

Role of Intrafocal Pinning in Distal Radial Metaphyseal Fractures in Children

Mohammad Asaduzzaman^{a*}, Mohammad Sadiqul Amin^b, K M Shorfuddin^c

ARTICLE INFO

Received: 2 Feb 2026
Accepted: 7 Feb 2026
Published Online: 16 Feb 2026

DOI: 10.5281/zenodo.18661735

Volume: 8, Number: 2, Page: 32-36

e-ISSN: 2789-5912
ISSN: 2617-0817

*Corresponding author



ABSTRACT

Background: Distal radial metaphyseal fractures are among the most common orthopedic injuries in children, frequently resulting from falls during daily activities and play. While many fractures can be treated conservatively, displaced and unstable fractures often require surgical intervention. Intrafocal pinning is a minimally invasive technique that provides stable fixation while preserving soft tissue and growth potential. This study aimed to evaluate the radiological and clinical outcomes of intrafocal pinning in pediatric distal radial metaphyseal fractures. **Methods & Materials:** This prospective observational study was conducted in the Department of Orthopaedic Surgery at Sylhet MAG Osmani Medical College Hospital from July 2024 to June 2025. A total of 32 children below 16 years of age with displaced distal radial metaphyseal fractures were included. All patients were managed surgically using the intrafocal pinning technique. **Results:** The majority of patients were aged 6–10 years (43.8%), with a male predominance (68.8%). Falls while playing were the most common mode of injury (56.3%). Radiological union was achieved within 6 weeks in 37.5% of patients and within 7–8 weeks in 43.8%, with overall union within 8 weeks in most cases. Postoperative complications were minimal, with 78.2% of patients experiencing no complications. Pin tract infection occurred in 9.4%, while loss of reduction and wrist stiffness were observed in 6.2% each. **Conclusion:** Intrafocal pinning is a safe and effective

treatment option for displaced distal radial metaphyseal fractures in children, providing satisfactory radiological union, good functional outcomes and a low complication rate.

Keywords: Distal radius fracture, Intrafocal pinning, Pediatric fractures, Kirschner wire, Radiological union.

- ^{a.} Associate Professor, Department of Pediatric Orthopaedic, Sylhet MAG Osmani Medical College, Sylhet, Bangladesh (ORCID: 0009-0005-7435-8050)
- ^{b.} Associate Professor, Department of Orthopaedic Surgery, Gopalganj Medical College, Gopalganj, Bangladesh (ORCID: 0009-0005-7435-8050)
- ^{c.} Assistant Professor, Department of Orthopaedic Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh (ORCID: 0009-0004-5368-1724)

Introduction

Distal radial fractures are among the most common skeletal injuries in children, accounting for a significant proportion of pediatric fractures presenting to orthopedic emergency departments [1]. The unique anatomical and physiological characteristics of the growing bone, including the presence of a thick periosteum and active growth plates, influence both the pattern of fracture and the potential for remodeling [2]. Distal radial metaphyseal fractures commonly occur following low-energy trauma such as falls during play, although higher-energy mechanisms may also be responsible [3]. While many of these fractures can be managed conservatively, displaced and unstable fractures often require surgical intervention to achieve and maintain acceptable alignment [4].

Conventional treatment options for unstable distal radial metaphyseal fractures in children include closed reduction with cast immobilization, percutaneous K-wire fixation and in selected cases open reduction and internal fixation [5]. However, maintaining reduction solely with casting can be challenging,

particularly in fractures with significant displacement or comminution, leading to loss of alignment and suboptimal functional outcomes [6]. Percutaneous pinning techniques have therefore gained popularity as they provide additional stability while preserving soft tissue integrity [7].

Intrafocal pinning, originally described by Kapandji, is a minimally invasive technique that utilizes Kirschner wires placed directly into the fracture site to aid in reduction and stabilization [8]. This method offers several advantages, including improved fracture control, minimal surgical exposure and preservation of the periosteal blood supply [9]. In pediatric patients, intrafocal pinning allows stable fixation while respecting the growth potential of the distal radius, making it an attractive option for managing unstable metaphyseal fractures [10].

Despite the widespread use of intrafocal pinning in adult distal radius fractures, its application in children has been less extensively studied, particularly in resource-limited settings [11]. Variations in patient age, fracture pattern and surgeon

experience may influence outcomes and concerns remain regarding complications such as pin tract infection, loss of reduction and wrist stiffness. Therefore, evaluating the effectiveness and safety of this technique in pediatric populations is essential to guide clinical practice [12].

In Bangladesh, data on the surgical management of pediatric distal radial metaphyseal fractures are limited. Assessing local outcomes is important to establish evidence-based treatment protocols suitable for tertiary care hospitals. This study was undertaken to evaluate the role of intrafocal pinning in the management of distal radial metaphyseal fractures in children treated at Sylhet MAG Osmani Medical College Hospital, with emphasis on radiological union, functional outcome and associated complications.

Methods & Materials

This prospective observational study was carried out in the Department of Orthopaedic Surgery at Sylhet MAG Osmani Medical College Hospital over a period of one year from July 2024 to June 2025. A total of 32 pediatric patients with

distal radial metaphyseal fractures were included in the study. Children below 16 years of age presenting with displaced distal radial metaphyseal fractures requiring operative intervention were selected. Patients with open fractures, pathological fractures, associated neurovascular injury, multiple injuries, previous deformity of the wrist, or those medically unfit for anesthesia were excluded from the study.

After obtaining informed written consent from parents or legal guardians, detailed clinical evaluation and radiological assessment were performed for all patients. Standard anteroposterior and lateral

radiographs of the wrist were taken to determine fracture type, displacement and angulation. All cases were managed surgically using the intrafocal pinning technique under general anesthesia and strict aseptic precautions. Fracture reduction was achieved by Kapandji's intrafocal method and stabilization was confirmed intraoperatively with fluoroscopic guidance. Following fixation, an above-elbow or below-elbow plaster cast was applied depending on fracture stability.

Postoperatively, patients were monitored for immediate complications and discharged with appropriate advice.

Follow-up visits were scheduled at 2 weeks, 6 weeks and 12 weeks. Clinical outcomes were evaluated in terms of pain relief, wrist range of motion and functional recovery, while radiological outcomes included maintenance of reduction and time to fracture union (Figure 1). Complications such as pin tract infection, loss of reduction and wrist stiffness were also documented. Data were recorded in a structured data collection sheet and analyzed using SPSS version 25. Descriptive statistics were used to present the results, with continuous variables expressed as mean and standard deviation and categorical variables as frequency and percentage.



a) Preoperative X-ray



b) Intraoperative pin insertion



c) Intraoperative confirmation images



d) Postoperative fluoroscopic view



e) 2 weeks after operation



f) 6 weeks after operation



g) Clinical outcome (pronation)

h) Clinical outcome (supination)

Figure 1 Sequential Radiological and Clinical Evaluation of a Pediatric Distal Radial Metaphyseal Fracture Managed by Intrafocal Pinning.

Results

Table I shows the age and sex distribution of the study population comprising 32 children with distal radial metaphyseal fractures. The majority of patients

belonged to the 6–10 years age group, accounting for 14 cases (43.8%), followed by the 11–15 years group with 12 patients (37.5%). Children aged 5 years or younger constituted 6 cases (18.8%). Male patients

predominated the study population with 22 cases (68.8%), while females accounted for 10 cases (31.2%), indicating a clear male preponderance across all age groups.

Table I
Age and Sex Distribution of the Study Population (n = 32).

Age Group (years)	Male n (%)	Female n (%)	Total n (%)
≤5	4 (12.5)	2 (6.3)	6 (18.8)
6–10	10 (31.3)	4 (12.5)	14 (43.8)
11–15	8 (25.0)	4 (12.5)	12 (37.5)
Total	22 (68.8)	10 (31.2)	32 (100)

Table II illustrates the mode of injury among the study participants. Most fractures occurred due to falls while

playing, which was the leading cause in 18 patients (56.3%). Falls from height were the second most common mechanism,

observed in 9 cases (28.1%), whereas road traffic accidents accounted for 5 cases (15.6%).

Table II
Mode of Injury Among Study Participants (n = 32).

Mode of Injury	Number of Patients (n)	Percentage (%)
Fall while playing	18	56.3
Fall from height	9	28.1
Road traffic accident	5	15.6
Total	32	100

Table III presents the radiological union time following intrafocal pinning among the 32 pediatric patients. Radiological

union was achieved within 6 weeks in 12 patients (37.5%), while the majority of cases, 14 patients (43.8%), showed union

between 7 and 8 weeks. Delayed union beyond 8 weeks was observed in 6 patients (18.7%).

Table III
Radiological Union Time Following Intrafocal Pinning (n = 32).

Time to Union (weeks)	Number of Patients (n)	Percentage (%)
≤6 weeks	12	37.5
7–8 weeks	14	43.8
>8 weeks	6	18.7
Total	32	100

Table IV demonstrates the postoperative complications following intrafocal pinning among the 32 study participants. The majority of patients experienced an

uncomplicated postoperative course, with 25 cases (78.2%) showing no complications. Pin tract infection was the most frequently observed complication,

occurring in 3 patients (9.4%). Loss of reduction and wrist stiffness were each noted in 2 patients (6.2%).

Table IV
Postoperative Complications After Intrafocal Pinning ($n = 32$).

Complication	Number of Patients (n)	Percentage (%)
Pin tract infection	3	9.4
Loss of reduction	2	6.2
Wrist stiffness	2	6.2
No complications	25	78.2
Total	32	100

Discussion

Distal radial metaphyseal fractures are among the most frequent upper limb injuries in children, largely due to increased outdoor activities and vulnerability to falls. The present study evaluated the role of intrafocal pinning in managing these fractures and demonstrated favorable radiological and clinical outcomes with a low complication rate. In our series of 32 pediatric patients, the majority were males (68.8%) and most belonged to the 6–10 years age group (43.8%), findings that are consistent with the epidemiological pattern reported in pediatric fracture literature. Male predominance and higher injury rates in school-aged children have similarly been reported by Klein et al., who emphasized increased physical activity as a major contributing factor in this age group [13].

Regarding the mechanism of injury, falls while playing accounted for more than half of the cases (56.3%) in our study, followed by falls from height (28.1%). This predominance of low-energy trauma is comparable to observations by Chauhan et al., who reported that simple falls were the leading cause of distal radius fractures in children treated with percutaneous pinning [14]. These findings reinforce the notion that most pediatric distal radius fractures are accidental and activity-related rather than due to high-energy trauma.

Radiological outcomes in our study were encouraging, with union achieved within 8 weeks in 81.3% of patients and within 6 weeks in 37.5% of cases. Jerome et al. reported similar healing times in children treated with combined intrafocal K-wire pinning, highlighting the effectiveness of this technique in achieving stable fixation and early union [15]. Likewise, Babu CP demonstrated satisfactory radiological union and maintenance of reduction using the Kapandji intrafocal technique for completely displaced pediatric distal radius fractures [16]. The relatively short union time observed in our series supports the biological advantage of intrafocal pinning, which preserves periosteal blood supply while providing adequate mechanical stability.

Postoperative complications in the present study were minimal, with 78.2% of patients experiencing no complications. Pin tract infection was the most common complication (9.4%), followed by loss of reduction and wrist stiffness (6.2% each). These rates are comparable to those reported by Khanal et al., who observed low complication rates following percutaneous Kirschner wire fixation for Salter-Harris II distal radius fractures [17]. De Vitis et al. also reported that K-wire-based fixation techniques are generally safe in children, with pin tract infection being the most frequent but usually minor complication [18]. Importantly, no major complications such as growth disturbance or neurovascular injury were observed in our study.

The functional outcome, as assessed clinically by wrist and forearm movements, was satisfactory in most patients, as reflected by good pronation and supination at follow-up. This aligns with the findings of Ohshima et al., who emphasized that minimally invasive pinning techniques allow early functional recovery when combined with appropriate immobilization and follow-up [19]. The low incidence of wrist stiffness in our study further supports the effectiveness of intrafocal pinning in maintaining joint mobility.

Recent advances in pediatric forearm fracture management have introduced alternative fixation techniques such as elastic stable intramedullary nailing and modified intramedullary K-wire methods. Studies by Bi et al. and Saliba et al. have reported good outcomes with these techniques, particularly for metaphyseal–diaphyseal junction fractures [20, 21]. However, intrafocal pinning remains a simple, cost-effective and technically less demanding option, especially suitable for resource-limited settings like ours. Hasan et al., in their comparative analysis of pinning techniques in pediatric fractures, also highlighted that simpler pinning methods can achieve outcomes comparable to more complex fixation techniques when appropriately selected [22].

Limitations

This study has several limitations. The sample size was relatively small and the

study was conducted at a single center, which may limit the generalizability of the findings. The absence of a control or comparison group treated with alternative fixation methods restricted direct comparison of outcomes. In addition, the follow-up period was relatively short, which may not fully reflect long-term functional outcomes or late complications such as growth disturbances. Further multicenter studies with larger sample sizes and longer follow-up are recommended to validate these results.

Conclusion

Overall, the findings of this study support intrafocal pinning as an effective and safe method for managing distal radial metaphyseal fractures in children. The high rate of timely radiological union, satisfactory functional outcomes and low complication rates observed in our series are consistent with previously published studies. Given its simplicity, minimal invasiveness and favorable outcomes, intrafocal pinning can be considered a reliable treatment option for unstable distal radial metaphyseal fractures in the pediatric population.

Financial Support & Sponsorship

No funding sources.

Conflicts Of Interest

There are no conflicts of interest.

References

- Laakkonen T, Kosola J, Nietosvaara N, Puhakka J, Nietosvaara Y, Stenroos A. Epidemiology, treatment and treatment quality of overriding distal metaphyseal radial fractures in children and adolescents. *JBJS*. 2022 Feb 2;104(3):207-14.
- Zhu H, Gao C, Wang M, Zhang N, Cao J. Modified external fixation technique for treatment of distal radial metaphyseal–diaphyseal junction fractures in pediatric patients. *Frontiers in Pediatrics*. 2025 Dec 8;13:1719011.
- Stark D, Denzinger M, Ebert L, Brandl R, Knorr C. Therapeutic approaches of diametaphyseal radius fractures in children. *Archives of Orthopaedic and Trauma Surgery*. 2024 Mar;144(3):1179-88.
- Sato K, Mimata Y, Takahashi G, Murakami K, Numata N, Doita M. Fractures of the proximal segments of the pediatric distal radial metaphysis exhibit

- less angular stability than fractures of the distal segments. *Journal of Pediatric Orthopaedics B*. 2022 Sep 1;31(5):471-8.
5. Liu DS, Murray MM, Bae DS, May CJ. Pediatric and adolescent distal radius fractures: current concepts and treatment recommendations. *JAAOS-Journal of the American Academy of Orthopaedic Surgeons*. 2024 Nov 1;32(21):e1079-89.
 6. Guenbdar M, Ouahdi M, Cherrad T, Zejjari H, Louaste J, Amhajji L. Kapandji's intra-focal pinning in treating unstable or irreducible displaced distal radius metaphyseal fractures in children: a prospective study. *PAMJ Clinical Medicine*. 2022 Feb 9;8(31).
 7. Jianyi J, Chaoyu L, Lian M, Ge M, Hailong M, Jun S, Guoqiang J. Comparison of three fixation methods in paediatric metaphyseal-diaphysis junction fracture of the distal radius: a retrospective study in two centres. *Frontiers in Pediatrics*. 2023 Aug 24;11:1244704.
 8. Chaoyu L, Guoqiang J, Wenqiang X, Lian M, Jing S, Yong L. Precision shaping of elastic stable intramedullary nail for the treatment of metaphyseal diaphysis junction fracture of the distal radius in children: a preliminary report in two centers. *BMC Musculoskeletal Disorders*. 2023 Mar 29;24(1):237.
 9. Bassi C, Heimann AF, Schwab JM, Tannast M, Raabe I. Modified Kapandji technique in pediatric displaced distal radius fractures: results in 195 patients. *European Journal of Orthopaedic Surgery & Traumatology*. 2024 Jan;34(1):489-97.
 10. Wu R, Wen Y, Wang C, Liu T, Yu J. Elastic stable intramedullary nailing versus Kirschner wire in the treatment of pediatric metaphyseal–diaphyseal junction fractures of the distal radius: a case-control study. *BMC Musculoskeletal Disorders*. 2023 Nov 30;24(1):922.
 11. Kim HJ, Park H. Physeal and metaphyseal fractures of the distal radius in pediatric patients. *Journal of the Korean Medical Association*. 2024 Jun;67(6):403-12.
 12. Wang R, Chen D, Tang Y, Fan M, Wang Y, Zhuang H, Guo R, Zheng P. A novel method for treating distal radius diaphyseal metaphyseal junction fracture in children. *Medical Science Monitor: International Medical Journal of Experimental and Clinical Research*. 2023 Jul 3;29:e939852-1.
 13. Klein C. Management of forearm fracture in children in 2025. *Orthopaedics & Traumatology: Surgery & Research*. 2025 Sep 24:104439.
 14. Chauhan J, Vora P, Kushakiya P, Kothiya V, Sheladiya B. Functional outcomes of Percutaneous Kirschner Wire Pinning in Paediatric Distal Radius Physeal Fracture(Salter Harris Type 2). *Res. J. Med. Sci*. 2024 Aug 19;18:350-3.
 15. Jerome JT. Combined intrafocal K-wire pinning for unstable pediatric distal forearm fractures. *Journal of Musculoskeletal Surgery and Research*. 2025 Jul 1;9(3):379-86.
 16. Babu CP. Closed Reduction and K-Wiring with the Kapandji Technique for Completely Displaced Paediatric Distal Radius Fractures. *European Journal of Cardiovascular Medicine*. 2023 Apr 1;13(2).
 17. Khanal S, Khanal S, Panthi S, Neupane B, Shrestha R. Percutaneous Kirschner Wire Pinning for Salter-Harris II Distal Radius Fractures. *Arch SurgClin Case Rep*. 2022;5(174):2689-0526.
 18. De Vitis R, D'Orto M, Passiatore M, Perna A, Cilli V, Taccardo G. Elastic stable intramedullary fixation using epibloc versus crossed Kirschner wires fixation for distal forearm fractures in children: a retrospective analysis. *African Journal of Paediatric Surgery*. 2022 Jul 1;19(3):153-9.
 19. Ohshima K, Tokutake K, Takegami Y, Asami Y, Matsubara Y, Natsume T, Kimura Y, Ishihara N, Imagama S. Longer time of implantation using the buried pin technique for intramedullary nailing would decrease refracture in the diaphyseal forearm fracture in children-retrospective multicenter (TRON) study. *Injury*. 2023 Mar 1;54(3):924-9.
 20. Bi W, Xu W, Fan Y, Yao Y, Ma X, Zhang J, Wang W, Liu C. Modified retrograde K-wire intramedullary fixation for treating pediatric distal radius diaphyseal–metaphyseal junction fractures: a novel method and a retrospective study. *European Journal of Medical Research*. 2025 Oct 9;30(1):944.
 21. Saliba E, Munoz C, Bizdikian AJ, Lefevre Y. Modified Elastic Stable Intramedullary Nailing: A New Approach for Metaphyseal-Diaphyseal Fractures of the Forearm in Children. *Orthopaedics & Traumatology: Surgery & Research*. 2025 Nov 5:104549.
 22. Hasan SU, Pervez A, Usmani SU, Tahseen MU, Asghar S, Ahmed JW, Manal I. Comparative analysis of pinning techniques for supracondylar humerus fractures in paediatrics: a systematic review and meta-analysis of randomized controlled trials. *Journal of Orthopaedics*. 2023 Oct 1;44:5-11.