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Clinical outcomes of titanium elastic nailing system for middle third clavicular fracture

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Abstract
Aim: Clinical outcome of displaced middle third clavicular fracture using intramedullary fixation by titanium elastic nail.
Materials and Methods: 20 cases of displaced middle third clavicular fracture underwent closed reduction internal fixation with Intra medullary fixation by titanium elastic nail. The study was conducted from July 2020 to August 2022 admitted to Narayana Medical College and hospital, Nellore. We evaluated the Constant score to determine the outcomes.
Results: All fractures got united in our study. Average time taken for full clinical and radiological union was 11.8 weeks (Range 10- 14 weeks).There were no major complications noted. Average Constant Score at final follow up was 95.16.
Conclusion: Minimally invasive fixation with TENS is a safe method and can be performed with minimal complications. This method of fixation of displaced middle third clavicular fractures should result in less soft tissue injury, shorter operating time, satisfactory stabilization, a good cosmetic appearance, quick pain relief, early return to work and easy implant removal under local anaesthesia as an outpatient department procedure.

Keywords: Middle third clavicular fractures, intramedullary nailing, titanium elastic nailing system (TENS).

Introduction
Clavicle fractures represent 6% to 12% of all fractures seen in orthopaedics. 70% of all clavicle fractures are localized to the middle third of the clavicle and approximately 80% of these fractures are displaced.
Displaced middle third fractures have traditionally been treated non- operatively in the form of a simple sling, figure of eight. Studies have historically reported a high rate of union and insignificant sequelae from malunited fractures [2, 3]. However, recent studies have found higher rates of delayed union, shoulder pain, and residual pain with non- operative treatment.(4)
Recent data suggest that displaced middle third clavicular fractures will have better outcomes with operative reduction and internal fixation [5]. Titanium elastic nail system of the clavicle is a minimally invasive procedure and aims at restoration of the clavicular length with early range of movements, with a good cosmetic and minimal morbidity.
This study was taken to assess the clinical outcome of displaced middle third clavicular fracture using Intra- medullary fixation by titanium elastic nail.

Materials and Methods
It is a prospective study of 20 patients carried out from July 2020 to June 2022 admitted to Narayana Medical College and Hospital, Nellore, after approval from ethical committee.
A detailed history was elicited from the patients to reveal the duration of injury and the mode of injury. Radiographs of the fractured clavicle were obtained in anteroposterior and 45° cephalic tilt views. We classified the fractures based on the Orthopaedic Trauma Association (OTA) classification scheme for midclavicular fractures [6].

Inclusion criteria
1. Patients above 18 years and less than 60 years age

1. OTA type A and B fractures
2. Fracture with minimum 2 cm displacement
3. Fractures with impending skin puncture

Exclusion criteria

1. OTA type C fractures
2. Open and pathological fractures
3. Clavicle fractures with associated neurovascular injuries
4. Polytrauma patients
5. Patients who were surgically unfit

After obtaining necessary investigations and surgical fitness, patients were informed for usual surgical risks and additional incision for open reduction. Then patients were subjected to intramedullary fixation with titanium elastic nail system by the closed/open reduction method under Image intensifier control. The timing of the operation was 2 days to 10 days post- injury. The surgery was performed under general anaesthesia.

Technique: After general anesthesia, the patient was positioned in the beach-chair position with a folded sheet under the affected shoulder. Parts were painted with providing iodine solution and sterile drapes were applied with adequate exposure of the whole clavicle and whole ipsilateral upper limb draped free.

Elastic intramedullary nailing was done using the technique described first by Jubel [7].

A small skin incision was made approximately 2cm lateral to the sternoclavicular joint. The medullary cavity of the clavicle was opened using an awl. Titanium nail was bent at tip about 15deg to facilitate insertion. T- Handle was used to push and rotate the nail into the medullary cavity under fluoroscopic control until it reaches the fracture site. Single elastic nails of different diameters varying from 2 to 3.5mm were used, depending on the width of the bone. Closed reduction was done under an image intensifier and provisionally fixed with two percutaneously pointed reduction clamps. In 6 cases close reduction of the fracture site could not be done, so an additional small incision was made above the fracture site for direct manipulation of the main fragments before the nail was introduced into the lateral fragment and the fracture was compressed. After adequate engagement in lateral segment, nail cut after little bent on medial side and buried under skin.

For all patients arm sling support was given to all the patients for 2 weeks postoperatively. The sling prevented the arm from drooping and interfering with bone union while allowing passive exercises in the early post- operative period. Early mobilization was started if pain was reduced. Patients were encouraged to resume their normal daily activities after 4-week postoperative period. Shoulder function was evaluated according to shoulder Constant score [8]. 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- 79 and poor if the scores are 69 or less. Patients called up for follow-up at monthly intervals for 4 months. After clinical and radiological union, they were called up after sixth, ninth and at 12 month.

Results

All the patients were available for follow up in our study. The average age was 38 years (Range 22 to 48 years). Out of the 20 patients, 12(70.58%) were male and 8(29.41%) were females. 11(64.70%) patients sustained injury to right clavicle compared to 6(35.29%) who sustained injury to the left clavicle. Out of 20 patients, 12 (58.8%) got injured due to fall on the ground, 7 patients met road traffic accident and 1 patient sustained injury in sport activity. Patient demo-graphic and clinical data are presented in Table 1.

Table 1: Demographic and clinical characteristics of 17 patients who underwent intramedullary fixation with titanium elastic nail

Characteristic	No.
Age in years (mean)	38 years
Male	12
Female	8
Right clavicle	14
Left clavicle	6
Fall	7
Sport	1

The mean duration of surgery was 60 minutes (range: 40-90 min). In 11 patients we could achieve closed reduction and internal fixation under fluoroscopic control. In 6 patients, we achieved reduction by open method and holding the fracture fragments together while passing the nail. Minor Nail prominence was felt in 3 patients at the sternal end, but was not of much concern to the patient. 3 patients had wound (superficial infection) at the medial end of clavicle at the nail insertion site and after nail removal healed by secondary intention. 1 patient landed in delayed union. There were no major complications noted i.e. nonunion, deep infection or refracture. There were no neurovascular complications. The average time of union was 12 weeks (Range 10 and 14 weeks) except one case which went for delayed union and healed by 20 weeks after surgery. The pin was removed once clinical and radiographic sign of fracture healing was obtained in an outpatient.

Patients had returned to their previous activity level at approximately 3 months follow-up with full range- of- motion and strength in the affected extremity. Follow-up period ranged between 9 months and 18 months with an average of 10 months. Radiographic course of a displaced mid shaft clavicular fracture of a 23 year old patient is depicted in the [Fig. 1, 2, 3 and 4].Intraoperative and postoperative Pictures are depicted in [Fig. 5, 6, 7] and [Fig. 8 & 9] respectively.

Fig 1: Pre-op x-ray

Fig 2: Immediate post op

Fig 3: Post-op X-ray at final follow up

Fig 4: X-ray after implant removal

Fig 5: Intra-op pic making window medial end of clavicle

Fig 6: Intra-op pic Inserting TENS through the window

Fig 7: Guiding TENS through distal fragment

Fig 8: Clinical photograph of healed wounds under c-arm guidance

Fig 9: Photograph depicting ROM

Discussion

Traditionally, mid shaft clavicular fracture has been managed conservatively with this assumption that it does not hamper shoulder function [9]. Although fracture healing and functional outcome is usually satisfactory, significant shortening with mal-union or non-union is described in the literature [10, 11, 12]. Wick and Eskola observed high rates of non-union, shoulder pain and poor functional results when the fracture had healed with shortening of more than 2cm. [13, 10]. These findings were confirmed by Lazaridesand, Wild [14, 15] in comparison to surgically treated patients [7]. Open reduction with plate fixation is the operative standard treatment for clavicular shaft fractures [11]. However disadvantages of plate fixation include the necessity for increased exposure and soft- tissue stripping, increased risk of damage to the supraclavicular nerve, slightly higher infection rates and the risk of refracture after plate removal [5]. In contrast TENS overcomes several disadvantages of plate fixation. Wijdicksin their study found that plating is associated with higher refracture, major revision surgery and implant failure in comparison to elastic stable nail [16]. In our study 70.58% were male and 29.41% were female. 64.70% patients sustained injury to right clavicle compared to 35.29% who sustained injury to the left. The average age was 38 years (SD: 24 to 48 years). A study by Meier C has similar comparable data [17]. In another study by Peter JM, 77.58% were males, 22.42% were females and the mean age was 38 years old (range 18- 67 years) [18].

The mean duration of surgery was 62.39 minutes (range: 40-90 min). In 64.70% patients, we could achieve closed reduction and internal fixation under fluoroscopic control. In 35.29% patients, we achieved reduction by open method and holding the fracture fragments together while passing the nail.

In our study minor complications (3 Nail prominence with skin irritation at the stern al end, 3 superficial wound infection and 1 delayed union) were noted in total 41.17% patients. There were no major complications noted (Nonunion, deep infection or refracture) in our study (Table 2). In a study by Peter JM, complications rate was 25.8% which included 8.6% major (5 non-.unions requiring revision surgery) and 17.2% were minor (1 delayed union, 2 superficial wound infections, 2 hardware failures after union, 5 skin erosions with pin exposure but without significant infection) [18] In another study by Pankajkumar Mishra, 20.5% encountered minor complications (3 delayed union in three cases, 2 iatrogenic perforation of lateral cortex, 7 skin irritation, 3 wound superficial infection) There were no major complications noted i.e. non-union or revision surgery [19].

Table 2: Complications noted after surgery Complication

	Type	No
Minor	Nail prominence	3(17.64%)
Wound superficial infection		3(17.64%)
Delayed union		1(5.88%)
Major		None

Limitations

There are some limitations of the study that should be considered. The primary limitation of our study was that it was a small prospective study including a small number of patients and done at a single center. Larger randomized controlled trials are needed to further evaluate outcomes and complications TENS in displaced mid shaft clavicle fractures. We interpreted our results in comparison with those of the studies in the literature that used other methods. However, the outcomes achieved with the technique in this study were favourable.

Conclusion

Minimally invasive fixation with TENS is a safe method and can be performed with minimal complications. This method of fixation of displaced midclaviclular fractures should result in less soft tissue injury, shorter operating time, satisfactory stabilization, a good cosmetic appearance, quick pain relief, early return to work and easy implant removal under local anaesthesia as an outpatient department procedure. It can be seen as an alternative to plate fixation or nonsurgical treatment in displaced mid shaft clavicle fractures.

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References

1. Robinson CM. Fractures of the clavicle in the adult. Epidemiology and classification J Bone Joint Surg. Br. 1998;80:476-84.
2. Neer CS. 2nd Nonunion of the clavicle JAMA. 1960;172:1006-11.
3. Rowe CR. An atlas of anatomy and treatment of midclavicular fractures Clin Orthop. Relat. Res. 1968;58:29-42.
4. Hill JM, McGuire MH, Crosby LA. Closed treatment of displaced middle-third fractures of the clavicle gives poor results J Bone Joint Surg. Br. 1997;79:537-539.
5. Canadian Orthopaedic Trauma Society. Non-operative treatment compared with plate fixation of displaced mid shaft clavicular fractures A multicenter randomized clinical trial J Bone Joint Surg. Am. 2007;89:1-10.
6. Marsh JL, Slongo TF, Agel J, *et al*., Fracture and dislocation classification compendium-2007: Orthopaedic Trauma Association classification, database and outcomes committee J Orthop Trauma. 2007;21(Suppl):S1-133.
7. Jubel A, Andermahr J, Schiffer G, Tsironis K, Rehm KE. Elastic stable intramedullary nailing of midclavicular fractures with a titanium nail Clin Orthop Relat Res. 2003;408:279-285.
8. Constant CR. A clinical method of functional assessment of the shoulder Clin Orthop. 1987;214:160-164.
9. Neer S. Fractures of the clavicle, in Fractures in Adults, Rockwood CA, Green DP, Eds. J. B. Lippincott, Philadelphia, Pa, USA, 2nd edition. 1981, 707-713.
10. Eskola A, *et al*., Outcome of clavicular fracture in 89

patients Arch Orthop Trauma Surg. 1986;105:337-33.
11. Schwarz N, Sim E, Pienaar S. The treatment of shaft fractures of the clavicle Eur J Trauma. 2001;27:211- 217.
12. Wilkins RM, Johnston RM. Ununited fractures of the clavicle J Bone Joint Surg. 1983;65-A:773-778.
13. Wick M, Muller EJ, Kollig E, Muhr G. Midshaft fractures of the clavicle with shortening of more than 2 cm predispose to non-union Arch Orthop Trauma Surg. 2001;121(4):207-211.
14. Lazarides S, Zafiropoulos G. Conservative treatment of fractures at the middle third of the clavicle: The relevance of shortening and clinical outcome J Shoulder Elbow Surg. 2006;15(2):191-194.
15. Wild LM, Potter J. Deficits following non-operative treatment of displaced midshaft clavicular fractures J Bone Joint Surg. 2006;88-A:35-40.
16. Wijdicks FJ, Houwert M, Dijkgraaf M, de Lange D, Oosterhuis K, Clevers G. Complications after plate fixation and elastic stable intra- medullary nailing of dislocated mid shaft clavicle fractures: a retrospective comparison Int Orthop. 2012 Oct;36(10):2139-45.
17. Meier C, Grueninger P, Platz A. Elastic stable intramedullary nailing for midclavicular fractures in athletes: indications, technical pitfalls and early results" Acta Orthop Belg. 2006;72:269-75.
18. Peter J Millett, Jason M Hurst, Marilee P Horan, Richard J Hawkins. Complications of clavicle fractures treated with intramedullary fixation J Shoulder Elbow Surg. 2011;20;86-91.
19. Pankajkumar Mishra, Gupta A, Gaur SC. Midshaft Clavicular Fracture and Titanium Elastic Intra-medullary Nail Journal of Clinical and Diagnostic Research. 2014;8(1):129-132.
20. Zhang W, Chen QY, Kou DQ, Cheng SW, Zhao JK, Qi YJ. Use of titanium elastic intra-medullary nails in the treatment of adult midshaft clavicular fractures: technical skills, precautions and complications. Zhongguo Gu Shang. 2012;25(4):274-7.
21. Hartmann F, Hessmann MH, Gercek E, Rommens PM. Elastic Intramedullary Nailing of Midclavicular Fractures Acta Chir Belg. 2008;108:428-432.
22. Chen YF1, Zeng BF, Chen YJ, Wang HM, Xue JF, Chai YM. Clinical outcomes of midclavicular fractures treated with titanium elastic nails Can J Surg. 2010 Dec;53(6):379-84.