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Functional Outcome of Plating Versus Intramedullary Nailing in Displaced Midshaft of Clavicle Fracture: A Compartive Study

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ABSTRACT
Clavicle is a unique S-shaped bone that is the only long bone oriented horizontally. Clavicle fractures account for approximately 50%-60% of all shoulder-related fractures. Non-surgical management encompasses several treatment methods however surgical options for fixing clavicle fractures includes the use of dynamic compression plates, tubular plates, reconstruction plates, Rockwood pins, titanium elastic nails and external fixators. Among the surgical management intramedullary nailing with titanium elastic nails and plate fixation are popular methods for addressing displaced mid-shaft clavicle fractures. This is a Prospective Study conducted among 34 patients in Sree Mookambika Institute of Medical Sciences, Kulasekharam, who were diagnosed to have mid shaft clavicle fracture. Inclusion criteria included patient aged 18-70 years, closed fracture and Allman type I displaced mid shaft clavicle fracture with displacement <2 cm. Exclusion criteria includes comminuted fracture, Allman type I fracture with displacement >2 cm, Allman type II and III fracture, paediatric fracture, fracture associated with neurovascular injury, floating shoulder, pathological fracture, associated head injury, acromioclavicular joint dislocation and those not giving consent for this study. Functional outcome was assessed with VAS score and DASH score. The DASH score for plating group was <10 in 10 patient, 10-15 in 5 patient and >15 in 2 patients. Whereas DASH score for intramedullary nailing group <10 in 13 patient, 10-15 in 3 patient and >15 in 1 patient. For managing displaced midshaft clavicular fractures, intramedullary nailing proves to be more effective than plating.

INTRODUCTION

The clavicle is a unique S-shaped bone that is the only long bone oriented horizontally. It is the first bone to ossify during fetal development and the last to fully ossify in adulthood. This bone plays a crucial role in stabilizing the connection between the appendicular and axial skeletons. The medial end of the clavicle is convex in shape, while the lateral end is concave. The lateral end creates the acromioclavicular joint, whereas the medial end joins the sternum to produce the sternoclavicular joint. The medial third of the clavicle protects several vital structures, including the brachial plexus, subclavian vessels and axillary vessels. The medial end is supported by anterior and posterior sternoclavicular ligaments, the interclavicular ligament, and the costoclavicular ligaments. In contrast, the lateral end is secured by the coracoclavicular ligament, which consists of the trapezoid and conoid ligaments. These provide superior stability to the lateral end of clavicle compared to the acromioclavicular ligaments. Clavicle fractures account for approximately 50%-60% of all shoulder-related fractures. They can arise from various causes, such as trauma to the shoulder, direct strikes to the clavicle, falls onto an outstretched hand, seizures, pathological conditions, or stress injuries. It is the most frequently fractured bone in newborns. Fractures most frequently occur in the middle portion of the clavicle, then the medial and lateral ends. Patients with a clavicle fracture typically exhibit pain, swelling, and deformity at the fracture site, as well as difficulty using the affected arm. As a subcutaneous bone, the clavicle often reveals skin tenting and bruising at the fracture[1-3]. Although this fracture is prevalent, selecting the appropriate treatment remains a challenge for orthopaedic surgeons[4]. non-surgical management encompasses several treatment methods such as strapping, figure-eight bandaging, slings, or combinations of these techniques and is usually the first line of care for undisplaced shaft fractures. However, for displaced shaft fractures, surgical intervention is generally preferred over conventional conservative treatment. Various surgical options for fixing clavicle fractures have been documented, including the use of dynamic compression plates, tubular plates, reconstruction plates, Rockwood pins, titanium elastic nails and external fixators[5-7]. Among these, intramedullary nailing with titanium elastic nails and plate fixation are popular methods for addressing displaced mid-shaft clavicle fractures. Each approach has its distinct benefits., plating offers rigid stabilization and encourages early rehabilitation, while intramedullary fixation is noted for better preservation of soft tissues and enhanced callus formation[8,9]. Therefore, the aim of our study is to evaluate the functional outcomes of plate fixation versus intramedullary fixation for displaced mid-shaft clavicle fractures.

MATERIALS AND METHODS

This prospective study was done in department of orthopaedics, Sree Mookambika institute of Medical Sciences, Kanyakumari from April 2022 to August 2024. In this study 34 patients with displaced mid shaft of clavicle fracture attending OPD and causality were included. Patient diagnosed clinically and radiologically with displaced mid shaft clavicle fracture and willing to participate in this study were included in this study. Inclusion criteria included patient aged 18-70 years, closed fracture and Allman type I displaced mid shaft clavicle fracture with displacement <2 cm. Exclusion criteria includes comminuted fracture, Allman type I fracture with displacement >2 cm, Allman type II and III fracture, paediatric fracture, fracture associated with neurovascular injury, floating shoulder, pathological fracture, associated head injury, acromioclavicular joint dislocation and those not giving consent for this study. Patient were separated into two group randomly with 17 patients in each group. Patients treated with plating are included in the first group. Second group includes patient treated with intra medullary nail (TENS).

Procedure: Patient in supine position parts were painted and draped in sterile manner for intraoperative manipulation.

Plate Fixation: A transverse incision was made just below the site of the fracture. Soft tissue was carefully dissected to minimize injury. Once the fractures were aligned, a pre-contoured locking plate was secured to the anterosuperior surface of the bone, starting from the medial side with bi-cortical screws. The surgical wound was closed meticulously.

Intramedullary Nailing Technique: A vertical incision was performed 2 cm lateral to the sternoclavicular joint and entry was made into the anterior cortex of the bone using a small bone awl. Throughout the procedure, proper anterior-posterior (AP), caudal and cranial views were taken. An appropriately sized TENS was inserted from the medial end, passed through the fracture site and advanced until the nail tip engaged with the supero-lateral cortex of the lateral end of the clavicle. The nail size was determined using the formula: 0.4 x canal diameter in mm.

Standardized Post-Operative Protocol and Follow-Up: Both groups received intravenous antibiotics for three days, which were then switched to oral antibiotics for an additional seven days. The operated arm was kept immobilized in an arm sling. The wound was assessed on the third post-operative day and an X-ray was performed to examine the alignment of the fracture fragments. Patients were discharged with their arm in the sling. Follow-up appointments were scheduled at

two weeks, one month, six months and one. Rehabilitation for the affected arm commenced at the two-week mark. During this time, patients were allowed to engage in gentle pendulum exercises for the shoulder while still in the sling. Between four-and six-weeks post-surgery, patients could begin gentle range of motion exercises for the shoulder, with abduction limited to 80-90 degrees. From six to eight weeks, active range of motion was permitted in all directions. Outcomes were evaluated based on bone union, the Visual Analog Scale for pain and any complications. Shoulder function was measured using the DASH score.

Table 1: Age Distribution of Study Population

Age in Years	Plating Group	Intramedullary Nail Group	Total
18-30	6 (35.2%)	5(29.4%)	11 (32.4%)
31-40	4(23.5%)	7(41.7%)	11 (32.4%)
41-50	4(23.5%)	4(23.5%)	8 (23.5%)
51-60	2(11.7%)	1(5.8%)	3(8.8%)
61-70	1(5.8%)	0(0%)	1(2.9%)
Total	17(100%)	17(100%)	34 (100%)

Table 2: Gender Distribution of Study Population

Gender	Plating Group	Intramedullary Nail Group	Total
Female	5(29.4%)	6 (35.2%)	11 (32.4%)
Male	12(70.6%)	11(64.7%)	23 (67.6%)
Total	17(100%)	17(100%)	34 (100%)

Table 3: Side of Injury

Side of Injury	Plating Group	Intramedullary Nail Group	Total
Right	12 (70.6%)	10 (58.8%)	22 (64.7%)
Left	5(29.4%)	7 (41.2%)	12 (35.3%)
Total	17(100%)	17(100%)	34 (100%)

Table 4: Mode of Injury

Mode of Injury	Plating Group	Intramedullary Nail Group	Total
Rta	7 (41.2%)	6 (35.2%)	13(38.2%)
Fall	5(29.4%)	7 (41.2%)	12 (35.3%)
Sports	5(29.4%)	4(23.5%)	9 (26.5%)
Total	17(100%)	17(100%)	34 (100%)

Table 5: Functional Outcome in Plating Group

Parameters	Variables	Results
Type of fracture	2b1	14(82.4%)
	2b2	3(17.6%)
Duration of surger (minutes)	<40 minutes	5(29.4%)
	>40 minutes	12 (70.6%)
Blood loss	50-100ml	4(23.5%)
	100-150ml	9 (52.9%)
	>150ml	4(23.5%)
Vas score	1-4	2(11.8%)
	5-7	13 (76.5%)
	7-10	2(11.8%)
Dash score at 6 months	<10	10 (58.8%)
	10-15	5(29.4%)
	>15	2(11.8%)

Table 6: Functional Outcome in Intramedullary Nailing Group

Parameters	Variables	Results
Type of fracture	b1	13 (76.5%)
	b2	4(23.5%)
Duration of surger(minutes)	<40 minutes	12 (70.6%)
	>40 minutes	5(29.4%)
Blood loss	50-100ml	10 (58.8%)
	100-150ml	6 (35.2%)
	>150ml	1(5.9%)
Vas score	1-4	13 (76.5%)
	5-7	4(23.5%)
	7-10	0(0%)
Dash score at 6 months	<10	13 (76.5%)
	10-15	3(17.6%)
	>15	1(5.9%)

Table 7: Complications Associated with Nailing and Plating

Complication	Plating Group	Intramedullary Nailing Group
Hardware migration	0(0%)	1(5.9%)
Infection	1(5.9%)	0(0%)
Malunion	1(5.9%)	1(5.9%)
Nonunion	0(0%)	0(0%)
Skin irritation	0(0%)	2(11.8%)

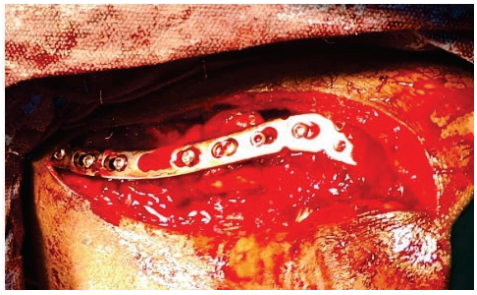

Image 1: Intraoperative Plate Fixation Image

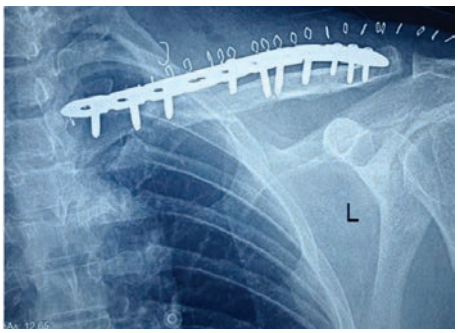

Image 2: Postoperative Plate Fixation Image

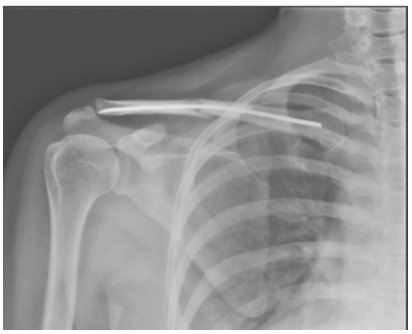

Image 3: Postoperative Intramedullary Nailing Image

RESULTS AND DISCUSSIONS

In this research, a total of 34 participants were involved, with each group-plating and intramedullary nailing-comprising 17 individuals. (Table 1) indicates that the majority of injured patients were in the 18-40 age range in both the plating and intramedullary nailing groups. According to (Table 2), the plating group had 12 males (70.6%) and 5 females (29.4%), while the intramedullary nailing group included 11 males (64.7%) and 6 females (35.3%). The male-to-female ratio in the plating group was 2.4:1, whereas in the intramedullary nailing group it was 1.8:1. This data clearly shows that males are more susceptible to clavicle fractures due to their higher involvement in high-impact trauma. (Table 3) reveals that the right limb was the most frequently affected in both groups, accounting for 70% in the plating group and 60% in the

intramedullary nailing group. As shown in (Table 4), road traffic accidents were the leading cause of injury in the plating group, with 7 cases (41.2%), while falls were the predominant cause in the intramedullary nailing group, also with 7 cases (41.2%). In the plating group, falls were the second most common cause at 5 cases (29.4%), whereas in the intramedullary nailing group, falls were followed by road traffic accidents, with 6 cases (35.2%) recorded. (Table 5) provides details on fracture types within the plating group, showing that 14 patients (82.4%) had type 2B1 fractures and 3 patients (17.6%) had type 2B2 fractures. A surgery duration of over 40 minutes was observed in 12 patients (70.6%). Blood loss of 50-100ml occurred in 4 patients, whereas 9 patients experienced blood loss of 100-150ml and 4 patients had <150ml of blood loss. The post-operative Visual Analog Scale (VAS) scores in the plating group were mainly between 5-7. At the 6-month mark, the Disability of the Arm, Shoulder and Hand (DASH) score was greater than 15 in 2 patients, 10-15 in 5 patients, and >10 in 10 patients. Radiological union within 9-12 weeks was achieved by 12 patients, 13-15 weeks in 4 patients in the plating group, with one case of malunion. (Table 6) highlights the fracture types within the intramedullary nailing group, where 13 patients (76.5%) had type 2B1 fractures and 4 patients (23.5%) had type 2B2 fractures. A surgery duration of over 40 minutes was noted in 5 patients (29.4%). Blood loss exceeding 150ml was recorded in 1 patient, while 6 patients experienced blood loss of 100-150ml and 10 patients had 50-100ml of blood loss. The post-operative VAS scores in the intramedullary nailing group were primarily between (1-4). At the 6-month follow-up, the DASH score was greater than 15 in 1 patient, between 10-15 in 3 patients and >10 in 13 patients. Radiological union within 9-12 weeks was observed in 15 patients, while 2 patients achieved union at 13-15 weeks and no cases of malunion were reported. According to (Table 7), there were no incidents of hardware migration in the plating group, whereas one case was reported in the intramedullary nailing group. An infection occurred in one case within the plating group, while no infections were documented in the intramedullary nailing group. Additionally, one case of malunion was reported in both groups and skin irritation was recorded in two cases exclusively within the intramedullary nailing group. Clavicle plays a crucial role in the mechanics the pectoral girdle and the functioning of the upper limb. Most clavicle fractures (80-85%) occur in the midsection of the bone, where the usual compressive forces on the shoulder, combined with the bone's narrow cross-section, lead to fractures[4,10,11]. Our research aimed to assess the healing rates and functional outcomes for displaced midshaft clavicle fractures treated surgically using TENS compared to plating. There are several techniques for clavicle fracture fixation, with plating and nail fixation being the most prevalent and thoroughly studied. Many studies support the use of plating over nailing, but there are also numerous studies indicating that nailing can be just as effective. Hence this present study was undertaken in department of orthopaedics, Sree Mookambika institute of medical sciences from April 2022 to August 2024 assess the functional outcome using DASH score, union time and post operative complications. In our present study the age of 18-40 was prevalent among both the groups which is similar to study done by Ganai[12]. In this study sex ration of male to female was 2.4:1 and 1.8:1 in plating and intramedullary nailing group respectively. Males were predominantly involved in both groups which were comparable with study made by Zehi[13] where males affected were 58.3% and females affected were 41.7% for intramedullary nailing group and 57.1% males and 42.9% females for plating group. In our study clavicle of right limb was found to be frequently involved with 70% in plating group and 60% in intramedullary nailing group which was comparable with study of Sahu[14] whose study also had predominantly dominant side involvement of 76% for intramedullary nailing group and 52% for plating group. In this study blood loss among intramedullary nailing group was found to be less compared to plating group due to less soft tissue exposure this is comparable to study done by Ganai[12] DASH score noted at 6 months was also found to better among intramedullary nailing group as compared with plating group. This is compared with study done by Ganai[12]. This study also suggest rate of radiological union was found to superior among intramedullary nailing group. This is comparable with study done by Ganai[12]. In this research, the male-to-female ratio was 2.:1 in the group and 1.8:1 the intramedullary nailing group. Both groups showed a predominance of males, consistent with the findings of Zehi[13] where 58.3% of those in the intramedullary nailing group were male, while the plating group had 57.1% males and 42.9% females. Our study identified that the right clavicle was most commonly affected, showing a prevalence of 70% in the plating group and 60% in the intramedullary nailing group. This finding aligns with the research conducted by Sahu[14] which also indicated a dominant side involvement of 76% for the intramedullary nailing group and 52% for the plating group. Additionally, our results indicated that blood loss was less in the intramedullary nailing group due to reduced soft tissue exposure, a finding that parallels the study by Ganai[12] The DASH score after six months was also superior in the intramedullary nailing group compared to the plating group, echoing the results found in Ganai[12] study. Furthermore, this study suggests that the rate of radiological union was better in the intramedullary nailing group, in line with the

work of Ganai[12] Ferran[15]. Conducted a study in 2010 where patients were randomly assigned the intramedullary nail fixation group and patients to the plating group. Over a mean-up period of. 4 months, was no statistically significant difference between the two groups constant scores (p=.0365) and scores (p=0.773). In a prospective comparative involving 80 patients with unilateral displaced mid shaft clavicular fractures, Saha[16] noted that nailing group achieved union, shorter operative, fewer complications, reduced blood loss over a 24-month-up. Meanwhile, Adrade[17]. categorized 59 into a plate group (33 patients) and intramedullary nailing group (26 patients). They found no statistically significant differences in DASH, union rates, or patient satisfaction between the groups. In our research, we discovered that intramedullary nailing outperformed other methods in several key areas: it required less time in the operating room, resulted in reduced blood loss, showed a higher rate of healing and had a lower incidence of infections.

CONCLUSION

For managing displaced midshaft clavicular fractures, intramedullary nailing proves to be more effective than plating. It offers a quicker healing process, minimizes infection rates, lowers blood loss, causes less soft tissue damage and creates less surgical stress. Consequently, surgeries utilizing intramedullary nailing yield superior functional outcomes compared to surgical plating. Nevertheless, a limitation of this study is the small sample size, indicating the need for further research with a larger group and longer follow-up periods to validate the long-term advantages.

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