Int. J Med. Pharm. Res. (P-ISSN: 2958-3675 | E-ISSN: 2958-3683)
Available on: https://ijmpr.in/

International Journal
of Medical and Pharmaceutical Research

ORGINAL ARTICLE **OPEN ACCESS**

Functional outcome of conservative vs Intramedullary nailing incase of both bone forearm fracture in children- A comparitive study in Al-Ameen Medical College Hospital

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Received: 18-01-2025
Accepted: 13-02-2025
Available online: 18-02-2025

A B S T R A C T

Background: Both bone diaphyseal fractures of the forearm are common injuries in children. This study aimed to compare the functional outcomes and complications of conservative management and surgical treatment with titanium elastic nailing system (TENS) for these fractures.

Methods: A total of 40 children (aged 4-14 years) with both bone diaphyseal fractures of the forearm were included in this study. Twenty patients were treated conservatively, and 20 underwent surgical treatment with TENS nailing. Functional outcomes, time to union, and complications were assessed at 6 months post-treatment.

Results: The surgical group had a significantly higher proportion of patients aged ≥ 10 years (75% vs. 15%; p=0.0001) and required longer duration of surgery (95% requiring 90 minutes vs. 100% requiring < 20 minutes; p<0.001). The mean time to union was significantly shorter in the surgical group (6.70 ± 1.867 weeks) compared to the conservative group (8.80 ± 1.642 weeks) (p=0.01). The functional outcome at 6 months was excellent in 90% and good in 10% of the surgical group, compared to 80% excellent and 20% good in the conservative group (p=0.3753). Complication rates were minimal and comparable between the two groups (p=0.1060).

Conclusion: TENS nailing is an effective treatment option for both bone diaphyseal fractures of the forearm in children, particularly in older children, providing faster union times with comparable functional outcomes and complication rates to conservative management.

Keywords: Pediatric forearm fractures, both bone fractures, conservative treatment, intramedullary nailing, TENS, functional outcome.

INTRODUCTION

Forearm fractures are among the most common injuries encountered in the pediatric population, accounting for approximately 40% of all fractures in children.[1] Both bone forearm fractures, involving the radius and ulna, are particularly prevalent and can significantly impact a child's daily life and functional abilities.[2] The management of these fractures has been a topic of ongoing debate, with conservative treatment and surgical intervention, particularly intramedullary nailing, being the primary treatment options.[3]

Conservative management, which includes closed reduction and cast immobilization, has been the traditional approach for treating both bone forearm fractures in children.[4] This method relies on the unique remodeling potential of the pediatric bone, which allows for the correction of angular deformities over time.[5] However, concerns have been raised regarding the potential for malunion, loss of reduction, and functional limitations associated with conservative treatment, especially in older children and those with unstable fracture patterns.[6]

In recent years, there has been a growing interest in the use of intramedullary nailing for the treatment of both bone forearm fractures in children.[7] This surgical technique involves the insertion of flexible nails into the medullary canal of the radius and ulna, providing stability and allowing for early mobilization.[8] Intramedullary nailing has been reported to offer several advantages over conservative treatment, including better fracture reduction, lower rates of

malunion, and earlier return to function.[9] However, the surgical approach is not without risks, such as infection, hardware-related complications, and the need for a second procedure for nail removal.[10]

Despite the increasing popularity of intramedullary nailing, the optimal treatment approach for both bone forearm fractures in children remains controversial.[3] Several studies have compared the outcomes of conservative management and intramedullary nailing, yielding mixed results.[4,7,9] Some authors have reported superior functional outcomes and lower complication rates with intramedullary nailing,[7,9] while others have found no significant differences between the two treatment methods.[4]

The purpose of this comparative study is to evaluate the functional outcomes of conservative treatment versus intramedullary nailing for both bone forearm fractures in children.

The results of this study will have important implications for clinical practice and patient care. By identifying the optimal treatment approach for both bone forearm fractures in children, we can improve functional outcomes, minimize complications, and enhance the overall quality of life for young patients. The findings may also inform the development of evidence-based guidelines and protocols for the management of these injuries, promoting standardization and consistency in care delivery.

AIMS AND OBJECTIVES

This study was conducted with the following aims and objectives:

1. To analyze the results of management of diaphyseal fractures of the forearm in children.
2. To compare the functional outcome of diaphyseal forearm fractures treated with conservative methods and TENS nails.

MATERIALS AND METHODS

Study Design and Setting:

This comparative study was conducted at Al-Ameen College and Hospital, Vijayapura, from December 2022 to December 2024. The study included children between 4-14 years of age with both bone diaphyseal fractures of the forearm who met the inclusion and exclusion criteria.

Inclusion Criteria:

The inclusion criteria for this study were children aged 4 to 14 years with diaphyseal fractures of both bones of the forearm, all closed diaphyseal fractures of the forearm in the above age group, and patients fit for surgery.

Exclusion Criteria:

The exclusion criteria for this study were children less than 4 years of age and more than 14 years of age, children unfit for surgery, not willing for surgery and casting, children with open fractures, and those with associated neurovascular injuries.

Sample Size and Grouping:

A total of 40 patients were included in the study, with 20 patients treated conservatively and 20 treated surgically using TENS nails. The treatment method was selected based on the age and angulation criteria.

Initial Assessment and Management:

Upon admission, the patient's airway, breathing, and circulation were assessed, and a complete survey was carried out to rule out other significant injuries. Plain radiographs of AP and lateral views of the forearm with elbow and wrist joint were taken to assess the extent of fracture comminution, geometry, and dimensions of the fracture.

Conservative Management:

Closed both bone forearm fractures with minimal displacement were taken to the operation theatre, and under C-arm guidance, the fracture was reduced, and an above elbow cast was applied. Patients were admitted for one day for observation. Check X-rays were done on Day 1, and patients were followed up at 2 weeks, 6 weeks, 3 months, and 6 months. Functional outcomes were assessed at each visit, and cast removal was done at the 6th week. X-rays were taken at 6 weeks, 3 months, and 6 months, and functional outcomes were assessed in terms of the presence of pain, restriction of supination and pronation, and signs of union on X-ray.

Operative Management:

Patients scheduled for surgery underwent a detailed history taking, routine investigations, and pre-operative anesthetic evaluation. The nail size was determined using Flynn et al.'s formula, and the length was decided based on the age and built of the child. The nailing procedure was performed under general anesthesia with the patient in a supine position and the affected arm on a side table. The surgical technique involved making stab incisions for the ulna and radius, introducing the prebent nails, and advancing them through the fracture site under fluoroscopic guidance. The nails were cut close to the bone, leaving enough end for easy removal later without tenting the skin.

Post-operative Care and Follow-up:
Post-operatively, patients were kept nil orally for 4 to 6 hours and received IV fluids, analgesics, and antibiotics. The limb was kept elevated over a pillow. Patients were immobilized with an above elbow POP slab for 3 weeks, after which active movements were encouraged. Assessment was done at 3, 6, 12, and 24 weeks, and follow-up continued till 6 months. At each follow-up, patients were assessed clinically, radiologically, and complications were noted. Nail removal was done at 1-year post-operatively.

Clinical and Radiological Assessment:
Clinical assessment included evaluating pain and range of motion of the elbow, forearm, and wrist. Radiological assessment was performed using X-rays of the forearm with both elbow and wrist joints in AP and lateral views. Alignment, circumferential callus formation, and visibility of the fracture line were assessed.

Complications:
Minor complications included pain at the site of nail insertion, minor angulation (<10° sagittal/coronal; <10° rotational malalignment) at final follow-up, inflammatory reaction to nails, bursitis at the insertion site, superficial infection at the site of nail insertion, and delayed union. Major complications included minor angulation (>10° sagittal/coronal; >10° rotational malalignment) at final follow-up, deep infection, loss of reduction requiring new reduction or surgery, surgery to revise nail placement, compartment syndrome requiring surgery, delayed or nonunion leading to revision, and refracture.

Evaluation:
The results were evaluated using the modified Anderson's AO criteria for forearm bone fractures extracted from the study of functional outcome of fracture forearm bones by surgical reduction.

Statistical Analysis:
Descriptive statistics like numbers, percentages, average, and P-values were used. Data was presented in the form of tables and graphs wherever necessary.

RESULTS
The study included a total of 40 patients with both bone diaphyseal fractures of the forearm, out of which 20 were treated conservatively and 20 underwent surgical treatment with TENS nailing. The demographic characteristics and mode of injury are presented in Table 1. The conservative group had a significantly higher proportion of patients aged < 10 years (85%) compared to the surgical group (25%) (p=0.0001). The mean age was 7.60 ± 2.037 years in the conservative group and 90.0 ± 2.212 years in the surgical group. The distribution of gender was similar between the two groups, with males comprising 65% of the conservative group and 75% of the surgical group (p=0.4902). The most common mode of injury was fall, accounting for 85% of cases in the conservative group and 90% in the surgical group, followed by road traffic accidents (RTA) (15% and 10%, respectively) (p=0.6326).

Table 2 presents the fracture characteristics and treatment details. The side affected was comparable between the two groups, with the right side being affected in 55% of the conservative group and 65% of the surgical group (p=0.5186). All fractures were simple in both groups. The level of fracture was similar between the groups, with mid-shaft fractures being the most common (70% in both groups), followed by distal (15% in conservative and 20% in surgical) and proximal (15% in conservative and 10% in surgical) fractures (p=0.8425). All patients in both groups presented within 24 hours of injury. The reduction method was significantly different between the groups, with 100% of the conservative group undergoing closed reduction, while 80% of the surgical group had closed reduction and 20% required open reduction (p=0.0354). The duration of surgery was significantly longer in the surgical group, with 95% of patients requiring 90 minutes, compared to 100% of the conservative group requiring < 20 minutes (p<0.001).

The outcomes and complications are presented in Table 3. The time of union was significantly shorter in the surgical group, with 85% achieving union at 6 weeks, compared to 0% in the conservative group (p<0.001). The mean time of union was 8.80 ± 1.642 weeks in the conservative group and 6.70 ± 1.867 weeks in the surgical group (p=0.01). The loss of supination/pronation movements was less than 10° in 85% of the conservative group and 100% of the surgical group, while 15% of the conservative group had a loss of 10-30° (p=0.0717). The outcome at 6 months was excellent in 80% and good in 20% of the conservative group, compared to 90% excellent and 10% good in the surgical group (p=0.3753). Complications were minimal in both groups, with loss of reduction (LOR) occurring in 10% of the conservative group, and bursitis and superficial infection occurring in 10% each of the surgical group (p=0.1060). No complications were observed in 90% of the conservative group and 80% of the surgical group.

In summary, the surgical group had a significantly higher proportion of patients aged ≥ 10 years, required longer duration of surgery, and had a higher percentage of open reduction compared to the conservative group. The surgical group achieved significantly faster union times. The functional outcome at 6 months and the complication rates were comparable between the two groups.

Table 1: Demographic characteristics and mode of injury

Variable	Conservative (n=20)	Surgical (n=20)	P-value
Age (years)			
< 10	17 (85%)	5 (25%)	0.0001*
≥ 10	3 (15%)	15 (75%)	
Mean ± SD	7.60 ± 2.037	90.0 ± 2.212	
Gender			
Female	7 (35%)	5 (25%)	0.4902
Male	13 (65%)	15 (75%)	
Mode of injury			
Fall	17 (85%)	18 (90%)	0.6326
RTA	3 (15%)	2 (10%)	

Table 2: Fracture characteristics and treatment details

Variable	Conservative (n=20)	Surgical (n=20)	P-value
Side affected			
Left	9 (45%)	7 (35%)	0.5186
Right	11 (55%)	13 (65%)	
Type of fracture			
Simple	20 (100%)	20 (100%)	NA
Level of fracture			
Distal	3 (15%)	4 (20%)	0.8425
Mid-shaft	14 (70%)	14 (70%)	
Proximal	3 (15%)	2 (10%)	
Time of presentation (hrs)			
< 24	20 (100%)	20 (100%)	NA
Reduction method			
Closed	20 (100%)	16 (80%)	0.0354*
Open	0 (0%)	4 (20%)	
Duration of surgery (min)			
< 20	20 (100%)	0 (0%)	<0.001*
30-60	0 (0%)	1 (5%)	
90	0 (0%)	19 (95%)	

Table 3: Outcomes and complications

Variable	Conservative (n=20)	Surgical (n=20)	P-value
Time of union (weeks)			
6	0 (0%)	17 (85%)	<0.001*
8	16 (80%)	1 (5%)	
12	4 (20%)	2 (10%)	
Mean ± SD	8.80 ± 1.642	6.70 ± 1.867	0.01*
Loss of movements (sup/pro)			
< 10°	17 (85%)	20 (100%)	0.0717
10-30°	3 (15%)	0 (0%)	
Outcome at 6 months			
Excellent	16 (80%)	18 (90%)	0.3753
Good	4 (20%)	2 (10%)	
Complications			
LOR	2 (10%)	0 (0%)	0.1060
Bursitis	0 (0%)	2 (10%)	
Superficial infection	0 (0%)	2 (10%)	
Nil	18 (90%)	16 (80%)	

***Statistically significant; NA: Not applicable; SD: Standard deviation; RTA: Road traffic accident; LOR: Loss of reduction; sup/pro: Supination/pronation**

DISCUSSION

The present study compared the functional outcomes of conservative treatment and surgical management with TENS nailing for both bone diaphyseal fractures of the forearm in children. The results demonstrated that surgical treatment with TENS nailing achieved significantly faster union times compared to conservative management, with a mean time of union of 6.70 ± 1.867 weeks in the surgical group and 8.80 ± 1.642 weeks in the conservative group (p=0.01). These findings are consistent with those of a previous study by Colaris et al., which reported a mean time to union of 6.9 weeks in the elastic stable intramedullary nailing (ESIN) group and 9.1 weeks in the above-elbow cast group (p<0.001) [11].

The functional outcome at 6 months was excellent in 90% and good in 10% of the surgical group, compared to 80% excellent and 20% good in the conservative group (p=0.3753). These results are comparable to those of a meta-analysis by Patel et al., which found no significant difference in functional outcomes between the two treatment methods [12]. However, a study by Parajuli et al. reported a higher proportion of excellent results in the ESIN group (92.3%) compared to the conservative group (77.8%) [13].

The complication rates in the present study were minimal and comparable between the two groups (p=0.1060). Loss of reduction (LOR) occurred in 10% of the conservative group, while bursitis and superficial infection were observed in 10% each of the surgical group. These findings are in line with those of a systematic review by Vopat et al., which reported low complication rates for both conservative and surgical treatment of pediatric diaphyseal forearm fractures [14].

The present study found that the surgical group had a significantly higher proportion of patients aged ≥ 10 years (75%) compared to the conservative group (15%) (p=0.0001). This is consistent with the findings of a study by Shah et al., which reported that older children (>10 years) were more likely to undergo surgical treatment due to the higher risk of re-displacement and malunion associated with conservative management [15].

The duration of surgery was significantly longer in the surgical group, with 95% of patients requiring 90 minutes, compared to 100% of the conservative group requiring < 20 minutes (p<0.001). This finding is expected, as surgical treatment involves additional steps such as anesthesia, incision, and implant insertion. However, the longer duration of surgery did not appear to negatively impact the functional outcomes or complication rates in the surgical group.

The present study has several limitations. The sample size was relatively small, which may have limited the power to detect significant differences in certain outcomes. Additionally, the follow-up period of 6 months may not have been sufficient to capture long-term functional outcomes and complications. Future studies with larger sample sizes and longer follow-up periods are needed to validate these findings.

The present study demonstrates that surgical treatment with TENS nailing achieves faster union times compared to conservative management for both bone diaphyseal fractures of the forearm in children, with comparable functional outcomes and complication rates at 6 months. These findings support the use of TENS nailing as an effective treatment option for these fractures, particularly in older children. However, the decision to proceed with surgical intervention should be based on a careful consideration of patient factors, fracture characteristics, and surgeon experience.

CONCLUSION

The present study compared the functional outcomes and complications of conservative management and surgical treatment with TENS nailing for both bone diaphyseal fractures of the forearm in children. The results demonstrated that surgical treatment with TENS nailing achieved significantly faster union times compared to conservative management

(6.70 ± 1.867 weeks vs. 8.80 ± 1.642 weeks, respectively; p=0.01), with comparable functional outcomes at 6 months (excellent: 90% vs. 80%; good: 10% vs. 20%; p=0.3753) and minimal complication rates (p=0.1060). The surgical group had a significantly higher proportion of patients aged ≥ 10 years (75% vs. 15%; p=0.0001) and required longer duration of surgery (95% requiring 90 minutes vs. 100% requiring < 20 minutes; p<0.001). These findings suggest that TENS nailing is an effective treatment option for both bone diaphyseal fractures of the forearm in children, particularly in older children, providing faster union times with comparable functional outcomes and complication rates to conservative management. However, the decision to proceed with surgical intervention should be based on a careful consideration of patient factors, fracture characteristics, and surgeon experience. Further studies with larger sample sizes and longer follow-up periods are needed to validate these findings and assess the long-term outcomes of these treatment methods.

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