

Results of Intra-Medullary Fixation of Displaced Midshaft Fracture Clavicle in Adult

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Abstract

Background: Clavicle fractures are common fractures, comprising 5% to 10% of all fractures seen in emergency departments. Fractures of the middle third, or midshaft, are the most common, accounting for up to 80% of all clavicle fractures. Intramedullary fixation is thought to allow for a smaller incision, which can be more cosmetically appearing.

Aim of the study: Assessment of the outcomes of intramedullary fixation (TEN) of displaced midshaft fracture of the clavicle in adults.

Patients and Methods: This was a prospective interventional study with a comprehensive sample of all cases that met the inclusion and exclusion criteria have included in the study, 18 cases have included. All patients were suffered from displaced midshaft clavicular fractures classified as type I according to *Allman* and *Craig* classification and type IIb in Robinson's classification and all were managed by intramedullary fixation. All patients were subjected to full history taking, clinical evaluation, local examination, radiological examination. Postoperative visits were scheduled every 2-4 weeks until the bone union and 3 months after the union then every 6 months until 2.5 (2.2-4.5) years after surgery.

Results: Age was distributed as 34.05 ± 11.65 with minimum 18 and maximum 62 years, regard sex distribution male were majority with 77.8%. Time of union was distributed as 9.64 ± 3.21 with a minimum 6 and maximum of 20 weeks. Time of return to normal activity was distributed as 12.0 ± 4.07 with a minimum 8.0 and maximum of 24 Weeks. Quick dash score was distributed as 7.59 ± 7.01 with a minimum of 0.0 and a maximum of 45.4. that only one case had no-union and also just one case had an infection and 2 cases had implant prominence with 11.1%, and overall complication was founded in 11.1%. Time of union weeks, return to ADL weeks and Quick dash score were significantly higher among complicated cases.

Conclusion: IM fixation (TEN) of DMFC in adults is an available technique especially for early pain relief and resuming good shoulder function, resulting in a fast return to activities and a high patient satisfaction score.

Keywords: Midshaft Fracture Clavicle, Intra Medullary Fixation

1. Introduction:

The clavicle is an elongated, S-shaped bone that rests horizontally at the sternum across the upper part of the ribcage, and the acromial end of the scapula[1].

Surgical fixation of clavicle fractures has been traditionally performed with the use of plates and screws. However, intramedullary fixation is also possible, and different types of devices have been used for intramedullary fixation of the clavicle throughout the years, including smooth K-wires, Hagie pins, Knowles pins, Rockwood Clavicle Pins, and titanium elastic nails [2].

Intramedullary fixation is thought to allow for a smaller incision, which can be more cosmetically appearing. It may also decrease soft tissue dissection and hardware prominence associated with the plate and may allow for easier hardware removal. Contraindications of the use of intramedullary fixation include significant comminution, small canal diameter, and lateral third clavicle fractures [3].

The majority of available clavicular intramedullary devices have no locking capability and are unable to control for length and rotation at the fracture site. The lack of control for length causes fracture shortening, malunion, as well as implant prominence and soft tissue irritation [4]. One randomized controlled trial reported a 23% rate of nail protrusion due to cut-out or fracture shortening. Implant failure and breakage have also been reported[8]. Intramedullary devices can also migrate, especially smooth Kirschner wires, which have been reported to migrate to the thorax or aorta. Intramedullary devices can cause local irritation and prominence at the insertion site [5,6].

We aimed in this study to Assess the outcomes of intramedullary fixation (TEN) of displaced midshaft fracture of the clavicle in adults.

2. Patients and Methods:

This was a prospective interventional study with a comprehensive sample of all cases that met the inclusion and exclusion criteria have included in the study, 18 cases have included. All patients were suffered from displaced midshaft clavicular fractures classified as type I according to Allman and Craig classification and type IIb in Robinson`s classification and all were managed by intramedullary fixation.

Ethical consents were taken from all patients including all data about pre intra and post-operative procedures and all possible complications.

2.1.Inclusion criteria:

- Unilateral fracture clavicle.
- Displaced midshaft clavicular fracture with no cortical contact between the main fragments.
- After skeletal maturity

2.2.Exclusion criteria:

- Before skeletal maturity.
- Fractures that are involving proximal and distal third.
- Severely comminuted fractures.
- Neurovascular insults.
- Polytraumatized patient.

2.3. Clinical Evaluation:

I. History Taking: including personal data (name, age, sex, address, occupation), mode of trauma and past medical history.

II. Clinical examinations:

1- General examination: (ABCD) for all patient with full systematic assessment of associated injuries or comorbidity.

2- Local examinations:

- On inspection we have detected the following signs:

- i. The affected limb was flexed at the elbow and supported by another hand.

- ii. Swelling over the middle third of the clavicle.

- iii. Skin tenting.

- iv. Bruises, abrasions or lacerations.

- v. Movements of the affected shoulder were restricted.

- On palpation we have detected the following signs:

- i. Tenderness (it is severe even with superficial palpation).

- ii. Crepitus and abnormal mobility.

- iii. Hotness.

- iv. Swelling (collected hematoma).

- Neurovascular assessment; distal pulse and brachial plexus functions.

III. Radiological examinations:

Plain radiograph of the affected shoulder in anteroposterior view and chest radiograph posteroanterior was taken to assess the fracture type, and posttraumatic displacement and shortening.

IV. Laboratory investigations:

Routine investigations: CBC, RFT, Blood sugar, LFT, Bleeding profile tests, Viral screening was done, in addition to ECG.

The affected limb was immobilized in a pouch arm sling and the patient had admitted to the word, received good analgesia and antibiotic and prepared for surgery. The patients should be fasting at least 6 hours before the operation.

2.3 Operative procedure:

Patients had been positioned in breach chair (semi-sitting position) on a radiolucent operation table.

Fluoroscopy (c-arm) placed cranially or laterally at the affected shoulder.

Under general anaesthesia. Two surgeons were required in our work, one to insert the implant from the medial side the other to do a reduction on the lateral side of the clavicle. The ipsilateral arm was kept free and mobile. Good drapping was done from the base of the neck until the hand. The TEN suitable size to the medullary canal was confirmed by fluoroscopy by putting it in front of the clavicle.

A small incision about 1 cm was done 1-2 cm lateral to sternoclavicular joint with splitting until the bone. The anterior cortex was opened with 2.5- or 2.7-mm drilling. After unicortical opening, the awl inserted and pointed lateral to the direction of the medullary canal under the guiding of fluoroscopy to confirm the position. The TEN was inserted directly into the canal and pushed until the fracture site. The close reduction was done and fixed percutaneously by two-pointed reduction clamps, when it was difficult a small incision was made at the fracture site for manipulation and open reduction.

The TEN was inserted as far as possible in the lateral part of the clavicle just engaging the lateral cortex. Any distraction on the fracture site was relieved by lateral manual compression on the

shoulder. The implant was cut off as short as possible at the medial end. Good reduction and fixation were confirmed by manipulation under fluoroscopic control. The wounds were closed layerly, dressing applied, and the arm placed in a sling.

2.4. Postoperative follow up:

All patients were treated with an arm sling after operation for 6 weeks. Few days after surgery the patient allowed to do passive exercises of the shoulder joint under the guidance of the physiotherapist with gradually increasing the range of motion depending on the degree of pain.

Postoperative visits were scheduled every 2-4 weeks until the bone union and 3 months after the union then every 6 months until 2.5 (2.2-4.5) years after surgery.

The TENs were removed after the complete union.

Data were collected including patient characteristics, shoulder functions and complications assessment at 6 weeks, 3 months and 6 months after surgery using the short version of the Disabilities of the Arm, Shoulder, and Hand (Quick Dash) score and radiological evaluation.

2.5. Statistical analysis:

Data were considered using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0). Difference and association of qualitative variable were analyzed by Chi square test (X²). Differences between quantitative independent groups by unpaired t. P value was set at <0.05 for significant results & <0.001 for high significant result.

3. Results

Age was distributed as 34.05±11.65 with minimum 18 and maximum 62 years, regard sex distribution male were majority with 77.8%. (Table 1). Time of union was distributed as 9.64±3.21 with a minimum 6 and maximum of 20 weeks (Table 2). Time of return to normal activity was distributed as 12.0±4.07 with a minimum 8.0 and maximum of 24 Weeks (Table 3).

Quick dash score was distributed as 7.59±7.01 with a minimum of 0.0 and a maximum of 45.4. (Table 4). Only one case had no-union and also just one case had an infection and 2 cases had implant prominence with 11.1%, and overall complication was founded in 11.1% (Table 5). Time of union weeks, return to ADL weeks and Quick dash score were significantly higher among complicated cases (Table 6).

Table (1): Age and sex distribution among the studied group (N=18)

		AGE	
Mean± SD		34.05±11.65	
Median (Range)		31.0 (18.0-62.0)	
Sex	Female	N	%
	Male	4	22.2
	Total	14	77.8
		18	100.0

Table (2): Time of union weeks distribution among the studied group

		Time of union /weeks
Mean± SD		9.65±3.48

Median (Range)	8.0 (6-20)
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Table (3): Time of return to normal activity distribution among the studied group

	Return to ADL /weeks
Mean± SD	12.0±4.07
Median (Range)	11.0 (8.0-24.0)

Table (4): QUICK DASH SCORE distribution among the studied group

	QUICK DASH SCORE
Mean± SD	7.59±7.01
Median (Range)	2.27 (0.0-45.4)

Table (5): Complication distribution among the studied group

		N	%
Nonunion	-VE	1	94.4
		7	
	+VE	1	5.6
Infection	-VE	1	94.4
		7	
	+VE	1	5.6
Implant prominence	-VE	1	88.9
		6	
	+VE	2	11.1
Overall complication	-VE	1	88.9
		6	
	+VE	2	11.1
		1	100.
	Total	8	0

Table (6): Relation between complication and other parameters

	Not complicated (N=16)	Complicated (N=2)	t/ Mann Whitney/ X²	P
Age	32.37±9.93	41.50±16.9	1.850	0.083
Time of union weeks	9±0.2.28	20.0±0.0	4.621	0.00**
Return to ADL weeks	11.25±2.74	24.0±0.0	4.507	0.00**
Quick dash score	3.00±1.88	44.3±1.55	18.369	0.00**

Sex	Female	N	4	0		
		%	25.0%	0.0%		
	Male	N	12	2	0.64	0.42
		%	75.0%	100.0%		
Mode of trauma	Fall down	N	3	1	1.4	0.49
		%	18.8%	50.0%		
	Road traffic accident	N	8	1		
		%	50.0%	50.0%		
	Sport injury	N	5	0		
		%	31.2%	0.0%		
Total		N	16	2		
		%	100.0%	100.0%		

4. Discussion:

The clavicle has an S-shaped configuration with medial and lateral flat ends, a tubular middle and a very small medullary canal. These considerations explain that plates or rigid nails are relatively unsuitable implants [7]. The clavicle acts as a bone strut to maintain the width of the shoulder and therefore provides power and stability to the arm-trunk mechanism; thus, shortening after clavicle fractures may have an effect on shoulder function. This might be a specific problem with the use of intramedullary nailing with telescoping and nail protrusion [5]. Clavicular shortening leads to static changes in the shoulder girdle. The sternoclavicular joint angle increases, and the resting position of the scapula and the preload of the muscles of the shoulder girdle change. This might lead to limitations in the overhead motion and symptoms such as pain, weakness and easy fatigability [8]. Restoration of clavicular length was therefore stated as a primary goal of IM fixation [9].

Traditionally, conservative treatment has been the major treatment of the clavicular fracture. In two landmark studies from 1960s by Neer [23] and Rowe [25], nonunion rates were relatively low when conservative treatment was applied.

Neer [23] reported nonunion in only three out of 2235 mid-shaft clavicular fracture patients treated conservatively, whereas Rowe [24] reported four non-unions out of 566 patients.

These findings have dominated the clinical approach for displaced clavicular fractures for a long time. However, more studies showed much higher nonunion rates and unsatisfactory functional outcomes [10], [11], [9], [12], [13].

Open reduction and internal fixation have gradually been recognized as an effective treatment for displaced or shortened (>2 cm) mid-shaft clavicular fractures [11], [12]. Plating has been considered the gold standard for operative treatment of displaced mid-shaft clavicular fractures for decades. Various types of plates are commonly used. Reconstruction plates are easier to contour to fit the irregular curve of the clavicle, which promotes bone healing [14], [15]. Plating has the

advantages of rigid fixation and improved rotational stability that may offer a superior construct for highly comminuted fractures. However, it requires large incisions and extensive soft-tissue dissection, which could cause complications such as infection, scarring and refracture after plate removal [16].

Compared with plate fixation, intramedullary fixation showed better clinical outcomes in the terms of operative time, wound size, subjective time to pain relief, and the postoperative functional scores of the shoulder joint during the treatment of displaced midshaft clavicular fractures.[85] Besides, IM fixation provided a shorter average period of bone union, faster functional recovery, higher patient satisfaction, and higher satisfaction with appearance [17].

In our study, we aimed to assess the outcomes of intramedullary fixation of a displaced midshaft fracture of the clavicle. 18 patients with a broken midshaft clavicle were treated with IM fixation in this study. After 6 months, 17 patients had a full union, accounting for 94.4 %, with only one patient (5.6 percent) still non-union, as well as one patient suffering from a superficial infection. The mean Quick DASH Score was 7.59 in the postoperative evaluation.

In contrast to other studies that have been performed on the effects of IM in the treatment of DMCF. In our sample, 18 patients with a mean age of 34 years (range 18-62 years) were included, with 78 % and 22 %. Another research by Elgeidi A et al [18]included 36 patients, with a mean age of 31.25 years (range 18-44 years) and 61 percent males and percent females. Kumar H et al [19] conducted a study on 50 patients, 64 percent of whom are males, with a mean age of 31.2 years (18-54 years), while Kadakia A et al [20]conducted a study on 38 patients, 84 percent of whom are males, with a mean age of 38 years (14-57years).

The mean Quick DASH Score in our study was (7.59), compared to (2.74) in Chen Qing-yu study [22]and closer to Kumar H et al [19]and Kadakia A et al [20](7.7 and 6.7) respectively.

In the current study, we discovered that 94.4 % had union after a mean time of 9.64 weeks and that 5.6 % of them had non-union suffered from pain and shoulder movement limitations. Elgeidi A et al [18]study showed the same proportion of non-union (5.6%) but with a mean time of union of 9.3 weeks. In the Kumar H et al [19]study, the mean time to union was 10.3 weeks, and in the Beinang Fu et al [21]study, it was 11.58 weeks, with no cases of non-union reported in either study. Likewise, Chen Qing-yu et al [22]reported in their research that the mean time for nonunion was 13.2weeks, with nonunion occurring in 3.33%.

In our study, we discovered that only one patient had a superficial wound infection, accounting for 5.6 %, while in Algeidi A et al [18] study 2.78 % (only one) were infected, and in Chen Qing-study yu et al [22] 3.33 % were infected. Beinang Fu et al [21] and Kadakia A et al [20]found no infections in their studies.

In our study, 11.1% had an implant-related complication (one patient had skin irritation, and another had implant protrusion), while Algeidi A et al [18] found 2.78 % had implant migration, and Kadakia A et al [20] found 47 % of patients had implant irritation and prominence at the skin. In Kumar H et al [19] study, 20% of cases showed implant-related complications.

The drawbacks of our study were the limited size of the sample and the short duration of the study; in the future, we plan to conduct this study on larger sample size, including polytraumatized patients, for a longer period of time to obtain a more reliable outcome of our study goal.

5. Conclusion

IM fixation (TEN) of DMFC in adults is an available technique especially for early pain relief and resuming good shoulder function, resulting in a fast return to activities and a high patient satisfaction score

6. Conflict of Interest: No conflict of interest.

7. References

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