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A study on conservative management on paediatric bone forearm fractures in tertiary care hospital in Cuddalore district

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ABSTRACT

Background: Diaphyseal fractures of the radius and ulna are common in the pediatric population. The standard management for pediatric forearm fractures remains conservative management with closed reduction and immobilization with an above elbow plaster cast. Though the fracture unites readily, malunion is very common. Stiffness of joints, compartment syndrome is other complications of conservative management with plaster cast Forearm fractures are common in the pediatric population. These fractures are mostly managed conservatively by means of closed manual reduction and casting. The aim of this study was to reiterate the importance of conservative management in both bone forearm fractures in the pediatric population.
Methods: This was a prospective study from a tertiary level trauma center on 70 children up to 14 years of age with both bone forearm fractures from June 2018 to June 2019, cases were obtained from medical records. Data were collected and confirmed by plain X-ray films and medical records.
Results: All fractures achieved union at the final visit. More than 90 of diaphyseal forearm fractures achieved exceptional radiological and clinical outcomes and almost no case had a significantly poor outcome. There were significantly reduced angulation deformities before and after treatment ($p<0.05$).
Conclusions: Nonsurgical treatment as a model of management by means of closed reduction and casting is a very well accepted method of treating pediatric diaphyseal forearm fractures.

Keywords: Pediatric, Both bone fractures, Conservative, Casting

INTRODUCTION

Pediatric diaphyseal both bone fractures can be treated conservatively by means of closed manual reduction and casting because of the extraordinary capability of the pediatric bones to remodel.[1] This unique feature of pediatric bones helps in correcting the angular deformity. As much as 5% of all diaphyseal involve the radius and ulna. The reduction is deemed successful on the basis of the return of pronation and supination to normal limits.[2] The frequent causes of diaphyseal both bone forearm fractures include a fall in or near home, followed by sports-related injuries. Approximately 75% to 84% of forearm fractures occur in the lower third with another 20% to 25% in the middle third, while up to 10% of cases occur in the proximal third.[3] An eligible percentage of fractures occur bilaterally, and as many as 13% have an associated supracondylar fracture.[4] Just a bit over 50% of these diaphyseal forearm fractures are greenstick fractures. Injuries to the distal growth plate of the radius bone occur in 14% to 18% of forearm fractures.[5] In an earlier study of 500 consecutive fractures in the pediatric age group, the site of a forearm fracture was likely to be more proximal with advancing skeletal age and the occurrence of physeal fractures was more common in adolescents than in younger

individuals.[6] Rotation of the forearm is the most frequently lost movement following these type of fractures.[7] Residual rotational losses of greater than 15° have been recorded in more than 50% of patients post conservative management of forearm fractures.[8]

The aim of this study was to reiterate the importance of conservative management in both bone forearm fractures in the pediatric population.

METHODS

The present study was a prospective study concerned with the functional outcomes of conservative treatment in pediatric diaphyseal forearm fractures. This study was carried out at the Orthopaedic department of Rajah Muthiah Medical College and Hospital, Annamalai Nagar from May 2018 to May 2019. The minimum follow-up period to study the outcome was 6 months after the injury. Inclusion criteria of the study were the followings. Diaphyseal forearm fractures of either single or both bones of the forearm in the pediatric population of 6 to 14 years of age, fractures without external injuries treated with closed methods and forearm fractures without any associated ipsilateral humeral bone fracture. A fracture is said to be diaphyseal if it occurs within the middle third of the forearm in order to eliminate elbow fractures and to eliminate fractures at the junction of the metaphysis and the distal part. The acceptable angulations in this study were set at 25° or less and less than 1 cm bayonet approximation with corrected pronation and supination. Forearm radiographs included anteroposterior and lateral views of the entire length of both radius and ulna bones including the elbow and wrist joints. Radiographs were repeated two times in the initial 3 weeks. Exclusion criteria were compound fractures of the forearm, extra-diaphyseal fractures, fractures in association with same side humeral fractures, pathological fractures, monteggia or Galleazi fractures and patient with only partial radiographic views of the radius and ulna. All patients were treated with closed manual reduction under sedation (intravenous Pethi-dine and intravenous Midazolam) administered according to their weight) and a full-length cast above the elbow was applied. They were managed on an outpatient basis. None of these patients had re-manipulation after the initial treatment. The mean duration of casting was 4.6 weeks (range 3 to 7 weeks).

Methods of assessment of outcomes

The functional and radiological outcomes were assessed during the final visit with the arc of movement of the forearm being the most important criteria, measured in terms of pronation and supination. The forearm rotation was measured by making the patient to hold a pen and then asking him to supinate and pronate his forearm. The arc of supination and pronation were calculated by means of a goniometer. The patients were asked subjectively whether they had had any symptoms or any limitation in function. The radiographic alignment of the fracture was measured at the final visit. Angulation was defined as the maximal angulation of each bone presents either on the AP or lateral view. Union was defined with respect to two factors, no pain at the site of injury and radiographs showing healthy callus formation across all four cortices.

Outcome measurement based on criteria

Excellent: no symptoms with substantial physical labor and/or loss of ≤10° rotational movement. Good: mild symptoms with substantial physical labour and//or loss of 11°-30° loss of rotational movement. Fair: mild subjective symptoms during daily activities and//or a 31°- 90° loss of rotational movement. Poor: all other results.[1,2,9]

Statistical analysis

For statistical analysis, the chi-square test was used, with a p value of less than 0.05 considered significant. The 95% confidence intervals were calculated with a statistical computer program and interpreted as the range of values that has a 95% chance of including the true values.

RESULTS

A total of 70 patients were included in the study. However, 22 patients declined to return for assessment because they claimed that they had apparently recovered without any functional deficit. Thus, only 48 cases were used in the final assessment. The mean age was 9 years and 6 months. A total of 38 patients were boys (79.2%) and 10 were girls (20.8%). The most frequent mode of injury was a fall from height usually less than 1m, accounting for 96% (n=22), one child was involved in a road traffic accident and the other had a trivial domestic injury). 40 patients sustained diaphyseal both bone fractures and eight patients had single-bone fractures (6 patients had isolated radius fractures and other 2 had isolated ulna fractures). With regard to fracture of the radius, the commonest site was the middle of the radius (n=29 or 69.0%), followed with upper third (n=7 or 16.7%) and distal third (n=6 or 14.3%). As for ulnar fractures, the most common site was also at the middle third (n=30 or 65.2%), equally followed by upper third and lower third areas (both equal n=8 or 17.4%) (Tab. 1).A total of 31 radius fractures were complete (73.8%) and 11 incomplete (26.2%). For ulnar fractures, 30 were complete (65.2%) and 16 incomplete (34.8%).

All the fractures united at an average 10 to 12 weeks without any malunion. Three patients had a superficial infection and three patients had pain due to nail prominence. Seven patients had a restriction of supination and pronation. Elbow flexion and extension, palmar flexion and dorsiflexion at the wrist was normal (Table 1).

Figure 1 depicts the completeness of fracture of radius and ulna at the time of initial presentation on antero-posterior and lateral radiographs. Complete radius facture was 74% (31) cases incomplete was 26% (11) cases in ulnar complete was 70% (38) cases and incomplete was 30% (16) cases.

Figure 2 shows the type of angular deformity of radius and ulna in lateral plane in radiographs following closed manual reduction and casting. In radius 14% of cases were neutral, 71% was volar, 14% were dorsal. In ulnar 22% were neutral, 48% volar, 30% were dorsal.

Figure 3 shows the degree of coronal plane deformity of radius and ulna in frontal plane in radiographs following closed manual reduction and casting. neutral was 43%, radial deviation was 36% ulnar deviation were 21% in radius fracture. In the ulnar bone 54% were neutral, 33% radial deviation, 13% were an ulnar deviation.

Figure 4 shows the degree of deformity of radius and ulna in frontal plane in radiographs following closed manual reduction and casting. Inradius bone 0-5 degree were 36%, 6-10 degree were 7%, 11->20 degree were 0 percent which is statistically significant. In ulnar bone 0-5 degree were 20%, 16-20 degree was 4%. 11-15 and >20 were not statistically significant.

Figure 5 shows the degree of angular deformity of each bone in the lateral plane in radiographs following closed manual reduction and casting. Inradius bone 0-5 degree were 17%, 6 to 10 were 55%, 11 to 15 were -21% 16-20 were 5% and >20 were 1%. In ulnar bone 0-5 degree were 54%, 6 to 10 degree were 26%, 11-15 were 17%, 16 to 20 were 0%.

Functional outcomes

Assessment of the movement at the last visit demonstrated the full arc of motion in both elbow and wrist joints in all patients compared with the unaffected extremity. The rotational movement was equivalent to the noninjured extremity in 40 of 48 patients (83%). Eight patients had some restriction of motion (4 patients had restriction in pronation; 3 patients had restricted supination and 1 patient had an abatement in both). As indicated by the reviewing criteria, there were 40 brilliant results (85%), 6 great outcomes (12%), 1 reasonable outcome (3%) and no poor outcomes. Of six patients with great result, 3 had restricted pronation, 2 had restricted supination and 1 had both pronation and supination constrained. Also, one patient had a radial angulation with restricted supination of 60°. She broke her forearm at 11 years with a complete midshaft fracture of the radius and a fragmented midshaft break of the ipsilateral ulna. In the sagittal plane, she had 10° of dorsal angulation of both bones and forearm and 14° radial angulation of the ulna. However, she was happy with the capacity of her forearm, and we declared it as a decent result Bayonet apposition, location of fracture and patients age did not influence the pronation and supination that was achieved.

Table 1: Outcomes among the cases based on prince criteria.

Outcomes	Symptoms	Loss of forearm rotation (in degree)
Excellent	No complaints with strenuous activity	<15
Good	Mild complaints with strenuous activity	15-30
Fair	Mild complaints with daily activities	31-90
Poor	All other results	>90

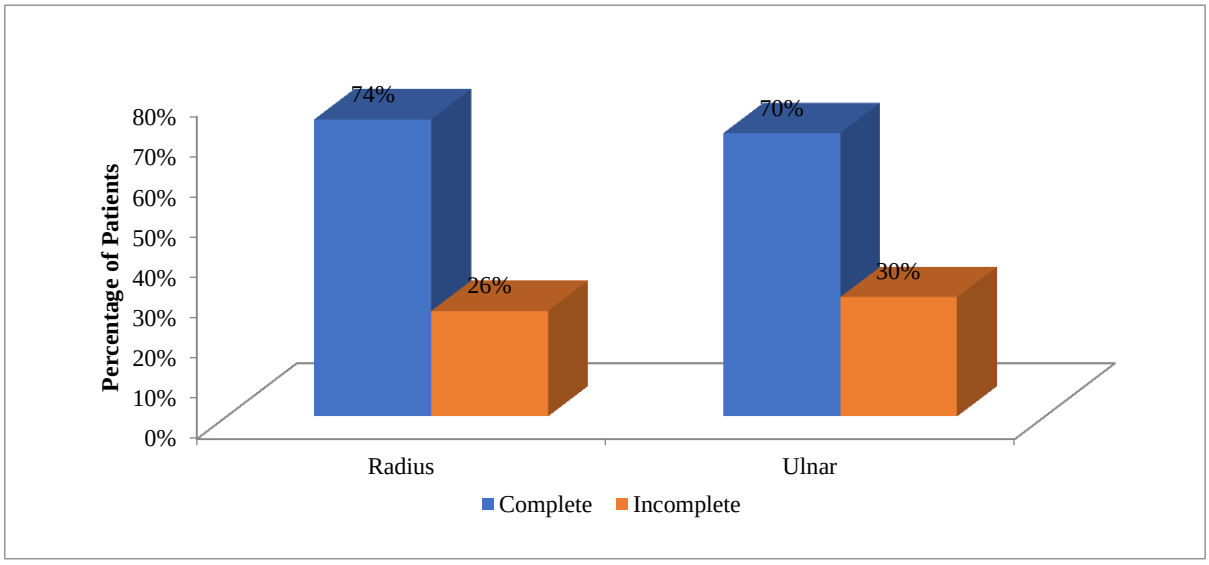

Figure 1: Completeness of bone fractures.

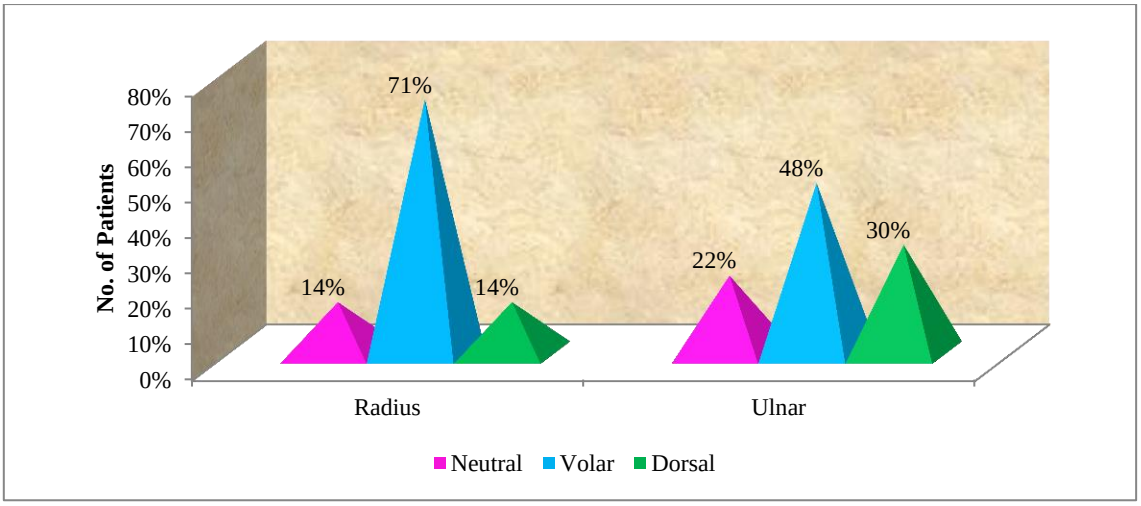

Figure 2: Deformity of bones in lateral plane after treatment.

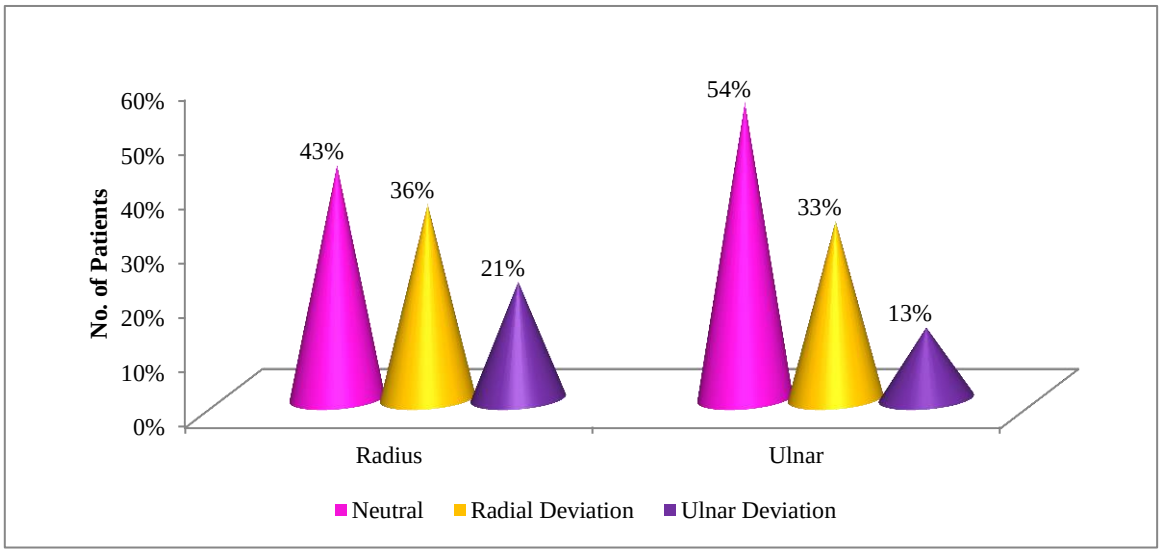

Figure 3: Bone deformities in frontal plane after treatment.

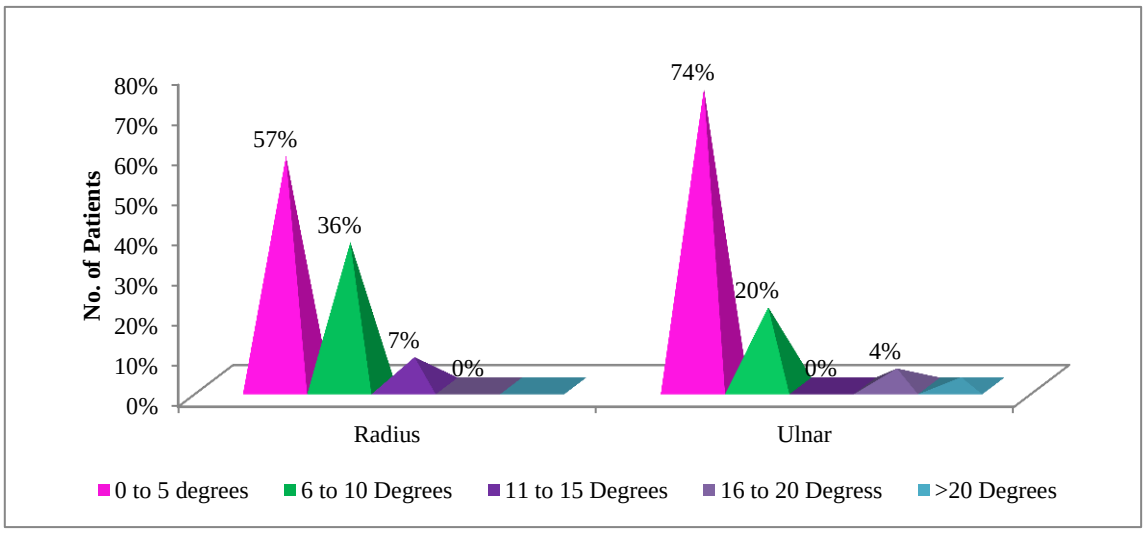

Figure 4: Degree of deformity in frontal plane for each bone.

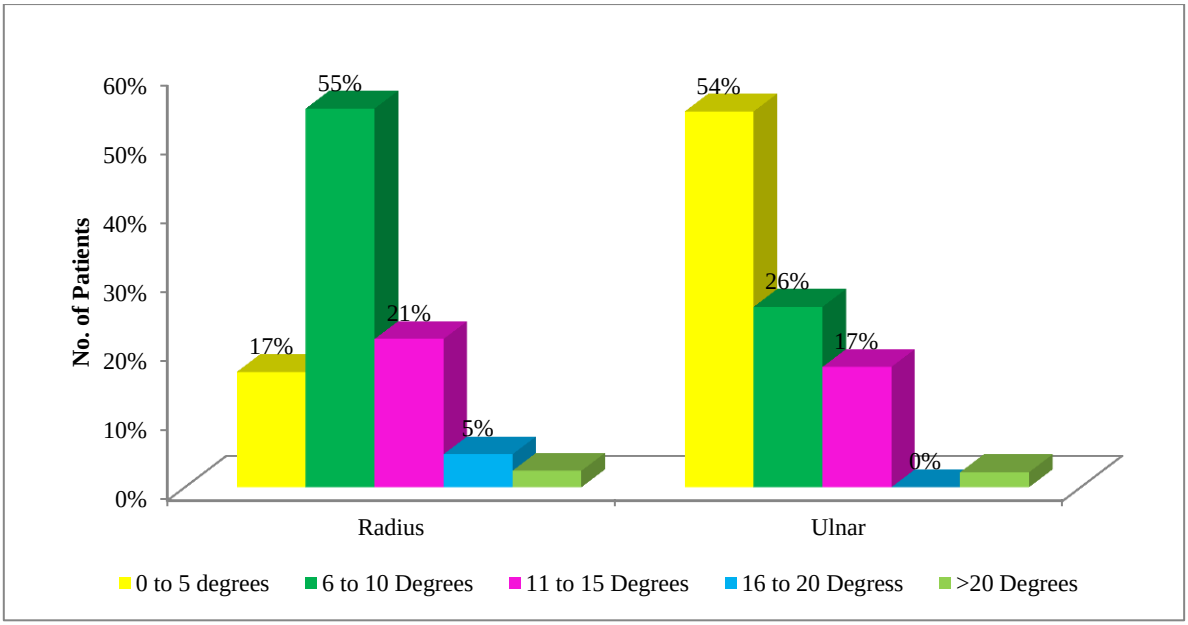

Figure 5: Degree of deformity in lateral plane for each bone.

DISCUSSION

Children most of the time sustains diaphyseal lower arm fractures. Closed reduction and casting have been the essential methods for treatment for more than 90% of these cases. Totally angulated fractures of the middle third of both bones of forearm in young children less than 8 or 9 years old can generally be effectively treated by closed techniques due to the quick healing time and foreseeable remodeling that is found in this age group.[10] conservatively treated diaphyseal fractures are reported to have a rate of angulation deformities spanning from 10-60% Angulation malalignment of both bones of forearm are implicated with impedance of forearm rotation rotation in 10-50% of cases.[11] It has been accounted for that 14.8% of patients treated by conservative methods had an unsuitable result with impairment of forearm pivot and additionally cosmetic defects.[12] In our examination, we found no limitation of pronation and supination albeit two cases had cosmetic complaints. A 10-20° angulation in diaphyseal fractures and a 20-30°angulation in metaphyseal fractures for early remodelling capability is an acknowledged certainty. In this prospective study, we picked an age range of 6 to 14 years since we accepted that the bone has the capability to mend and rebuild with an adequate functional outcome after traditional conservative treatment of the diaphyseal forearm fracture.[13] Clinical investigations of diaphyseal malunions recommend that angulation alone is a poor indicator of forearm movement. Elements other than angulation may add to the loss of forearm movement, such as undetected malrotation and contracture of the interosseous membrane. Most exercises of day by day living could be accomplished with 100-of forearm rotation equally partitioned between pronation and supination.[14] It was accounted for that 2 of 17 patients with a tenacious malunion (characterized as angulation of 20°) noted an utilitarian or corrective issue (Our clinical results were ordered as 20 patients with excellent results (85%), 6 with great outcomes (12%), 2 with fair results (3%) and no patients with poor outcomes.[15] The reasonable outcome was a case with both, radius and ulna malalignment in the similar plane with ulna angulated >20°. It has been stressed that the radius has a conclusive role in forearm movement.[16] This shows palmar and torsional deformities of the radius are all the more as often as possible related with the poor functional result, particularly in regards to pronation. These results were affirmed by a prior examination giving evidence that a poor result is essentially connected with palmar angular distortion of the radius shaft.[17] In our investigation, we showed that residual volar deformities of the radius had a higher probability of causing a restriction in pronation (5 out of 8 of our patients suffered lost forearm rotational movement albeit measurably untested). Deformities coordinated towards the same plane did not necessarily limit the forearm rotation, and deformations in the frontal plane of the two bones being angulated one way did not cause any restriction. In our study, 7 patients out of 8 with limitation of forearm supination and pronation had restricted pronation and supination with combined disfigurement coordinated in a similar plane. Complete bayonet apposition did not impact the functional outcome as depicted in a prior examination. We concede to this statement as one of our patients with 5 mm pike apposition in the range had a dorsally and radially angulated ulna with forearm impediment yet this had a negligible effect on his functional result.[18]

CONCLUSION

Great clinical outcomes can be accomplished in the treatment of malaligned diaphyseal forearm fractures in older kids and early adolescents by conservative

management. In children, more than 10 years, an angulation of 20° or more should not be acknowledged so as to have an adequate functional result and cosmetic outcome. For young children for more than 10 years, an angulation up to 20° can be deemed acceptable and treated conservatively. Generally speaking, conservative management of forearm fractures is a well-accepted and safe modality of treatment with excellent functional outcomes.

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Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Barry M, Paterson JM. A flexible intramedullary nails for fractures in children. J Bone Joint Surg Br. 2004;86:947-53.
2. Ceroni D, Martin X, Delhumeau-Cartier C, Rizzoli R, Kaelin A, Farpour-Lambert N. Is bone mineral mass truly decreased in teenagers with the first episode of forearm fracture? A prospective longitudinal study. J Pediatr Orthop. 2012;32:579-86.
3. Cheng JC, Ng BK, Ying SY, Lam PK. A 10-year study of the changes in the pattern and treatment of 6,493 fractures. J Pediatr Orthop. 1999;19:344-50.
4. Flynn JM, Jones KJ, Garner MR, Goebel J. Eleven year's experience in the operative management of pediatric forearm fractures. J Pediatr Orthop. 2010;30:313-9.
5. Franklin CC, Robinson J, Noonan K, Flynn JM. Evidence-based medicine: management of pediatric forearm fractures. J Pediatr Orthop. 2012;32:S131-4.
6. Jones K, Weiner DS. The management of forearm fractures in children: a plea for conservatism. J Pediatr Orthop. 1999;19:811-5.
7. Khosla S, Melton LJ, 3rd, Dekutoski MB, Achenbach SJ, Oberg AL, Riggs BL. Incidence of childhood distal forearm fractures over 30 years: a population-based study. JAMA. 2003;290:1479-85.
8. Ligier JN, Metaizeau JP, Prevot J. Closed flexible medullary nailing in pediatric traumatology. Chir Pediatr. 1983;24:383-5.
9. Lyons RA, Delahunty AM, Kraus D, Heaven M, McCabe M, Allen H, et al. Children's fractures: a population-based study. Inj Prev. 1999;5:129-32.
10. Noonan KJ, Price CT. Forearm and distal radius fractures in children. J Am Acad Orthop Surg. 1998;6:146-56.
11. Price CT. Acceptable alignment of forearm fractures in children: open reduction indications. J Pediatr Orthop. 2010;30:S82-4.
12. Quail IH, Kareem BA, Tan AB, Harwant S. Early remodeling in children's forearm fractures. Med J Malaysia. 2001;56:34-7.
13. Richter D, Ostermann PA, Ekkernkamp A, Muhr G, Hahn MP. Elastic intramedullary nailing: a minimally invasive concept in the treatment of unstable forearm fractures in children. J Pediatr Orthop. 1998;18:457-61.
14. Rivara FP, Grossman DC, Cummings P. Injury prevention. First of two parts. N Engl J Med. 1997;337:543-8.
15. Ryan LM, Teach SJ, Searcy K, Singer SA, Wood R, Wright JL, et al. Epidemiology of pediatric forearm fractures in Washington, DC. J Trauma. 2010;69:S200-5.
16. Shah AS, Lesniak BP, Wolter TD, Caird MS, Farley FA, Vander Have KL. Stabilization of adolescent both-bone forearm fractures: a comparison of intramedullary nailing versus open reduction and internal fixation. J Orthop Trauma. 2010;24:440-7.
17. Sinikumpu JJ, Pokka T, Serlo W. The changing pattern of pediatric both-bone forearm shaft fractures among 86,000 children from 1997 to 2009. Eur J Pediatr Surg. 2013;23:289-96.
18. Tammuz NA, Abdullah S, Osman Z, Das S. Paediatric forearm fractures: functional outcome of conservative treatment. Bratisl Lek Listy. 2009;110:563-8.

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