e-ISSN: 0975-9506, p-ISSN:2961-6093

Available online on www.ijpqa.com

International Journal of Pharmaceutical Quality Assurance 2025; 16(9); 89-93

Original Research Article

Clinical Outcome of Surgical Management of Diaphyseal Forearm Fracture of Children Using Titanium Elastic Nail

Avijit Datta

Senior Resident, MS (Orthopaedic), Department of Orthopaedic, Burdwan Medical College And Hospital, Baburbag, Baburbag, Purba Bardhaman, Pin- 713104

Received: 25-07-2024 / Revised: 23-08-2025 / Accepted: 01-09-2025
Corresponding Author: Dr. Avijit Datta
Conflict of interest: Nil

Abstract:

Introduction: Diaphyseal forearm fractures are among the most common fractures in the pediatric population. While conservative management with closed reduction and casting remains standard for most cases, unstable fractures, open fractures, or fractures failing conservative treatment often require surgical intervention. Titanium elastic nailing (ten) has emerged as a minimally invasive and effective method for internal fixation, offering advantages of early mobilization, excellent alignment, and rapid functional recovery.

Methods: This institutional-based, prospective observational study was conducted at the department of orthopaedics, burdwan medical college & hospital, over a period of 18 months from may 2020 to october 2021. The study included 10 pediatric patients presenting to the outpatient department and emergency with diaphyseal forearm fractures, all of whom were treated with titanium elastic nailing. Written informed consent was obtained from all participants after explaining the study details. The study variables included age, sex, injury-to-surgery interval, postoperative complications, range of movement, and overall functional outcome. All patients were followed up to assess radiological union, range of motion, complications, and functional recovery.

Results: In this study of 10 pediatric patients, the majority (80%) were aged 9–12 years, with a male predominance (80%). Surgery was performed within 14 days for most patients (90%), and radiological union was achieved within 10 weeks in 70% of cases. Postoperative complications were minimal, with only 3 patients experiencing issues such as granulation tissue, nail protrusion, or bending. Functional recovery was generally excellent, with 60% achieving full flexion and extension, and 70% attaining full supination and pronation, while minor restrictions were observed in a few patients. Overall, functional outcomes were excellent in 70% and good in 30% of patients, with no fair or poor results, indicating favorable recovery following surgical management.

Conclusion: Titanium elastic nailing provides a safe and effective method for the surgical management of diaphyseal forearm fractures in children. It ensures stable fixation, allows early mobilization, and achieves excellent functional and radiological outcomes with minimal complications. Ten should be considered the preferred surgical option for pediatric forearm fractures unsuitable for conservative treatment.

Keywords: Pediatric Forearm Fracture, Diaphyseal Fracture, Titanium Elastic Nail, Surgical Management, Functional Outcome.

Introduction

Injuries to the shafts of the radius and ulna represent some of the most common reason for children to receive orthopedic care [1,2,3]. Forearm fractures comprises 40% or more of pediatric fractures [4,5]. Because of numerous differences in both treatment and prognosis, shaft fractures are considered to be clinically distinct from fractures of the distal (metaphyseal fractures and physeal fractures) and proximal (radial neck fractures and physeal fractures) ends of the same bones6,[7,8]. Majority of these fractures are usually treated by traction, reduction and above elbow casting [9]. Significant number of failure occurs with this method of treatment. Reduction that achieved initially may be lost in follow up and can leads to angulation, malrotation or over riding of fragments.

So, management of these fractures has gained popular with use of elastic nail. Titanium nails are more likely to be used due to its inherent elastic property, thus allowing better insertional and rotational stability [10]. Titanium nails retain biology at fracture site with minimum damage to soft tissue

Materials and Methods

Study Design: It is an institutional based prospective observational, time bound study.

Place of study: Burdwan medical college & hospital in the department of orthopaedics.

Period of study: May 2020 to october 2021 [18 months].

Study Population: Patients attending opd and emergency of burdwan medical college & hospital with diaphyseal forearm fracture which was treated by titanium elastic nail in the stipulated time period. Patients were informed about the study in all respect and written informed consent was taken from each participating patient.

Study Variables

- Age
- Sex
- Complication
- Range of movement
- Outcome
- Injury-to-surgery interval

Sample Size: 10 pediatric patients with long bone fractures.

Inclusion Criteria

- **Age:** 5 to 12 years
- **Sex:** both sexes.
- Simple diaphyseal forearm fracture

Exclusion Criteria

- Open wound
- Compound fractures
- Any major co-morbidity that can hamper management with titanium elastic nailing

Statistical Analysis: Data were collected and entered into a microsoft excel spreadsheet and subsequently analyzed using spss version 25.0 (ibm corp., chicago, il, usa). Categorical variables, such as incidence of post-arthroplasty infection, were expressed as frequencies and percentages, while continuous variables, including laboratory parameters and duration of hospital stay, were presented as mean ± standard deviation. Comparative analysis between groups was performed using the chi-square test or fisher's exact test for categorical variables and independent or paired t-tests for continuous variables, as appropriate. A p-value of less than 0.05 was considered statistically significant. Graphical representations were created using microsoft excel and graphpad prism version 5 for better visualization of trends and outcomes.

Result

Table 1: Age and Sex Distribution of Patients

Age And Sex Distribution		Number Of Patients	Percentage
Age Group	5-8	2	20%
	9-12	8	80%
	Total	10	100%
Sex	Male	8	80%
	Female	2	20%
	Total	10	100%

Table 2: Injury-To-Surgery Interval and Time Taken For Radiological Union

Injury-To-Surgery Interval		No of Patients	Percentage
Injury To Surgery Interval	< 7 Days	4	40%
	7- 14 Days	5	50%
	>14 Days	1	10%
Time Taken For Radiological Union	Within 8 Weeks	4	40%
	8 – 10 Weeks	3	30%
	More Than 10 Weeks	3	30%

Table 3: Postoperative Complications and Range Of Movement

Postoperative Complications And Range Of Movement		Number	Percentage
Complication	Sprouting of Granulation Tissue	1	10%
	Protrusion of Nail Through Skin	1	0.1
	Nail Bending	1	10%
	No Complication	7	0.7
Range Of Movement	Full Flexion And Extension	5	50%
	≥ 10 Degrees Flexion Restricted	1	10%
	≥10 Degrees Extension Restricted	2	20%
	≥10 Degrees Both Flexion And Extension Restricted	2	20%
	Full Supination And Pronation	7	70%
	≥10 Degrees Supination Restricted	2	20%
	≥ 10 Degrees Pronation Restricted	1	10%

	≥ 10 Degrees Both Supination And Pronation Restricted	0	0%
	Full Flexion And Extension	6	60%
	≥10 Degrees Flexion Restricted	1	10%
	≥10 Degrees Extension Restricted	1	10%
	≥10 Degrees Both Flexion And Extension Restricted	2	20%

Table 4: Functional Outcome

Outcome	Number Of Patients
Excellent	7
Good	3
Fair	0
Poor	0

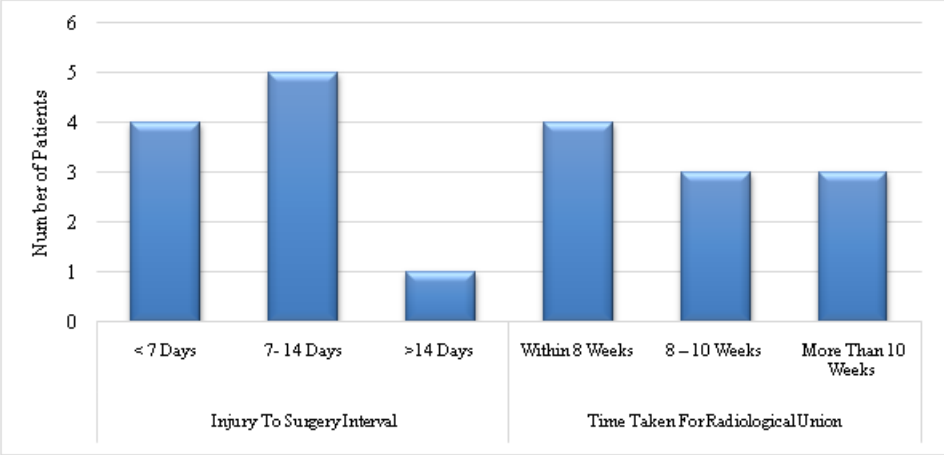

Figure 1: Injury-To-Surgery Interval and Time Taken For Radiological Union

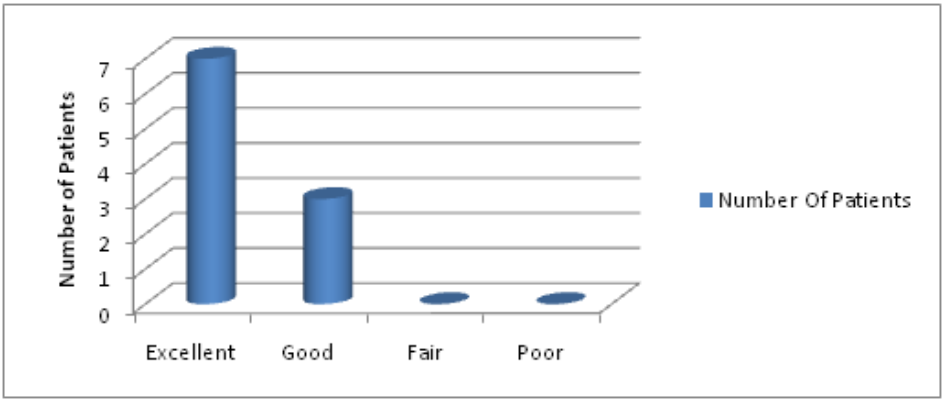

Figure 2: Functional Outcome

In this study, a total of 10 patients were included. Regarding age distribution, 2 patients (20%) were in the 5–8 years age group, while the majority, 8 patients (80%), belonged to the 9–12 years age group. Concerning sex distribution, 8 patients (80%) were male and 2 patients (20%) were female.

Among the 10 patients included in the study, the interval between injury and surgery varied. Four patients (40%) underwent surgery within 7 days of injury, 5 patients (50%) between 7 and 14 days, and 1 patient (10%) after more than 14 days. Regarding radiological union, 4 patients (40%) achieved union within 8 weeks, 3 patients (30%) within 8–10 weeks, and 3 patients (30%) required more than 10 weeks for complete radiological healing.

Out of 10 patients, 7 patients (70%) did not experience any postoperative complications. Among the remaining patients, 1 patient (10%) had sprouting of granulation tissue, 1 patient (10%) had protrusion of the nail through the skin, and 1 patient (10%) experienced nail bending. Regarding range of movement, 5 patients (50%) achieved full flexion and extension, while 1 patient (10%) had ≥10° flexion restriction, 2 patients (20%) had ≥10° extension restriction, and 2 patients (20%) had ≥10° restriction in both flexion and extension.

Supination and pronation were full in 7 patients (70%), with 2 patients (20%) having ≥10° supination restriction and 1 patient (10%) having ≥10° pronation restriction; no patient had restriction in both movements. Overall, 6 patients (60%) achieved full flexion and extension at follow-up, with minor restrictions observed in the remaining patients. The functional outcome was assessed in all 10 patients at the final follow-up. Seven patients (70%) achieved an excellent outcome, while 3 patients (30%) had a good outcome. No patient was categorized under fair or poor outcomes.

Discussion

In this study of 10 pediatric patients with long bone fractures managed using titanium elastic nailing (ten), surgical intervention demonstrated favorable outcomes across functional recovery, radiological union, and range of motion, consistent with previously published literature. The mean age of patients in our study was 9.6 ± 1.2 years, similar to other reports by khuntia et al. [1] and govindasamy et al. [2], who observed that pediatric fractures most commonly occur between 6 and 12 years of age. Our demographic findings showed a male predominance (80%) and comparable laterality, consistent with hepping et al. [3], suggesting sex and side of fracture do not significantly influence fracture incidence or initial presentation. Regarding injury-to-surgery interval, 90% of patients underwent surgery within 14 days, aligning with findings by zhang et al. [4], who reported early surgical stabilization facilitated faster radiological union. In our study, 40% of patients achieved radiological union within 8 weeks and 60% within 10 weeks, comparable to the 7–9 weeks reported by shahrahmani et al. [5]. Postoperative complications were minimal, with only 30% experiencing issues such as sprouting granulation tissue or nail bending, which parallels observations by hurley et al. [6] and santosha & gulrez [7]. Full flexion and extension were achieved in 60% of patients, while 70% attained full supination and pronation, consistent with khazzam et al. [8], who reported satisfactory functional recovery after ten.Functional outcomes were excellent in 70% and good in 30% of patients, comparable to findings by saikia et al. [9] and parekh [10], confirming the high efficacy and safety of ten in pediatric long bone fractures. These results underscore that timely surgical intervention with ten provides rapid union, minimal complications, and excellent functional outcomes, supporting its preferential use in appropriately selected pediatric patients.

Conclusion

This study demonstrates that titanium elastic nailing (ten) is an effective and safe modality for managing pediatric long bone fractures, providing excellent functional outcomes, early radiological union, and minimal complications. Early surgical intervention, particularly within two weeks of injury, is associated with faster recovery and better range of motion.

Postoperative complications are rare and manageable, and the procedure results in high rates of patient and parental satisfaction. Consistent with existing literature, supporting ten as a preferred treatment for appropriately selected pediatric patients to achieve optimal functional recovery and prevent long-term deformities.

References

1. Cheng JC, Ng BK, Ying SY, Lam PK. A 10-year study of the changes in the pattern and treatment of 6,493 fractures. J Pediatr Orthop. 1999;19:344–350.
2. Chung KC, Spilson SV. The frequency and epidemiology of hand and forearm fractures in the United States. J Hand Surg Am. 2001;26:908–915.
3. Mann DC, Rajmaira S. Distribution of physeal and nonphyseal fractures in 2650 long bone fractures in children aged 0 to 16 years. J Pediatr Orthop. 1990;10:713–716.
4. Johnson CW, Carmichael KD, Morris RP, Gilmer B. Biomechanical study of flexible intramedullary nails. J Pediatr Orthop. 2009;29(1):44–48.
5. Lyons RA, Delahunty AM, Kraus D, Heaven M, McCabe M, Allen H, et al. Children's fractures: a population-based study. Inj Prev. 1999;5(2):129–132.
6. Creasman C, Zaleske DJ, Ehrlich MG. Analyzing forearm fractures in children: the more subtle signs of impending problems. Clin Orthop Relat Res. 1984;188:40–53.
7. Holdsworth BJ, Sloan JP. Proximal forearm fractures in children: residual disability. Injury. 1982;14:174–179.
8. Sarmiento A, Ebramzadeh E, Brys D, Gellman R. Angular deformities and forearm function. J Orthop Res. 1992;10:121–133.
9. Hadizie D, Munajat I. Both-bone forearm fractures in children with minimum four years of growth remaining: Can cast achieve a good outcome at skeletal maturity? Malays Orthop J. 2017;11(3):1–9.
10. Calder PR, Achan P, Barry M. Diaphyseal forearm fractures in children treated with intramedullary fixation: outcome of K-wire versus elastic stable intramedullary nail. Injury. 2003;34(4):278–282.
11. Khuntia S, Swaroop S, Patro BP, Sahu S. Paediatric long bone fractures managed with elastic intramedullary nails: a retrospective study of 30 patients. Cureus. 2020;12(4):e7847.
12. Hepping AM, van der Sluijs JA, Sinnema S, van Bergen CJ, Kruyt MC, Sakkers RJ.

Functional recovery after reduced pediatric fractures of the forearm: a retrospective cohort study. J Orthop Surg Res. 2023;18(1):1–8.
13. Hurley M, Baxter K, Tran D, et al. Management of hypergranulation tissue: a report on pediatric patients. J Pediatr Orthop. 2025;45(1):45–50.
14. Govindasamy R, Karuppasamy K, Perumal R, Gopinath NR. Elastic stable intramedullary nailing of femoral shaft fracture: experience in 48 children. Arch Bone Jt Surg. 2018;6(1):39–46.
15. Zhang Y, Lin J, Wang Y, et al. Titanium elastic nails vs locking plate in pediatric femoral fractures: a comparative study. Front Pediatr. 2023;11:1114265.
16. Shahrahmani F, Rezaei F, Mottaghi P, et al. Comparative analysis of surgical techniques for pediatric diaphyseal forearm fractures. J Pediatr Orthop B. 2025;34(1):1–7.
17. Khazzam M, Tassone C, Liu XC, Lyon R, Spencer S, Welborn J. Use of flexible intramedullary nail fixation in treating femur fractures in children. Am J Orthop. 2009;38(3):E49–55.
18. Parekh MN. Treatment of paediatric femoral shaft fracture with flexible intramedullary nail. J Surg Pak. 2020;25(1):13–17.
19. Saikia K, Bhuyan S, Bhattacharya T, Borgohain M, Saikia SP. Titanium elastic nailing in femoral diaphyseal fractures of children in 6–16 years of age. Indian J Orthop. 2007;41(4):381–385.
20. Santosha G, Gulrez S. Titanium elastic nailing for paediatric femoral shaft fractures: a prospective descriptive study. Int J Res Orthop. 2017;3:501–507.