OPEN AIMJ ORIGINAL ARTICLE

Orthopedic Surgery

Comparative Study between Conservative Treatment and K-wires Fixation of Both Bones Forearm in Children from 5-12 years

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Received *for publication April 18, 2022; Accepted October 8, 2022; Published online October 8, 2022.*

doi: 10.21608/aimj.2022.134632.1919.

Citation: *Haitham H., Ismail A. and Amro A. Comparative Study between Conservative Treatment and K-wires Fixation of Both Bones Forearm in Children from 5-12 years. AIMJ. 2022; Vol.3-Issue10 .1-7.*

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ABSTRACT

Background: Forearm fractures are the most prevalent kind of fracture in children, accounting for 13 to 40% of all fractures. After distal radial fractures and supracondylar humeral fractures.
Aim of the study: The purpose of the study was to assess the outcomes of conservative and percutaneous pinning for the management of diaphyseal fractures of the radius and ulna in youngsters.
Patients and Methods: Thirty patients aged 5 to 12 years old with closed displacement fractures of the shaft of both forearm bones were separated into two groups in this research at Al Azhar University Hospital and El Talaba Hospital. A total of 15 children in Group A were managed conservatively with closed reduction and immobilization in an above-elbow cast. A total of 15 children in Group B were managed with closed reduction and percutaneous intramedullary k-wires.
Results: Complications encountered were loss of primary reduction (6.7% of group A patients), Superficial pin site infection (33% of group B patients), refracture after removal of cast (6.7% of group A patients), and post cast edema (20% of group A). Both groups showed equal rate of complications.
Conclusion: According to this research, displaced diaphysis of the radius and ulna fractures in children under the age of 8 or 9 years old can be managed with closed methods, whereas displaced fractures of both forearm bones in older children are preferred to be intramedullary fixed with K-wires with excellent outcomes.

Keywords: *Anteroposterior; Kirschner Wire..*

Disclosure: *The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.*
Authorship: *All authors have a substantial contribution to the article.*
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INTRODUCTION

Children's forearm fractures are the most prevalent, accounting for 13 to 40% of all fractures in children. [1, 2] After distal radial fractures and supracondylar humeral fractures, forearm shaft fractures of the radius were the third most frequent fracture.[3] Furthermore, midshaft forearm fractures are the commonest refracture sites as well as open fractures in children. [4]

Forearm shaft fractures are more than twice as common in school-aged children (over 5 years old) as they are in toddlers (1.5 to 5 years old). [5] There is a bimodality peak in males, with the first peak occurring around 9 years and the second around 13 or 14 years. Girls reach a single peak at the age of 5 or 6. [5]

More than 100 percent initial preoperative translation has been linked to a higher risk of tissue interposition, necessitating a mini-open reduction. [6]

The aim of therapy for forearm injuries is to achieve fracture union in a way that lets the elbow and forearm regain functional range of motion. [7] Due to the unique quality of the young skeleton's development potential, most shaft injuries require nothing more than skilled closure reduction and cast stabilization. [8] There is a significant rate of re-displacement, malunion, and mobility restrictions as a result of this. Remodeling of malunion may rectify any remaining deformity, so perfect anatomical reduction is not necessarily required.[9, 10]

This study aimed to assess the outcomes of conservative therapy with percutaneous intramedullary kirschner wiring in children 5 to 12

years with displaced closed diaphyseal forearm fractures.

PATIENTS AND METHODS

The patients in this research ranged from 5 to 12 years old and had closed displacement fractures of the shaft of both forearm bones.

Closed reduction and above elbow plaster cast (group A) was used on fifteen patients, while closed reduction and intramedullary fixation (group B) was used on fifteen others, with frequent follow-up at AL Azhar University Hospital and El Talaba Hospital.

Inclusion criteria: From 5-12 years, BothSex, Closed displaced diaphyseal fractures both bones forearm or open fractures GI.

Exclusion criteria: Below 5 and above 12 years; Non displaced fractures and Open fractures GII and GIII.

Pre-operatively assess: Fracture pattern: Angulation, distal segment translation, and radial malrotation.

Postoperative assess: Degree of reduction (length, rotation, angulation and translation).

At follow up to assess: Union and Loss of reduction and complications related to pins

Postoperative care: The limb was elevated and circulation was closely monitored. Fingers could be actively mobilized without causing discomfort. It was decided to keep a close eye on the patient for any signs of compartment syndrome. Postoperative radiographs were obtained to check the reduction and adequacy of the fixation. Analgesics were taken until resolution of pain.

Follow-up for each group: The average period of follow-up for both groups in the present research was 4.60 ± 2.84 months. Patients were checked clinically and radiologically at two weeks. Then, after four weeks, eight weeks, twelve weeks, sixteen weeks, and six months. The average cast lasted 5.8 ± 1.3 weeks, with the shortest being 6 weeks and the longest being 12 weeks. The patient was urged to continue exercises to regain normal range of motion. Patients were checked for fracture union, range of motion, and angular abnormalities during follow-up appointments. On normal AP and lateral radiographs, fracture union is described as the presence of callus across at least three cortices of bone, as well as obliteration of the fracture line and non-tender fracture site. Union was classified as delayed after three months and non-union after six months.

Implant removal: The mean time of removal of K-wires was 9.7 $\pm$ 1.28 weeks, the earliest was 8 weeks and the latest was 12 weeks. The removal of the implant was postponed until callus development and cortical healing had occurred.

Statistical analysis of the data: The IBM SPSS software program version 20.0 was used to examine the data that was supplied to the computer. (IBM Corporation, Armonk, NY). The used tests were: Chi-square test: To compare various groups using categorical variables. Fisher's Exact or Monte Carlo correction: When more than 20% of the cells have an anticipated count of less than 5, chi-square is corrected. Student t-test: To compare two groups of people that have regularly distributed quantitative data.Mann Whitney test: To compare two investigated groups with improperly distributed quantitative variables. T: Student t test, p: p value for comparing the groups under investigation. Patients in Group A will be treated with a closed reduction and an above-the-elbow plaster cast. Patients in Group B will have closed reduction and intramedullary fixation, as well as frequent follow-up. FE: Fisher's exact test, χ^2: Chi square test Exact, p: p value for comparing the two groups being examined, MC is for Monte Carlo test, while U stands for Mann Whitney test.

RESULTS

Table (1) Shows that age at diagnosis was divided into somewhat 3 equal values; 31.9%, 33.1%, and 35.0% in 3 age sectors; <40, 40-59, and ≥60 years, respectively. Rectal bleeding, chronic severe constipation/diarrhea, and intestinal obstruction were the most common presenting symptoms; 51.3%, 34.4%, and 21.9%; respectively. The site of CRC was the distal-, proximal- colon, and rectum among 45.6%, 33.8%, and 20.6% of cases, respectively. The histopathological diagnosis was adenocarcinoma, mucoid carcinoma, and signet-ring cell carcinoma in 75.0%, 16.9%, and 8.1% of cases, respectively. Modified Astler-Coller's staging was Dukes' B and C in 40.6% and 36.9%, of cases, respectively. Lastly, lymph node involvement was found in 50.6% of cases.

Table (2) shows that overweight/obese (OR=2.12, 95% CI: 1.41-3.2), Under-weight <18 (OR=2.34, 95% CI: 1.21-4.56) ,history of DM (OR=2.13, 95% CI: 1.28-3.53), history of bowel habit change (OR=2.23, 95% CI: 1.17-4-25), history of IBD (OR=4.91, 95% CI: 2.42-10.07), history of precancerous colonic lesions (OR=5.46, 95% ECL:1.58-23.83), no regular use of NSAIDs (OR=3.69, 95% CI: 2.27-6.0), no use of HRT (OR=6.3, 95% CI: 3.36-11.99), cholecystectomy (OR=3.84, 95% CI: 1.57- 9.59), and positive family history of CRC (OR=8.88, 95% ECL: 1.8-85.08], 1st degree relatives with CRC (OR=9.65, 95% ECL: 1.06-457.67), and other GIT cancers (OR=6.82, 95% ECL: 1.27-67.74).

Table 3 clarifies considerable dietary life-style risk factors for CRC are history of intake high red and processed red meats (OR=5.12, 95% CI: 3.08-8.53), lower white meats consumption (OR=2.17, 95% CI: 1.4-3.37), higher animal fat consumption (OR=5.59, 95% CI: 3.52-8.9), high dairy products, sour cream, and cheese intake (OR=2.58, 95% CI: 1.69-3.94), low fibers intake (OR=2.79, 95% CI: 1.82-4.29), low

fruits and vegetables consumption (OR=3.05, 95% CI: 1.82-5.11), high salty/spicy foods intake (OR=2.5, 95% CI: 1.65-3.79), current smoker (OR=1.58, 95% CI: 1.05-2.38), smoking index >20 cigarette/day (OR=1.66, 95% CI: 1.03-2.65), caffeine consumption (OR=4.17 95% CI: 2.57-6.8), alcohol/beer use (OR=6.6, 95% ECL: 1.66-37.71), previous/ current physically active (OR=4.87, 95% CI: 3.06-7.77), and no compliance with medical follow up (OR=1.85, 95% CI: 1.1-3.11).

Table 4 clears considerable socio-demographic risk factors for CRC are age group ≥ 60 year (OR=2.08, 95% CI: 1.33-3.26), male gender [OR=2.45, 95% CI: 1.6-3.7], single marital status [OR=1.87, 95% CI: 1.01-3.48], urban residence (OR=1.95, 95% CI: 1.24-3.9), higher education level (secondary and university) (OR=1.99, 95% CI: 1.22-3.25), professional occupation level (OR=1.76, 95% CI: 1.01-3.07], and high social status (OR=1.73, 95% CI: 1.07-2.79)].

Union weeks	Group A (n = 15)	Group B (n = 15)	U	p
Min. – Max.	6.0 – 12.0	8.0 – 12.0	75.50	0.095
Mean ± SD.	8.13 ± 1.77	9.07 ± 1.28		
Median (IQR)	8.0 (7.0 – 9.0)	8.0 (8.0 – 10.0)		

Table 1: Comparison of the two groups evaluated in terms of union weeks.

This table shows that union occurs in both groups from 6 to 12 weeks with Mean ±SD of Time of union in group A is 8.13 ± 1.77weeks, and 9.07 ± 1.28 weeks in group B, and there is no statistically substantial variance in the period of union between the two groups.

Active range of motion deficit	Group A (n = 15)	Group B (n = 15)
Difference in supination (degrees)		
Range	5.0 – 35.0	10.0 – 40.0
Mean	21.67	20.0
S.D.	9.0	8.24
t (p)	0.529 (0.601)	
Difference in pronation (degrees)		
Range	5.0 – 20.0	5.0 – 20.0
Mean	12.33	10.67
S.D.	4.58	4.95
t (p)	0.957 (0.347)	

Table 2: Comparison of the two groups evaluated in terms of active range of motion deficit

This table shows difference in range of supination and pronation between the two sides: In group A patients, the least supination difference was 5 degrees, while the largest difference was 35 degrees with a mean of 21.67± 9. In group B patients, the least supination difference was 10 degrees, while the largest difference was 40 degrees with a mean of 20± 8.24. The variance in range of supination and pronation between the two groups is statistically negligible.

Complications	Group A (n = 15)		Group B (n = 15)		χ^2	p
	No.	%	No.	%		
No	10	66.7	10	66.7	0.000	1.000
Yes	5	33.3	5	33.3		
Post cast edema	3	20.0	0	0.0	3.333	FEp=0.224
Loss of reduction	1	6.7	0	0.0	1.034	FEp= 1.000
Re fracture	1	6.7	0	0.0	1.034	FEp= 1.000
Pin tract infection	0	0.0	5	33.3	6.000*	FEp= 0.042*

Table 3: Comparison of the two groups evaluated in terms of complications.

In the current study, in group A and group B patients, complications occurred in 5/15 (33.3%) patients. All patients with complications had excellent results. In group A patients, three patients had post cast edema after closed trials all are managed by release of cast, raising arm. In group B patients, five patients developed pin tract infection, controlled by local pin site care.

Assessment	Group A (n = 15)		Group B (n = 15)		χ^2	^{FE}p
	No.	%	No.	%		
Excellent	11	73.3	14	93.3	2.160	0.330
Satisfactory	4	26.7	1	6.7		

Table 4: Comparison of the two groups evaluated in terms of Anderson et al assessment.

Eleven patients (73.3%) were categorized as good, whereas four patients (26.7%) were classed as excellent. In group B patients, fourteen patients (93.3%) were classified as excellent. one patient (6.7%) was classified as satisfactory.

DASH score	Group A (n = 15)	Group B (n = 15)	U	p
Min. – Max.	9.20 – 25.80	9.20 – 20.80		
Mean ± SD.	13.51 ± 5.57	11.39 ± 2.84	99.50	0.585
Median (IQR)	10.80 (9.6 – 15.45)	10.80 (10.0 – 11.7)		

Table 5: Comparison of the two studied groups according to DASH score.

According to DASH Score. In group A patients, the score ranges from 9.20 – 25.80 with mean 13.51 ± 5.57. In group B patients, the score ranges from9.20 – 20.80 with mean 11.39 ± 2.84.

Age (years)	Assessment Excellent	Satisfactory	t	p
Group A	(n = 11)	(n = 4)		
Min. – Max.	5.0 – 10.0	8.0 – 12.0		
Mean ± SD.	7.73 ± 1.79	10.25 ± 1.71	2.435*	0.030*
Median	8.0	10.50		
Group B	(n = 14)	(n = 1)		
Min. – Max.	5.0 – 11.0			
Mean ± SD.	8.29 ± 2.20	12.0	1.632	0.127
Median	8.0			

Table 6: Relation between assessment and age in each group

In group A, the mean age for excellent results was 7.73 ± 1.79 years while the satisfactory result was10.25 ± 1.71. The difference in means was statistically significant. In group B, the mean age for excellent results was 8.29 ± 2.20 years while the only case with satisfactory result was 12 years.

Case 1

7 years old male patient presented with fracture dominant both-bones forearm

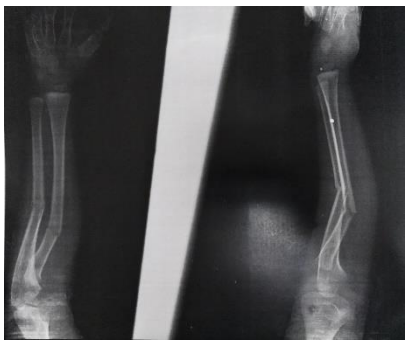

Fig 1: Fracture dominant mid-shaft both-bones forearm .

Fig 2 : After 1month of closed reduction.

Fig 3: After 2month of closed reduction.

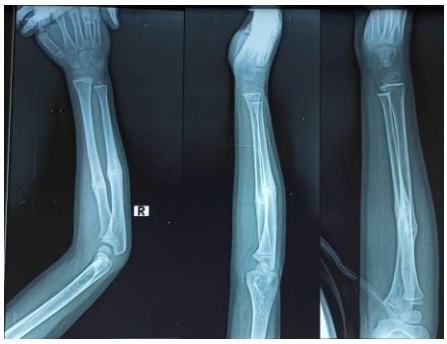

Fig 4: After 2month of closed reduction.

Case 2

9 years old male patient presented with fracture dominant both-bones forearm.

Fig 5: Fracture dominant mid-shaft both-bones forearm.

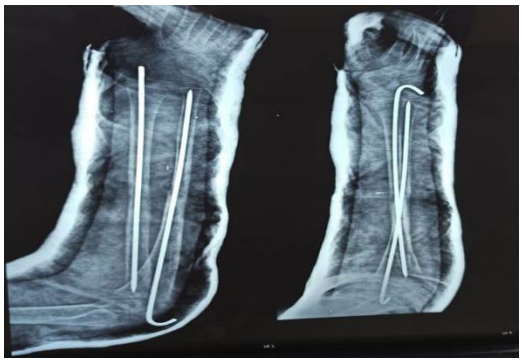

Fig 6: After 6 weeks of closed reduction.

Fig 7: After 4 months of closed reduction

DISCUSSION

Numerous studies have shown that conservative treatment of both-bone forearm fractures in older children, results in problems. This is because acquiring and sustaining a reduction in cast is challenging. As the edema subsides and the muscles spasm, a subsequent fracture displacement in cast is possible. [11]

In our study closed reduction gives excellent results in children younger than 8 years with less satisfactory results in older children.

Recent investigations have shown that intramedullary fixation, which provides relative stability, is the preferred approach. It provides fixation without disrupting the periosteal blood flow or removing the hematoma, which aids healing. Micromotion is also possible with this approach, which stimulates the callus to bridge the fracture spaces (Type 2 union). Because the insertion land-marks are subcutaneous, there is no need for dissection or additional apparatus when using K-wires percutanous. In other trials, the use of intramedullary K-wires for repair of diaphyseal forearm fractures in children had excellent clinical and functional outcomes. [12, 13] all children with unstable forearm fractures treated with intramedullary K-wires had great outcomes in our study.

Nailing of forearm fractures remained an equally efficient form of fixation in skeletally immature kids 10 to 16 years when compared to plating, according to a report published in June 2008 at the Hospital for Special Surgery in New York. [14]

Many authors stated that fractures of both forearm bones in children occur around the age of 8.4±3.5 years. [15, 16] In this study the age is included between 5 to 12 years were found to occur around the age 8.4 years for group A and 8.5 years for group B patients, this is explained by increased activity during this age group in patients referred to our hospital. It was found that the mean age for excellent cases at the end of follow-up for group A patients was younger than the mean age for satisfactory and failed cases. This suggests that the younger the age the better the results in conservatively managed patients.

Many studies as Lyons et al reported that Males were more likely than females to get pediatric forearm fractures. [17, 19] In this study, males (73.3% in group A and 93.3% in group B) were also found to be more frequently affected than females. In the present study, we found that 60% of participants were dominant handed and 40% were Nondominant handed. The study of Hassan found that the non-dominant hand had 59.17 percent of the forearm broken bones.[20]

Regarding mechanism of injury, the present study revealed that in group A majority of cases are due to falling 80 %, 13.3 % was due to RTA and 6.7 % due to direct trauma, while in group B falling 73.3 %, 20 % was due to RTA and 6.7 % due to direct trauma, In Alrashedan et al's research, A fall was the most prevalent mechanism of injury (83.96 percent). Fractures produced by a direct hit, such as those caused by motor vehicle collisions, have been reported (16.04 percent). Falls were more prevalent in younger children, whereas direct hits were more likely in children 12 years old. [21]

The mean time to union in our investigation for patients treated conservatively was 8.13 ± 1.77 weeks whereas, for patients that were treated operatively, the mean time for fracture union was 9.07 ± 1.28 weeks. This was similar to the results reported by Ali et al [22] and Akgülle et al [23]

In the current study, Complications were detected in five patients (33.3%) of group A patients and five patients (33.3%) of group B patients., Akgülle et al, [23] reported 18.9%, Luhmann et al. [24] reported 24%, Shoemaker et al [25] reported 25% complication rate, while Cullen et al,[26] reported 50% complication rate.

Infection at the pin site after pinning of forearm fractures in children. Five superficial infections were observed in 553 youngsters by Fernandez [27]. Five superficial infections in children were treated operatively in our research, and they were effectively managed with local pin site care and a short course of oral antibiotics. In their investigations, the majority of investigators found that between 5% and 15% of their patients had superficial pin site infection. [18, 22].

In forearm shaft fractures treated with pinning, hypoesthesia is a frequent consequence as superficial radial nerve might be injured during original fracture therapy or during material removal. In 553 children with forearm fractures treated by pinning, Fernandez et al. [27] observed 15 lesions of the superfacial radial nerve. Hypoesthesia was only temporary in 13 of the children, but it did persist in two of them. In a study of 45 children, Yalcinkaya et al [28] found that three of them exhibited temporary hypoesthesia. The sensory branches of the radial nerve were not irritated in any of the patients in our investigation.

One patient (6.7 %) in group A sustained a refracture 5 months after his first injury which was 3 months after removal of cast, after full union. Khalil et al [18] showed that Refracture occurred in 5% of their patients. Cullen et al 27 described a case in which the nails were removed at the time of fracture union, six weeks after the injury, and the patient re-fractured four weeks later.

Tsukamoto et al [29] found that Refractures of the forearm occurred on median 6 months following the initial injury. Despite apparent satisfactory bone healing on x-rays, parents must be warned about the danger of refracture.

Only a few cases of delayed union after pinning of forearm fractures in youngsters have been reported. In 532 youngsters, Schmittenbecher et al [30] identified ten delayed unions. Lieber et al [31] reported two incidences of prolonged union in a multi-center research with 400 patients. There were no cases of prolonged union in our research.

In the present investigation, there were no instances of nonunion, compartmental syndrome, or cross synostosis.

CONCLUSION

According to this study, displaced diaphysis of the radius and ulna fractures in children under the age of 8 or 9 years old can be addressed with closed methods, whereas displaced fractures of both forearm bones in older children are preferred to be intramedullary fixed with K-wires with excellent functional results.

Conflict of interest : none

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