SURGICAL MANAGEMENT OF CLAVICLE FRACTURE WITH PRECONTOURED LOCKING PLATE

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ABSTRACT

INTRODUCTION

Traditionally, displaced midshaft clavicle fractures have been treated by nonoperative methods but had high rates of malunion and prolong pain. Therefore, fixation with precontoured locking compression plates (LCP) has become the ideal mode of treatment as plate fixation restores the anatomy and provides excellent radiological and functional outcomes.

MATERIAL AND METHODS

This prospective and observational study was carried out in Orthopedics department of Universal College of Medical Sciences-Teaching Hospital (UCMS-TH) from January 2022 to March 2024. After Ethical clearance (UCMS/IRC/164/21) from Institutional Review Committee (IRC) and informed written consent, all selected patients with midshaft clavicle fracture were treated with precontoured locking plate. Post-operatively patients were regularly followed at 6 weeks, 3 months and 6 months. At 6 months, functional outcome was assessed by Constant and Murley Score (CMS). Descriptive statistics like frequency, percentage, mean and standard deviation were used to analyze the data by SPSS 20 whereas Chi square test was used as an inferential statistics.

RESULTS

In our study of 50 cases, the mean age group was 35±7.2 years (20-46 years). Most of the cases were Robinson 2A2 (60%) type. The average duration of fracture union was 4.14± 0.7 months (3-6 months). Only 1 patient (2%) had superficial wound infection and another 1 patient (2%) had implant failure. The average CMS and Visual Analogue Scale (VAS) at 6 months was 96.26±2.57 (86-99) and 0.06±0.23 (0-1) respectively. At 6 months, 96% cases had excellent result. Finally, we observed statistically significant difference between the fracture classification and fracture union time (p=0.003); as well as fracture classification and patient satisfaction (p=0.004).

CONCLUSION

Precontoured locking plate is an effective treatment method for midshaft clavicle fracture in adults with benefits of early pain relief, early union and excellent functional outcome.

KEYWORDS

Clavicle fracture, Functional outcome, Midshaft, Precontoured locking plate

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INTRODUCTION

Clavicle fracture is one of the most common fractures in all age groups accounting for 2.6% to 4% of adult fractures and 35% of injuries to the shoulder girdle.[1] Midshaft clavicle fractures, one of the commonest clavicle fractures, have traditionally been treated non-operatively. However, the prevalence of non-union or mal-union in displaced midshaft clavicle fractures after conservative treatment is higher than previously presumed. There is 15% nonunion rate in widely displaced fractures of midshaft clavicle treated without surgery and all fractures with initial shortening of more than 2 cm resulted in nonunion.[2] Therefore, surgical treatment is increasing recently to reduce these complications. Nowadays, surgical treatment is accepted more and more as primary treatment for displaced mid shaft clavicle fractures, mainly because the results of non-operative treatment are interpreted as inferior to operative treatment both clinically and functionally. Several studies have examined the safety and efficacy of primary open reduction and internal fixation for completely displaced midshaft clavicle fractures and have noted high union rate with a low complication rate.[3] Even in complex clavicle fractures a satisfactory outcome is possible with a low complication rate using a locking compression plate.[4] Primary internal fixation of displaced mid-shaft clavicle fractures provides immediate rigid stabilization, pain relief, facilitates early mobilization and return to pre injury activities.[5-8] Moreover superior placement of plate is biomechanically more stable especially in presence of inferior cortical comminution.[9] Previous consensus of majority of clavicle fractures heal with non-operative treatment is no longer valid now. The amount of pain and disability during the first three weeks of conservative treatment has been underrated and the view that nonunion does not occur is no longer accepted. Therefore, surgical treatment of displaced midshaft clavicle fracture with precontoured locking plates helps to reduce this problem as well as provides early pain relief and excellent functional outcome.[10] Thus, with this background we have conducted this study to determine the clinical, radiological and functional outcome of midshaft clavicle fracture managed with precontoured locking plates.

MATERIAL AND METHODS

This prospective, hospital-based, longitudinal and observational study was carried out in Department of Orthopedics of UCMS-TH, Bhairahawa, Nepal from January 2022 to March 2024. After ethical clearance (UCMS/IRC/164/21) from Institutional Review Committee (IRC) of UCMS-TH, all patients with midshaft clavicle fracture, who fulfilled the inclusion criteria, were enrolled in the study. Patients were informed about the purpose of the study and written consent was taken. Cases were admitted either via Out-patient department (OPD) or Emergency department of UCMS-TH. Data collection was done by the researcher. The targeted sample size after using the sample size formula was 45. So, approximately convenient sample of 50 patients were selected by using purposive sampling technique.

$n=z^2pq/d^2$ [n=required sample size; p=prevalence of disease (3%),[1] q=100-p, z=1.96 taken at 95% confidence interval, d=allowable error taken as 5%, P= 3%,[1] q=97%]
Isolated midshaft displaced clavicle fracture (Robinson's 2A2-2B2) and age ≥ 18 years was used as an inclusion critera. Those patients were excluded who had polytrauma, head injury, open fractures, neuromuscular problems, pathological fractures and previous fracture of same clavicle.

Detailed history and systemic examination was done in all selected cases to rule out any other co-morbidity. Before admission to ward, all preoperative investigation was sent. Depending on the radiological findings, fracture was classified according to Robinson's classification.[11] (Figure 1) Preoperatively patients were managed by analgesics, anti-swelling agents, clavicle brace and shoulder immobilizer.

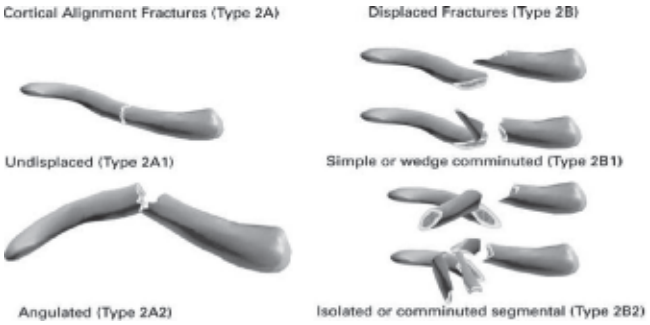

Figure 1. Robinson's classification[11] type 2 fractures

In the operation theatre, prophylactically all patients were given cefuroxime 1.5 gram intravenous injection half an hour before surgery. After general anaesthesia, patient was placed in a supine position with bolster in between the scapula. Direct anterior approach was used. Precontoured anatomical clavicle locking plate was used in all patients to fix the fracture. In case of oblique, spiral and butterfly fragment, the fracture was initially fixed with inter-fragmentary screws prior to plate fixation.

Post-operatively, x-ray was taken on the day of surgery. Analgesics and antibiotics were given for days to week depending upon the patient's pain tolerance and wound status. Post-operative immobilization was done by arm pouch sling with intermittent regular active and passive shoulder range of motion exercises. Wound dressing was done on the 3rd, 6th and 10th day and suture removal on 14th postoperative day. Generally, patients were discharged between 5 to 10 days depending upon the condition of the wound.

Regular follow ups were done at 6 weeks, 3 months and 6 months. In every follow-up patient's clinical, radiographic findings, range of motion and patient's daily functional activity were assessed and recorded. Finally at 6 months, functional assessment was done by Constant and Murley Score12. Radiological evaluation was made based on the signs of fracture union, malunion and implant loosening or failure. Union was considered when there was no visible fracture line in x-ray. At 3-4 weeks full shoulder movement and resume to normal daily activities were allowed.

All the data was collected using preformed pro forma that included patients demographic profile, general history, clinical and radiological findings, its management and regular follow up. Data were entered and analyzed by SPSS Vs.20. Descriptive Statistics like frequency, percentage;

mean and standard deviation were used to analyze the data and Chi-square test was used as an inferential statistics.

RESULTS

A total of 50 patients were selected in this study. The mean age group was 35±7.2 years (20-46 years) with male predominance (70%) and RTA (80%) was the most common mode of injury. Right side (60%) was more involved than the left side (40%). The common fracture pattern was oblique (36%) and comminuted type (32%). In Robinson classification, 2A2 (60%) was the predominant type. Most of the cases were operated within 1-2 days of trauma and the average duration of hospital stay was 8.08±2.34 days (5-15 days). Only 1 patient (2%) had superficial wound infection and another 1 patient (2%) had implant failure. (Table 1)

Table 1. Demographic data, general characteristics and fracture complications

Variables	Frequency (n)	Percentage (%)	Mean±SD (Range)
Gender			
Male	35	70	
Female	15	30	
Age(years)			35± 7.2 years (20-46 years)
Side			
Right	30	60	
Left	20	40	
Mode of injury			
RTA	40	80	
Fall/Injury	10	20	
Fracture type			
Comminuted	16	32.0	
Transverse	12	24.0	
Oblique	18	36.0	
Segmental	4	8.0	
Robinson Classification			
2A2	30	60.0	
2B1	16	32.0	
2B2	4	8.0	
Interval(days)			1.38±0.49;Range (1-2)
Hospital stay(days)			8.08±2.34;Range (5-15)
Complication			
Infection	1	2.0	
Implant failure	1	2.0	

The average duration of fracture union was 4.14± 0.7 months (3-6 months). The average CMS at 3 months and 6 months was 83.54±4.07 (72-91) and 96.26±2.57 (86-99) respectively. The average VAS at the time of presentation and at 6 months was 7.08±0.77 (5-8) and 0.06±0.23 (0-1) respectively. At 6 months, patient satisfaction was assessed where excellent result was seen in 96% cases and good results in 4% cases. (Table 2)

Table 2. Functional outcome

Variables		Frequency (n)	Percentage (%)	Mean±SD; Range
Fracture Union (months)				4.14± 0.7;Range (3-6)
CMS	**3 Months**			83.54±4.07;Range
	6 Months			(72-91)
VAS	**Presentation**			96.26±2.57;Range
	6 weeks			(86-99)
	3 months			7.08±0.77;Range (5-8)
	6 months			3.14±0.75;Range (1-4)
Patient Satisfaction				0.82±0.66;Range (0-2)
(6 months)				0.06±0.23;Range (0-1)
Excellent		48	96	
Good		2	4	

We observed statistically significant difference between the fracture classification and time for fracture union where Robinson 2A2 fracture united earlier than 2B1 and 2B2 (P 0.003). We also observed statistically significant difference between fracture classification and patient satisfaction score at 6 months where Robinson 2A2 had excellent result than 2B1 and 2B2 (p=0.004). (Table 3)

Table 3. Fracture union and patient satisfaction according to Robinson classification (Chi-square test)

Variables		Robinson classification			p value
		2A2	2B1	2B2	
Union	3 Months	7(100%)	0	0	0.003
	4 Months	21(67.7%)	9(29%)	1(3.2%)	
	5 Months	2(20%)	6(60%)	2(20%)	
	6 Months	0	1(50%)	1(50%)	
Patient Satisfaction	Excellent	30(62.5%)	16(33.3%)	2(4.2%)	0.004
	Good	0	0	2(100%)	

p<0.05 significant

Pre-operative, intraoperative, immediate post-operative and 1 year follow up images are shown in respective figures (Figure. 2, 3, 4 and 5)

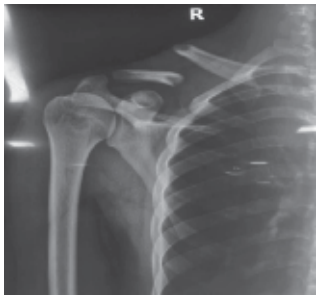

Figure 2. Pre operative image

Figure 3. Intraoperative image

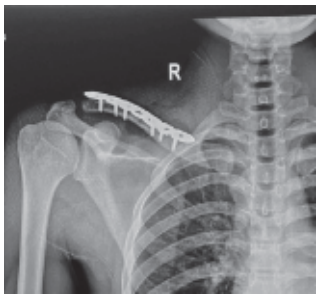

Figure 4. Immediate post-operative image

Figure 5. United clavicle fracture (1 year follow-up)

DISCUSSION

A total of 50 patients were selected in this study. The mean age group was 35±7.2 years (20-46 years) and RTA (80%) was the most common mode of injury. Similar result was seen in Prabhu et al[10] (mean age 32 years; RTA 85%), Cho et al[13] (45 years) and Bostman et al[14] (33.4 years) where mean age groups were similar to our study and RTA was the major cause of fracture. In Robinson classification, 2A2 (60%) was the predominant type which is similar to Bostman et al[14] (2A2-78.64%). Most of the cases were operated within 1-2 days of trauma which is similar to Prabhu et al[10] (91% cases

operated within 2 days). Only 1 patient (2%) had superficial wound infection and another 1 patient (2%) had implant failure. Prabhu et al[10] also observed 1 case (1.66%) of implant failure similar to our study. Wound infection healed with regular dressing and oral antibiotics whereas implant failure that occurred at 2 months was managed with replating that also united normally.

The average duration of fracture union was 4.14± 0.7 months (3-6 months) which is similar to Panwar et al[15] (3-4 months), Prabhu et al[10] (3-4 months) and Cho et al[13] (14.6 weeks). At 6 months, the average CMS was 96.26±2.57 (86-99) which is similar to Van D et al[16] (95.9±10.5). The VAS at 6 months was 0.06±0.23 (0-1) which is similar to Rens at el[17] (1.1). At 6 months, patient satisfaction was assessed where excellent result was seen in 96% cases and good results in 4% cases which is better than Prabhu et al[10] where only 76.7% cases and 16.7% cases had excellent and good result respectively.

We observed statistically significant difference between the fracture classification and time for fracture union where Robinson's 2A2 fracture united earlier than 2B1 and 2B2 (P 0.003). We also observed statistically significant difference between fracture classification and patient satisfaction score at 6 months where Robinson 2A2 had excellent result than 2B1 and 2B2 (p=0.004). We were unable to compare these results with other results as we were unable to find similar data. The major limitation of this prospective study is the small sample size. A further prospective study with a larger number of patients is recommended for more appropriate result.

CONCLUSION

Precontoured locking compression plate is a time demanded implant of choice for treating midshaft clavicle fracture as it is associated with excellent functional and radiological outcome; early fracture union and minimal manageable complication.

CONFLICT OF INTEREST

None

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