



COMPARATIVE STUDY OF FUNCTIONAL AND RADIOLOGICAL OUTCOME BETWEEN ORIF WITH PLATE AND CRIF/ORIF WITH TENs FOR MIDSHAFT DISPLACED CLAVICULAR FRACTURE: A RETROSPECTIVE STUDY

Orthopedics

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ABSTRACT

Introduction-Clavicle fracture constitutes about 44% of shoulder injuries and 2.6%-10% of all fractures. Undisplaced and minimally displaced fracture of clavicle are acceptably treated conservatively with Arm pouch or triangular sling and clavicular brace or figure of eight bandage. Conservative treatment for displaced fracture has risk of malunion, nonunion and cosmetic unacceptability. Different surgical measures were popularised to address this problems. Fixation by Locking Plate or intra-medullary TENs are current gold standard. This study aims to compare TENs and Plate fixation for midshaft displaced clavicular fracture in terms of rate of union and functional outcome and complications on either methods. **Material And Methods**- This retrospective comparative study analysed result of 53 patients of clavicular fracture treated by TENs (21) or Plating (32) done at Department of Orthopaedics, Bankura Sammilani Medical College, Bankura between November 2020 to February 2022. Radiological outcome measured with Rate and Time of union assessed by skiagram and functional outcome measured by DISABILITIES OF THE ARM, SHOULDER AND HAND (DASH) score. **Results**-When compared to plate fixation, TENs had lesser Time of union the Functional outcome measured showed TENs having better average score than Plate fixation. Both finding were statistically significant. **Conclusion**-TENs had lesser union time, better functional outcome and comparative complications rate to plate fixation. So, Midshaft Clavicular Fractures managed with TENs have comparative better result than clavicular plating.

KEYWORDS

Mid shaft clavicular fracture, TENs, Plating

INTRODUCTION-

Clavicle is a strut like bone that transmits weight or force over upper limb to the trunk. It is placed superficially between angle of acromion and sternal notch. Its' superficial location, innate small midshaft diameter and function of transmitting force from upper limb to trunk makes it vulnerable to fracture both from direct bodily blow or fall on out stretched hand during a accident. Clavicle fracture constitutes about 44 % of shoulder injuries and 2.6-10% of all fractures¹. Predominantly clavicle fracture can be found among elderly where commonly a fall on outstretched hand is the reason, and younger patients where it is commonly due to direct blow on front or side of shoulder during a road traffic accident¹. Clavicle fracture are classified into type I or middle third fracture, Type II or lateral third fracture and Type III or medial third fracture as per Allman classification. Among them Type I or middle third clavicle fracture constitutes about 80-85 % of all clavicle fractures¹.

Undisplaced and minimally displaced fractures of clavicle are acceptably treated conservatively with Arm pouch or triangular sling and clavicular brace or figure of eight bandage². But with increase in Road traffic accidents chances of grossly displaced and comminuted clavicle fractures are on the rise, which on treatment by conservative measures risks into malunion, nonunion and cosmetic unacceptability^{3,4}. Different surgical measures were popularised to address this problem, namely Reconstruction plate and Locking precontoured plate fixation for rigid fixation and Intramedullary kirschner wire, Austin more pin, steinmann pin and titanium elastic nails(TENs) for relative stability. Surgical treatment had reduced chances of non union and malunion and improved functional outcome than conservative measures for displaced midshaft clavicle fractures^{5,6}. Gold standard for fixation of displaced clavicular midshaft fracture are either open reduction internal fixation(ORIF) with reconstruction plate or locking clavicle plate or ORIF with TENs^{7,8}. Closed reduction internal fixation (CRIF) with TENs can also be done if reduction is achieved under image intensifier. TENs achieves reduction by minimal or no soft tissue stripping giving it edge over plate fixation in terms of rapid wound healing, smaller surgical scar and fewer complications⁹. Whereas Rigid Plate fixation provides better stress shielding which often help in early resumption of day to day activity⁹. Both TENs and Plate fixation are accepted measures for stabilisation of clavicle

fracture but, both have their own limitation.

This study aims to compare TENs and Plate fixation for midshaft displaced clavicle fracture in terms of Rate of union and Functional outcome and incidence of complications on either methods.

MATERIAL AND METHODS-

This retrospective comparative analysis of functional and radiological outcome between two fixation methods namely ORIF with plate and CRIF/ORIF with TENs for midshaft displaced clavicular fracture was conducted at Department of Orthopaedics, Bankura Sammilani Medical College, Bankura. Both methods are routinely used as standard methods of fixation in our institute. Patient records were procured from Institute Records section after identifying patients, who were operated by either of the methods from operative register kept with the department. All patients who were operated with either of methods between November 2020 and February 2022 were informed to review with Department of Orthopaedics for assessment of functional outcome. Proper informed consent were obtained before enrolling each patient in the study. Inclusion criteria for the study was age between 18 and 65 years, who had closed displaced mid shaft clavicle fracture, treated by either ORIF with plate or CRIF/ORIF with TENs, who have completed at least 6 months follow up after fixation. Exclusion criteria were age below 18 and above 65 years, open injury, medial or lateral third clavicle fracture and presence of any other shoulder pathology or upper arm fracture which can influence functional outcome.

Rate and time of union were recorded with help of skiagram available with patient and patient records available with hospital and patient himself. Complications were recorded from patient records and by examining patient clinically for any hardware prominence, any prominent or pain full scar.

Functional outcome were measured by Using DISABILITIES OF THE ARM, SHOULDER AND HAND (DASH) Score questionnaire. DASH have two components, Disability or symptom questions of 30 items scoring between 1 to 5 and optional high performance sports/music or work section having 4 items scoring between 1 to 5. Patients have to answer at least 27 questions of Disability component and all questions of optional high performance component for

meaning full calculation of score. Assigned values of all completed response are simply summed and averaged, producing a score out of five.

This value is then transformed to a score out of 100 by subtracting one then multiplying by 25. This transformation is done to make the score easier to compare to other measures scaled on a 0-100 scale. A higher score indicates greater disability (10).

DASH disability/symptom score = $[(\text{sum of } n \text{ response}/n) - 1] * 25$

Where n is equal to the number of completed responses.

Results were analysed by entering data into a Microsoft excel spreadsheet and summarising as mean and standard deviation for numerical variables and count and percentage for categorical variables. Paired t-tests, chi-squared test (χ^2), Fischer's exact test were used as appropriate. SPSS (version 27.0) was used for data analysis when appropriate. If calculated p-value is below 0.05 then it was considered as statistically significant.



Figure 1 ORIF With Plate

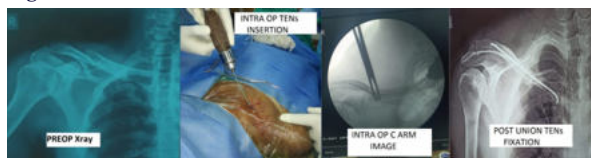


Figure 2 CRIF/ORIF with TENs



Figure 3 complication-Exposed TENs medial entry point

Observations:

In this retrospective analysis of functional and radiological outcome of midshaft clavicular fracture treated by either ORIF with plate or CRIF/ORIF with TENs, 53 patients were found to be operated by either of methods between November 2020 and February 2022 in our institute. Out of 53 patients 21 patients were operated by CRIF/ORIF with TENs and 32 patients were operated by ORIF with plate. Most of the patients (43,81%) were found to be between 20 and 40 years of age, with mean age of 31.51 years. Out of 53 patients 48 (90.57%) patients were male where as 5 patients were female. 31(58.49%) patients had right clavicle fracture 22(41.51%) had left clavicle fracture. While 42(79.24%) patient had history of road traffic accident as cause of clavicle fracture, 11 (20.76%) patients had clavicle fracture due to fall at home. 28 (52.83%) patients had transverse or oblique fracture of clavicle, 22 (41.51%) patients had simple wedge fracture and 3 (5.66%) patients had comminuted clavicle fracture.

Out of 21 patients treated by TENs Intramedullary Nailing, only 4 (23.53%) fractures were successfully reduced and fixed by closed reduction and internal fixation, rest 17 (76.47%) fracture had to undergo limited open reduction internal fixation as closed reduction internal fixation could not be achieved.

Table 1: Comparative Time Of Union Between TENs And Plate Fixation.

Union /non union	Time of union	CRIF/ORIF with TENs	ORIF with plate
Union	6 week to 12 week	18	11

	12 week to 18 week	1	13
	18 week to 26 week	2	6
Non union	After 26 week	0	2

21 patients treated by CRIF/ORIF with TENs have a mean time for union of 10.48 weeks with a range of 6 weeks to 22 weeks and standard deviation of 3.91. Whereas 32 patients treated by ORIF with Plate had 2 non union among them the mean time for union for rest of 30 patients were 14.23 weeks with a range of 10 weeks to 24 weeks and standard deviation of 3.51. Statistical analysis of mean and standard deviation of two respective procedure shows **p value of <0.0008**. Which is statistically significant meaning CRIF/ORIF with TENs have shorter time for union than ORIF with Plate.

Table 2: Comparative Functional Outcome As Per DASH Score Between TENs And Plate Fixation.

Functional outcome as per DASH score	CRIF/ORIF with TENs	ORIF with plate
Excellent 0-20	21	26
Good 21-40	0	4
Fair 41-60	0	2
Poor >60	0	0

21 patients treated by CRIF/ORIF with TENs have a mean DASH score of 9.76 with a range of 2.5 to 19.2 and standard deviation of 4.753. Whereas 32 patients treated by ORIF with Plate have a mean DASH score of 15.82 with a range of 3.3 to 48.3 and standard deviation of 10.166. Statistical analysis of mean and standard deviation of two respective procedure shows **p value of <0.0139**. Which is statistically significant meaning CRIF/ORIF with TENs have better functional outcome than ORIF with Plate.

Table 3: Comparative Complications Between TENs And Plate Fixation

Complications	CRIF/ORIF with TENs	ORIF with plate
Superficial infection	3(14.28%)	3(9.37%)
Deep infection	0	2(6.25%)
Neurovascular injury	0	0
Implant prominence	7(33.33%)	0
Implant failure	0	0
Ugly scar	0	1(3.12%)
Delayed union	2(9.52%)	4(12.5%)
Non union	0	2(6.25%)
No Complications	12(57.14%)	22(68.75%)

Among 21 patients treated with CRIF/ORIF with TENs 2 (9.52%) suffered from delayed union but all fractures united radiologically and clinically by 6 months from operation. But 7 of the patients presented with prominence of implant at medial entry port site of clavicle, 3 of the patients had superficial skin infection due to prominent hardware needing early implant removal as soon as fracture got united. 12 (57.14%) fractures united with out any complications.

Among 32 patients treated with ORIF with plate 3 (9.37%) patients had superficial skin infection which were treated with regular dressing and antibiotics. 2 (6.25%) had deep infection needing early implant removal leading to Non union of fracture clavicle. 4 (12.5%) patients had delayed union of the fracture, where as 1 (3.12%) patient had a keloid formation at incision site. 22 (68.75%) fractures united with out any complications.

DISCUSSION-

In this retrospective study 53 patients were reviewed who were operated between November 2020 and February 2022. 48 out of 53 (90.57%) patients were men, where as 43 patients (81%) were in the age group between 20 and 40 years. Both these observations are consistent with other studies^{1,11-14}. Mid shaft clavicular fracture is more common among people active in outdoor activity often meeting with road traffic accident. Male gender and younger age group, both are consistent with higher outdoor activity and resultant road traffic accident. 42 out of 53 (79.24%) fractures of this study were due to road traffic accident.

Comparing Time to union from operation CRIF/ORIF with TENs was found to be significantly better than ORIF with Plate. Minimal periosteal stripping and principle of relative stability allows abundant callus formation at fracture site resulting earlier union. This is consistent with finding of other studies as well^{7,15-17}. On the other hand plate provides rigid stability, which is better for comminuted fracture⁷.

In this study most TENs fixation had mini open reduction at fracture site, only 4 out of 21 (19.04%) fractures, we were able fix the fracture by closed reduction internal fixation. As per our experience it is very difficult to negotiate intramedullary TENs through fracture site to the lateral fragment, especially if there is wedge fracture or comminution.

Both CRIF/ORIF with TENs and ORIF with Plate had complications. TENs fixation had most common complication of medial end prominence, 3 out of 21 patients had early implant removal as their prominent implant has caused skin lesion with external exposure of medial end of TENs. 2 patients of plate fixation had suffered deep infection causing exposed implant leading to early implant removal and Non union. 3 fractures with plate fixation also had superficial skin infection which were successfully treated with regular dressing and antibiotics. 4 patients of plate fixation and 2 patients of TENS fixation had delayed union. Over all 57.14 % of TENs fixation and 68.75% of plate fixation had complication free recovery.

Comparing functional outcome with the help of DISABILITIES OF THE ARM, SHOULDER AND HAND (DASH) Score questionnaire all 21 TENs fixation had Excellent outcome, whereas 26 plate fixation had excellent outcome , 4 had good and 2 had poor outcome. Comparing mean DASH score of both procedure TENs had a significantly better outcome than Plate fixation. Hao Xiao et al¹⁸ on their meta-analysis and Yaseen M et al¹⁹ on their study also opined intramedullary TENs fixation have significantly better result than Plate fixation , whereas Weina Ju et al²⁰ on their meta analysis and Siddharth Jadav et al²¹ on their study showed there is no significant difference in Outcome between two procedures.

CONCLUSION-

CRIF/ORIF with TENS have better Time to union, better Functional outcome in comparison to ORIF with plate but both procedure have complications due to superficial position of clavicle. Both procedure can give good result , but also may cause wound infection and early implant removal.

Conflict of Interest –None

Declaration Of Funding- None

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