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Original Article

Association of Displaced Midshaft Clavicle Fractures Treated with Intramedullary Titanium Elastic Nail System and Its Outcome

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Abstract

Introduction: Fractures of the clavicle, which primarily occur in young males, constitute 2.6–4% of all fractures in adults. A male dominance of approximately 70% has been reported. The most frequent injury mechanism is a direct fall on the shoulder. Fractures are often sustained during sports activities or traffic accidents. The majority (69–82%) of fractures occur in the midshaft of the clavicle followed by 12–26% in the lateral part and 2–6% in the medial part. Advantages of TENS over plate fixation include shorter operative time and lesser chance of post-operative infection.

Materials and Methods: The study was conducted in College of Medicine and J.N.M Hospital including inpatient and outpatient in Orthopaedic department', from 1½ years. Twenty-five patients were taken and divided in two groups.

Results: In our study, 2 (10.0%) patients had FFH injury, 2 (10.0%) patients had FOOSH injury, and 16 (80.0%) patients had RTA injury. In good outcome, 3 (60.0%) patients had FOOSH injury and 2 (40.0%) patients had RTA-related injury. This was statistically significant (P = 0.0410).

Conclusion: Excellent outcome was more in male but good outcome was more in female which was statistically significant. Time for shoulder movements union in week was higher in excellent outcome patient compared to good outcome patient though it was not significantly associated with outcome. Abduction, external rotation, and internal rotation were significantly higher in excellent outcome patient compared to good outcome patient. We found that Constant score was higher in excellent outcome patient compared to good outcome patient. We concluded that functional outcome of displaced midshaft clavicle fractures was excellent treated with intramedullary titanium elastic nail system.

Key words: Clavicle fracture, Intramedullary nailing, Midshaft fractures, Titanium elastic nail

INTRODUCTION

Fractures of the clavicle, which primarily occur in young males, constitute 2.6–4% of all fractures in adults. A male dominance of approximately 70% has been reported. The most frequent injury mechanism is a direct fall on the shoulder. Fractures are often sustained during sports activities or traffic accidents. The majority (69–82%) of fractures occur in the midshaft of the clavicle followed by 12–26% in the lateral part and 2–6% in the medial part.[1]

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The clavicle is easily fractured because of its subcutaneous, relatively anterior location, and frequent exposure to transmitted forces. The middle third, or midshaft, is the thinnest, least medullous area of the clavicle, and thus, the most easily fractured; the lack of muscular and ligamentous support makes it vulnerable to injury.[2] The muscle attachments often cause a dislocation of the major fragments in clavicle fractures and a shortening of the clavicle, particularly in midshaft fractures.[2] This can be anatomically explained by the fact that the medial and lateral parts of the clavicle are firmly secured by strong ligaments and muscles, whereas the middle part of the clavicle lacks any strong attachments and thus is more

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vulnerable to trauma. The muscle attachments often cause a dislocation of the major fragments in clavicle fractures and a shortening of the clavicle, particularly in midshaft fractures.[3]

Initially, the aim of treatment was union of fracture in whatsoever position fracture unites. Many methods of conservative treatment, namely, triangular sling, cuff and collar sling, three sling method, figure of eight bandage, figure of eight POP shoulder spica, clavicular brace, arm shoulder pouch, and many others have been described from time to time.[4] All these methods did not involve the reduction of fracture or unable to hold the fracture reduced hence the end results were malunion/nonunion in various cases. Malunion resulted in shortening, deformation, disfigurement, and poor cosmoses shortening (reduced distance between sternoclavicular joint to the shoulder joint) resulted in biomechanical disadvantage, persistence of pain, limitations of functions, and reduction of strength in upper limb in some of these cases.[4]

The majority of recent data suggests that operative treatment may be more appropriate as it improves functional outcome and reduces the risk of complications such as non-union and malunion. This is particularly evident in midshaft fractures. Displaced midshaft fractures were the most common type of clavicle fracture as well as the most frequently operated type of fracture.[1]

There are various surgical methods available for treating displaced midshaft clavicle fracture including TENS and PLATING. The study found that patients treated with TENS showed excellent outcome in 84% of cases while 60% in plating group for displaces midshaft clavicle fracture. Patients in TENS group better in terms of Constant and Murley score and DASH score than treated with plate.[5-7] The study also shows that intramedullary nailing and plate fixation have same long-term functional outcomes and treatment failure, but plate fixation leading to significant greater risks of adverse events not requiring surgery such as infection. Advantages of TENS over plate fixation include shorter operative time and lesser chance of post-operative infection.[8] Clavicle fractures are most common injuries in young and active individuals, especially those who participate in sports where high-speed falls (e.g., bicycling and motorcycles) or violent collisions (e.g., football and hockey) are frequent. In contrast, in children and elderly, they are related to falls, and they account for approximately 2.6% of all fractures. The most common site of fracture is a middle-third shaft; it accounts for 80% of all clavicle fractures. Older studies suggested that a fracture of the shaft of the clavicle, even when significantly displaced, was a mostly benign injury with an inherently good prognosis when treated nonoperatively.

- This study is aimed to assess the functional outcome of intramedullary titanium elastic nail system for displaced clavicle fracture.

MATERIALS AND METHODS

Study Population

The study was conducted in COM and JNM Hospital including inpatient and outpatient in Orthopaedic departments.

Study Design

This was an analytical study.

Study Duration

The study duration was 1½ years.

Study Group

Twenty-five patients were taken and divided into two groups.

Inclusion Criteria

The following criteria were included in the study:

- All skeletally mature patients.
- All the displaced diaphyseal non commented/simple commination clavicle fractures (>2 cm displacement) – AO B1 and B2 fractures.
- Fractures with shortening of over 20 mm
- Fractures within 1 week

Exclusion Criteria

The following criteria were excluded from the study:

- Fractures with marked comminution.
- Brachial plexus injuries
- Paediatric fractures
- Pathological fractures
- Open fractures congenital anomaly or bone disease.
- Any medical contraindication for surgery.

RESULTS AND DISCUSSION

A total of 25 patients were present in this study.

In our study, 10 (40.0%) patients were 21–30 years old, 6 (24.0%) patients were 31–40 years old, 7 (28.0%) patients were 41–50 years old, and 2 (8.0%) patients were >51 years old. The mean age (mean ± SD.) of patients was 34.7600 ± 10.0635 years. In this study, male population [17 (68.0%)] was higher than the female population [8 (32.0%)].

We found that 2 (8.0%) patients had FFH injury, 5 (20.0%) patients had FOOSH injury, and 18 (72.0%) patients had RTA injury. Ten (40.0%) patients had left limb involvement

Table 1: Parameters

Outcome	Excellent	Good	Total	Chi-square value	*P*-value
Mode of injury					
FFH	2	0	2	6.3889	0.0410
Row %	100.0	0.0	100.0		
Col %	10.0	0.0	8.0		
FOOSH	2	3	5		
Row %	40.0	60.0	100.0		
Col %	10.0	60.0	20.0		
RTA	16	2	18		
Row %	88.9	11.1	100.0		
Col %	80.0	40.0	72.0		
Total	20	5	25		
Row %	80.0	20.0	100.0		
Col %	100.0	100.0	100.0		
Limb involved					
Left	8	2	10	0.0000	1.0000
Row %	80.0	20.0	100.0		
Col %	40.0	40.0	40.0		
Right	12	3	15		
Row %	80.0	20.0	100.0		
Col %	60.0	60.0	60.0		
Total	20	5	25		
Row %	80.0	20.0	100.0		
Col %	100.0	100.0	100.0		
AO classification					
B1	11	5	16	3.5156	0.0607
Row %	68.8	31.3	100.0		
Col %	55.0	100.0	64.0		
B2	9	0	9		
Row %	100.0	0.0	100.0		
Col %	45.0	0.0	36.0		
Total	20	5	25		
Row %	80.0	20.0	100.0		
Col %	100.0	100.0	100.0		
Associated injuries					
Bb Leg	1	0	1	8523	0.6530
Row %	100.0	0.0	100.0		
Col %	5.0	0.0	4.0		
I/L scapula spine	2	0	2		
Row %	100.0	0.0	100.0		
Col %	10.0	0.0	8.0		
No	17	5	22		
Row %	77.3	22.7	100.0		
Col %	85.0	100.0	88.0		
Total	20	5	25		
Row %	80.0	20.0	100.0		
Col %	100.0	100.0	100.0		

and 15 (60.0%) patients had right limb involvement. Sixteen (64.0%) patients had B1 and 9 (36.0%) patients had B2 in AO classification.

It was found that 1 (4.0%) patient had Bb leg injuries and 2 (8.0%) patients had I/L scapula spine in associated injuries. Twenty (80.0%) patients were excellent outcome and 5 (20.0%) patients were good outcome.

Our study showed that the mean days before surgery (mean ± SD) of patients were 3.5600 ± 1.3565 days. The mean follow-up in months (mean ± SD) of patients was 9.1200 ± 2.3861. The mean time for shoulder movements union in week (mean ± SD) of patients were 8.5200 ± 2.0841. The mean flexion (mean ± SD) of patients was 163.6000± 10.4602. The mean abduction (mean ± SD) of patients was 164.2000 ± 12.0485. The mean external rotation (mean ± SD) of patients was 71.2000 ± 6.5000. The mean internal rotation (mean ± SD) of patients was 73.0000± 5.4006 and the mean Constant score (mean ± SD) of patients was 88.9200 ± 4.1324.

It was found that in excellent outcome, 9 (45.0%) patients were 21–30 years old, 5 (25.0%) patients were 31–40 years old, 4 (20.0%) patients were 41–50 years old, and 2 (10.0%) patients were >51 years old. In good outcome, 1 (20.0%) patient was 21–30 years old, 1 (20.0%) patient was 31–40 years old, and 3 (60.0%) patients were 41–50 years old and this was not statistically significant ($P = 0.3270$).

We found that in excellent outcome, 4 (20.0%) patients were female and 16 (80.0%) patients were male. In good outcome, 4 (80.0%) patients were female and 1 (20.0%) patient was male. This was statistically significant ($P = 0.0100$).

We observed that in excellent outcome, 2 (10.0%) patients had FFH injury, 2 (10.0%) patients had FOOSH injury, and 16 (80.0%) patients had RTA injury. In good outcome, 3 (60.0%) patients had FOOSH injury and 2 (40.0%) patients had RTA-related injury. This was statistically significant ($P = 0.0410$).

It was found that in excellent outcome, 8 (40.0%) patients had left limb involvement and 12 (60.0%) patients had right limb involvement. In good outcome, 2 (40.0%) patients had left limb involvement and 3 (60.0%) patients had right limb involvement which was not statistically significant ($P = 1.0000$).

Our study showed that in excellent outcome, 11 (55.0%) patients had B1 and 9 (45.0%) patients had B2 in AO classification. In good outcome, all patients [5 (100.0%)] had B1 in AO classification. This was not statistically significant ($P = 0.0607$).

The present study showed that in excellent outcome, 1 (5.0%) patient had Bb leg injuries and 2 (10.0%) patients had I/L scapula spine in associated injuries which was not statistically significant ($P = 0.6530$).

In our study in excellent outcome, the mean age (mean ± SD) of patients was 33.9000 ± 10.2746 years and in good outcome, the mean age (mean ± SD) of patients was 38.2000 ± 9.3648 years which was not statistically significant ($P = 0.4043$).

Our study showed that in excellent outcome, the mean days before surgery (mean ± SD) of patients was 3.5000 ± 1.4690 days and in good outcome, the mean days before surgery (mean ± SD) of patients was 3.8000 ± 0.8367 which was not statistically significant ($P = 0.6678$).

Ferran *et al.*[7] (2010) found that mean follow-up was 12.4 months. There was no significant difference in either Constant scores ($P = 0.365$) or Oxford scores ($P = 0.773$).

We found that the mean follow-up in months (mean ± SD) of patients was higher in patients with excellent outcome [9.6000 ± 1.9841 Months] compared to patients with good outcome [7.2000 ± 3.1145 months] which was statistically significant ($P = 0.0415$).

Khalil *et al.*[8] (2009) found that two cases had intraoperative failure of fixation, nine complained of subcutaneous prominence of the screw head, five experienced decreased sensation over the site of incision, and three had symptoms of frozen shoulder.

In our study, in excellent outcome, the mean time for shoulder movements union in week (mean ± SD) of patients was 8.9000 ± 2.1250 weeks and in good outcome, the mean time for shoulder movements union in week (mean ± SD) of patients was 7.0000 ± 1.0000 weeks. It was not statistically significant ($P = 0.0669$).

McKee *et al.*[9] (2006) found that the range of motion was well maintained, with flexion averaging 170° ± 20° and abduction averaging 165° ± 25°. Compared with the strength of the uninjured shoulder, the strength of the injured shoulder was reduced to 81% for maximum flexion, 75% for endurance of flexion, 82% for maximum abduction, 67% for endurance of abduction, 81% for maximum external rotation, 82% for endurance of external rotation, 85% for maximum internal rotation, and 78% for endurance of internal rotation ($P < 0.05$ for all values). The mean Constant score was 71 points, and the mean DASH score was 24.6 points, indicating substantial residual disability.

The present study showed that the mean flexion (mean ± SD) of patients was higher in patients with excellent outcome [168.0000 ± 5.9383] compared to patients with good outcome [146.0000 ± 2.2361] which was statistically significant ($P < 0.0001$).

Our study showed that the mean abduction (mean ± SD) of patients was higher in patients with excellent outcome [169.0000 ± 7.5394] compared to patients with good outcome [145.0000 ± 5.0000] which was statistically significant ($P < 0.0001$).

We found that the mean external rotation (mean ± SD) of patients was higher in patients with excellent outcome [72.7500 ± 6.3815] compared to patients with good outcome [65.0000 ± 0.0000] and this was statistically significant ($P = 0.0136$).

In our study, the mean internal rotation (mean± SD) of patients was higher in patients with excellent outcome [74.5000 ± 4.8395] compared to patients with good outcome [67.0000 ± 2.7386] which was statistically significant ($P = 0.0031$).

Smekal *et al.*[10] (2009) found that Constant scores were significantly higher after 6 months and 2 years after intramedullary stabilization.

Bithrey *et al.*[11] (2017) found that the difference in Constant shoulder scores between the affected and unaffected shoulders for 14 patients was below 11 at 12 weeks' follow-up and all patients were satisfied with their scar after 12 weeks.

We also found that the mean Constant score (mean ± SD) of patients was higher in patients with excellent outcome [90.4500 ± 2.9465] compared to good outcome patients [82.8000 ± 1.6432] which was statistically significant ($P < 0.0001$) [Table 1].

CONCLUSION

Excellent outcome was more in male but good outcome was more in female which was statistically significant.

Associated injuries were not significantly related with outcome.

Days before surgery were not significantly associated with outcome but excellent outcome patients were higher follow-up in months.

Time for shoulder movements union in week was higher in excellent outcome patient compared to good outcome patient though it was not significantly associated with outcome.

Excellent outcome patients had higher flexion which was statistically significant.

Abduction, external rotation, and internal rotation were significantly higher in excellent outcome patient compared to good outcome patient.

We found that Constant score was higher in excellent outcome patient compared to good outcome patient.

We concluded that functional outcome of displaced midshaft clavicle fractures was excellent treated with intramedullary titanium elastic nail system.

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