

**Original Article**

**Pediatric Femoral Neck Fractures**

*Sahu RL*

**Abstract:**

**Introduction:** Femoral neck fractures are rare injuries in children, but the high incidence of long term complications make it an important clinical entity. The aim of this prospective study was to analyze the clinical outcomes of pediatric femur neck fractures. **Methods:** The study included 16 children (10 boys and 6 girls) who sustained femoral neck fractures and completed an average follow-up of 28 months. The children were treated with anatomical reduction and internal fixation with partially threaded cancellous screws. The outcomes were clinically and radiologically assessed for fracture healing, joint movements and implant failure. **Results:** The mean age of included patients was 10 years (range, 6 to 16 years) and the average follow-up was 28 months (range, 17 -48 months). Coxa- vara was the most common complication. Other complications included nonunion associated with Partial avascular necrosis and delayed union was seen in one case but later on it had been corrected. Two cases of slight coxa vara were seen radiologically but clinically patients had no problem in walking and daily activities. All children achieved union in a mean time of 10 weeks (range from 6 - 16 weeks) except two cases. Full weight bearing was possible in a mean time of 8.8 weeks. The results were excellent in 68.75% and good in 18.75% patients. **Conclusions:** We conclude that the early operation using anatomical reduction and internal fixation of pediatric femoral neck fracture offers the best results and provide early healing less complication with good results and is economical.

**Key words:** Pediatric femur neck fracture, Avascular necrosis, Anatomical reduction and internal fixation, Nonunion.

DOI: <http://dx.doi.org/10.3329/bjms.v13i2.18303>

Bangladesh Journal of Medical Science Vol.13(2) 2014 p.198-204

**Introduction:**

Fractures of the femoral neck in children are rare and accounts for less than 1% of all pediatric fractures<sup>(1-5)</sup>. High energy force is required for the fracture of neck of the femur in normal children because the dense bone of femoral neck is surrounded by a thick periosteum<sup>(6)</sup>. Intracapsular fracture neck femur is notoriously known as an orthopaedic enigma, since as a permanent solution for its treatment still eludes the orthopaedic surgeon. Hence, it is infamously termed as an unsolved problem. Fracture neck of femur does not unite readily and this makes it a difficult problem to tackle. Fracture neck femur is an orthopaedic emergency which needs to be reduced and fixed within 24 hrs to get optimal results. These fractures are commonly associated with severe complications, especially a vascular necrosis of the femoral head, non-union, coxa vara and premature closure of the upper femoral epiphysis. The classification system originally described by Delbet and popularized by Colonna is most

commonly used for these fractures<sup>(7)</sup>. A thorough understanding of anatomy is important to ensure proper treatment and to understand associated complications. Proper primary treatment of this hazardous fracture is the key to a successful outcome. We share our experience and understanding of this fracture by prospective study of our 16 cases and critically analyzing the complications and treatment received. The modes of treatment we review here are internal fixation by either closed or open means.

**Methods:**

This prospective study was carried out at Orthopaedics department of M. M. Medical College from July 2005 to November 2009. It was approved by institutional medical ethics committee. A total of 16 patients with closed femoral neck fractures admitted to our institute were included in present study. A written informed consent was obtained from all the patients; they were explained about treatment plan, cost of operation, and hospital stay after

**Correspond to:** Dr Ramji Lal Sahu. Associate Professor, Department of Orthopaedics, SMS and RI, Sharda University, Greater Noida, U. P. Indin, Email [drrihsahu@gmail.com](mailto:drrihsahu@gmail.com)

surgery, and complications of anaesthesia. They were followed up after surgery, were clinically and radiologically assessed for fracture healing, joint movements and implant failure. According to the criteria the results are graded as excellent when the fractures unite within 16 weeks without any complication, good when union occur within 24 weeks with treatable complications like superficial infection and knee stiffness and poor when union occur before or after 24 weeks with one or more permanent complications like infection (osteomyelitis), implant failure, non-union, limb shortening and permanent knee stiffness. Delayed union was recorded when the fracture united between three to six months while nonunion was noted when union had not occurred after eight months of treatment Follow-up was done. Patients with closed femoral neck fracture with age between 6-16 years and presented within a week of the injury and did not have any previous surgical treatment for the fracture was included in the study. Malnourished patients and those with open fractures, pathological fractures and fracture nonunion were excluded from the study. Examination of patients was done thoroughly at the time of admission to exclude other injuries. In majority of the patients cannulated cancellous screws were used in treatment of fracture neck femur. The treatment installed as early as possible. In patients who were not fit for surgery due to associated injuries to vital organs, were haemodynamically unstable or due to active infection at injury site, or were pyrexial delayed treatment was performed when their over-all condition improved. There were sixteen patients in this study, ten patients were male and six patients were females who completed an average follow-up of 28 months (range 17-48 months) were included in the study. The fractures were classified according to the Delbet system as popularized by Colonna<sup>7</sup> and were further subdivided into displaced and undisplaced. The treatment modalities used were open reduction and internal fixation (ORIF), or closed reduction and internal fixation (CRIF) depending upon the patient profile and the fracture pattern. The clinical results of our study were rated on the basis of the criteria of union, nonunion, delayed union or malunion (Table 3).

### **Results:**

There were 10 (62.5%) male and 12 (37.5%) female patients (Table 1). The mechanism of injury was road traffic accident in 60% of patients, during playing in 20%, fall from height 10% and industrial accident was 10%. Injury to left lower limb was seen in 37.5% and right lower limb in 62.5% of patients. The average hospital stay was 18 days. There were 14 children with isolated fractures of the femoral neck. The remaining 2 children had associated injuries of clavicle and both bone forearm fractures. Two cases (12.5%) were of Delbet type I (transepi-physeal), five cases (31.25%) were of Delbet type II (transcervical), seven cases (43.75%) were of Delbet type III (cervicotrochanteric), and two cases (12.5%) were of

Delbet type IV (intertrochanteric) (Table 2).. These fractures were further classified as displaced (8 cases) and undisplaced (8 cases). All the patients were taken into operation Theater as they being fit for surgery. Fourteen cases (87.5%) out of sixteen were treated with close anatomical reduction and internal fixation with partially threaded cannulated cancellous screws and two cases (12.5%) were treated with open anatomical reduction and internal fixation with partially threaded cannulated cancellous screws. All the cases were fixed under image intensifier (Figure 1-4). The mean age of included patients was 10 years (range, 6 to 16 years) and the average follow-up was 28 months (range, 17 -48 months). The results were excellent in 68.75% and good in 18.75% patients (Table 4). Nonunion associated with a vascular necrosis and a primary screw perforation of head was the most common complication (Table 5). One case of nonunion associated with a vascular necrosis was seen in my study that has been corrected with bone grafting. Revised surgery was done in case of primary screw perforation of head. Delayed union was seen in one case but later on it had been corrected. Two cases of slight coxa vara were seen radio logically but clinically patients had no problem in walking and daily activities. At follow-up all patients went on to osseous union and regained a full range of movement after rehabilitation.

### **Discussion:**

Fractures of the femoral neck in children are rare. High energy force is required for the fracture of neck of the femur in normal children because the dense bone of femoral neck is surrounded by a thick periosteum<sup>8</sup>. In my study, 60% of fractures were due to RTA and 10% were due to falls from height. These data matched the incidence reported in the literature<sup>1-5</sup>. As per the available literature, most of the large series on fractures of neck of femur in children<sup>9-11</sup> report Delbet type II fractures as the most common, followed by type III and type IV. My findings also matched with this data (43.75% of our cases were type III, followed by 31.25% being type II, 12.5% type IV and 12.5% type I). The risk of avascular necrosis depends on several factors, including age, degree of initial displacement, type of fracture, time to surgery, and method of fixation<sup>9, 12-15</sup>. The most important factor is likely the severity of vascular compromise sustained at the time of trauma. Avascular necrosis develops in approximately 17% to 47% of the cases<sup>9, 11, 16, and 17</sup>. This is because the adult hip has intraosseous blood vessels that supply the femoral head, whereas the blood vessels of pediatric hip have cannot cross the open physis.

Therefore, blood supply to the femoral head is critical in a child and can be disrupted easily by hip fracture<sup>18</sup>. As mentioned by Ratliff,<sup>1</sup> the presence of avascular necrosis adversely affects the prognosis. In my study, the development of avascular necrosis contributed to one case that

was slight avascular necrosis. The rate of avascular necrosis in my study was 6.25%, which was slightly less as compared to the previous studies. Based on my results, we believe that internal fixation of pediatric femur neck fractures should be performed whenever feasible because conservative treatment carries a high risk of failure of reduction. The femoral neck in children consists of smooth, hard, dense bone which does not have the typical adult trabecular pattern<sup>19</sup>. Fracture lines are often uniplanar (unlike spiral and triplanar in adults) and less jagged with very little interlocking patterns which makes these fractures highly unstable. Loss of reduction commonly occurs in traditionally applied hip spica. Coxa vara is a major complication leading to unsatisfactory results, as seen in the series of Lam<sup>11</sup> and Ratliff<sup>1</sup>. In my study, two cases of slight coxa vara were seen radio logically but clinically patients had no problem in walking and daily activities. My results matched these studies. However, the incidence of coxa vara is significantly lower in the series where internal fixation has been predominantly used. For persistent coxa vara, subtrochantric valgus osteotomy has been suggested and this has produced uniformly satisfactory results<sup>16, 20</sup>. Although non-union occurs in pediatric femoral neck fractures, the incidence is much less than in adults. The thick functional periosteum in children primarily accounts for this difference<sup>4</sup>. The primary cause of nonunion is inadequate reduction and most cases of non-union had occurred in displaced fractures<sup>9, 14, and 20</sup>. We had 1 case of nonunion of Delbet type II displaced fracture who was presented to us 14 days later with loss of reduction that had been corrected with rigid screw fixation then bone grafting and ultimately had a satisfactory outcome. The reported rate of infection is 1% in pediatric femur neck fractures<sup>9, 11, and 20</sup>. Infection was not found in any case in our series. We believe that a clean soft tissue dissection goes a long way is important in avoiding the potential complication of infection. The results of our series suggest that children who underwent anatomical reduction and internal fixation had fewer complications than other treatment groups. It is possible that orthopedic surgeons avoid open reduction and internal fixation in pediatric femur neck fractures for fear of disrupting vascular supply which may increase the risk of avascular necrosis. However, recent studies<sup>21</sup> report a decreased incidence of avascular necrosis in patients treated by open reduction and internal fixation. One possible reason for this might be the release of intracapsular pressure by capsulotomy<sup>3, 22-24</sup>. Moreover, the lateral epiphyseal vessels course mainly along the femoral neck and not the capsule, and the anterior capsulotomy done for open reduction and internal fixation does not endanger the vessels which course in the neck<sup>1, 9, and 20</sup>. Thus, we believe that anatomical reduction and internal fixation reduces complications like non-union and coxa vara. We also believe that open reduction and internal fixation does not lead to increased incidence

of avascular necrosis and that it is actually the initial trauma and the disruption of head vascularity that determines the likelihood of avascular necrosis in long run. Although my experience limited to a small number of patients, we believe that femoral neck fractures in children need aggressive operative treatment aiming at anatomical reposition of femoral neck rather than conservative treatment. There should not be any hesitation to perform open reduction to achieve a stable anatomical reduction. These fractures still remain unsolved regarding avascular necrosis and it is of the utmost importance to inform at the outset.

**Conclusions:**

We conclude that the early operation using anatomical reduction and internal fixation of pediatric femoral neck fracture offers the best results. Outcome of patients is influenced primarily by development of AVN which occurs as an independent entity without much relation to the mode of treatment carried out.

**Conflict of interest:** None.

**Table 1. Age and sex variations in study group (n=16)**

**Table 2. Site of femoral neck fracture according to delbet classification. (n=16)**

Age (years)	Male R L		Female R L		Total		
6-8	2	1	1	1	0	3	
9-12	3	2	1	2	1	5	
13-16	5	3	2	3	2	8	
Total	10	6	4	6	4	2	16

Site of fracture	No.	Percentage
1. Trans - epiphyseal (Sub capital)	2	12.5%
2. Tran cervical	5	31.25%
3 Cervico-trochanteric (Basal)	7	43.75%
4. Inter-trochanteric	2	12.5%

**Table 3. Percentage of cases that had unions, malunion, delayed unions, and non union (n=16)**

	Total Cases	Percentage of cases
1.Union	11	68.75%
2.Delayed union	1	6.25%
3.Non union associated with a vascular necrosis	1	6.25%
4.Malunion (coxa-vara)	2	12.5%
5.A primary screw perforation of head	1	6.25%

**Table 4. Out come of results of fracture neck femur. (n=16)**

Out comes	No	Percentage
Excellent	11	68.75%
Good	3	18.75%
Poor	2	12.5%

**Table 5. Complications. . (n=16)**

Complications	No
1 Nonunion	1
2 Malunion (coax-vara)	2
3 Delayed union associated with a vascular necrosis	1
4 .A primary screw perforation of head	1



**Figure-1a:**



**Figure-1b:**



**Figure-1c:**

**Pre and post operative views of fracture neck femur of 7 years old girl.**



**Figure 2a**



**Figure 2b** Pre and post operative views of sub capital femoral neck fracture of 10 years old boy



**Figure 3a**



**Figure 3b.** Pre and post operative views of Tran's cervical fracture of neck femur in 16 years old boy.



**Figure 4.** Post operative view of cut out screws in fracture neck femur.

**References:**

1. Ratliff AH. Fractures of the neck of the femur in children. *J Bone Joint Surg Br.* 1962; 44(3):528-42.
2. Hamilton CM. Fractures of the neck of the femur in children. *JAMA.* 1961; 178(8):799-801.
3. Cheng JC, Tang N. Decompression and stable internal fixation of femoral neck fractures in children can affect the outcome. *J Pediatr Orthop.* 1999; 19(3):338-43.
4. Sferopoulos NK, Papavasiliou VA. 'Natural' healing of hip fractures in childhood. *Injury.* 1994; 25(8):493-6.
5. Davison BL, Weinstein SL. Hip fractures in children: a longterm follow-up study. *J Pediatr Orthop.* 1992; 12(3):355-8.
6. Meyers MH. Fractures of the hip. Chicago: Year Book Medical Publishers; 1985.
7. Colonna PC. Fracture of the neck of the femur in children. *Am J Surg.* 1929; 6(6):793-7.
8. Quinlan WR, Brady PG, Regan BF. Fracture of the neck of the femur in childhood. *Injury.* 1980; 11(3):242-7.
9. Canale ST, Bourland WL. Fracture of the neck and intertrochanteric region of the femur in children. *J Bone Joint Surg Am.* 1977; 59(4):431-43.
10. Heiser JM, Oppenheim WL. Fractures of the hip in children: a review of forty cases. *Clin Orthop Relat Res.* 1980 ;( 149):177-84.
11. Lam SF. Fractures of the neck of the femur in children. *J Bone Joint Surg Am.* 1971; 53(6):1165-79.
12. Moon ES, Mehlman CT. Risk factors for avascular necrosis after femoral neck fractures in children: 25 Cincinnati cases and meta-analysis of 360 cases. *J Orthop Trauma.* 2006; 20(5):323-9.
13. 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. *Clin Orthop Relat Res.* 2007; 454:169-73.
14. Morrissy R. Hip fractures in children. *Clin Orthop Relat Res.* 1980 ;( 152):202-10.
15. Togrul E, Bayram H, Gulsen M, Kalaci A, Ozbarlas S. Fractures of the femoral neck in children: long-term follow-up in 62 hip fractures. *Injury.* 2005; 36(1):123-30.
16. Hughes LO, Beaty JH. Fractures of the head and neck of the femur in children. *J Bone Joint Surg Am.* 1994; 76(2):283-92.
17. Ratliff AH. Fractures of the neck of the femur in children. *Orthop Clin North Am.* 1974; 5(4):903-24.
18. Pring ME, Rang MR, Wenger DR. Pelvis and hip. In: Rang MR, Pring M, Wenger DR, eds. Rang's children's fractures. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2005. 165-79.
19. Miller WE. Fractures of the hip in children from birth to adolescence. *Clin Orthop Relat Res.* 1973 ;( 92) :155-88.
20. Ingram AJ, Bachynski B. Fractures of the hip in children; treatment and results. *J Bone Joint Surg Am.* 1953; 35(4):867- 87.
21. Song KS. Displaced fracture of the femoral neck in children: open versus closed reduction. *J Bone Joint Surg Br.* 2010; 92(8):1148-51.
22. Ng GP, Cole WG. Effect of early hip decompression on the frequency of avascular necrosis in children with fractures of the neck of the femur. *Injury.* 1996; 27(6):419-21.
23. Pforringer W, Rosemeyer B. Fractures of the hip in children and adolescents. *Acta Orthop Scand.* 1980; 51(1):91-108.
24. Song KS, Kim YS, Sohn SW, Ogden JA. Arthrotomy and open reduction of the displaced fracture of the femoral neck in children. *J Pediatr Orthop B.* 2001; 10(3):205-10.