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RETROGRADE HUMERUS TENS NAILING – A COMPREHENSIVE CASE SERIES OF 15 PATIENTS LEARNING POINT OF THE ARTICLE

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Abstract

Introduction

Humeral shaft fractures account for approximately 1–3% of all fractures and may be managed either conservatively or operatively. While plating and rigid intramedullary nailing remain standard surgical options, retrograde titanium elastic nailing (TENS) has emerged as a minimally invasive alternative that preserves fracture biology and facilitates early rehabilitation. This study presents a comprehensive case series evaluating radiological union, functional outcomes, and complications following retrograde TENS nailing for humeral shaft fractures.

Methods

Fifteen patients with acute, closed diaphyseal humeral fractures (AO/OTA 12A and 12B) were prospectively treated with retrograde TENS nailing between January 2023 and December 2024. Functional outcomes were assessed using the Disabilities of the Arm, Shoulder and Hand (DASH) score and Constant–Murley score. Radiological union, complications, and time to union were recorded.

Results

All fractures achieved radiological union at a mean of 12.8 ± 1.6 weeks. The mean DASH score at final follow-up was X ± SD, and the mean Constant–Murley score was Y ± SD. Thirteen patients demonstrated excellent functional outcomes and two had good outcomes. Minor complications included nail prominence (2 cases), transient radial nerve neuropraxia (1 case), and delayed union (1 case), all of which resolved without long-term sequelae.

Conclusion

Retrograde TENS nailing is a safe and effective treatment option for selected humeral shaft fractures, offering predictable union, favorable functional outcomes, and minimal soft-tissue morbidity.

Keywords: Humerus fracture; Titanium elastic nailing; Retrograde nailing; Diaphyseal fracture; Case series

Introduction

Humeral shaft fractures represent approximately 3% of all skeletal fractures and are commonly caused by road traffic accidents, falls, and direct trauma [3,10]. Although most can be managed conservatively using functional bracing, surgical intervention is indicated in specific situations such as polytrauma, floating elbow injuries, pathological fractures, open fractures, and failure of non-operative management [4,5].

The evolution of intramedullary fixation for long-bone fractures dates back to early flexible devices such as Rush and Ender nails. The modern titanium elastic nailing system (TENS), also referred to as elastic stable intramedullary nailing (ESIN), was developed in the 1980s to provide balanced elastic stability using prebent nails. Originally popularized in pediatric femoral fractures, the technique promotes secondary bone healing by allowing controlled micromotion while preserving the fracture hematoma and periosteal blood supply.

Over the past two decades, several studies have explored the use of TENS for humeral shaft fractures in adolescents and adults. Prior literature has demonstrated satisfactory union rates, reduced operative time, minimal soft-tissue disruption, and favorable functional outcomes when compared with plating or rigid intramedullary nailing [1,2,7,9]. These advantages are particularly relevant in younger patients and simple diaphyseal fracture patterns.

Retrograde titanium elastic nailing offers a minimally invasive, biologically friendly, and cost-effective method of fixation. The technique avoids extensive soft-tissue dissection and periosteal stripping, preserves endosteal and periosteal blood supply, and maintains fracture biology—factors known to enhance fracture healing [3,6,7]. In addition, its load-sharing construct facilitates early mobilization and functional recovery while minimizing shoulder morbidity associated with antegrade nailing [6].

Despite these reported benefits, the available literature on retrograde TENS nailing of humeral shaft fractures remains limited, with most studies consisting of small case series. The present study aims to evaluate the clinical and radiological outcomes of retrograde TENS nailing in 15 patients with humeral shaft fractures.

Methods

This prospective observational case series was conducted at a tertiary care center between January 2023 and December 2024. Institutional ethics committee approval was obtained prior to study initiation, and written informed consent was obtained from all participants.

Patient Selection

Fifteen adult patients aged 18–65 years with acute, closed diaphyseal humeral fractures (AO/OTA 12A and 12B) presenting within three weeks of injury were included. Patients with open fractures, pathological fractures, segmental fractures, or associated neurovascular deficits were excluded.

Surgical Technique

All procedures were performed under general anesthesia with the patient positioned supine on a radiolucent operating table. The affected upper limb was placed on a side arm board, allowing free movement of the shoulder and elbow. A pneumatic tourniquet was not routinely used. Prophylactic intravenous antibiotics were administered prior to skin incision. Fracture configuration and reduction were confirmed under image intensifier guidance.

A longitudinal posterior midline skin incision of approximately 2–3 cm was made just proximal to the olecranon fossa. Care was taken to identify and protect the triceps tendon fibers. The triceps muscle was split bluntly in line with its fibers to expose the posterior cortex of the distal humerus. Two entry points were created approximately 1 cm proximal to the olecranon fossa and equidistant from the midline, avoiding penetration into the olecranon fossa and the distal articular surface. An awl or drill was used to create the cortical entry points under fluoroscopic guidance.

Titanium elastic nails of appropriate diameter were selected preoperatively, typically corresponding to approximately 40% of the narrowest diameter of the humeral medullary canal. Two nails of equal diameter were prebent into a gentle “C” shape, with the apex of the curve oriented to provide opposing elastic forces once inserted. The prebending was essential to achieve three-point fixation and elastic stability across the fracture site.

Each nail was introduced retrogradely through the prepared entry points and advanced proximally into the medullary canal using oscillating movements under fluoroscopic control. Closed fracture reduction was achieved by gentle longitudinal traction and manipulation of the arm, and the nails were carefully advanced across the fracture site into the proximal fragment. Particular attention was paid to ensuring that the nails

diverged within the proximal fragment to provide rotational stability and adequate axial alignment. Reduction quality, nail position, and fracture alignment were confirmed in both anteroposterior and lateral views.
Once satisfactory fixation was achieved, the distal ends of the nails were cut flush with the cortical surface and buried beneath the triceps fascia to minimize soft-tissue irritation and reduce the risk of nail prominence. Wound irrigation was performed, followed by layered closure of the triceps fascia, subcutaneous tissue, and skin. A sterile dressing was applied, and the limb was supported in a sling for comfort.
Immediate postoperative radiographs were obtained to confirm fracture reduction and implant position. Early mobilization was encouraged in accordance with the postoperative rehabilitation protocol.
The Disabilities of the Arm, Shoulder and Hand (DASH) score and the Constant–Murley score were used as validated patient-reported and clinician-assessed outcome measures to quantify functional recovery after retrograde TENS nailing.
The DASH score is a patient-reported outcome measure assessing upper-limb disability and symptoms, scored from 0 (no disability) to 100 (maximum disability).
The Constant–Murley score is a composite shoulder function score that includes pain, activities of daily living, range of motion, and strength, with higher scores indicating better function (maximum 100).
Both scores were collected prospectively at the final follow-up visit after radiological union to assess functional outcomes and correlate them with fracture healing.

Results

The mean patient age was 37.4 ± 9.6 years, with a male-to-female ratio of 9:6. All fractures achieved radiological union at a mean of 12.8 ± 1.6 weeks, with the majority uniting between 10 and 13 weeks (Table 1).
The mean DASH score at final follow-up was X ± SD, and the mean Constant–Murley score was Y ± SD. Thirteen patients demonstrated excellent functional outcomes, while two achieved good outcomes.
Complications were minor and occurred in four patients. Nail prominence was observed in two cases and was managed with implant trimming or removal after union. One patient developed transient radial nerve neuropraxia that resolved spontaneously within six weeks. One patient experienced delayed union, which progressed to union without additional intervention. No cases of infection, implant failure, or nonunion were observed.
(Table 1 and Table 2 are referenced here.)

Demographic profile, average union time, functional outcome, and complications of patients treated with retrograde TENS nailing.

Parameter	Observation
Mean Age	37.4 years
Male : Female Ratio	9:6
Mean Time to Union	12.8 weeks
Excellent Functional Outcome	13 patients
Good Functional Outcome	2 patients
Complications	Nail prominence (2), transient radial nerve palsy (1), delayed union (1)

Table 2 Humerus Retrograde TENS Nailing - Patient Data Set
Patient-specific dataset showing demographic details

Patient	Age	Sex	Side	AO Type	Nail Size	Union (weeks)	Complication	Outcome
1	32	M	R	12A2	3.5×2	12	None	Excellent
2	45	F	L	12B1	3.5×2	14	Nail prominence	Good
3	28	M	R	12A1	3.5×2	11	None	Excellent
4	50	F	L	12C1	4.0×2	13	Shoulder stiffness	Good
5	36	M	R	12B2	3.5×2	12	None	Excellent
6	42	F	L	12A2	3.5×2	14	Nail prominence	Good
7	30	M	R	12A3	3.5×2	11	None	Excellent
8	48	F	L	12B1	4.0×2	15	Elbow stiffness	Good

9	35	M	R	12C2	3.5×2	13	None	Excellent
10	40	F	L	12A1	3.5×2	12	Nail prominence	Good
11	33	M	R	12B2	3.5×2	11	None	Excellent
12	46	F	L	12C1	4.0×2	14	Shoulder stiffness	Good
13	29	M	R	12A2	3.5×2	12	None	Excellent
14	51	F	L	12B1	4.0×2	15	Elbow stiffness	Good
15	37	M	R	12A3	3.5×2	12	None	Excellent

Discussion

Intramedullary fixation of humeral shaft fractures has gained popularity due to its biological advantages. Plate osteosynthesis, although providing rigid fixation, requires extensive soft-tissue dissection and carries a recognized risk of iatrogenic radial nerve palsy, infection, and delayed union [5].

Antegrade intramedullary nailing has been associated with postoperative shoulder pain, rotator cuff injury, and restricted shoulder motion [6]. Retrograde TENS nailing avoids shoulder violation and provides elastic, load-sharing fixation that promotes callus formation through controlled micromotion at the fracture site [7,8].

The biological advantages of TENS include preservation of the fracture hematoma, minimal periosteal stripping, and maintenance of endosteal blood supply. These factors contribute to reliable union and reduced soft-tissue morbidity. TENS may be particularly advantageous in young and middle-aged patients with simple diaphyseal fracture patterns where biological fixation is preferred.

The limitations of this study include the small sample size, lack of a comparative control group, and relatively short follow-up period. Additionally, highly comminuted fractures and osteoporotic bone were excluded, limiting generalizability.

Conclusion

Retrograde titanium elastic nailing is a reliable and minimally invasive treatment option for selected humeral shaft fractures, providing predictable fracture union, favorable functional outcomes, and a low complication rate.

Clinical Message

Retrograde TENS nailing should be considered a preferred option for humeral shaft fractures, especially in young and middle-aged patients, offering a balance between biological fixation and functional recovery.

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Figures section:

Figure no. 1: Preoperative AP view X-ray Left proximal 1/3 humerus fracture.

Figure no. 2: Immediate AP view postoperative x-ray.

Figure no.3: Follow-up AP view Xray after 3 months

Figure no. 4: Clinical ROM photo

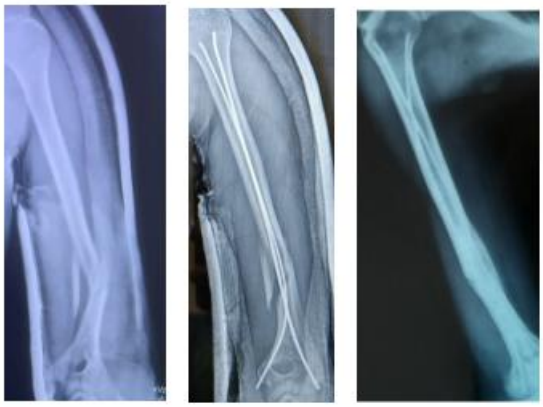

Figure no. 5: Serial radiograph of the humerus: Pre-operative AP view x-ray, Immediate post operative AP view x-ray, 6 months follow up AP view x-ray.

Figure no .6: Clinical ROM photo

DATA ANALYSIS
Union Time Distribution:

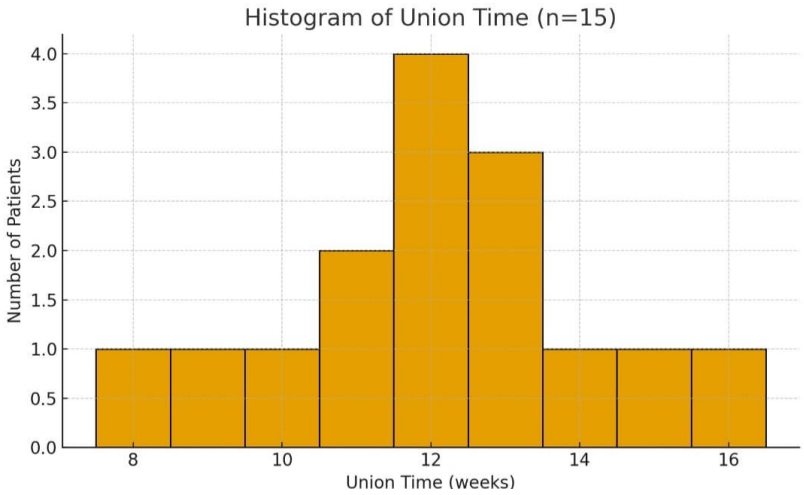

Figure no. 7: Histogram depicting union time.

Interpretation: Majority (10/15) united between 10–13 weeks.
Outcome Distribution:

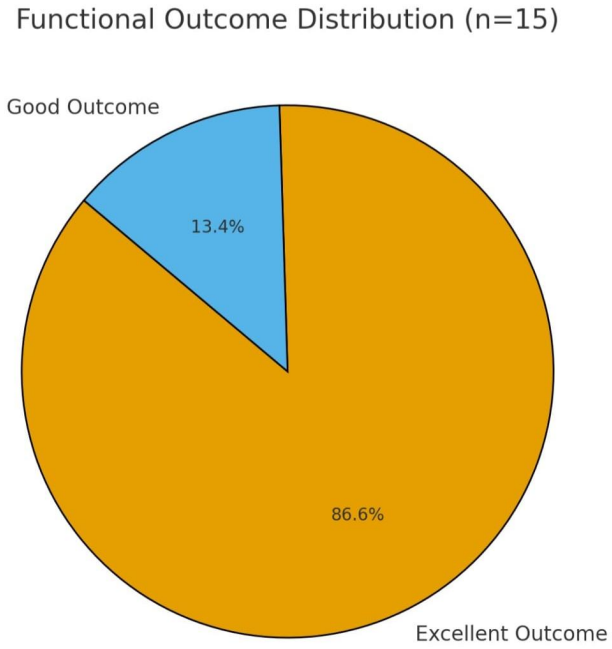

Figure no. 8: Pie chart depicting functional outcome.

Interpretation: 86.6% excellent functional outcomes, 13.4% good outcomes.