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COMPARATIVE OUTCOME ANALYSIS OF FRACTURE TREATMENT OF MID-SHAFT OF CLAVICLE WITH TITANIUM ELASTIC NAILING AND PLATING TECHNIQUES

Orthopaedics

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ABSTRACT

Background: Traditionally, clavicle fractures were treated conservatively either by figure of 8 bandage or clavicle brace. This resulted in malunion, nonunion, persistent pain and residual deficit in shoulder strength in many cases. Now-a-days, intramedullary nailing or plating is gaining acceptance. The current study analyses the operative management of midshaft clavicle fractures with titanium elastic nailing and precontoured plating.

Methods: Clinical study of 48 patients aged 25-60 years with fracture of clavicle was carried out. All traumatic displaced midshaft clavicle fractures OTA (Orthopaedic Trauma Association) type B and < 3weeks old were included. Open fractures, pathological fractures and OTA type A/C fractures were excluded. Precontoured plating system (3.5mm) or titanium elastic nails (2.5/3.0mm) were utilized for fixation. Radiological and clinical evaluation using Constant shoulder scoring system was done at regular intervals.

RESULTS: All cases were followed up for an average period of 2.4 years. There was significant difference in both groups (less in nailing group) regarding surgery time (p-0.031), blood loss (p-0.004) and duration of hospital stay (p-0.032). The mean union time was shorter in nailing group (4.1±1.8mo; range 2.5-6mo) than in plating group (7.4± 2.7mo; range 3-11mo). Hypertrophic scar and implant prominence was observed in all cases of plating group.

CONCLUSION: We concluded that titanium elastic nailing was less invasive, easier to do, and less expensive option with better cosmetic outcomes and early return to work for displaced midshaft clavicle fractures.

KEYWORDS

Clavicle; Midshaft; Fracture; Plating; TENS

INTRODUCTION

Fracture of the clavicle is one of the most common fractures encountered in orthopaedic emergency and mostly treated conservatively (1, 2). Operative interventions were introduced in the form of plating and more recently in the form of minimal access titanium elastic nailing system (TENS) because of the occasional malunion, nonunion and persistent shoulder pain that may complicate the conservative treatment (3).

Plating of displaced midshaft clavicle fracture came out to be a standard operative treatment and can be done by placing the plate anterosuperiorly or anteroinferiorly. Newer method like intramedullary nailing is in use and can be done by putting Rockwood pin, K-wires or elastic intramedullary nail (4). Intramedullary nailing was introduced because there were many complications associated with plating like implant prominence, hypertrophic scar formation and supraclavicular nerve palsy associated with persistent pain or numbness.

This comparative study was designed to compare outcomes and complications of titanium elastic intramedullary nailing and anatomically precontoured plating in displaced midshaft clavicle fractures.

MATERIAL AND METHODS

A total of 48 patients with closed displaced midshaft clavicle fractures were operated and followed up for minimum of eighteen months. In this study, patients were divided consecutively according to inclusion and exclusion criteria into two groups, to be treated surgically with either a 3.5-mm precontoured dynamic compression plate (plate group) or with a single titanium elastic intramedullary nail fixation (TENS group) by closed or open reduction method under image intensifier guidance.

Inclusion criteria were patients aged 18-60 years of age with fracture duration <3 weeks, OTA type B and shortening of 15mm and axial malalignment of >30° without any cortical bone contact. Fractures with marked comminution, duration >3weeks, open fractures and OTA classification type A and C fractures were excluded.

Surgical Tactic:

Titanium elastic nailing: Under general anaesthesia patient is placed in supine position with towel below the operative shoulder. After part preparation, sternoclavicular joint and medial portion of clavicle is palpated and 1cm horizontal incision is given lateral to joint. Entry is made with help of bone awl under image intensifier then titanium elastic nail of 2.5/3.0mm is introduced and advanced into the medullary canal with help of T- handle. At fracture site closed reduction is tried first, if not possible then a small incision is given over fracture site to facilitate nail entry in the lateral fragment. Laterally nail is advanced up to a point just medial to acromioclavicular joint (5). Care has to be taken not to penetrate the dorsal cortex of clavicle. Medially nail is bent and cut leaving sufficient length for easy removal later on. Wound is washed and closure done in layers.

FIGURE 1

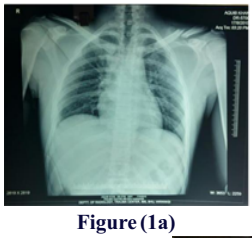

Figure (1a)

Figure (1b)

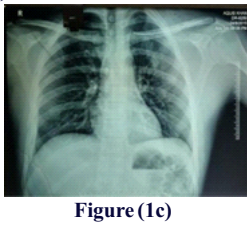

Figure (1c)

(1a)Pre operative x-ray.
(1b) C-Arm image intensifier showing passage of intra medullary nail from 1 fractured segment to other.
(1c) Post operative x-ray.

Plate fixation: Patient positioning and preparation remains the same. Transverse incision is given under the fracture site. Supraclavicular nerves are identified and saved. Minimum soft tissue dissection is done. At fracture site both fracture fragments are cleared from clots and soft tissue and held by bone holder and reduced, then a 3.5mm precontoured plate is placed is fixed to bone with bicortical screws. Additional interfragmentary screw is placed for oblique fractures. Wound is washed closed in layers (6).

FIGURE 2

Figure (2a)

Figure (2b)

Figure (2c)

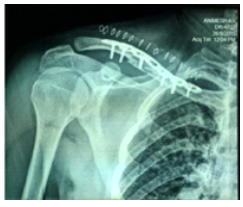

Figure (2d)

(2a) Photograph showing plate fixation of clavicle along with supraclavicular nerves.
(2b) Photograph showing closure of wound with subcuticular suture.
(2c) Pre operative x-ray.
(2d) Post operative x-ray.

Post-operatively, pendulum exercises were started as tolerated. In both groups patients were not allowed over head abduction and forward flexion above 90° for 3 weeks and limb was supported by a sling.

Evaluation: Cases were evaluated in terms of per operative measures and postoperative measures. Surgery time, incision length, duration of hospital stay, and pain visual analogue scale (0: none to 10: severe) were calculated for each patient. In the follow-up visits, all patients were re-evaluated clinically and radiologically at 1st, 2nd, 4th, 6th, 12th, 18th and 24th month to assess outcomes of fracture fixation in both the groups, like time of fracture union, shoulder and arm function.
Scoring system: Shoulder function was evaluated according to the Constant Murley shoulder score, (100-point scoring systems). The scoring system comprises the combined assessment of subjective and objective findings. The test is divided into four subscales: pain (15 points), activities of daily living (20 points), strength (25 points) and range of motion (40 points). The parameters tell us about the level of pain and the ability to carry out the normal daily activities of the patient (7). In the Constant scoring system, the overall grading is excellent if the total score ranges from 90 to 100, good for 80–89, fair for 70–79and poor if the scores are 69 or less. More the score, better the quality of the function. It required about 5-7 minutes completing the constant scoring test (8, 9).

Complications of both groups were assessed; nonunion was defined clinically as pain and mobility at fracture site and radiologically as visible gap after 6 months, infection was classified as superficial, requiring treatment with antibiotics, and deep infection, those which required implant removal.

Statistical Analysis: Student's t-test was utilized to calculate the difference of means for different parameters. The test was used to calculate the p value, and a 95 % confidence interval was constructed around a sensitivity proportion using a normal approximation method. A value of $p<0.05$ was considered as statistically significant.

RESULTS

A total of 48 patients (21 in TENS group and 27 in Plating group) with displaced mid shaft clavicle fractures were included and underwent surgery. Male to female ratio was 3:1. Right to left side involvement was 1:1. Road traffic injury was the commonest cause (28 cases), followed by fall on ground (15 cases) and sports activity in 5 cases.

In the TENS group, closed reduction and internal fixation was done in 8 cases (38.08%), and open reduction was done in the remaining 13 patients (61.92%). There was significant difference in both the groups (less in TENS group) regarding mean surgery time (p-0.031), incision length (p-0.008 and duration of hospital stay (p-0.033) as shown in table 1. The average union time was shorter in the TENS group (4.5 months; range 3–8 months) as compare to the plating group (6.93 months; range 3–11 months) but this difference was not significant (p-0.42).

Table 1: Comparison of perioperative measures and outcomes of both groups

Outcome	Plating group (n=27)	Titanium elastic nailing group (n=21)	p value
Surgery time (min)	68.77 (60-90)	47.90 (40-60)	0.031
Length of incision (cm)	7.292 (8-15)	3.024 (1-5)	0.008
Pain (visual analogue scale)	6.12 (2-9)	4.38 (2-9)	0.18
Hospital stay (days)	4.77 (2-6)	2.10 (1-4)	0.032
Average blood loss (ml)	120.58 (90-150)	50.00 (30-90)	0.004
Union time (months)	6.923 (3-11)	4.500 (3-8)	0.42

In the TENS group, one patient developed superficial infection at entry point which was controlled by antibiotics and one patient in plating group developed implant failure due to re-trauma which required implant removal and was further managed conservatively. No patient developed non-union of fracture. These are depicted in table 2.

Table 2: Comparison of complications of both groups

Outcome	Plating group (n=27)	Titanium elastic nailing group (n=21)	p value
Infection	0 (0)	1 (4.76)	-
Implant failure	1 (3.84)	0 (0)	-
Hypertrophic scar	18 (69.23)	5 (23.80)	0.029
Re-fracture	0 (0)	0 (0)	1
Non union	0 (0)	0 (0)	1
Supraclavicular nerve palsy	10 (0)	0 (0)	0.001

Out of 48 patients, 28 had no pain, 16 had occasional pain and only 4 had pain after doing heavy work (Table 3). There was no implant failure in the TENS group while one implant failure occurred in the plating group (3.84%), which was due to re-trauma. The case with implant failure was treated conservatively after removal of implant as patient denied further surgery and this resulted in undesirable outcome. Hypertrophic scar formation was the main problem among the patients which was observed in 18 cases in the plating group (69.23%), 5 in the TENS group (23.8%) (p-0.029).

Table 3: Pain

Pain	No. of patients	Percentage
No pain	28	58.33
Occasional	16	33.33
After hard work	4	8.33
Total	48	100.0

FIGURE 3

Figure 3 showing Six months follow up showing plate prominence and hypertrophic scar formation

Constant Shoulder score for functional assessment was done at every 2-monthly visit and showed significantly higher Constant score in the precontoured plating group than in the TENS group during early follow up period. The scores at the last follow-up showed no significant difference between two groups. (Table 4)

Table 4: Functional grading include pain and range of motion

Functional grading	No. of patients	Percentage
Excellent	10	2.08
Good	29	61.41
Fair	7	14.58
Poor	2	4.16
Total	48	100.0

DISCUSSION

Conservative treatment of fracture of the clavicle leads to many cases of malunion, nonunion and persistent shoulder dysfunction. So, currently operative intervention is recommended for midshaft clavicle fractures (10). Both plating and intramedullary nailing techniques are in practice now-a-days. But among plating and intramedullary nailing technique which is better is a topic of debate. In this study we compared results of anterosuperiorly pre-contoured plating and titanium elastic nailing.

In our study we achieved good to excellent results in both the groups. Overall no unsatisfactory results were present. In our study no implant failure occurred in the TENS group while one implant failure was seen in the plating group (3.84%), which occurred within three months of the primary surgical procedure due to an episode of re-trauma. Hypertrophic scar formation was observed in 18 cases in the plating group (69.23%) and 5 in the TENS group (23.8%) (p-0.029). Constant Shoulder score at the 2 year follow-up visit showed no significant difference between the two groups.

There were many studies in past which compared plating and some form of intramedullary nailing technique and all came to conclusion that both techniques show no significant difference in term of final functional outcome. In one study carried by Liu *et* al comparison between titanium elastic nailing and plate fixation in displaced midshaft clavicle fractures was done and there was no significant difference between the two techniques after 18 months in terms of functional outcome assessed by DASH (disability of arm shoulder and hand score) score (11). In another study by Ferranti et al, comparison was done between Rockwood pin fixation and low contact dynamic compression plate in displaced midshaft clavicle fractures. They also found no significant difference after 1-year in functional outcome assessed by Constant score (12).

Complications encountered in our study were mainly the hypertrophic scar, implant prominence and supraclavicular nerve injury which were more in the plating group. In a retrospective study done by Thyagarajan et al, 51 patients with clavicle fractures were evaluated. They were divided in 3 groups- in Group 1 intramedullary pins were used, plating in group 2 and group 3 was managed conservatively. Group 2 patients complained of hardware prominence for which implant removal was done. No refracture was encountered after implant removal (13). Complications like migration of implant into thoracic cavity after intramedullary nailing were not encountered in our study. This type of complication was not encountered after fixation with TENS in any study (14).

Limitation of titanium elastic nailing is that it requires image intensifier which was not necessary in open surgeries. Surgery for implant removal required general anaesthesia in cases treated with plate and bone quality after removal was not good due to multiple bicortical holes but in TENS group implant removal was done under local anaesthesia and quality of bone is much better than plating group.

CONCLUSION

Although it is a small study in terms of cases but from this study we can bring out the essence that both precontoured plating and intramedullary flexible nailing are more or less equally effective in dealing with midshaft clavicle fractures in terms of union of fracture and shoulder function. Precontoured plating is much more effective in term of fixation and providing rotational stability but at the same time also associated with much higher complication rate in form of supraclavicular nerve injury, implant prominence and hypertrophic scar formation. On the other hand elastic intramedullary nailing is somewhat inferior to plating in terms of fixation but is much easier technically, less expensive, less time consuming, more patient friendly and associated with lesser complication rate. So elastic intramedullary nailing can be considered as a better option than plating in dealing with displaced non-comminuted midshaft clavicle fracture.

Conflict of interest: There was no conflict of interest.

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