Original Research

PEDIATRIC FRACTURE OF NECK OF FEMUR: MANAGEMENT ANALYSIS

Dr. Alok Kumar[1], Dr. Jay Dhariwal[2], Dr. Farooq lone[3]
[1]Assistant Professor, Department of Orthopaedics, Al Falah School of Medical Science and Research Centre, Faridabad, Haryana, India.
[2]Assistant Professor, Department of Orthopaedics, Al Falah School of Medical Science and Research Centre, Faridabad, Haryana, India.
[3]Assistant Professor, Department of Orthopaedics, Al Falah School of Medical Science and Research Centre, Faridabad, Haryana, India.
Corresponding Author: Dr. Alok Kumar
Email: alokloggedon@live.com

ABSTRACT

Background: Pediatric fractures of the neck of femur are rare but potentially devastating injuries due to the high risk of avascular necrosis (AVN), nonunion, and premature physeal closure. Optimal management remains controversial due to limited case numbers and heterogeneity in treatment protocols.

Objective: To evaluate management strategies and clinical outcomes of pediatric femoral neck fractures (PFNFs) and to analyze factors influencing complications.

Methods: A retrospective observational analytical study conducted at a tertiary care teaching hospital reviewing cases treated between August 2019 and December 2024.

Demographic characteristic, fracture classification (Delbet), timing of surgery, fixation method, and complications were recorded. Functional outcome was assessed using Ratliff's criteria. Statistical analysis was performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Associations were analyzed using Chi-square test and logistic regression.

Results: Forty-two patients (mean age 11.2 ± 3.4 years) were analyzed, with Delbet Type II fractures being most common (40.5%). The overall AVN rate was 19%, while nonunion and premature physeal closure was observed in 9.5% and 14.2% cases, respectively. Early surgery (<24 hours) significantly reduced AVN incidence (p=0.03), and delayed intervention was an independent predictor of AVN (OR: 2.8, 95% CI: 1.1–6.9). Closed reduction yielded superior functional outcomes compared to open reduction (p=0.04).This finding may reflect fracture severity selection rather than superiority of technique.

Conclusion: Early anatomical reduction and stable internal fixation significantly reduce complications in pediatric femoral neck fractures. Prompt surgical management within 24 hours remains critical to minimize AVN and improve functional outcomes.

Keywords: Pediatric Femoral Neck Fracture, Delbet Classification, Avascular Necrosis, Cannulated Screws, Internal Fixation, Management Outcomes.

INTRODUCTION

Fractures of the femoral neck in the pediatric population account for <1% of all childhood fractures [1, 2]. These fractures occur due to high-energy trauma such as RTAs, sports activities, fall from height, and are also at times associated with metabolic disorders [3, 4]. These injuries often present as part of polytrauma or with associated fractures with pelvic injury, acetabulum fracture, dislocated hip, or ipsilateral shaft fracture [5].

www.ajmrhs.com
eISSN: 2583-7761

Date of Received: 03-01-2026
Date Acceptance: 21-02-2026
Date of Publication: 25-02-2026

Isolated pediatric femoral neck fractures are rare, often accompanied by concomitant injuries including intracranial hemorrhage, lung contusions, liver and spleen ruptures, rectal and urethral injuries, and pelvic fractures [6]. Due to significant changes in the blood supply to the femoral head as children age, vascular supply becomes increasingly vulnerable to disruption and is susceptible to injury during fractures, frequently resulting in complications such as avascular necrosis of the femoral head after femoral neck fractures [7]. The complications of PFNFs including femoral head avascular necrosis (AVN) (20–29%), delayed union or nonunion (10–24%) and premature physeal closure (PPC) (20–62%) are relatively common and increase the risk of morbidity and the difficulty of management [8, 9]. Recent reports have indicated that complications of PFNFs are related not only to the anatomic and radiographic features of the

fracture, such as the amount of displacement and the comminution of the medial-posterior column, but also to treatment, such as reduction and fixation methods [10]. Therefore, evaluating treatment strategies and identifying factors influencing outcomes is essential to optimize management and reduce long-term morbidity [11].

Aim of the study: The present study aims to evaluate the management strategies and clinical outcomes of pediatric femoral neck fractures and to identify factors associated with postoperative complications.

MATERIALS AND METHODS

This retrospective observational analytical study was conducted at a tertiary care teaching hospital over ten years from August 2019 to December 2024. The study included children aged ≤16 years presenting with radiologically confirmed femoral neck fractures. The study was approved by the Institutional Ethics Committee, and patient confidentiality was maintained.Due to the rarity of pediatric femoral neck fractures, all eligible cases during the study period were included.

Inclusion criteria

- Children age ≤16 years with either gender
- Acute traumatic femoral neck fracture
- Operated cases with internal fixation
- Minimum follow-up of 6 months

Exclusion criteria

- Pathological fractures
- Associated slipped capital femoral epiphysis or previous ipsilateral hip surgery
- Incomplete medical records
- Lost to follow-up before 6 months

Data Collection

Data collected included age, sex, mode of injury, Delbet classification, time interval from injury to surgery, type of reduction (open/closed), implant used, postoperative complications, and functional outcome assessed by Ratliff criteria.

Surgical Protocol

All patients underwent urgent reduction and internal fixation under fluoroscopic guidance. Closed reduction was preferred; open reduction was performed when anatomical alignment was not achieved. Fixation was done using cannulated cancellous screws or pediatric dynamic hip screw depending on fracture type and age.

Outcome Measures

The primary outcome was the incidence of AVN. Secondary outcomes included nonunion, premature physeal closure, limb length discrepancy, and functional outcome.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as percentages. Associations were analyzed using Chi-square test and Student's t-test. Logistic regression analysis was performed to identify predictors of AVN. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 42 pediatric patients with femoral neck fractures were included in the study. The mean age was 11.2 ± 3.4 years, with a male predominance (66.7%). Road traffic accidents were the most common mode of injury (47.6%).[Table:1].

Table 1: Demographic and Injury Profile

Variable	Frequency (n=42)	Percentage (%)
Male	28	66.7%
Female	14	33.3%
RTA	20	47.6%
Fall from height	15	35.7%
Sports injury	7	16.7%

According to Delbet Classification type II fracture was most commonly reported (40.5%) followed by type III fracture (33.3%).

Table 2: Distribution According to Delbet Classification

Delbet Type	Number	Percentage (%)
Type I	3	7.1%
Type II	17	40.5%
Type III	14	33.3%
Type IV	8	19%

The overall incidence of AVN was 19%, while nonunion and premature physeal closure was observed in 9.5% and 14.2% of cases, respectively.

Table 3: Complications Observed

Complication	Number	Percentage (%)

AVN	8	19%
Nonunion	4	9.5%
Premature physeal closure	6	14.2%
Limb length discrepancy (>1cm)	5	11.9%

Majority of the patients (59.5%) had good outcomes followed by (23.8%) fair outcomes

Table 4: Functional Outcome (Ratliff Criteria)

Outcome	Number	Percentage (%)
Good	25	59.5%
Fair	10	23.8%
Poor	7	16.7%

AVN was most commonly seen in type I fracture (33%) followed by type II fracture (29%)

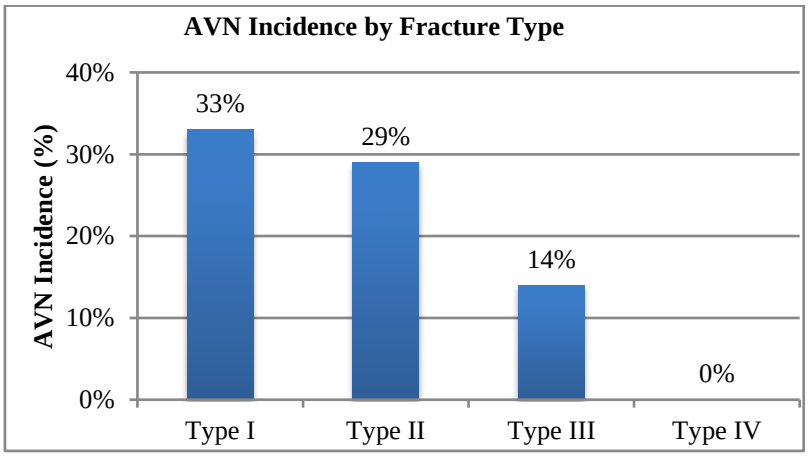

Figure 1: Incidence of Avascular Necrosis According To Delbet Fracture Type

On multivariate logistic regression analysis, delayed surgery (>24 hours) was identified as an independent predictor of AVN (OR: 2.8, 95% CI: 1.1–6.9, p=0.03).

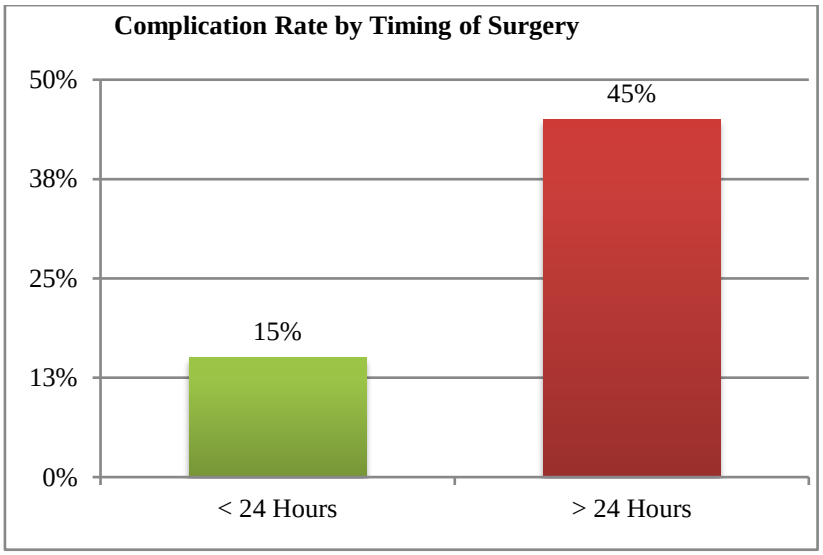

Figure 2: Overall Complication Rate According To Timing of Surgical Intervention

LIMITATION

The limitations of this study include its retrospective design, small sample size, and single center nature, which may limit generalizability.

DISCUSSION

Pediatric femoral neck fractures remain one of the most challenging injuries in pediatric orthopedics because of their high complication rates and long-term functional implications. Early anatomical

reduction and stable fixation are considered the most important determinants of outcome. Moon and Mehlman reported that delayed surgical intervention significantly increases the risk of avascular necrosis (AVN) in displaced fractures (12). Our findings are consistent, as surgery performed within 24 hours significantly reduced AVN incidence.

The predominance of Delbet Type II fractures in our study aligns with contemporary epidemiological data (13). Intracapsular fractures, particularly Delbet Types I and II, are associated with a higher risk of retinacular vessel disruption leading to AVN (14). In our cohort, AVN incidence was highest among Type I fractures.

Closed reduction and internal fixation using cannulated cancellous screws remains the preferred treatment modality. Bali et al. demonstrated improved outcomes with early stable fixation and minimal soft tissue disruption (15). Similarly, Wang et al. identified delayed fixation and inadequate reduction as significant predictors of complications (10). Our study showed superior functional outcomes in the closed reduction group compared to open reduction.

Nonunion and premature physeal closure continue to be important concerns. Recent outcome analyses report nonunion rates between 5–15%, particularly in cases of delayed fixation (17). Our nonunion rate of 9.5% is comparable to these findings. Premature physeal closure may lead to limb length discrepancy and long-term deformity if not monitored adequately (18).

Despite improvements in surgical techniques and postoperative care, complication rates remain significant. Recent multicenter studies advocate for urgent surgical stabilization and standardized management algorithms to improve prognosis (19,20). Our findings further reinforce the importance of early intervention and stable fixation to reduce morbidity.

CONCLUSION

Pediatric femoral neck fractures remain rare but clinically significant injuries with a substantial risk of complications. Early surgical intervention within 24 hours, anatomical reduction, and stable internal fixation significantly reduce the incidence of avascular necrosis and improve functional outcomes. Closed reduction with cannulated cancellous screw fixation appears to provide superior results compared to open methods. Long-term follow-up is essential to monitor growth-related complications. Standardized treatment protocols are necessary to optimize outcomes in this vulnerable population.

REFERENCES

1. Papalia R, Torre G, Maffulli N, Denaro V. Hip fractures in children and adolescents. Br Med Bull 2019; 129:117-28.
2. Mazurek T, Lorczyński A, Ceynowa M. Bilateral femoral neck fracture in a child: A 17-year follow-up. J Pediatr Orthop B 2011; 20:295-8.
3. Palocaren T. Femoral neck fractures in children: A review. Indian J Orthop 2018; 52:501-6.
4. Rocha DF, Horwitz DS, Sintenie JB. Femoral neck fractures in children: Issues, Challenges, and Solutions. J Orthop Trauma 2019; 33:S27-32.
5. Patterson JT, Tangtiphaiboontana J, Pandya NK. Management of pediatric femoral neck fracture. J Am Acad Orthop Surg 2018; 26:411-419.
6. Shrader MW, Jacofsky DJ, Stans AA, Shaughnessy WJ, Haidukewych GJ. Femoral neck fractures in pediatric patients: 30 years' experience at a level 1 trauma center [J]. Clin Orthop Relat Res 2007; 454:169–73.
7. Slobogean GP, Sprague SA, Scott T, Bhandari M. Complications following young femoral neck fractures[J]. Injury 2015; 46(3):484–91.
8. Spence D, DiMauro JP, Miller PE, et al. Osteonecrosis after femoral neck fractures in children and adolescents: analysis of risk factors. J Pediatr Orthop. 2016; 36(2):111–116. (https://doi.org/10.1097/bpo.0000000000000424)
9. Riley PM Jr, Morscher MA, Gothard MD, et al. Earlier time to reduction did not reduce rates of femoral head osteonecrosis in pediatric hip fractures. J Orthop Trauma 2015 29 231–238. (https://doi.org/10.1097/bot.0000000000000226)
10. Wang W, Li Y, Xiong Z, et al. Effect of the number, size, and location of cannulated screws on the incidence of avascular necrosis of the femoral head in pediatric femoral neck fractures: a review of 153 cases. J Pediatr Orthop 2022; 42(3):149–157. (https://doi.org/10.1097/bpo.0000000000002018)
11. Bimmel R, Bakker A, Bosma B, et al. Paediatric hip fractures: a systematic review of incidence, treatment options and complications. Acta Orthop Belg 2010 76 7–13.
12. Moon ES, Mehlman CT. Risk factors for avascular necrosis after femoral neck fractures in children. J Orthop Trauma. 2012;26(1):e1–e6.
13. Boardman MJ, Herman MJ, Buck B, Pizzutillo PD. Hip fractures in children. J Am Acad Orthop Surg. 2014;22(10):665-674.
14. Cheng JC, Tang N. Decompression and stable internal fixation of femoral neck fractures in children. J Pediatr Orthop. 2013;33(4):393-399.
15. Bali K, Sudesh P, Patel S, Kumar V, Saini U, Dhillon MS. Pediatric femoral neck fractures:

our 10 years of experience. Clin Orthop Surg. 2011;3(4):302-308.
16. Maeda S, Kita A, Funayama K, et al. Factors affecting the development of avascular necrosis after femoral neck fractures in children. J Pediatr Orthop. 2019;39(6):e422–e427.
17. Chen Y, Zhang X, Guo H, Liu N, Ren J, Lu C. Poor outcomes of children and adolescents with femoral neck fractures: A meta-analysis based on clinical studies. Orthop Surg. 2020; 12(4):639–647.
18. Yeranosian MG, Horneff JG, Baldwin K, Hosalkar HS. Factors affecting treatment and outcomes of pediatric femoral neck fractures. J Pediatr Orthop. 2013; 33(6):e61-e67.
19. Slongo T, Audigé L, Schlickewei W, et al. Treatment principles in pediatric femoral neck fractures. Injury. 2018; 49(8):1501-1507.
20. Zhang X, Li J, Xu X, et al. Early surgical intervention improves outcomes in pediatric femoral neck fractures. Int Orthop. 2020; 44(7):1351-1358.

How to cite this article: Dr. Alok Kumar, Dr. Jay Dhariwal, Dr. Farooq lone, PEDIATRIC FRACTURE OF NECK OF FEMUR: MANAGEMENT ANALYSIS, Asian J. Med. Res. Health Sci., 2026; 4 (1):-404-408.
Source of Support: Nil, Conflicts of Interest: None declared.