

A study of functional outcome of fractures of radius and ulna in adults treated with tens nailing

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Abstract: *Background:* Fractures involving the radius and ulna in adults are clinically important because, the forearm functions as a coordinated unit that enables pronation and supination. Proper restoration of alignment and stability is necessary to regain normal forearm movement and upper limb function. While plate fixation has traditionally been the preferred treatment method, it often requires extensive soft-tissue dissection and exposure. The Titanium Elastic Nailing System (TENS) on the other hand offers a minimally invasive alternative that preserves the biological environment of the fracture with less soft tissue disruption, less bleeding and also facilitates early mobilization. *Objectives:* To assess range of motion, radiological union and complications. *Methods:* This study was conducted on 30 adults presenting with diaphyseal both bones fracture who came to Orthopaedics OPD at Al-Ameen hospital from December 2023 to November 2025. All patients were treated with closed reduction and intramedullary fixation with TENS nails. Postoperative protocols were followed and it included early mobilization and follow up at regular intervals and assessed for fracture union, range of motion, complications, and functional recovery using standard scoring systems such as the DASH score and Everman's criteria. *Results:* Almost all patients achieved radiological union within 6 to 12 weeks. Functional outcomes were excellent to good in 98% of cases, with early return of movements and grip strength. Complications such as delayed union, infection, nail irritation were rare and manageable. Compared to conventional plating, patients reported less postoperative pain and faster return to activities. *Conclusion:* TENS nailing is safe, minimally invasive for the management of adult diaphyseal forearm fractures. It provides stable fixation, allows early mobilization, and yields good to excellent functional outcomes.

Keywords: Both-bone forearm fractures, Titanium Elastic Nailing System (TENS), Intramedullary nailing, adult forearm fractures, Functional outcome, DASH score.

Introduction

Fractures of the radius and ulna are also known as both bone forearm fractures, caused by either direct or indirect trauma. They pose a challenge due to need for anatomical reduction and stable fixation to restore forearm rotation and function, because it is the rotations of the forearm that play an important role in the functioning of the forearm and hand movements. When it comes to fixing them, Plating offers reliable outcomes but requires extensive soft tissue dissection and carries risks such as infection, delayed union, neuro-vascular and implant-related complications. Fixation with a limited contact dynamic compression plate is considered to be more biological. However, it produces extensive soft tissue damage and the fracture hematoma is disturbed [1-3].

Titanium Elastic Nailing System (TENS), though widely used in children since ages, has now been explored as a minimally invasive alternative in adults to achieve stability with less soft tissue disruption, faster recovery and fewer complications in a well selected cases of both bone forearm fractures. This technique preserves the periosteum, allowing bone healing within a closed and intact biological environment [2, 4-5].

The biomechanical principal of the TEN is based on the symmetrical bracing action of elastic nails inserted into the metaphysis, which bears against the inner bone at three points. This method has the benefits of early immediate stability to the involved bone segment, which permits early mobilization

and returns to the normal activities of the patients, with very low complication rate. TENS lack axial and rotational stability but they are relatively stable with secondary bone healing [3].

Conservative approach is less frequently used as it is difficult to maintain reduction with forearm shaft fractures having rotatory as well as angular motions. Also, it is most commonly associated with cast complications, non-union, malunion, compartment syndrome and Volkmann ischemic contracture. Hence, surgical approach is the preferred option with final decision resting upon the treating doctor [4, 6].

Material and Methods

This single centre, hospital-based study was conducted over a period of 2 years from December 2023 to November 2025 in the department of Orthopedics at a tertiary care medical college and hospital, following ethical approval from the Institutional Ethics Committee. A total of 30 adult patients with both bone forearm fractures were recruited using a non-probability convenience sampling method. These patients, who presented to the department of orthopedics and were treated using the TENS, were included after providing informed consent [5, 7-8].

Inclusion Criteria:

- All skeletally mature patients.
- Patients with fracture of both bones (radius & ulna) of forearm.
- Patients who have got fitness for surgery

Exclusion Criteria:

- Pathological fractures.
- Skeletally immature patients.
- Open fractures.
- Fractures involving the epiphysis and metaphysis

Operative Principle and Technique: In this technique, the emphasis is laid upon the closed, indirect, and acceptable reduction, biological fixation, and relative stability with flexible titanium nails that have the Young's modulus close to that of the cortical bone and almost half of the same for stainless steel. The TENS nail as shown in Fig. 1 below, acts as a pure internal

splint without any compression and allows the fracture to heal naturally in the setting of no damage to the surrounding soft tissues.

Fig-1: Titanium Elastic Nails of different sizes



In a fracture of both bones of forearm, we preferred nailing the ulna first to restore the length that facilitates the subsequent reduction of the radius fracture. The diameter of the nail was tentatively selected based on the size of the medullary canal on X-ray. However, we relied more upon the intra-operative 'feeling' and 'fit' of the size that was subsequently increased or decreased until satisfactory reduction and stability were achieved. The nails were pre-bent as per the shape of the normal bone on the opposite side

The radial entry point is distal and the ulnar entry point is proximal, guided by an intraoperative image intensifier. To access the radial entry point, a 2-3 cm transverse or longitudinal incision is made over the palpable dorsal tubercle and an awl instrument is used to create an entry, starting perpendicularly and then angling obliquely towards the elbow. To access the ulnar entry point, a 1.5 to 2 cm transverse incision is made over the proximal lateral aspect of the olecranon. After reduction is achieved through external manipulation, the appropriate size TENS nail is passed and fixed to the injured bone's metaphysis. The distal end of the nail is cut 5-10mm from the bone before closing the entry point [5-6, 9].

The supination and pronation range of motion (ROM) of the forearm, distal radioulnar joint (DRUJ) stability, and the fracture reduction stability were checked on the operating table. Postoperatively, patients were immobilized in an above-elbow splint for 2 weeks for comfort

and soft tissue healing. Active finger movements were encouraged immediately after surgery. At 2 weeks, the splint was removed, and gentle active-assisted range of motion exercises of the wrist and elbow were initiated under the supervision of a physical therapist. Strengthening exercises were added progressively based on radiographic evidence of fracture healing. Weight bearing and strenuous activities were restricted until radiographic union was achieved [7, 9-10].

Clinical and radiological follow-up (standard AP, lateral view x-rays) was carried out at 2 weeks, followed by 6 weeks, 12 weeks, and subsequently at 6 months. Radiological union was confirmed and was defined by the presence of bridging callus across the fracture site with obliteration of the fracture line, along with pain-free functional movements. Below in the Fig. 2 are x rays showing a) Fracture of both bones of forearm and b) Post op x ray with TENS in situ.

Functional outcomes were subsequently evaluated by measuring the range of motion at the elbow joint, wrist, and forearm rotation, along with standardized functional scoring systems. Implant removal was planned electively after

complete fracture union, usually between 6 to 12 months, or earlier if symptomatic nail prominence was noted.

Fig-2: a) pre-op x-ray of radius and ulna, (b) Post op x-ray with TENS in situ



Grace and Eversmann rating system was used to assess functional evaluation. With the use of a forearm goniometer, the ranges of pronation and supination were evaluated according to the neutral zero method, with the elbow flexed 90°, and were recorded as a percentage of the range of motion on the contralateral side. The Fig 3 shows range of motion post op a) neutral position b) supination and c) pronation to assess the functional outcomes post op.

Fig-3: (a) Neutral, (b) Supination and (c) pronation movements of both bones



The results were rated as excellent when the fracture had united and there was at least 90% of the normal forearm rotation arc, good when the fracture had united and there was 80%–89% of the rotation arc, acceptable when the fracture had united and there was 60%–79% of normal forearm rotation, and poor when there was a non-union or <60 % of normal forearm rotations.

Patient-reported outcomes were assessed using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire scores. A score of zero point indicates a perfectly functioning upper

extremity, whereas a score of 100 points indicates a complete impairment [5, 8-9, 11].

Sample Size Calculation: Considering a 95% confidence level ($Z = 1.96$) and a permissible margin of error of 10% ($d = 0.10$), the sample size was computed accordingly using the standard formula.

$$n = \frac{Z^2 p(1-p)}{d^2}$$

$$n = \frac{(1.96)^2 \times 0.92 \times 0.08}{(0.10)^2} \approx 28$$

Thus, the minimum sample size as per the above was 28 patients.

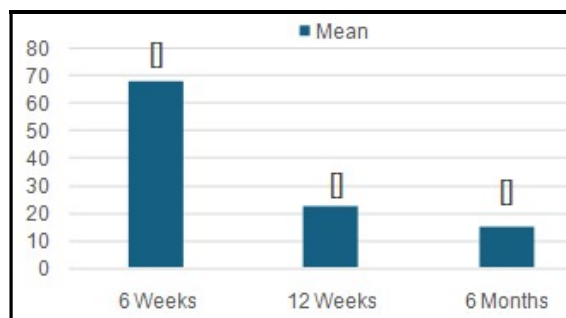
Taking into account the number of adult patients with diaphyseal fractures of the radius and ulna eligible for TENS fixation during the study duration, along with the institutional case volume, a total of 30 patients were enrolled

Results

A total of 30 adult patients with fractures of the radius and ulna treated with TENS nailing were included in the study. The age of the patients ranged from 27 to 63 years, with a mean age of 49.03 years. The majority of patients were in the 40–49 year age group (40%). There was a male predominance, with 17 males (56.7%) and 13 females (43.3%). The right forearm was involved in 23 patients (76.7%), while 7 patients (23.3%) had fractures on the left side. Road traffic accidents were the most common mechanism of injury, accounting for 63.3% of cases, followed by falls (36.7%). The mean interval between injury and surgical fixation was 2.38 ± 1.23 days.

Radiological assessment showed that all fractures achieved union, with a mean union time of 6.6 ± 1.0 weeks. Functional outcome evaluated using the Grace and Eversmann scoring system revealed excellent results in 23.3%, good results in 46.7%, fair results in 23.3%, and poor results in 6.7% of patients.

Fig-4: Mean DASH scores at the end of 6 weeks, 12 weeks and 6 months



The mean DASH score improved progressively from 67.9 ± 3.6 at 6 weeks to 22.3 ± 8.7 at 12 weeks, and further to 14.8 ± 10.1 at 6 months ($p < 0.001$), indicating significant functional recovery.

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Postoperative complications were minimal, with 90% of patients showing no complications. Nail irritation occurred in 6.7%, while delayed union was noted in 3.3% of cases, all of these findings are well depicted in the below figure (Fig-4).

Discussion

Fractures of the radius and ulna in adults require accurate anatomical reduction and stable fixation to restore forearm rotation that can help in upper limb function [10]. In the present study, TENS nailing demonstrated satisfactory clinical and radiological outcomes in the majority of patients. The mean union time of 6.6 weeks observed in this study indicates early fracture healing, which may be attributed to preservation of periosteal blood supply and minimal soft-tissue disruption associated with the intramedullary technique.

Functional assessment using the Grace and Eversmann scoring system showed predominantly good to excellent results, while the DASH score improved significantly during follow-up, reflecting progressive recovery of upper limb function. The complication rate was low, with only a few cases of nail irritation and delayed union. These findings are comparable with previously reported studies, suggesting that TENS nailing is a reliable minimally invasive option for selected adult forearm fractures, particularly simple diaphyseal fracture patterns [10-19].

Conclusion

TENS nailing is safe, minimally invasive for the management of adult diaphyseal forearm fractures. It provides stable fixation, allows early mobilization, and yields good to excellent functional outcomes.

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Conflicts of interest: There are no conflicts of interest.

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