Open Access

Original Article

Outcome of Flexible Nailing in Forearm Fractures in Children

Hafiz Faiz ur Rehman, Muhammad Suhail Amin, Mian Qaisar Ali Shah*, Muhammad Labib, Muhammad Nouman Iqbal, Bilal Ahmed Qureshi

Department of Orthopedics Surgery, Combined Military Hospital /National University of Medical Sciences (NUMS) Rawalpindi Pakistan,
*Department of Orthopedics Surgery, Pak Emirates Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To look for outcome and analyze the factors influencing outcome of flexible nailing in forearm fractures in children managed at tertiary care orthopedics unit.
Study Design: Case series.
Place and Duration of Study: Orthopedic Department, Combined Military Hospital, Rawalpindi Pakistan, from Jul 2022 to Mar 2023.
Methodology: A prospective case series was conducted on the pediatric patients managed for forearm fractures with flexible nailing in our orthopedics unit. Outcome was assessed at 10 weeks after the surgical procedure. Poor outcome was defined if there was non-union on x-ray, pain on range of motion or skin erosion at site of nailing. Factors like age, gender, poly trauma and anemia at time of presentation were associated with poor outcome in children recruited in this case series.
Results A total of 30 children with forearm fractures treated with flexible nails were included in the final analysis. Out of them 23 (76.6%) were male while 07 (23.4%) were females. Mean age of the children recruited in study was 5.83±2.16 years. About 20 (66.7%) children with forearm fracture treated with flexible nails had good outcome after surgery while 10(33.3%) had poor outcome. Chi-square analysis revealed that poly trauma and presence of anemia at the time of presentation were the factors statistically significant associated with poor outcome (p-value <0.001) in our study participants.
Conclusion: Skin erosion at skin site was a common finding seen in pediatric patients managed for forearm fractures with flexible nailing. Patients with poly-trauma and anemia at the time of presentation were more at risk of having poor outcome after flexible nailing.

Keywords: Children; Flexible nailing; Forearm fracture; Outcome.

How to Cite This Article: *Rehman HF, Amin MS, Shah MQA, Labib M, Iqbal MN, Qureshi BA. Outcome of Flexible Nailing in Forearm Fractures in Children. Pak Armed Forces Med J 2024; 74(Suppl-2): S300-S303. DOI: https://doi.org/10.51253/pafmj.v74iSUPPL-2.10436*

INTRODUCTION

Orthopedics and neurology teams bare most of the trauma burden in our part of the world due to lack of specialized trauma teams working in general hospitals in most areas of Pakistan.[1] Situation becomes grave when trauma patients are children and need specialized multi-disciplinary care for different types of injuries and fractures.[2] Epidemiological data suggests that forearm fractures are commonly encountered in children in all types of health care settings demanding prompt action by treating teams to avoid serious health related consequecnces.[3]

Forearm fractures in children can be managed in number of ways ranging from conservative treatment to various forms of surgical treatment.[4] Intramedullary nails with and without hybrid fixation can be used in children depending upon the age of child and type of fracture.[5] Children less than 10 years of age are usually managed by intramedullary nails alone until and unless there is any other compelling indication for any additional procedure.[6]

Outcome of any surgical procedure is a complex phenomenon and depend upon number of patient, illness and service related factors. Studies in recent past done in various parts of the world have assessed outcome of flexible nailing procedures in fractures of forearm among pediatric patients. Hansen *et al*. recently published a nation-wide survey from national registry which comprised more than 35000 paediatric forearm fractures over 19 years. They noticed a clear shift in preferences of clinicians regarding treatment options. Intramedullary nailing was a preferred treatment option and this trend was increasing over last one decade.[7] Leuba *et al*. in 2022 compared the clinical and financial aspects of intramedullary nailing with other treatment options. They did the study with case-control design and studied number of parameters but found no gross difference in any of the parameters.[8] A systematic review was published in 2020 regarding use of flexible nailing in forearm fractures among children and adolescents. They found it an effective technique to manage these fractures but it was not free of complications and irritation of skin,

Correspondence: Dr Hafiz Faiz ur Rehman, Department of Orthopedics Surgery, Combined Military Hospital, Rawalpindi Pakistan
Received: 05 Jun 2023; revision received: 23 Aug 2023; accepted: 29 Aug 2023

muscle and nerve injuries, delayed, mal and non-unions and re-fractures were seen in few patients managed with this technique.[9]

Nation-wide statistics regarding paediatric-forearm fractures may not be very up-to-date but trauma and orthopaedic departments bear huge burden of paediatric population. A local study performed in biggest city of Pakistan tried to look for basic epidemiological data regarding paediatric fractures. Forearm fractures in children made a big chunk of all the fractures occurring in this group of population.[10] Limited local data has been available regrading use of intramedullary nailing in children forearm fractures despite their routine use in clinical practice. We therefore planned this study with the rationale to look for outcome and analyze the factors influencing outcome of flexible nailing in forearm fractures in children managed at tertiary care orthopedics unit of CMH Rawalpindi.

METHODOLOGY

This case series was conducted at the Orthopedics department of Combined Military Hospital Rawalpindi, from July 2022 to March 2023. Non probability Consecutive sampling technique was used to gather the sample and as it was a case series so all patients presenting in given time were recruited.

Inclusion Criteria: Children of both genders between the age of 2 and 10 years presenting with fracture of forearm diagnosed by consultant orthopedic surgeon were recruited for this case series.

Exclusion Criteria: The children with severe congenital malformations or those with other metabolic, immunological, endocrine or skeletal problems (Type-I diabetes mellitus, rickets, osteomalacia, glycogen storage diseases, nephrotic syndrome, chronic liver disease, congenital heart diseases etc.) were excluded. Those presenting with redo-fractures or having any contraindication to flexible nailing were not included in the study.

After approval from the ethical review board committee via IREB letter no. 390 and written informed consent from the parents or guardians of the potential participants or their care-givers, children with forearm fractures managed at our orthopedic unit with flexible nailing were included in the study. Fracture of forearm was diagnosed by consultant orthopedic surgeon with the help of relevant X-rays.[11] After diagnosis and typing of fracture, treatment plan was discussed among the team and with the parents of the child. Surgery was performed under general anesthesia in all the study participants. Standard Titanium intramedullary nails were used and selected for each child according to length of bone and intramedullary cortex width on radiograph of the patient. Consultant orthopedic surgeon lead the team and performed the surgery according to set protocols.[12] Patients were assessed on regular intervals for seeing the recovery process. At the end of ten weeks, good outcome was defined as complete union on x-ray, no pain on range of motion and absence of any other complication. Poor outcome was defined as non-union on x-ray, pain on range of motion and erosion of skin at nail site.[13] Anemia at the time of presentation was assessed by carrying out blood complete picture in all the children as per hospital protocol. Patients were classed as having anemia if hemoglobin levels were less than 10 g/dl.[14]

Characteristics of children participating in the study and the outcome variables were described with the help of descriptive statistics. Pearson chi-square analysis and Fischer exact test were done to evaluate the association of various factors with outcome of flexible nailing in children managed for forearm fractures. Statistics Package for Social Sciences version 24.0 (SPSS-24.0) was used for all the above-mentioned analysis. The *p*-values less than or equal to 0.05 were considered significant for ascertaining the association between variables.

RESULTS

A total of 30 children with forearm fractures treated with flexible nails were included in this case series. Out of them 23 (76.6%) were male while 07 (23.4%) were females. Mean age of the children recruited in study was 5.83±2.16 years. Table-I summarized the basic characteristics of children recruited in this case series. Out of total 30 children, 20 (66.7%) children with forearm fracture treated with flexible nails had good outcome after surgery while 10(33.3%) had poor outcome. Out of total patients, 02(6.7%) had non-union on x-ray, 02(6.7%) had pain on range of motion while 06(20%) had erosion at nail site.

Table-II showed the results of statistical analysis. It was revealed that poly trauma and presence of anemia at the time of presentation were the factors statistically significant associated with poor outcome (*p*-value<0.001) in children managed with flexible nails for forearm fractures while age (*p*-value-0.068) and gender (*p*-value-0.758) had no such association established in our case series.

Table-I: Characteristics of Children Included in the Study (n=30)

Study parameters	n(%)
Age (years)	
Mean±SD	5.83±2.16 years
Range (min-max)	2-10 years
Gender	
Male	23(76.6%)
Female	07(23.4%)
Cause of fractures	
Fall	15(50%)
Alleged physical assault	05(16.7%)
Road traffic accident	08(26.7%)
Others	02(6.7%)
Outcome at 10 weeks	
Good	20(66.7%)
Bad	10(33.3%)
Complications	
Complications	
Nonunion at x-ray	02(6.7%)
Pain at range of motion	02(6.7%)
Erosion of skin at nail site	06(20%)

outcome of flexible nailing in forearm fractures in children managed at tertiary care orthopedics unit of CMH Rawalpindi.

A study was published in 2020 on patients managed at Ghana regarding factors associated with re-displacement of forearm fractures in children. They came up with the conclusion that degree of initial displacement was associated with re-displacement of fracture of forearm in children.[15] In our study 2 patients had non-union in addition to other complications and presence of anaemia at time of presentation and poly-trauma predicted poor outcome.

Patel *et al*. published a systematic review regarding complications of intramedullary nailing and plate fixation. It was revealed that intramedullary nailing was safe procedure for management of pediatric forearm fractures and only minor complications occurred in patients if any.[16] Skin erosion at nail site

Table-II: Association of Various Factors with Outcome of Flexible Nailing for Forearm Fractures in Children (n=30)

Parameters	Good Outcome (no Complications)	Bad outcome (Complications Like Non-union on x-ray, Pain on Range of Motion And erosion of Skin at Nail Site)	*p*-value
Age			
2-5 years	13(86.1%)	03(50%)	0.068
5-8 years	07(13.9%)	07(50%)	
Gender			
Male	15(75%)	08(80%)	0.758
Female	05(25%)	02(20%)	
Poly-Trauma			
No	19(95%)	04(40%)	<0.001
Yes	01(5%)	06(60%)	
Anemia at Time of Presentation			
No	19(95%)	04(40%)	<0.001
Yes	0(5%)	06(60%)	

DISCUSSION

Orthopedics or trauma surgeons specially dealing with children are almost non-existent in our part of the world. It is usually routine adult teams which manage children. Special cases may demand input from pediatric surgeons, anesthetist or general pediatricians but generally there is one orthopedic team in hospitals which caters for children as well. Forearm fractures can occur at any age including pediatric age group and can be managed by open or closed method. Choice of management option is discussed by team and multiple factors may influence this choice. We studied children with forearm fractures managed with flexible nails and tried to look for outcome and analyze the factors influencing

was not serious but common complication in our study participants. Other than this complications were rare and most of the children included in our study had smooth recovery at the end of 10 weeks.

Asadollahi *et al*. in 2017 studied factors which could predict poor outcome especially re-displacement of fractures of forearm in children. They revealed that initial failure to achieve anatomical reduction was main predictor of poor outcome in their study participants.[17] Skin erosion at skin site was a common finding seen in pediatric patients managed for forearm fractures with flexible nailing in our study. Patients with poly-trauma and anemia at the time of presentation were more at risk of having poor outcome after flexible nailing.

Antabaq *et al.* published an interesting study by recruiting children who had both-bone diaphyseal forearm fractures. They came up with the findings that that only 1.1% children had poor outcome. Only one fracture out of 88 had nonunion at the end of 8 weeks.[18] Our results supported the findings generated by Antabaq *et al*. as only 2 patients had non-union in our study participants. Other complications were pain on range of motion and skin erosion at site of nail insertion. Overall outcome in our study at the end of 10 weeks was not too bad.

LIMITATIONS OF STUDY

It was a case series of children mange at one military hospital. Studies with better design in multiple public and private sector hospitals may generate generalizable results. Multiple confounding factors can have an impact on outcome which sometimes could be missed at time of initial presentation and emergency management of fractures.

CONCLUSION

Skin erosion at skin site was a common finding seen in pediatric patients managed for forearm fractures with flexible nailing. Patients with poly-trauma and anemia at the time of presentation were more at risk of having poor outcome after flexible nailing.

Conflict of Interest: None.

Funding Souce: None.

Authors' Contributions

The following authors have made substantial contributions to the manuscript as under:

HFR & MSA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MQAS & ML: Conception, data analysis, drafting the manuscript, approval of the final version to be published.

MNI & BAQ: Data acquisition, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Salman S, Saleem SG, Shaikh Q, Yaffee AQ. Epidemiology and outcomes of trauma patients at The Indus Hospital, Karachi, Pakistan, 2017 - 2018. Pak J Med Sci 2020; 36(1): S9-S13. https://doi.org/10.12669/pjms.36.ICON-Suppl.1717
2. Hegde S, Bawa M, Kanojia RP, Mahajan JK, Menon P, Samujh R, et al. Pediatric Trauma: Management and Lessons Learned. J Indian Assoc Pediatr Surg 2020; 25(3): 142-146. https://doi.org/10.4103/jiaps.JIAPS_35_19.
3. Korup LR, Larsen P, Nanthan KR, Arildsen M, Warming N, Sørensen S, et al. Children's distal forearm fractures: a population-based epidemiology study of 4,316 fractures. Bone Jt Open 2022; 3(6): 448-454. https://doi.org/10.1302/2633-1462.36.BJO-2022-0040.R1
4. Kyriakides J, Peeters W, Ahluwalia AK, Elvey M. Paediatric forearm fractures: assessment and initial management. Br J Hosp Med (Lond) 2022; 83(9): 1-9. https://doi.org/10.12968/hmed.2021.0564
5. Caruso G, Caldari E, Sturla FD, Caldaria A, Re DL, Pagetti P, et al. Management of pediatric forearm fractures: what is the best therapeutic choice? A narrative review of the literature. Musculoskelet Surg 2021; 105(3): 225-234. https://doi.org/10.1007/s12306-020-00684-6
6. Wollkopf ADP, Halbeisen FS, Holland-Cunz SG, Mayr J. Diametaphyseal distal forearm fractures in children: a strobe compliant comparison of outcomes of different stabilization techniques regarding complications. Children (Basel) 2023; 10(2): 374. https://doi.org/10.3390/children10020374
7. Hansen RT, Borghegn NW, Gundtoft PH, Nielsen KA, Balslev-Clausen A, Viberg B, et al. Change in treatment preferences in pediatric diaphyseal forearm fractures: a Danish nationwide register study of 36,244 fractures between 1997 and 2016. Acta Orthop 2023; 94(1): 32-37. https://doi.org/10.2340/17453674.2023.7132
8. Leuba A, Ceroni D, Tabard-Fougère A, Lutz N. Clinical and financial impacts of flexible intramedullary nailing in pediatric diaphyseal forearm fractures: A case-control study. J Child Orthop 2022; 16(3): 220-226. https://doi.org/10.1177/18632521221106380
9. Poutoglidou F, Metaxiotis D, Kazas C, Alvanos D, Mpeletsiotis A. Flexible intramedullary nailing in the treatment of forearm fractures in children and adolescents, a systematic review. J Orthop 2020; 20(3): 125-130. https://doi.org/10.1016/j.jor.2020.01.002
10. Mansoor K, Shahnawaz S, Ahmad A, Arif MM, Hamza M. Epidemiology of childhood fractures in the city of Karachi. J Ayub Med Coll Abbottabad 2015; 27(3): 608-612.
11. Flynn H, Solarz MK, Rehman S. Forearm Fractures: Diagnosis and Contemporary Treatment Strategies. Instr Course Lect 2022; 71(3): 303-312.
12. Upasani VV, Li Y. Elastic Intramedullary Nailing of Pediatric Both-Bone Forearm Fractures. JBJS Essent Surg Tech 2020; 10(4): e19.00055. https://doi.org/10.2106/JBJS.ST.19.00055
13. Riccio AI, Blumberg TJ, Baldwin KD, Schoenecker JG. Intramedullary Ulnar Fixation for the Treatment of Monteggia Fracture. JBJS Essent Surg Tech 2021; 11(2): e19.00076. https://doi.org/10.2106/JBJS.ST.19.00076
14. Moscheo C, Licciardello M, Samperi P, La Spina M, Di Cataldo A, Russo G. New Insights into Iron Deficiency Anemia in Children: A Practical Review. Metabolites 2022; 12(4): 289. https://doi.org/10.3390/metabo12040289
15. Agbley DY, Holdbrook-Smith HA, Segbefia M, Ahonon Y, Marfo K. Factors affecting early re-displacement of paediatric diaphyseal forearm fractures at Korle Bu Teaching Hospital. Ghana Med J 2020; 54(3): 151-155. https://doi.org/10.4314/gmj.v54i3.5
16. Patel A, Li L, Anand A. Systematic review: functional outcomes and complications of intramedullary nailing versus plate fixation for both-bone diaphyseal forearm fractures in children. Injury 2014; 45(8): 1135-1143. https://doi.org/10.1016/j.injury.2014.04.020
17. Asadollahi S, Pourali M, Heidari K. Predictive factors for re-displacement in diaphyseal forearm fractures in children-role of radiographic indices. Acta Orthop 2017; 88(1): 101-108. https://doi.org/10.1080/17453674.2016.1255784
18. Antabak A, Luetic T, Ivo S. Treatment outcomes of both-bone diaphyseal paediatric forearm fractures. Injury 2013; 44 Suppl 3: S11-S15. https://doi.org/10.1016/S0020-1383(13)70190-6