative period antibiotics and analgesics were administered. Broad arm pouch was given and physiotherapy was started on the second post operative day as pain permitted. The patients were followed up at 2 weeks, 1 month, 6 month and 1 year and the outcomes were assessed in terms of union, Visual analog scale for pain (10:severe pain,

0:none), cosmesis, complications(infection, implant failure, nonunion). Shoulder function was assessed using DASH (Disability of Arm, Shoulder and Hand) score and Constant Murley score. In Constant Murley scoring system the grade is poor if score <69, fair: 70-79, good: 80-89 and excellent: 90-100.

Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected then non parametric test was used. Quantitative variables were compared using Unpaired t-test/Mann-Whitney Test (when the data sets were not normally distributed) between the two groups.Qualitative variables were compared using Chi-Square test /Fisher’s exact test. p value of <0.05 was considered statistically significant.

Results

Out of 62 patients, 48 were males (23 patients belonged to the nailing group and 25 to the plating group) and 14 were females (8 patients in the nailing group and remaining 6 in the plating group). The mean age was 38.2 years for the nailing group and 42, 6 for the plating group, however the difference was not statistically significant (p value 0.62). In the nailing group open reduction was done in 12 patients (38.7%) and closed in remaining 19 patients (61.29%). Statistically significant difference, favouring intramedullary nailing, was observed regarding incision length (p =0.008), blood loss (p=0.003) and surgical time (p=0.02) as shown in table 2. The hospital stay was almost same for both the groups. The post operative pain was comparatively higher for the plating group, however the difference was not significant (p=0.18).

Table 1: Demographic profile

Characteristic	Nailing group	Plating group	p value
Male : female	23:8	25:6	0.42
Age(mean) in years	38.2	42.6	0.62
Dominant : Non dominant	27:4	28:3	0.82
Mean duration of injury(days)	3.9	2.8	0.67

Table 2: Comparison of outcomes and perioperative factors

Perioperative parameters	Nailing group	Plating group	p value
Mean incision length (cm)	4.2	10.4	0.008
Mean Blood loss (ml)	50.8	165.3	0.003
Mean Surgical time (min)	38.6	65.4	0.02
Hospital stay	2.8	3	0.62
Post operative pain (VAS)	4	5	0.18
Union in first 6 months	30/31	29/31	0.36

Table 3: Comparison of complications between the groups

Complications	Nailing group	Plating group
Infection	0	1
Non union	1	2
Implant failure	1	3
Hypertrophic scar	0	3
Implant prominence	3	2
Asymmetry of shoulder	0	0

During the period of comparative study, 59 patients had union of the fracture site within first 6 months of the follow up. 1 patient in the nailing group and 2 patients in the plating group had non union at the fracture site for which open reduction

and plate fixation with autogenous corticocancellous bone grafting was done. The infection was reported in a single case belonging to the plating group during the early post operative period. It was controlled with intravenous antibiotics.

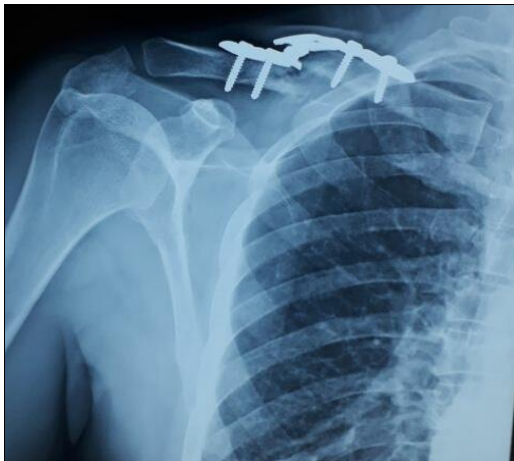


Fig 3: Implant failure in a 38 year old male patient

3 patients (9.6%) belonging to the clavicular plating group and one patient (3.2%) belonging to the nailing group had implant failure for which reoperation with plate fixation and bone grafting was done. Hypertrophic scar formation was seen in 3 patients in the plating group and was managed with intralesional steroid injection. 3 patients belonging to the nailing group had implant prominence over the medial aspect and were managed by implant removal in two of the cases following fracture union and nail re-impaction in one.

DASH score and Constant score were assessed throughout the follow up and it was found that the Constant score was significantly higher for the nailing group (72.8) as compared to the plating group (58.4) ($p=0.04$) during the initial 6 months follow up. There was no statistically significant difference between the groups using DASH score (Nailing group: 14 ± 4 ; Plating group: 13 ± 4 ; $p = 0.42$) and more than 6 months follow up using Constant score ($p>0.05$).

Discussion

Surgical management of fracture midshaft clavicle has never enjoyed the status of unambiguity in terms of implant selection. There are numerous methods for fracture clavicle fixation out of which plating and nail fixation are the most commonly used and most extensively researched. Numerous studies have been conducted which favour plating over nailing, however there are no less studies which suggest nailing to be an equally effective alternative Lee YS *et al.* [13] conducted a prospective comparative study on 62 elderly patients and observed that fixation with Knowles pin has more advantage over plate fixation because of small incision, less complications and shorter hospital stays. In a similar study conducted in 2008 on 88 patients (56 patients in the Knowles pin group and 32 patients in the plating group), pins were observed to be more advantageous in terms of healing and high shoulder scores. Ferran *et al.* [19] in 2010 randomly allotted 17 patients to the intramedullary fixation group and 15 patients to the plating group. During the mean follow up of 12.4 months, no statistically significant difference was observed between the groups in terms of constant scores ($p=0.0365$) and oxford scores ($p=0.773$). A biomechanical analysis was conducted by Drosdowech DS *et al.* [20] in which they fixed twenty fresh frozen clavicles using different fixation systems (plate and nail). After subjecting them to

mechanical testings it was observed that the plate construct demonstrated greater resistance to torque and bending loads as compared to the intramedullary nail. Jamal *et al.* [21] randomly allotted 38 patients with displaced midshaft clavicular fracture into plating and nailing group. Statistically significant difference was noted favouring the nailing group in terms of union and functional recovery. Complications and infection rate being higher for the plating group (15.8%; $p>0.05$).

Chen YF *et al.* [22] in a retrospective study included 141 patients who were treated with plate fixation and TENS (titanium elastic nailing system) fixation. They observed union time to be significantly shorter and shoulder score to be significantly better in the TENS group, however Houwert *et al.* [23] observed no such difference in the systematic review conducted on four studies comparing the plate and nail fixation. Barlow *et al.* [24] did a systematic review on one RCT (randomized controlled trial), two quasi-RCT and two retrospective studies, and they observed a lower complication rate for intramedullary fixation.

Saha *et al.* [25] in a prospective comparative study on 80 unilateral displaced midshaft clavicular fracture, observed faster union, less operative time, few complications and less blood loss for the nailing group in 24 months follow up. This was supported by a similar study conducted by Nidhi *et al.* [26] on 66 patients in a 2 year follow up. Wang *et al.* [27] performed meta-analysis on seven randomised controlled trials involving 421 patients. They observed a faster functional improvement and long mean surgical time for the plate group in the initial 6 months follow up, however beyond six months it was insignificant in terms of complication rates and recovery. Zehir *et al.* [28] randomly allocated 45 patients into plating group (21 patients) and intramedullary nailing group (24 patients) in a prospective randomized pilot study. They observe a shorter operative time ($p<0.001$), fluoroscopy time ($p=0.03$) and hospital stay ($p<0.001$) for the intramedullary pinning group. Adrade *et al.* [29] divided 59 patients into plate group (33 patients) and nailing group (26 patients). No statistically significant difference between the groups was observed in terms of DASH score, Constant Murley score, union and patient satisfaction. Vander *et al.* [30] conducted a multicentric RCT in four different hospitals which included 120 patients (58 plate fixation and 62 nail fixation). They observed no significant difference in Constant Murley score and DASH score in the initial 6 months follow up, however there was less disability experienced by the plate group beyond 6 months. Zhu Y *et al.* [31] included five RCTs in their meta-analysis study and observed intramedullary nail fixation to be better due to less surgical time, shorter incision, rapid union and better shoulder function. Hussain *et al.* [32] performed a meta-analysis on seven RCT and three quasi randomised trials. They observe equal long term functional outcomes for nailing and plating group but the treatment failure (2.19 times) and non operative complications (2.11 times) were significantly higher for the plating group.

In our study, intramedullary nailing was found to be superior in terms of less operative time, blood loss, hospital stay and incision length. Implant failure was more in the plating group and revision surgery was done. Some of the cases with nail fixation had implant prominence over the medial end of clavicle which led to pain and skin irritation. The problem of hypertrophic scar was comparatively more prevalent in the plating group. Major complications like implant migration into thoracic cavity or neurovascular injury were not observed in the study.

Limitation

Small number of patients, less follow up period and a single centre were the primary limitations of our study.

Conclusion

Both intramedullary nailing and plate fixation are equally effective alternatives for displaced midclavicular fracture fixation but intramedullary nailing would be a superior option because of less soft tissue damage, blood loss, surgical time, cosmetically better scar, shorter hospital stay and better shoulder score for the initial six month follow up using Constant shoulder score.

Conflict of interest: None

Future scope

Surgical fixation of clavicle is a superior alternative to the traditional conservative method, however debate for the implant of choice exists. Plating and nailing stand out to be the most effective alternatives but studies with large number of patients, long follow up time and in multiple centres would be needed to find out the superiority of one implant over the other.

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