Original article

Enhancing Pediatric Forearm Fracture Management: The Role of Extension Casting in Reducing Repeat Interventions

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Abstract

Background:
Fractures of the forearm are common in the pediatric population, often requiring careful management to ensure optimal outcomes and minimize long-term complications. Among the various treatment modalities available, extension casting has emerged as a promising approach in pediatric forearm fracture management.

Objective:
The aim was to evaluate the effectiveness of extension casting in reducing the need for repeat interventions in pediatric forearm fractures.

Methods:
This study was a prospective cohort study conducted at the Department of Orthopaedics & Traumatology of Khwaja Yunus Ali Medical College & Hospital, Enayetpur, Sirajganj, from July 2020 to July 2023. A total of 60 pediatric patients, aged 5-12 years, with acute forearm fractures were enrolled. Different statistical methods were adopted in this study. All analyses were performed using SPSS version 25.0.

Results:
The study of 60 pediatric patients with forearm fractures showed a mean age of 8.2 years, with 60% males. Most fractures were in the middle third of the forearm (60%). At 12 weeks, 87% maintained satisfactory reduction. Only 10% required repeat interventions. PODCI scores indicated excellent functional recovery, low residual pain, and high satisfaction. Minor complications included skin irritation (6.7%) and transient nerve palsy (3.3%), with no long-term complications.

Conclusion:
The results of this study affirm the effectiveness and safety of extension casting in managing pediatric forearm fractures. This method not only ensures better maintenance of fracture reduction and reduces the need for repeat interventions but also yields excellent functional outcomes and low complication rates.

Keywords: Forearm Fracture, Extension Casting, Repeat Interventions, Fracture Reduction

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Introduction:

Forearm fractures are among the most common injuries in the pediatric population, accounting for a significant proportion of emergency department visits and orthopedic consultations.[1] The rise in forearm fractures in children is partly due to increased sports and recreational activities, necessitating effective management to ensure proper healing, functional recovery, and minimize complications and intervention need.[2] Traditional casting techniques, such as the use of a short-arm or long-arm cast in a flexed position, have been standard practice for many years.[3] Several studies have highlighted the potential benefits of extension casting in pediatric forearm fractures.[4,5] A key advantage of this technique is its ability to maintain fracture reduction more effectively than traditional methods.[6] This is particularly important given that children's bones heal rapidly, and any loss of reduction can lead to malunion if not promptly addressed.[7] By improving initial stability, extension casting may decrease the likelihood of requiring repeat manipulations or surgical fixation, thus reducing overall healthcare costs and the burden on patients and their families.[8,9] The concept of extension casting is supported by biomechanical

principles.[10] In the extended position, the tension forces across the fracture site are minimized, which can help maintain proper alignment.[11] Additionally, this position can reduce the risk of compartment syndrome, a serious complication that can arise from increased pressure within the muscles and can compromise circulation and nerve function.[12] Clinical evidence supports the efficacy of extension casting in improving outcomes for pediatric forearm fractures.[13] For instance, studies have shown lower rates of displacement and better functional outcomes in patients treated with extension casts compared to those treated with traditional flexion casting methods.[14,15] These findings suggest that extension casting not only enhances the immediate stability of the fracture but also promotes better long-term healing and function. Moreover, patient compliance is a critical factor in the success of fracture treatment.[16] Extension casting may offer advantages in this regard, as it can be more comfortable for the child, leading to better adherence to post-treatment care instructions.[17] This technique offers improved fracture stabilization, reduces the risk of complications, and potentially lowers the need for repeat interventions. As the body of evidence supporting this method grows, it is likely to become a more widely adopted practice in pediatric orthopedic care, ultimately leading to better outcomes for young patients.This aspect is particularly important in pediatric care, where cooperation and comfort significantly impact the overall treatment process and outcomes.[18] In paediatric forearm fractures- irrespective of the level- a correct attempt at closed manipulation invariably brings the fracture into proper alignment. The forearm can be divided into three zones: the proximal zone, zone I: extending from the tip to the olecranon to the upper third of the shaft of the radius and ulna, the mid zone, zone II, the middle third of the forearm the lower zone, zone III, the lower third of the forearm up to 3cm above the radio carpal articulation. Intra and periarticular fractures of the wrist fall is a separate subdivision. The pronator quadratus is attached in the lower half of the forearm, thus all distal fractures need to be immobilized in mid or full pronation. On the contrary, mid shaft and proximal shaft fracture should be immobilized in mid to full supination.[19] This study aimed to assess the role of extension casting in reducing repeat interventions in pediatric forearm fractures. The aim of the study is to evaluate the effectiveness of extension casting in managing pediatric forearm fractures.

Methods:

This prospective cohort study was conducted at the Department of Orthopaedics & Traumatology of Khwaja Yunus Ali Medical College & Hospital, Enayetpur, Sirajganj, from July 2020 to July 2023, aiming to evaluate the effectiveness of extension casting in reducing repeat interventions for pediatric forearm fractures. Sixty pediatric patients aged 5-12 years, with acute forearm fractures were consecutively enrolled from the emergency department and OPD. Inclusion criteria included children aged 5-12 years with acute forearm fractures requiring casting, both bone and isolated radius or ulna fractures, closed fractures, and initial fracture displacement of less than 30 degrees. Exclusion criteria included children under 5 or over 12 years, open fractures, pathological fractures, fractures with neurovascular injury, previous forearm fracture on the same side, and associated injuries requiring alternative treatment methods. Extension casting involved having the patients extend their elbows and hang their arms for about five minutes to reduce complex fractures. The forearm was then rotated to the correct position based on the fracture level, and casts were applied from the head of the metacarpals to the midarm. Postoperative X-rays confirmed proper fracture reduction. The extension cast was retained for four weeks before converting to a below-elbow plaster gaiter for an additional four weeks, with patients encouraged to flex the elbow. Pediatric fractures typically unite in eight to twelve weeks. Primary outcomes included maintenance of fracture reduction, rate of repeat interventions, functional outcomes (PODCI scores), and complication rates, with data collected at baseline (post-casting), 4 weeks, 8 weeks, and 12 weeks post-casting. Maintenance of fracture reduction was assessed via follow-up radiographs, with satisfactory alignment maintained within 10 degrees of the initial reduction. Repeat interventions were recorded for additional casting or surgical procedures due to loss of reduction or complications. Functional outcomes were measured using the Pediatric Outcomes Data Collection Instrument (PODCI) at 12 weeks, and complications such as skin irritation, nerve palsy, and compartment syndrome were documented throughout the study. Descriptive statistics

summarized demographic and clinical characteristics, maintenance of reduction, and complication rates, with PODCI scores presented as means with standard deviations. Various statistical methods were used, and analyses were performed using SPSS version 25.0. Ethical approval was obtained from the institutional review board, and written informed consent was secured from parents or guardians, ensuring data confidentiality.

Results:

The mean age of the patients was 8.2 years (range 5-12 years). The sample consisted of 36 males and 24 females. Most fractures were located in the middle third of the forearm (60%), followed by the distal third (30%) and proximal third (10%) (Table-I).

Table-I: Basic characteristics of the study population (N=60)

Basic Characteristic	no. (%)
Age (years)	
Mean	8.2
Range	5-12
Sex	
Male	36(60)
Female	24(40)
Fracture location	
Distal third	18(30)
Middle third	36(60)
Proximal third	6(10)

At the initial post-casting assessment (4 weeks), 56 patients (93%) had satisfactory alignment. By the 12-week follow-up, 52 patients (87%) maintained satisfactory reduction (Table-II).

Table-II: The maintenance of fracture reduction over the study period (N=60)

Time Point	Satisfactory no. (%)	Unsatisfactory no. (%)
4 weeks	56(93)	4(7)
8 weeks	54(90)	6(10)
12 weeks	52(87)	8(13)

In this study, only 6 out of 60 patients (10%) required repeat interventions after initial extension casting. Specifically, 4 patients (6.7%) needed additional casting, and 2 patients (3.3%) required surgical intervention due to significant loss of reduction (Table-III).

Table-III: Rate of repeat interventions, such as additional casting or surgical procedures (N=60)

Intervention Type	no. (%)
Additional Casting	4(6.7)
Surgical Procedure	2(3.3)

Functional outcomes were assessed using the Pediatric Outcomes Data Collection Instrument (PODCI) scores at 12 weeks. The mean score for upper extremity function was 92.5±4.3, indicating excellent recovery of arm function. The pain/comfort domain had a mean score of 89.8±5.1, reflecting low levels of residual pain and high comfort. In terms of happiness with physical appearance, the mean score was 90.2±4.7, suggesting that the children were generally satisfied with the physical appearance of their healed forearms. Finally, the global function domain had a mean score of 91.7±4.5 (Table-IV).

Table-IV: Mean PODCI scores across different domains (N=60)

PODCI Domain	Mean Score±SD
Upper Extremity Function	92.5±4.3
Pain/Comfort	89.8±5.1
Happiness with Physical Appearance	90.2±4.7
Global Function	91.7±4.5

Out of the 60 patients, 4(6.7%) experienced skin irritation as a minor complication. There were 2 cases (3.3%) of transient nerve palsy, which resolved without long-term effects. Importantly, there were no instances of compartment syndrome or long-term complications in the study cohort (Table-V).

Table-V: Distribution of patients according to complications (N=60)

Complication Type	no. (%)
Skin Irritation	4(6.7)
Transient Nerve Palsy	2(3.3)
Compartment Syndrome	0(0)
Long-term Complications	0(0)

Discussion:

This study provided valuable insights into the management and outcomes of forearm fractures in pediatric patients using conservative treatment methods indicating a high rate of satisfactory fracture reduction maintenance and excellent functional recovery, with a relatively low incidence of complications.The study population had a mean age of 8.2 years, with a range of 5 to 12 years, which is consistent with the typical age group for pediatric forearm fractures. The gender distribution showed a higher prevalence in males (60%), which is corroborated by other studies indicating a higher incidence of fractures in boys due to their generally higher levels of physical activity.[20] The majority of fractures were in the middle third of the forearm (60%), followed by the distal third (30%) and proximal third (10%). This distribution is in line with previous research suggesting that the middle third of the forearm is more susceptible to fractures due to its anatomical and biomechanical properties.[21] Our results demonstrate a high rate of satisfactory reduction maintenance over the study period. At 4 weeks, 93% of patients maintained satisfactory alignment, decreasing slightly to 87% by 12 weeks. These findings are encouraging and compare favourably with those reported in similar studies. For instance, Sinikumpu et al reported a satisfactory reduction rate of 85% at 8 weeks in a cohort of children with distal forearm fractures managed conservatively.[22] The slight decrease in satisfactory reduction over time in our study highlights the importance of continuous monitoring and follow-up to ensure optimal outcomes.Only 10% of the patients required repeat interventions, with 6.7% needing additional casting and 3.3% requiring surgical intervention. These rates are relatively low compared to other studies. Flynn et al observed a 12% rate of surgical intervention in their study on pediatric forearm fractures.[23] The low incidence of repeat interventions in our study suggests that initial fracture management was largely effective, and complications necessitating further procedures were minimal.Functional outcomes assessed using the Pediatric Outcomes Data Collection Instrument (PODCI) at 12 weeks post-injury showed excellent results across all domains. The mean scores were high: 92.5 for upper extremity function, 89.8 for pain/comfort, 90.2 for happiness with physical appearance, and 91.7 for global function. These scores indicate not only a high level of functional recovery but also a positive psychosocial impact, as children were generally satisfied with their physical appearance and experienced low levels of residual pain. These outcomes are consistent with those reported by Schott et al., who found similarly high PODCI scores in children treated for forearm fractures.[24] The complication rate in our study was low, with only minor complications reported. Skin irritation occurred in 6.7% of patients, and transient nerve palsy was seen in 3.3%. Importantly, there were no cases of compartment syndrome or long-term complications. These findings compare favourably with existing literature. For example, Price et al reported a 5% incidence of skin irritation and a 2% incidence of transient nerve palsy in a similar cohort.[25] The absence of long-term complications in our study underscores the efficacy and safety of conservative management for pediatric forearm fractures.

Limitations:

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion:

The results of this study affirm the effectiveness and safety of extension casting in managing pediatric forearm fractures. This method not only ensures better maintenance of fracture reduction and reduces the need for repeat interventions but also yields excellent functional outcomes and low complication rates. These findings support the growing body of evidence favoring extension casting as a superior alternative to traditional flexion casting methods.

Recommendation:

Based on the findings of this study, extension casting is recommended as a superior method for managing pediatric forearm fractures due to its high rates of maintaining reduction, low repeat intervention requirements, excellent functional outcomes, and minimal complications. Clinicians should consider using extension casting for fracture treatment, with future research focusing on larger, multicenter trials to validate results and assess long-term outcomes, and evaluating cost-effectiveness compared to traditional methods.

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