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Operative Versus Conservative Treatment of Distal Forearm Fractures in Pediatric Age Group Between (6–10) Years Old

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Abstract

Background: Children most often sustain forearm fractures, which make up 30 %–40 % of all fractures. Due to the drawbacks of conservative treatments, such as mobility loss, compartment syndrome, residual deformation, and re-displacement, surgical intervention has gained popularity.

Aim and objectives: The study's objective is to assess the clinical and radiological results between operative versus conservative management of distal forearm fractures in the pediatric age group between 6 and 10 years old.

Patients and methods: This prospective research was done at Al-Azhar University Hospitals to 40 cases. Patients were randomly split into two groups based on the fracture care strategy; group A: 20 patients received conservative treatment by cast, and group B (control): 20 patients received operative treatment either by percutaneous K wire or intramedullary fixation.

Results: Union, healing, and reduction were insignificantly different between both groups. Group A's union time was substantially shorter than that of group B. (P value = 0.008).

Conclusion: Conservative therapy that immobilizes the forearm fracture with a cast may provide satisfactory clinical results. There was no substantial variation between conservative and surgical treatment as regards complications.

Keywords: Conservative treatment, Forearm, Fractures, Pediatric, Surgery casts, Trauma

1. Introduction

Up to 30 % of all pediatric fractures are distal forearm fractures. At age 10, the incidence is at its highest. Swelling, pain, and obvious deformity in displaced fractures are examples of clinical symptoms. Plain radiographs provide for the confirmation of the diagnosis and the classification of the fracture.¹

The majority of these fractures have historically been managed nonoperatively via closed reduction and casting. In an attempt to enhance clinical outcomes, there has been a recent trend toward more surgical care of these fractures. The treatment of these fractures is determined by the age, nature, and displacement of the fracture.²

Depending on the child's age and remodeling capacity, different degrees of angulation may be tolerated given their potential for physical development. Numerous of these fractures may be aligned within acceptable limits, long arm cast immobilization is still an effective therapeutic option, and children are often at minimal risk of experiencing substantial elbow stiffness after cast immobilization.³

Surgical intervention is advised for fracture patterns that cannot be closed and reduced to an appropriate position. Despite the fact that children's distal forearms are the most often fractured bones, there is no agreement on the best ways to treat and monitor these wounds.⁴

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Our study aims to assess the clinical and radiological results between operative versus conservative management of distal forearm fractures in the pediatric age group between 6 and 10 years old.

2. Patients and methods

From May 2022 to March 2023, a prospective case series study on 40 patients was conducted at Al-Azhar University Hospitals (Al-Hussein University Hospital and Bab El-Sharrya Hospital) on patients having fracture in the distal 1/3 of the forearm and aged between 6 and 10 years old.

Patients were randomized into: group (A): 20 patients received conservative treatment by cast. Group (B) 20 patients received operative treatment either by percutaneous crossing k wire or intramedullary fixation.

All patients in both groups were followed progressively for 3 months. The median follow-up period was 4.5 ± 1.5 months (range 3–6 months).

2.1. Inclusion criteria

Sex: both sexes are included, age: between 6 and 10 years old, metaphyseal fractures, distal 1/3 radius, distal 1/3 ulna, and distal 1/3 both bone forearm.

2.2. Exclusion criteria

Age above 10 years old, age below 6 years old, open fracture, poly trauma patient, monteggia fracture, recurrent fractures, and associated ipsilateral limb fractures.

2.3. Ethical consideration

The protocol was applied for approval of the Research Ethics Committee. Every participant was informed about the aim of the study, and its benefit to him and to the community.

Proper written consent was taken from all parents before including them in the including method of treatment benefits and possible risks, complications and follow-up protocol have clearly exploited.

Patients' assessment: History: the patient had history of trauma usually falling in outstretched hand and presented with wrist pain and swelling.

Physical exam: Inspection: ecchymosis, deformation, and swelling.

2.4. Palpation

Complete examination of the affected extremity for ipsilateral damage and tenderness to palpation.

2.5. Neurovascular examination

Check for neurovascular damage.

2.6. Imaging radiographs recommended views

AP and lateral forearm radiographs, orthogonal wrist and elbow radiographs, and thickness of the cortices (should match on the proximal and distal pieces to check rotational mal-alignment) are also recommended.

2.7. Management of both groups

Group (A) underwent conservative treatment by cast: An injured upper limb was put on an arm table, the shoulder was rotated 90° , and the forearm was stretched while the youngster was lying supine on the operating table.

2.8. Technique of closed reduction

Completely displaced fractures of the forearm are best reduced with adequate muscle relaxation. In most cases, the reduction can be accomplished with safe, conscious sedation techniques.⁵ Occasionally, general anesthesia is required to obtain enough analgesia and muscle relaxation to achieve an acceptable reduction. An image intensifier should be available to check the alignment of the fracture during reduction of the deformity. The fracture deformity must first be increased to disengage the fracture fragments and open the periosteal hinge. It is often necessary to increase the deformity to greater than 90° to allow sufficient distraction of the fracture for reduction to be accomplished. The radius and ulna are each reduced separately. With the operator applying traction in line with the angulated distal segment, the distal fragment is pushed with the operator's thumb onto the end of the proximal fragment. At the same time, the pronation or supination deformity is corrected. Once reduction has been achieved, maintaining pressure on the side of the intact periosteum stabilizes the reduction then application of above elbow cast for 1 and half month.^{6,7}

2.8.1. Surgical technique for group B patients

(1) Patient position: The child was positioned supine on the operating table with the injured upper limb placed on a radiolucent arm table, the shoulder abducted 90° and the forearm was extended and supinated.

- (2) Anesthesia: general anesthesia was used in all patients.
- (3) Antibiotic prophylaxis against infection was given 30 min before the operation.
- (4) The image intensifier was placed parallel to the patient's body. It was positioned directly vertical for AP view. For the lateral view, the patient's whole upper limb was internally rotated, to avoid displacement of the fracture [Figs. 1 and 2](#).
- (5) Preparation and disinfection of the entire limb were done by povidone-iodine.
- (6) Draping and towelling were performed.

2.9. Statistical analysis

SPSS version 23 was utilized for data processing, data checking, data entry, and data analysis. The findings of this investigation were analyzed using the following statistical techniques. The comparison was done using: The student 't' test utilized to compare the means of two distinct groups. The Mann–Whitney test was utilized to determine the distinction between quantitative data in two sets of data that were not normally distributed. χ^2 test (X2), Z-test for percentage: to compare percentage of



Fig. 1. Intraoperative site of entry for intramedullary fixation of radius.



Fig. 2. Intraoperative proximal ulnar entry site for intramedullary fixation.

Table 1. Patients characteristics of the studied groups.

	Group A (n = 20)	Group B (n = 20)	P value
Age (y)			
Mean \pm SD	7.9 \pm 1.21	8.2 \pm 1.66	0.590
Range	6–10	6–10	
Sex			
Male	13 (65 %)	12 (60 %)	0.113
Female	7 (35 %)	8 (40 %)	
Range	14.92–22.61	16.67–23.63	

outcome between the two groups. For all of the above statistical tests, the threshold of significance (*P*-value) was set at 5 % ([Table 1](#)).

3. Results

Age of the studied patients was ranged between 6 and 10 with Mean \pm SD 7.9 \pm 1.21 in group A and 8.2 \pm 1.66 in group B. males were higher in group A 13 (65 %) and males eiser were higher in group B. the range of males/females in group A was 14.92–22.61 while in group B was 23.63–16.67 ([Table 2](#)).

This table showed that there was no statistically significant difference between the studied groups regarding Injury characteristics (Side of injury, Dominant Hand, Mode of injury and Site of injury) ([Figs. 3 and 4](#)).

In group A 95 % had no complications as well as 80 % in group B. only 5 % had SRNI in group B and resolve after three months follow-up without intervention and none in group A. 15 % of patients in group B had Pin tract infection underwent superficial debridment and change of dressing and antibiotic and resolve within 1 week and none in group A. 5 % of patients had Malunion in group A because missed follow-up and treated by corrective

Table 2. Injury characteristics of the studied groups.

	Group A (n = 20)	Group B (n = 20)	P value
Side of injury			
Left	9 (45 %)	12 (60 %)	0.342
Right	11 (55 %)	8 (40 %)	
Dominant Hand			
Right	15 (75 %)	14 (70 %)	
Left	5 (25.0 %)	6 (30 %)	
Mode of injury			
Fall to ground	17 (85.0 %)	19 (95.0 %)	0.605
Road accident	3 (15.0 %)	1 (5.0 %)	
Site of injury			
Epiphyseal fractures	3 (15.0 %)	1 (5.0 %)	0.369
Metaphyseal fractures	12 (60.0 %)	8 (40 %)	
Physeal fractures	1 (5.0 %)	3 (15.0 %)	
Distal 1/3 radius	2 (10.0 %)	5 (25.0 %)	
Distal 1/3 ulna	2 (10.0 %)	3 (15.0 %)	



Fig. 3. Outside of the skin, the K-wires were twisted and severed.

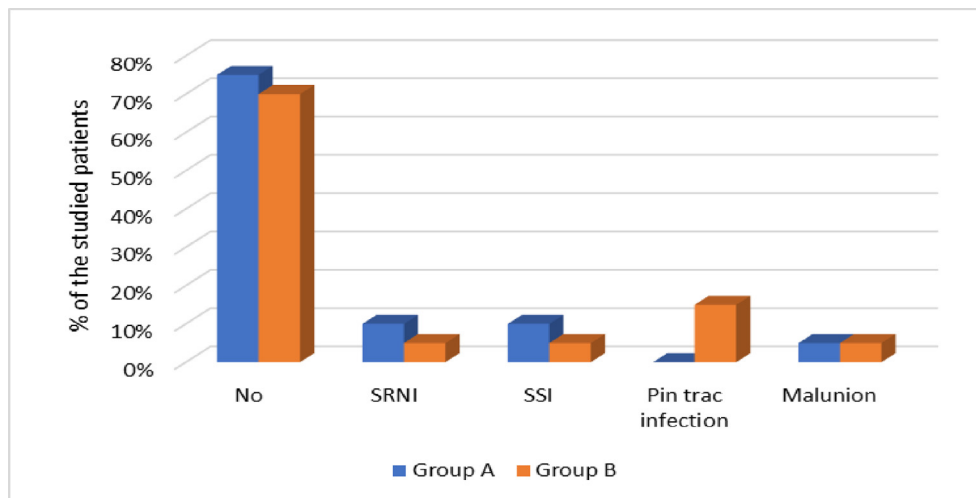


Fig. 4. Complications of the studied groups.

osteotomy and fixation by k wiers and none in group B (Fig. 5).

All patients in the studied groups were Followed-up for 6 weeks except those patients with malunion and Pin trac infection. Follow-up results were insignificantly different between both groups. 95 % of patients had Good reduction in both group A and B. 95 % of patients had Union in group A and B. 5 % of patients in group A had Malunion while none in group B. 15 % of patients had Pin trac infection in group B while none in group A (Fig. 6).

In the first group 6 patients had severe swelling and edema stabilized by below elbow slab for 5 days

until the swelling subsided then a bone elbow cast. Also 6 patients had moderate swelling and required change of cast after 1 week. Because of loosening and fear of loss of reduction. In the second group all patients had checked for vascularity and capillary filling and movement of fingers. In group a 30 % had swelling and 15 % had swelling in group B. 20 % of patients in group A and 25 % in group B had Deformity. 20 % of patients in group A and 15 % in group B had Pain. 15 % of patients in group A and 25 % in group B had Swelling and pain. 30 % of patients in group A and 20%in group B had Deformity and pain (Table 3).

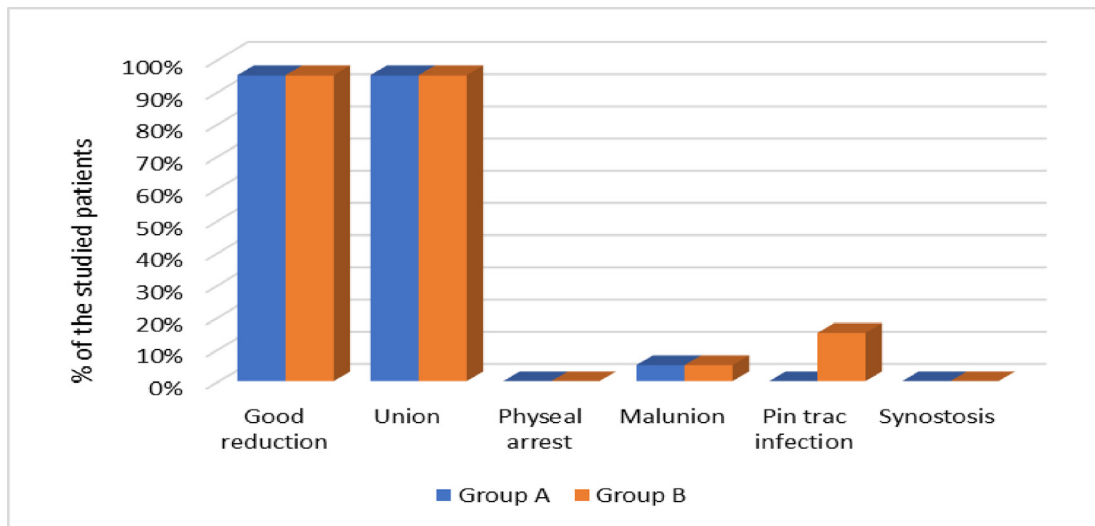


Fig. 5. Follow-up of the studied groups.

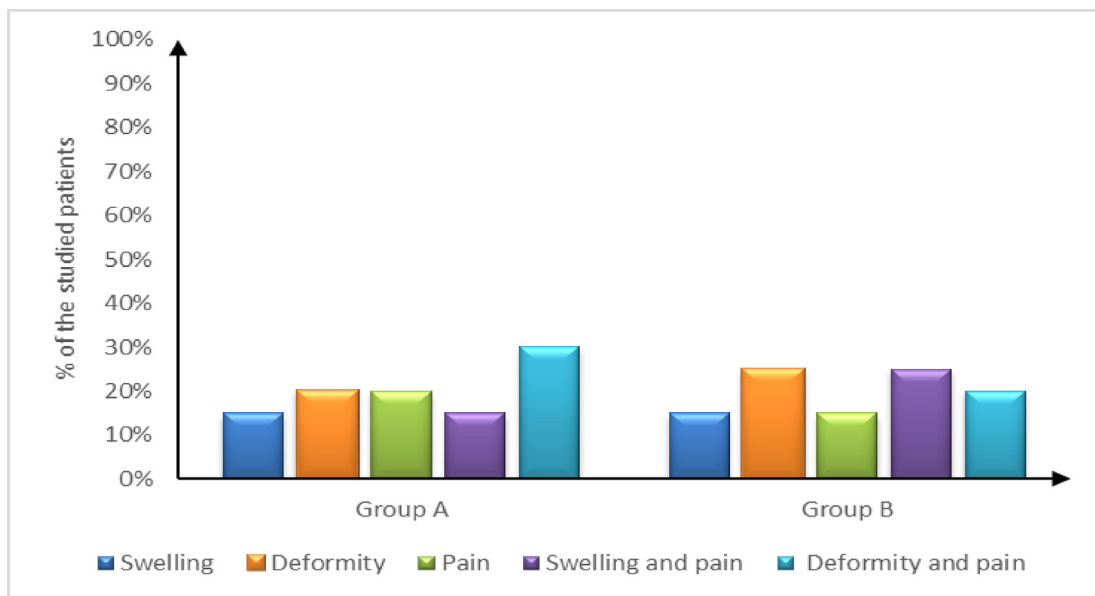


Fig. 6. Patients' complain of the studied groups.

Table 3. Assessment of bone union in the studied groups according to Anderson criteria.

	Group A (n = 20)	Group B (n = 20)	P value
Excellent	14 (70 %)	5 (25 %)	0.024 ^a
Satisfactory	3 (15 %)	7 (35 %)	
Unsatisfactory	1 (5 %)	6 (30 %)	
Failure	2 (10 %)	2 (10 %)	

According to Anderson criteria, group A had significantly better bone union compared with group B (P value = 0.024).

^a Statistically significant as P value less than 0.005.

This table showed that there was a statistically significant difference between the studied groups regarding Assessment of bone union (Excellent, Satisfactory, Unsatisfactory, and Failure) (Table 4).

This table showed that there was a statistically significant difference between the studied groups regarding Union duration (weeks). There was no statistically significant difference between the studied groups regarding Union, Healing and Reduction according to the Outcomes of the studied groups.

Table 4. Outcomes of the studied groups.

	Group A (n = 20)	Group B (n = 20)	P value
Union			
Mal union	1 (5 %)	1 (5 %)	1.51
Complete union	19 (95 %)	19 (95 %)	
Union duration (weeks)			
Mean \pm SD	7.7 \pm 1.04	8.9 \pm 1.6	0.008 ^a
Range	6–10	6–12	
Healing			
No	1 (5 %)	1 (5 %)	1.51
Complete	19 (95 %)	19 (95 %)	
Reduction			
Not	1 (5 %)	1 (5 %)	1.51
Accepted	19 (95 %)	19 (95 %)	

^a Significant as P value less than or equal to 0.05.

4. Discussion

Our study showed that age of the studied patients ranged between 6 and 10 with Mean \pm SD 7.9 \pm 1.21 in group A and 8.2 \pm 1.66 in group B. males were higher in group A 13 (65 %) while females were higher in group B. The range of males/females in group A was 14.92–22.61 while in group B was 16.67–23.63.

Our findings were consistent with research of Karslõ *et al.*⁸ as they reported that The median age and follow-up time for patients whose forearms were conservatively monitored were 5.67 (28) years and 62.17 (12–121) months, respectively. The average age of the patients who had forearm surgery was 8.79 (7–12) years, and the average follow-up was 47.14 (12–113) months. Males made up the majority in both categories. Regarding age and sex, there was no statistically substantial variation between the two groups.

According to Anderson's criteria, group A had significantly better bone union compared with group B (P value = 0.024). 14 (70 %) of patients in group A and 5 (25 %) had excellent bone union. 3 (15 %) of patients in group A and 7 (35 %) in group B had Satisfactory bone union. 1 (5 %) of patients in group A and 6 (30 %) in group B had Unsatisfactory bone union. 2 (10 %) of patients in both A and B groups had Failure of bone union.

In group A 19 (95 %) had no complications as well as 16 (80 %) in group B. Only 1 (5 %) had SRNI in group and none in group A. 3 (15 %) of patients in group B had Pin tract infection and none in group A. 1 (5 %) of patients had Malunion in group A and none in group B.

The present study showed that as regards Patients' complain in group A 19 (95 %) had no complications as well as 16 (80 %) in group B. Only 1 (5 %) had SRNI in group and none in group

A. 3 (15 %) of patients in group B had Pin tract infection and none in group A. 1 (5 %) of patients had Malunion in group A and none in group B.

Our results were in line with the study of Karslõ *et al.*⁸ as they reported that there was no statistical substantial variation between both groups as regard mechanism of injury and side of injury. Falling from a height is the most frequent etiological cause. The most frequent mechanism is a fall onto an extended hand with the elbow extended, the forearm pronated, and the wrist dorsiflexed. All patients in our research had injuries as a result of falling on an extended hand from various heights.

In the study of Souady *et al.*⁹ when it comes to the method of injury, FD was predominant with 12 (66.7 %) patients, DT with 4 (22.2 %) patients, and RTA with 2 (11.1 %) patients. The right side was the primary side with 72.3 % and the left with 27.7 %.

According to Anderson criteria, group A had significantly better bone union compared with group B (P value = 0.024). 14 (70 %) of patients in group A and 5 (25 %) had excellent bone union. 3 (15 %) of patients in group A and 7 (35 %) in group B had Satisfactory bone union. 1 (5 %) of patients in group A and 6 (30 %) in group B had unsatisfactory bone union. 2 (10 %) of patients in both A and B groups had Failure of bone union.

In group A 19 (95 %) had no complications as well as 16 (80 %) in group B. Only 1 (5 %) had SRNI in group and none in group A. 3 (15 %) of patients in group B had Pin tract infection and none in group A. 1 (5 %) of patients had Malunion in group A and none in group B.

All patients in the studied groups were Followed-up for 6 weeks except those patients with malunion and Pin tract infection. Follow-up results were insignificantly different between both groups. 19 (95 %) of patients had Good reduction in both group A and B. 19 (95 %) of patients had Union in groups A and B. 1 (5 %) of patients in group A had Malunion while none in group B. 3 (15 %) of patients had Pin tract infection in group B while none in group A.

In the study of Kushwah and colleagues while the cast group's outcomes were 60 % acceptable and 20 % good, the operational group's results were 20 % acceptable, 60 % good, and 20 % superb, leading experts to conclude that the operative approach is superior than the conservative approach.¹⁰

In the study of Caruso and colleagues, for pediatric forearm fractures, conservative care with cast immobilization is a secure and effective therapeutic choice. When a closed reduction and casting are unable to provide a satisfactory reduction, surgery is

advised. The surgical procedures intramedullary nail, plating, and hybrid fixing are available.¹¹

In a study conducted by Wahid Md and colleagues revealed that conservative treatments are superior than operational ones after treating 78 patients with the former and 25 with the latter.¹²

Shalimar Abdullah et al., did research in which he treated steady type forearm fractures in children with a cast, producing outstanding results in 80 % of the cases. He came to the conclusion that conservative therapy is a suitable method for treating children with steady type forearm fractures.⁵

Refracture is the most frequent complication in the majority of published studies, whether it occurs while the Elastic Stable Intramedullary Nail (ESIN) is in place or after the implant has been removed. A re-fracture incidence of 5%–10 % occurs following surgical management of pediatric both bone forearm fractures. Patients who have had implant removal are more likely to experience this. Refracture is more common when implants are removed 6 months have passed after surgery. In this instance, the implant was taken out six months later.⁶

Also, in a study by Biswajit Sahu et al., they looked at patients who had fractures of the radius and ulna and were managed with internal fixation using titanium elastic nails. They found that 87.5 % of patients had excellent results, 10 % had good outcomes, and 2.5 % had fair outcomes, and they came to the conclusion that surgery was superior to conservative treatment for these fractures.¹³

Moreover, Md. Ruhullah et al., 74 % of patients who had intramedullary flexible nailing for the management of both bone diaphyseal fractures experienced satisfactory outcomes, and the researchers came to the conclusion that flexible nailing results in a more versatile and effective internal fixation for both bone forearm fracture shafts, allowing for early patient mobilization and a swift return to their regular activities with a very low complication rate.⁷

Furthermore, During the severe acute respiratory syndrome coronavirus 2 pandemic 2020, Mhatre et al. reviewed 30 children with both-bone forearm fractures and found that excellent results with conservative management were achieved in 24 (80 %) patients, good results in 4 (13.33 %), fair results in 2 (6.6 %), and no poor results. They also concluded that nonoperative management of both-bone diaphyseal forearm fracture with closed reduction (CR) casting has well to excellent functional results in children in the age group of 4–15 years.¹⁴

The study's primary limitations are its single center design and limited sample size.

4.1. Conclusion

Conservative therapy that immobilizes the distal forearm fractures with a cast may provide satisfactory clinical results. There was no significant variation between conservative and surgical treatment. Both methods are valid option of treatment of distal both bone forearm fracture of pediatric between 6 and 10 years old.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

Conflicts of interest

The authors declared that there were NO conflicts of Interest.

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