E-ISSN 2250-0944

ISSN 2250-1150

doi: 10.31838/ijprt/15.01.20

Research Article

Comparative evaluation of result after internal fixation of clavicle fracture with titanium elastic nail and plate

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Abstract:

Objective: This study evaluated the outcomes of using titanium elastic nail (TEN) fixation in combination with plate fixation to treat midshaft clavicle fractures. **Methods:** 60 patients with displaced midshaft clavicle fractures were randomly assigned to either Group A (TEN fixation) or Group B (Plate fixation). At six weeks, three months, and six months following surgery, a number of factors were assessed. Surgical duration, intraoperative hemorrhage, radiological union time, functional results, and complications were among them. **Results:** The mean age was similar between the groups ($p = 0.08$), the TEN fixation procedure took less time (48 ± 8 min; 66 ± 13 minutes, p-value = 0.000), there was less blood loss (90 ± 18 milliliters), and radiological union was faster (9 ± 2 weeks; 12 ± 3 weeks, vs. p-value = 0.00). The functional outcomes (CMS and DASH scores) improved at 6 weeks and continued to improve at 3 and 6 months. The TEN group had fewer complications than the plate fixation group, with no infections, malunion, or implant prominence; ten patients were satisfied with their plate fixation procedures, but one patient expressed dissatisfaction with their appearance, and there were no significant differences in soft

tissue disruptions between the two groups. **Conclusion:** Titanium Elastic Nail (TEN) fixation demonstrates several advantages over plate fixation, including shorter operative time, lower blood loss, faster healing, better functional outcomes, and fewer complications. The minimally invasive nature of TEN fixations appears to offer quicker rehabilitation, lower risk of infection, and better cosmetic results. This study suggests that TEN fixation may be the preferred option for the treatment of midshaft clavicle fractures, particularly in patients seeking early functional recovery with minimal cosmetic concerns.
Keywords: clavicle fracture, titanium elastic nail, plate fixation

Introduction

The clavicle fractures are among the most frequent injuries constituting 2 to 6 percent of all fractures and between 35 to 44 percent of shoulder girdle injuries [1, 2]. These fractures result from direct trauma to the shoulder due to falls, auto accidents, or sports-related injuries and sometimes due to fall on outstretched hand. A fracture of the clavicle can have a major impact on upper limb function and general quality of life because it is essential to the stability and biomechanics of the shoulder joint [3].

The majority of midshaft clavicle fractures were conventionally treated conservatively with shoulder immobilizers, figure-of-eight bandages, or arm slings [4]. However, studies have shown that conservative treatment often leads to complications such as malunion, shoulder deformity, and functional impairment, particularly in displaced or comminuted fractures. Therefore there is an apparent shift towards internal fixation surgery, which aims to promote faster healing, better functional outcomes, and early mobilization [5].

For clavicle fractures, mainly two surgical methods are typically employed: internal fixation using plates and screws or intramedullary fixation using elastic intramedullary nails [6, 7]. In order to achieve firm fixation and better alignment, plate fixation-which is commonly accomplished using anatomical plates that have previously been contoured-requires considerable periosteal stripping and soft tissue dissection, which can reduce vascularity and slow the healing of fractures. Titanium Elastic Nail (TEN) fixation, on the other hand, provides biological fixation with little soft tissue damage, preserving fracture hematoma and accelerating healing. However, there are still problems with rotational stability, implant migration, and aesthetic outcomes with this method [8, 9].

This study compares the functional and clinical outcomes of internal fixation with plating for midshaft clavicle fractures utilizing titanium elastic nails (TEN). The study considers surgical time, intraoperative blood loss, and postoperative discomfort, time to union, cosmetic appearance, functional results, and complication rates. This study compares these two commonly used fixation procedures to enable orthopedic surgeons make evidence-based decisions for the optimal treatment of clavicle fractures, improve patient care, and aid in functional recovery.

Material and Methods

The purpose of this prospective, comparative clinical study is to assess and contrast the radiological and functional results of internal fixation of midshaft clavicle fractures using plate fixation and titanium elastic nail (TEN) fixation. Following Institutional Ethical Committee approval, the study was carried out in the Department of Orthopaedics. Patients who needed surgical treatment for displaced midshaft clavicle fractures were included in the study population. The following inclusion criteria were used to choose the patients -

closed fractures with no neurovascular involvement; patients between the ages of 18 and 60 years; displaced midshaft clavicle fractures classified as Robinson Type 2B1 or 2B2; fresh and less than 2 weeks old fractures and consent of the patients to participate in the study by attending scheduled follow-up appointments according to the guidelines.

The study excluded patients having pathological fractures, open fractures, a history of previous clavicle surgery or fractures associated with neurovascular damage were excluded from the study. Further, the patients having health issues entailing greater anaesthesia risk or who refused to have surgery or go to follow-up appointments were also excluded.

Sample size: 60 patients in all who met the inclusion requirements were added to the study. With the aid of a computer-generated random number table, these patients were divided into two groups at random. In Group A, thirty patients received treatment with titanium elastic nail (TEN) fixation, and in Group B, thirty patients received plate fixation.

Patients in Group A (Titanium Elastic Nail Fixation) underwent general anesthesia for the procedure. To elevate the afflicted side, a sandbag was positioned between the scapulae while the patient was in a supine position. The intramedullary canal was prepared by making a tiny skin incision close to the sternal end of the clavicle. Under fluoroscopic guidance, a titanium elastic nail (TEN) of the proper size was retrogradely inserted from the fracture's medial end. Once stable fixation was achieved, the incision was closed in layers and the nail was cut and bent at the entry site. Following surgery, early mobilization was advised and the arm was comfortably supported.

In Group B (Plate Fixation), the patient was positioned supine with a sandbag beneath the scapula to elevate the affected side, and the procedure was carried out under general anesthesia. Careful soft tissue dissection was used to reveal the fracture site after an incision was made along the clavicle's superior aspect. A pre-contoured locking compression plate (LCP) with screws was used for fixation once the fracture had been anatomically reduced. A sterile dressing was applied after the wound was properly fixed and closed in layers.

Following surgery, a sling was used to support the arm, and early mobilization was advised. Both groups followed a similar postoperative protocol. All patients received physiotherapy and pain management. To encourage an early recovery, range-of-motion exercises were started on the second postoperative day. On the fourteenth postoperative day, the sutures were removed. Following the observation of radiological evidence of fracture union, patients were permitted to bear their entire weight and move their shoulders freely

Outcome Measures: Several clinical and functional parameters were used to evaluate and compare the study's outcome measures between the two groups. From the moment of incision until the wound was closed, the operating time was noted and expressed in minutes. The amount of blood lost during surgery was measured in milliliters (ml). Based on how long it took for fractures to heal as seen on radiographs, the time to radiological union was calculated in weeks.

The Constant-Murley Score (CMS) and the Disabilities of the Arm, Shoulder, and Hand (DASH) Score were used to evaluate the patients' functional outcome at six weeks, three months, and six months following surgery. Infection, implant failure, malunion, non-union, implant prominence, and cosmetic dissatisfaction were among the intraoperative and postoperative complications that were noted. Patient satisfaction and the visible appearance of the surgical scar were used to evaluate the cosmetic result.

Statistical Analysis: The collected data was entered into Microsoft Excel, and the analysis was conducted using SPSS (Statistical Package for Social Sciences) version 26. Descriptive statistics were displayed as frequency/percentage for categorical variables and mean ± standard deviation (SD) for continuous variables. The Student's t-test was used to compare the variables. A p-value of less than 0.05 was considered to be statistically significant.

Follow-Up: Following surgery, patients were checked on at two, six, three, and six months. At each follow-up, radiological and clinical evaluations were performed to determine any surgical problems, fracture healing, and functional recovery.

Results

In this study, the results of plate fixation (Group B) and titanium elastic nail (TEN) fixation (Group A) in patients with midshaft clavicle fractures were compared. Table No. 1 shows that there was no discernible difference in the age distribution between the two groups, with the mean age of the patients being similar (p = 0.083). Nonetheless, the TEN group's operating time was considerably less (48 ± 8 minutes) than the plate fixation group's (66 ± 13 minutes) (p = 0.000). In a similar vein, the TEN group experienced significantly less intraoperative blood loss (90 ± 18 ml) than the plate fixation group (120 ± 22 ml) (p = 0.000), indicating that TEN is a less invasive procedure. Furthermore, the TEN group's time to radiological union was significantly shorter (9 ± 2 weeks) than that of the plate fixation group (12 ± 3 weeks) (p = 0.000), suggesting that TEN fixation promotes healing more quickly. Table No. 2 unequivocally demonstrates that the Constant-Murley Score (CMS) was continuously higher in the TEN group at all time points than in the plate fixation group, suggesting that patients treated with TEN had improved shoulder function and recovered more quickly. Comparing the TEN group to plate fixation, the DASH Score was lower in the TEN group during all follow-up periods, indicating less disability and better functional recovery. Early postoperative (6 weeks) was when the CMS and DASH Score differences between the two groups were most apparent, but even at 3 and 6 months, the TEN fixations were still preferred.

Table No. 1: Showing the age (years), Operative Time (minutes), Intraoperative blood loss (ml) and time to radiological union (weeks) for internal fixation of clavicle fracture with titanium elastic nail and plate

Parameters	Group A Mean ± SD	Group B Mean ± SD	P-value
Age (years)	38 ± 12	39 ± 13	0.08
Operative Time (minutes)	48 ± 8	66 ± 13	0.00
Intraoperative blood loss (ml)	90 ± 18	120 ± 22	0.00
Time to radiological union (Weeks)	9 ± 2	12 ± 3	0.00

Table No. 2: Showing the Constant-Murley Score (CMS) Score and Disabilities of the Arm, Shoulder, and Hand (DASH) Score at 6 weeks, 3 months, and 6 months for internal fixation of clavicle fracture with titanium elastic nail and plate

Surgical technique	CMS (6 weeks)	CMS (3 months)	CMS (6 months)
Group A	85	92	96
Group B	80	86	93
Surgical technique	**DASH Score (6 weeks)**	**DASH Score (3 months)**	**DASH Score (6 months)**
Group A	10	6	4
Group B	12	7	5

Table No. 3: Showing the intraoperative or postoperative complications and cosmetic outcome for internal fixation of clavicle fracture with titanium elastic nail and plate

Complications	Group A TEN (Number)	Group B Plate (Number)
Infection	0	2
Implant failure	0	0
Malunion	0	1
Non-union	0	0
Implant prominence	0	1
Cosmetic outcome		
Incision & Scar	0	1
Soft Tissue Disruption	0	0

Discussion

The results of plate fixation and titanium elastic nail (TEN) fixation in the treatment of midshaft clavicle fractures were compared in this study, with an emphasis on complications, functional recovery, and operative parameters. The results shed important light on the benefits and drawbacks of both approaches. The findings show that TEN fixation is superior to plate fixation in a number of ways, including improved functional outcomes, decreased blood loss, quicker healing, and operative efficiency. Compared to the plate fixation group (66 ± 13 minutes), the TEN group's operative time was significantly shorter (48 ± 8 minutes) (p = 0.00). The findings of Shahrahmani F et al. were similar. They demonstrate that the TEN group's surgery time was noticeably shorter (mean 73 minutes vs. 98 minutes, with a p-value of 0.035) [10]. The TEN group also experienced significantly less intraoperative blood loss, confirming its status as a less invasive procedure. A nearly identical outcome was discovered by Yadav S. et al.[11].

TEN fixation appears to promote faster bone healing, as evidenced by the significantly shorter time to radiological union (9 ± 2 weeks) compared to plate fixation (12 ± 3 weeks) (p = 0.00). Ganai AA et al. reported similar findings [12]. Better shoulder function and quicker recovery were indicated by the TEN group with consistently higher Functional Outcomes based on Constant-Murley Score (CMS) at all follow-up intervals. The TEN group had lower DASH scores, which may indicate less disability and better patient-reported outcomes. These disparities, which favored TEN at 3 and 6 months and were especially noticeable in the early postoperative phase (6 weeks), demonstrated TEN's potential for early mobilization and improved functional

restoration. Similar findings were made by other researchers as well [13-15].

The two groups experienced different complications and cosmetic results. Two patients in the plate fixation group experienced infection, whereas the TEN group did not experience any cases of infection. This indicates that the minimally invasive TEN techniques carry a lower risk of infection. Only the plate fixation group experienced malunion and implant prominence; the TEN group did not experience these issues. All of the patients in the TEN group were happy with the way their surgical incisions looked, but one patient in the plate fixation group complained of cosmetic issues like scar dissatisfaction. There were no appreciable differences between the groups, and both procedures caused very little soft tissue disruption. Other researchers also found similar results [16, 17]

Conclusion

The results of this study indicate that titanium elastic nail (TEN) fixation is a more aesthetically acceptable, less intrusive, and better-functioning choice than plate fixation for treating midshaft clavicle fractures. TEN fixations resulted in a faster bone healing process, less blood loss, a shorter operating time, and a superior functional recovery, as evidenced by higher CMS and lower DASH scores. Better cosmetic outcomes and a lower rate of problems further promote its usage, especially for patients who seek a less invasive surgery and an early functional recovery. TEN fixations have numerous advantages, but patient selection is essential. More thorough long-term study with larger sample numbers is needed to validate these findings and assess the long-term outcomes, need for implant removal, and patient satisfaction over time.

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