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Original Article

To Compare the Outcome of Diaphyseal Fracture Both Bones Forearm in Children Treated with Above Elbow Cast for 6 Weeks Versus 3 Weeks Followed by Below Elbow Cast for Another 3 Weeks

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ABSTRACT

Background: Diaphyseal fractures of both bones of the forearm are among the most common pediatric injuries encountered in orthopedic practice. Conservative management using cast immobilization remains the mainstay of treatment in children due to their excellent remodeling potential. However, the optimal duration and type of casting required to achieve satisfactory functional and radiological outcomes remains a subject of debate. Traditionally, above elbow cast immobilization for six weeks has been widely practiced, though prolonged elbow immobilization may lead to stiffness and delayed functional recovery. An alternative strategy involves initial above elbow casting followed by conversion to a below elbow cast, aiming to balance fracture stability with early joint mobilization. **Aim**: To compare the clinical, radiological, and functional outcomes of diaphyseal fractures of both bones of the forearm in children treated with above elbow cast immobilization for six weeks versus those treated with above elbow cast for three weeks followed by below elbow cast for another three weeks. **Methods**: This prospective comparative study was conducted in the Department of Orthopaedics, Government Medical College, Kathua. Children aged 5–14 years presenting with closed diaphyseal fractures of both bones of the forearm were enrolled and divided into two groups. Group A was treated with above elbow cast immobilization for six weeks, while Group B received above elbow cast for three weeks followed by below elbow cast for another three weeks. Patients were followed at regular intervals for clinical assessment, radiological union, range of motion at elbow and forearm, time to functional recovery, and complications. Functional outcomes were evaluated using standardized assessment criteria. **Results:** A total of 60 children were included in the study, with 30 patients in each group. Radiological union was achieved in 28 patients (93.3%) in Group A and 29 patients (96.7%) in Group B, with a mean union time of 7.8 ± 1.2 weeks and 7.4 ± 1.0 weeks respectively. At final follow-up, full or near-full elbow range of motion was observed in 21 patients (70%) in Group A compared to 26 patients (86.7%) in Group B. Restriction of forearm rotation exceeding 20 degrees was noted in 6 patients (20%) in Group A and 2 patients (6.7%) in Group B. Complications such as elbow stiffness were more common in Group A (8 patients, 26.7%) compared to Group B (3 patients, 10%). No significant difference was observed between the groups with respect to loss of reduction or malunion. **Conclusion**: Conversion from above elbow cast to below elbow cast after three weeks provides outcomes comparable to six weeks of above

elbow immobilization while offering the advantage of improved joint mobility and earlier functional recovery. This method represents an effective and patient-friendly alternative in the conservative management of pediatricdiaphyseal forearm fractures.

Keywords*: Pediatric forearm fractures, diaphyseal fractures, above elbow cast, below elbow cast, conservative management, functional outcome.*

INTRODUCTION

Diaphyseal fractures of both bones of the forearm represent one of the most common long bone injuries in the pediatric population and account for a significant proportion of orthopedic trauma cases in children [1]. These fractures typically occur following falls during play or sports activities and are especially frequent in school-aged children due to increased physical activity and developing motor coordination [2]. The pediatric forearm is anatomically unique, functioning as a single rotational unit, and restoration of normal alignment is essential for preserving pronation and supination movements of the hand [3].

Children possess a remarkable capacity for fracture healing and remodeling owing to the presence of active growth plates and a thick, biologically active periosteum [4]. As a result, most closed diaphyseal fractures of the radius and ulna in children are managed conservatively, with cast immobilization being the treatment of choice in the majority of cases [5]. Surgical intervention is generally reserved for unstable fractures, open injuries, or cases where acceptable alignment cannot be maintained by conservative means.

Traditionally, above elbow cast immobilization has been advocated for diaphyseal fractures of both bones of the forearm to control rotational forces and prevent displacement during the early phase of fracture healing [6]. Immobilization of the elbow joint restricts pronation and supination movements, thereby enhancing fracture stability and promoting union [7]. Several authors have reported high union rates and satisfactory functional outcomes with this method when proper reduction and casting techniques are employed [8].

However, prolonged immobilization of the elbow joint is not without disadvantages. Extended use of above elbow casts has been associated with elbow stiffness, muscle atrophy, delayed return of function, and patient discomfort, particularly in older children [9]. Loss of elbow motion may persist even after cast removal, necessitating prolonged physiotherapy and delaying return to normal activities [10]. These concerns have led to increasing interest in alternative immobilization strategies that minimize elbow stiffness without compromising fracture stability.

One such approach is the staged conversion from an above elbow cast to a below elbow cast after an initial period of immobilization. The biological rationale for this strategy is that early callus formation provides sufficient intrinsic stability, allowing safe mobilization of the elbow joint while maintaining fracture alignment [11]. Studies evaluating this approach have demonstrated that conversion to a below elbow cast after three to four weeks does not significantly increase the risk of loss of reduction or malunion [12].

Comparative studies examining short-arm versus long-arm casting in pediatric forearm fractures have shown comparable radiological outcomes, with improved functional recovery and patient satisfaction in children treated with shorter durations of elbow immobilization [13]. Despite these findings, there remains variability in clinical practice regarding the optimal duration of above elbow casting, and consensus guidelines are lacking.

In the Indian context, conservative management continues to play a crucial role due to its cost-effectiveness, avoidance of surgical risks, and suitability for resource-limited healthcare settings [14]. There is limited regional data directly comparing prolonged above elbow cast immobilization with staged above-to-below elbow casting for diaphyseal fractures of both bones of the forearm in children.

The present study was therefore undertaken in the Department of Orthopaedics, Government Medical College, Kathua, to compare the clinical, radiological, and functional outcomes of pediatricdiaphyseal forearm fractures treated with above elbow cast immobilization for six weeks versus those treated with above elbow cast for three weeks followed by below elbow cast for another three weeks.

MATERIALS AND METHODS

Study design and setting

This was a prospective comparative observational study conducted in the Department of Orthopaedics, Government Medical College, Kathua. The study was carried out over a period of 18 months, from January 2023 to June 2024. Ethical approval was obtained from the Institutional Ethics Committee prior to the commencement of the study. Written

informed consent was obtained from the parents or legal guardians of all participating children, and assent was taken from older children where appropriate.

Study population
Children aged 5 to 14 years presenting to the emergency department or outpatient clinic with closed diaphyseal fractures of both bones of the forearm were assessed for eligibility. A total of 60 patients fulfilling the inclusion criteria were enrolled in the study. Patients were consecutively recruited and allocated into two treatment groups based on the casting protocol followed.

Inclusion criteria
Children between 5 and 14 years of age
Closed diaphyseal fractures involving both the radius and ulna
Fresh fractures presenting within 7 days of injury
Fractures amenable to closed reduction
Patients with no prior history of fracture or deformity in the affected limb
Exclusion criteria
Open fractures
Pathological fractures
Fractures associated with neurovascular injury
Segmental fractures or fractures extending into the metaphysis or physis
Polytrauma patients
Patients requiring surgical intervention after initial assessment
Patients lost to follow-up
Grouping and treatment protocol
The enrolled patients were divided into two groups of 30 patients each.

Group A consisted of patients treated with above elbow cast immobilization for a total duration of six weeks. The cast extended from the upper arm to the metacarpal heads, with the elbow maintained at 90 degrees of flexion and the forearm positioned in neutral or slight supination depending on the fracture pattern.

Group B consisted of patients treated initially with an above elbow cast for three weeks, followed by conversion to a below elbow cast for an additional three weeks. After three weeks, the above elbow cast was removed, clinical and radiological assessment was performed, and a below elbow cast extending from below the elbow to the metacarpal heads was applied.

Reduction technique and casting
All fractures were managed with closed reduction under appropriate analgesia or sedation. Gentle traction and manipulation were performed to restore length, alignment, and rotation. Post-reduction alignment was confirmed using anteroposterior and lateral radiographs of the forearm including the elbow and wrist joints. Cast application was done using plaster of Paris with adequate three-point molding to maintain reduction. Neurovascular status was assessed before and after cast application.

Follow-up protocol
Patients were followed at regular intervals at 1 week, 3 weeks, 6 weeks, and 12 weeks post-reduction. At each follow-up visit, clinical evaluation included assessment of pain, swelling, cast-related complications, and neurovascular status. Radiographs were obtained at 3 weeks and 6 weeks to assess fracture alignment and progression of union. After cast removal, patients were encouraged to perform active range-of-motion exercises of the elbow, wrist, and forearm without formal physiotherapy unless clinically indicated.

Outcome measures
The primary outcome measures included radiological union and functional outcome. Radiological union was defined as the presence of bridging callus across at least three cortices on orthogonal radiographs. Functional outcome was assessed based on range of motion of the elbow and forearm, particularly pronation and supination, measured using a goniometer. Secondary outcome measures included time to union, restriction of forearm rotation, elbow stiffness, loss of reduction, malunion, and other complications such as cast-related problems. Functional results were categorized as excellent, good, fair, or poor based on the degree of motion loss and patient-reported functional limitation.

Statistical analysis
Data were entered into a Microsoft Excel spreadsheet and analyzed using statistical software. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages.

Comparison between the two groups was performed using the chi-square test for categorical variables and the independent t-test for continuous variables. A p value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 children with diaphyseal fractures of both bones of the forearm were included in the study. The patients were divided equally into two groups, with 30 patients in Group A treated with above elbow cast immobilization for six weeks and 30 patients in Group B treated with above elbow cast for three weeks followed by below elbow cast for another three weeks. All patients completed the planned follow-up period and were included in the final analysis.

The demographic profile of the study population is summarized in Table 1. The mean age of patients in Group A was 9.6 ± 2.4 years, while in Group B it was 9.2 ± 2.6 years. The majority of patients in both groups were males. Right-sided forearm fractures were more common than left-sided fractures in both groups. The most frequent mechanism of injury was fall while playing, followed by fall from height. There was no statistically significant difference between the two groups with respect to age, sex distribution, side of injury, or mechanism of injury, indicating that both groups were comparable at baseline.

Table 1: Demographic and injury profile of the study population

Parameter	Group A (n = 30)	Group B (n = 30)
Mean age (years)	9.6 ± 2.4	9.2 ± 2.6
Age group 5–9 years	14 (46.7%)	15 (50.0%)
Age group 10–14 years	16 (53.3%)	15 (50.0%)
Male	21 (70.0%)	22 (73.3%)
Female	9 (30.0%)	8 (26.7%)
Right side involved	18 (60.0%)	17 (56.7%)
Left side involved	12 (40.0%)	13 (43.3%)
Fall while playing	19 (63.3%)	20 (66.7%)
Fall from height / other causes	11 (36.7%)	10 (33.3%)

Radiological assessment revealed high union rates in both treatment groups. In Group A, radiological union was achieved in 28 patients (93.3%), while in Group B, union was observed in 29 patients (96.7%). The mean time to radiological union was slightly shorter in Group B compared to Group A, though the difference was not statistically significant. One patient in Group A and one patient in Group B showed delayed union but eventually healed with continued immobilization [Table 2].

Table 2: Radiological union and time to union

Parameter	Group A (n = 30)	Group B (n = 30)
Radiological union achieved	28 (93.3%)	29 (96.7%)
Delayed union	2 (6.7%)	1 (3.3%)
Mean time to union (weeks)	7.8 ± 1.2	7.4 ± 1.0
Non-union	0	0

Functional outcome was evaluated at the final follow-up by assessing elbow flexion-extension and forearm pronation-supination. Group B showed better restoration of elbow and forearm movements compared to Group A. Full or near-full elbow range of motion was observed in a higher proportion of patients treated with staged casting. Restriction of forearm rotation greater than 20 degrees was more commonly seen in Group A [Table 3].

Table 3: Functional outcome based on range of motion

Functional parameter	Group A (n = 30)	Group B (n = 30)
Full or near-full elbow motion	21 (70.0%)	26 (86.7%)
Mild elbow restriction	9 (30.0%)	4 (13.3%)
Forearm rotation loss < 20°	24 (80.0%)	28 (93.3%)
Forearm rotation loss ≥ 20°	6 (20.0%)	2 (6.7%)

Elbow stiffness was the most common complication and was significantly more frequent in Group A. Loss of reduction was uncommon and comparable between the two groups. No cases of malunion requiring corrective surgery, neurovascular compromise, or cast-related skin complications were observed [Table 4].

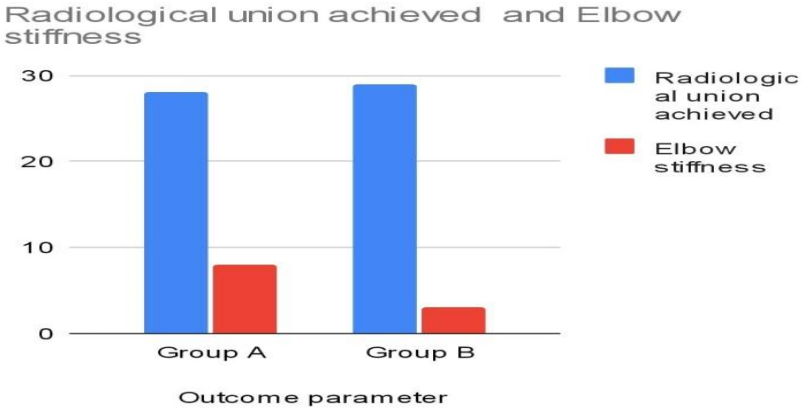
Table 4: Complications observed in both groups

Complication	Group A (n = 30)	Group B (n = 30)
Elbow stiffness	8 (26.7%)	3 (10.0%)
Loss of reduction	2 (6.7%)	1 (3.3%)
Malunion	1 (3.3%)	1 (3.3%)
Cast-related complications	0	0
Neurovascular complications	0	0

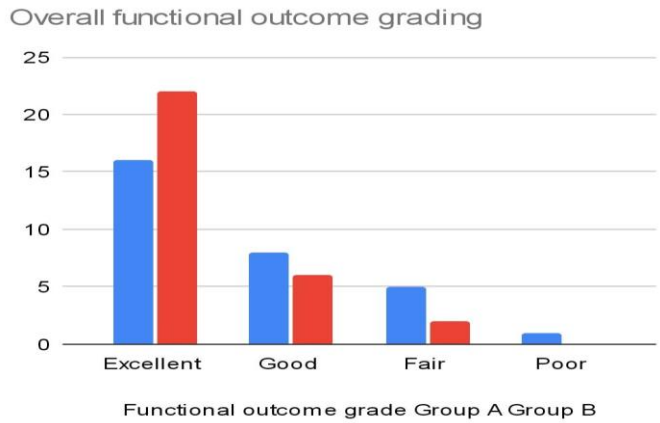
Overall functional outcomes were graded based on combined assessment of pain, range of motion, and ability to perform daily activities. A higher proportion of excellent and good outcomes was observed in Group B compared to Group A, indicating superior functional recovery with staged casting [Table 5].

Table 5: Overall functional outcome grading

Outcome grade	Group A (n = 30)	Group B (n = 30)
Excellent	16 (53.3%)	22 (73.3%)
Good	8 (26.7%)	6 (20.0%)
Fair	5 (16.7%)	2 (6.7%)
Poor	1 (3.3%)	0



Bar graph: Radiological union achieved and Elbow stiffness.



Bar graph 2: Overall functional outcome grading.

DISCUSSION

Diaphyseal fractures of both bones of the forearm in children continue to pose important considerations regarding optimal conservative management, particularly with respect to duration and extent of immobilization. While union rates are generally high due to the biological advantages of the pediatric skeleton, functional outcome—especially forearm rotation and elbow mobility—remains a critical determinant of treatment success. The present study compares two commonly used conservative immobilization protocols and provides evidence supporting staged casting in pediatric forearm fractures.

In the present study, radiological union was achieved in more than 93 percent of patients in both groups, with no cases of non-union. These findings are consistent with previous studies reporting high union rates following conservative treatment of pediatricdiaphyseal forearm fractures [15,16]. Sinikumpu et al. Observed that most pediatric forearm fractures unite reliably with non-operative treatment provided acceptable alignment is achieved and maintained [15]. Similarly, Jones and Weiner emphasized that conservative treatment yields predictable union in the majority of cases when careful reduction and casting techniques are employed [16].

The mean time to union in the present study was comparable between the two groups, with slightly faster union observed in the group treated with staged casting. This difference, though not statistically significant, aligns with findings reported by Carey et al., who noted that early mobilization of adjacent joints does not adversely affect fracture healing in children [17]. Early callus formation in pediatric fractures provides sufficient biological stability, allowing safe reduction in the extent of immobilization without compromising union.

Functional outcome, particularly restoration of elbow motion and forearm rotation, was superior in patients treated with conversion from above elbow to below elbow casting. In the present study, full or near-full elbow motion was observed in 86.7 percent of patients in the staged casting group compared to 70 percent in the prolonged above elbow cast group. This finding supports earlier observations that prolonged elbow immobilization contributes significantly to postoperative stiffness and delayed functional recovery [18].

Forearm rotation is particularly sensitive to malalignment and prolonged immobilization. Tarr et al. Demonstrated that even modest angular or rotational deformities of the radius and ulna can significantly impair pronation and supination [19]. In the current study, restriction of forearm rotation greater than 20 degrees was more frequently observed in patients treated with six weeks of above elbow casting. This suggests that prolonged immobilization may contribute not only to joint stiffness but also to soft tissue tightness affecting rotational movement.

Elbow stiffness was the most common complication observed, particularly in the prolonged above elbow cast group. Similar findings have been reported by Zionts et al., who noted higher rates of elbow stiffness in older children subjected to extended periods of above elbow immobilization [20]. The reduced incidence of elbow stiffness in the staged casting group highlights the benefit of early elbow mobilization once fracture stability has been established.

Loss of reduction was uncommon in both groups, and the incidence was comparable. This finding is consistent with studies by Bohm et al. And Webb et al., who demonstrated that below elbow casting after an initial period of stabilization does not significantly increase the risk of fracture displacement in pediatric forearm fractures [21,22]. These studies reinforce the concept that immobilization beyond the initial healing phase may not provide additional mechanical advantage.

Overall functional outcome grading in the present study favored the staged casting group, with a higher proportion of excellent and good outcomes. This observation aligns with evidence-based reviews suggesting that shorter durations of elbow immobilization result in faster return to daily activities, improved patient comfort, and better compliance without compromising fracture healing [23]. Early restoration of function is particularly important in school-aged children to minimize disruption to education and daily activities.

In the Indian healthcare context, conservative treatment remains the primary modality for managing pediatric forearm fractures due to its cost-effectiveness and feasibility in resource-limited settings. Studies from Indian centers have consistently reported favorable outcomes with non-operative management, while emphasizing the need to optimize casting protocols to reduce complications and improve functional recovery [24]. The findings of the present study add to this growing body of evidence by supporting a staged immobilization strategy that balances fracture stability with early mobilization.

The present study has certain limitations. The sample size was modest, and long-term functional outcomes beyond the early follow-up period were not assessed. Additionally, assessment of functional outcomes relied primarily on clinical examination without formal patient-reported outcome measures. Despite these limitations, the study provides clinically relevant evidence supporting staged casting as an effective alternative to prolonged above elbow immobilization.

CONCLUSION

Diaphyseal fractures of both bones of the forearm in children can be effectively managed with conservative treatment, with high rates of fracture union and satisfactory functional outcomes. The present study demonstrates that both treatment protocols—above elbow cast immobilization for six weeks and staged immobilization with above elbow cast for three weeks followed by below elbow cast for another three weeks—are successful in achieving reliable fracture healing.

However, staged conversion from above elbow to below elbow casting was associated with superior functional recovery, particularly with respect to elbow mobility and forearm rotation. Children treated with staged casting experienced earlier restoration of joint motion, fewer complications related to prolonged immobilization, and a higher proportion of excellent and good functional outcomes compared to those treated with prolonged above elbow casting.

Radiological union rates and time to union were comparable between the two groups, indicating that early mobilization of the elbow after an initial period of fracture stabilization does not compromise fracture healing. The reduced incidence of elbow stiffness in the staged casting group highlights the clinical benefit of limiting the duration of elbow immobilization once adequate fracture stability has been achieved.

Based on the findings of this study, conversion from above elbow to below elbow cast after three weeks appears to be a safe, effective, and patient-friendly alternative to prolonged above elbow cast immobilization in the conservative management of pediatricdiaphyseal forearm fractures. This approach may be particularly advantageous in resource-limited settings, where non-operative treatment remains the mainstay of care.

Further studies with larger sample sizes and longer follow-up periods are recommended to assess long-term functional outcomes and to establish standardized guidelines for optimal casting protocols in pediatric forearm fractures.

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