



## A Rare Case of Femoral Column Fracture in Children with Closed Reduction and Spica Cast: A Case Report

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ARTICLE INFO	ABSTRACT
Published Online: <b>22 September 2023</b>	<b>Background:</b> Femoral column fracture is a rare case fracture in children. This is usually caused by high-energy trauma, such as falling from a height, or, in some cases, can also occur due to pathological fractures or repetitive trauma, such as running or jumping. Femoral column fractures can occur several complications, such as avascular necrosis (AVN), coxa vara, malunion, and osteonecrosis. Therefore, appropriate treatment is needed to reduce the risk of complications that may occur. <b>Case Presentation:</b> A 15 year old boy came to the emergency room with complaints of pain in base of his right thigh after falling while jumping over a tennis net with focus on his right leg. On examination, vital signs were normal, pain in the right groin had limited range of motion (ROM), and no other injuries or pain were found in his parts of the body. Then treatment was carried out using the closed reduction method and the installation of a spica cast without internal fixation. <b>Conclusion:</b> Although there is still a lot of controversy regarding the best time and method for administering therapy, determining the Delbet classification is very helpful as a consideration in choosing treatment and patient prognosis. In this case, treatment was given using close reduction and spica cast techniques with the consideration that anatomical reduction could be achieved.
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<b>KEYWORDS:</b> femoral column fracture, paediatric, closed reduction, spica cast	

### BACKGROUND

Femoral column fractures are relatively rare in children, with an incidence percentage of between 0.3%-0.5% of all fractures that occur in children.<sup>2-4</sup> The highest incidence rate is between the ages of 10 and 13 years, with a male to female ratio of 1.3-1.7:<sup>1,3,5</sup> Femoral column fractures in children usually occur due to high-energy trauma, such as accidents or falls from heights. In addition, pathological fracture mechanisms can also play a role, and fractures due to repetitive trauma such as running and jumping have been found in several cases.<sup>1</sup>

Although rare, these fractures are closely associated with a high complication rate and risk of long-term dysfunction due to weak blood supply to the child's skeletal anatomy, resulting in poor outcomes.<sup>4,8-10</sup> Dysfunction and pain are the most frequently reported complications in 20%-50% of cases with femoral column fractures. Meanwhile, the rate of avascular necrosis (AVN) has been reported to vary between 0% and 92%.<sup>11</sup> Other complications related to surgery include premature physical closure (PPC), coxa vara, and fracture non-union.<sup>12</sup> Inadequate reduction results in the

appearance of coxa vara, while PPC is related to epiphyseal penetration during repair procedures.<sup>10,12</sup>

Treatment of femoral column fractures will be full of challenges due to the open physis and growth abnormalities in children. Therefore, all efforts and appropriate treatment are needed to reduce the risk of complications that may occur.

### CASE REPORT

A 15 year old boy was taken to the emergency room at Muhammadiyah Siti Aminah Bumiayu Hospital at 13.05 WIB, with complaints of pain in his right groin and difficulty moving his right leg. The patient's complaint arose due to a fall after jumping over a 90 to 100 cm high tennis net while exercising around 1 hour before entering the hospital. The patient fell in a landing position using support on his right leg. After falling, the patient was fully conscious and was immediately taken to the hospital without any manipulation of his legs. Meanwhile, the patient did not complain of injuries or pain in other parts of the body. The patient also did

## “A Rare Case of Femoral Column Fracture in Children with Closed Reduction and Spica Cast: A Case Report”

not have a history of diseases such as congenital abnormalities or previous bone malignancies.

Blood pressure at that time was 128/97 mmHg, pulse rate of 98 times per minute, temperature of 36 degrees Celsius, respiration rate of 20 times per minute, and oxygen saturation of 98 percent. On physical examination, there were no signs of injury, including lacerations or hematomas, on the right leg. Palpation examination revealed tenderness with palpation of the femoral artery, which was still palpable. There is limited range of movement (ROM) in both active and passive movements due to pain. Then, this patient underwent an X-ray examination of the right femur bone. The results obtained were garden type II femoral column fractures with Delbet type II transcervical femur classification.



**Figure 1.** X-ray of right column femur

After that, explain to the patient about the condition that occurred and provide medical therapy with crystalloid infusion and the analgesic Paracetamol 500mg. Then we suggest stabilizing the patient using the closed reduction method and installing unilateral spica casting. The closed reduction method begins with the patient lying on a fracture table and under anaesthesia, then positioning the patient in hyperextension of the hip by means of abduction and internal rotation, and maintaining slight knee flexion. Gently apply longitudinal tension and put the hip in a plaster cast or percutaneous fixation with 12 to 18 layers of 6 inch plaster of Paris. which has previously been coated with a 6 inch soft band. Then the hip hyperextension is set by abduction and internal rotation, and slight knee flexion while waiting for the plaster of Paris to dry within 10-15 minutes.

Next, the patient is taken to the recovery room for evaluation of vital signs and returned to the treatment room. The next day, the patient was declared in stable condition and was allowed to go home. The patient was asked to have another check-up one week after the spica cast was installed.

### DISCUSSION

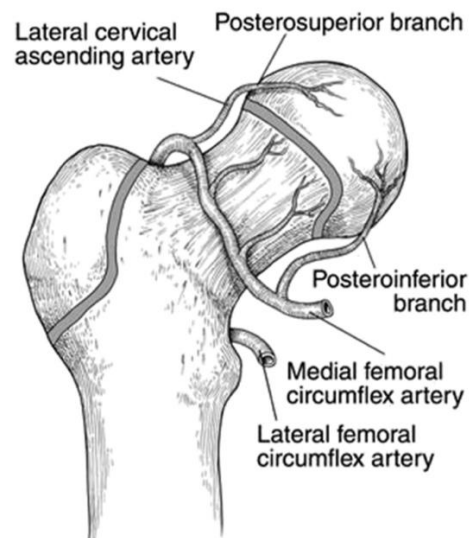
Femoral column fractures in children are extremely infrequent and generally arise from high-energy trauma. <sup>6,7</sup> Bali et al. stated that 53% of patients with femoral column

fractures were caused by traffic accidents, 36% were due to falls from heights and 8% were caused by trauma while playing. <sup>18</sup> In the case we reported, the patient was known to have fallen while jumping in the wrong position. This trauma may also be exacerbated by repetitive trauma when the patient jumps and runs.

Compared with older people who will experience femur fractures due to osteoporosis from trauma or minor injuries, 90% of children will be exposed to high energy trauma such as motor vehicle accidents and falls from heights. <sup>16</sup> This occurs because the child's femoral column has a lower bone mineral density. higher, so it is denser and harder compared to the femoral neck of adults and the elderly. <sup>1,11,17</sup>

At 7 weeks of gestation, the proximal femur in children starts to stiffen. The capital femoral epiphysis, which develops from the medial portion of the femur at the ages of 4 to 6 months and 14 to 16 years, merges via the proximal femoral physis. Traction on the apophysis of the greater trochanter is exerted by the lateral nucleus. At 14 years old in females and 16 years old in boys, the bones start to ossify and merge with the proximal femur. Damage to the trochanteric apophysis might prevent the femoral neck from growing and angling properly, causing coxa valga, while coxa vara will occur due to excessive growth. <sup>3</sup>

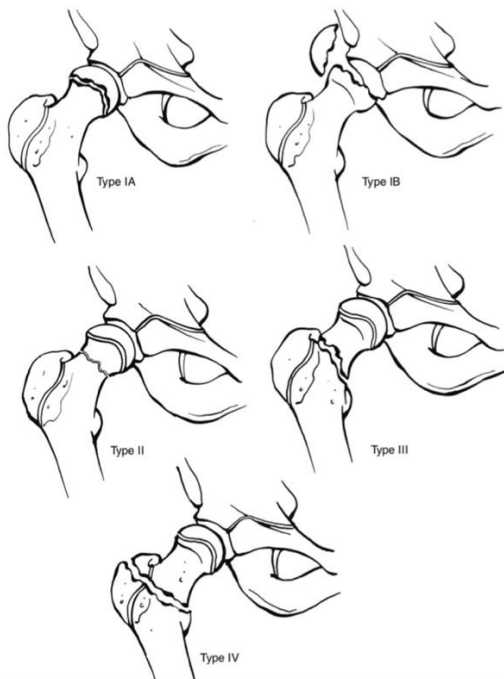
Vascular injuries are prone to occur in children's proximal femur development due to the proximal femoral physis separating the vascular supply of the femoral neck and epiphysis from childhood to young adulthood.



**Figure 2.** Before physical closure, the proximal femur is vascularized. There are no anastomoses between the epiphysis and the femoral neck, and the growth plate serves as a mechanical barrier to vascular supply. The primary blood supply to the femoral neck is provided by the medial circumflex artery. as well as the head given by its lateral cervical ascending, posteroinferior and metaphyseal branches. With permission from Rocha DFB, Horwitz DS, and Sintenie JB. Femoral Neck Fractures in Children: Issues, Challenges, and Solution; 2019.

The medial and lateral branches of the circumflex femoral artery traverse the physis at birth but thin out by 3 to 4 years of age. This results in the absence of vascular communication between the epiphysis and metaphysis until physical fusion occurs at the age of 14 to 17 years. Meanwhile, there is also a decrease in the contribution of blood vessels to the ligament teres from birth to 4 months of age, which will increase again at the age of 8 years and reach a peak of 20% of the total blood supply to the femoral head in young adulthood before decreasing again due to increasing age.<sup>3</sup>

Diagnosis of patients with femur fractures can be made based on the mechanism of injury, physical examination, and clinical radiographs. The Delbet classification can be used as a reference in determining the type of therapy and prognosis for patients with femoral column fractures.<sup>13</sup>



**Figure 3.** Classification of Delbet/Colonna Pediatric Femoral Neck Fractures. Type I: transepiphyseal, A-undisplaced, and B-displaced; Type II: transcervical; Type III: basicervical; and Type IV: intertrochanteric. With permission from Flynn JM, SkaggsDL, Waters PM. Rockwood and Wilkins’ Fractures in Children. LWW; 2014 (Chapter 21, figure 21-1).

Delbet classification system for femoral fractures has become a routine instructional tool used to advise of possible posttreatment risks or complications. Fractures known as type I occur along the growth plate, while types II, III, and IV are fractures that occur above the neck of the bone, as well as the area where the neck connects to the greater and lesser trochanters. In this case report, based on the location of the fracture line, it is classified as Delbet type II. Fracture classification aims to predict long-term outcomes and identify

the main complication associated with hip fractures in children, namely osteonecrosis.<sup>14</sup>

Pediatric femoral neck fractures cause osteonecrosis in 16%-47% of cases. Ratliff classifies acute osteonecrosis of the femoral head and neck into three types.: type I, characterized by radiographic sclerosis and head collapse; type II, characterized by focal sclerosis of the superior lateral aspect of the head; and type III, consisting of sub-capital neck effects with preserved epiphyseal supply.<sup>4</sup>

The timing of surgery in cases of femoral column fractures is a matter of debate.<sup>3,13,15,19</sup> A systematic review of 30 studies consisting of 935 patients who delayed treatment the incidence of osteonecrosis was found to be 4.2 times greater in individuals who received therapy within 24 hours of injury. Because when a delay in fixation occurs, the incidence of complications increases, increase by 64% of patients experiencing premature physical arrest and 55% showing osteonecrosis.<sup>3</sup>

Meanwhile, there is also a meta-analysis that explains that there is no discernible change in the frequency of complications (for example, AVN) between cases treated early (<24 hours) compared to cases treated late (> 24 hours) of injury.<sup>19</sup> However, with the limitations or contradictions in the research literature regarding fixation time, Spence et al (2016) and Gopinathan et al (2012) in their research explained that anatomic reduction of femoral column fractures carried out as soon as possible would be better.<sup>9,20</sup> In the case we are presenting, action was taken to handle the case within <24 hours after the trauma occurred, so it is hoped that it can provide a good outcome.

Apart from the importance of timing in treating femoral column fractures, the choice of reduction technique also plays a more important role in providing outcomes.<sup>11,14</sup> The choice between closed reduction and open reduction depends on the amount of fracture displacement present and the surgeon's ability to achieve anatomical or close to anatomical reduction in a closed manner.<sup>3</sup>

Patient is initially placed supine on a fracture and reduction table or radiolucent operating table and then assessed with intraoperative fluoroscopy. Open reduction with internal fixation (ORIF) is commonly utilized for significantly displaced fractures or in individuals who cannot achieve anatomic reduction with closed reduction. Additionally, when the fracture occurs through a suspected pathologic lesion, open reduction may be necessary to confirm the diagnosis of the lesion and treat the associated pathology.<sup>3</sup> Open reduction may be achieved using the Smith-Petersen approach (anterior), the Watson-Jones approach (antero-lateral), or the Hardinge approach (lateral) of the hip based on the fracture classification.<sup>1,13-15</sup> Fractures included in Delbet I and II classifications use the Smith-Petersen approach, which requires a separate lateral incision for implant placement, while Delbet III and IV use the

Watson-Jones approach, which uses the same incision location for reduction and fixation.<sup>14,15</sup>

The benefit of open reduction is immediate viewing so that the reduction can be better and decompression can be carried out simultaneously from the intracapsular hematoma and there is no need to decompress the joint by means of percutaneous aspiration or capsulotomy as in closed reduction.<sup>15</sup> A number of studies have reported better reduction quality and better results, better and fewer complications with open reduction compared with closed reduction.<sup>8,15</sup> Until now, the evidence regarding the benefits of open reduction in reducing complications such as osteonecrosis has been inconclusive. However, open reduction will require a longer operating time, a greater risk of bleeding, and a risk of postoperative joint infection. Basically anatomic fracture reduction with stable fixation is the goal of treatment.

Meanwhile, closed reduction is performed if anatomical reduction can be achieved by itself. The closed reduction method begins with the patient lying on a fracture table, hyperextending the hip by means of abduction and internal rotation, and maintaining slight knee flexion. Longitudinal traction is applied gently and the hip is placed in a spica cast or percutaneous fixation.<sup>3</sup> As was the case in the case we are presenting, it falls into the Delbet type II classification and closed reduction and plaster placement are performed.

The need for immobilization with a spica cast after surgical stabilization according to the kind of fracture, patient age, quality of fixation, and compliance with post-operative weight bearing and activity restrictions.<sup>3</sup> Hip spica can be given to children <8 years old for 6 weeks, while knee immobilizer can be given in older children and teenagers for 6 weeks.<sup>3,15</sup>

Complications from femoral column fractures can be reduced if the principles of early intervention, joint decompression, and anatomical reduction with stable fixation are achieved.<sup>13,15</sup> Although there is some controversy regarding the best management of cases of femoral column fractures, both in terms of operating time, surgical technique, and optimal type of fixation device, this is not an obstacle because it has the same goal, namely to achieve anatomical and stable reduction so as to reduce the complication rate.<sup>11,13</sup>

## CONCLUSION

Treatment of femoral column fractures in children is a big challenge considering the high risk of complications that can occur in the future. To minimize the possibility of this risk, it turns out that choosing a reduction technique is much more important than providing treatment time. Although there is some debate regarding surgical intervention, despite this controversy, the goal of management of femoral column fractures remains the same, namely to achieve fracture union, anatomic reduction, and prevent osteonecrosis. The Delbet

classification is used as a reference in determining the type of therapy and prognosis for patients with femoral column fractures. Based on the X-ray results, the femoral column fracture in this case can be classified as Delbet type II and close reduction using a spica cast can be carried out considering that anatomical reduction can be achieved.

## REFERENCES

1. Palocaren T. Femoral neck fractures in children: A review. *Indian J Orthop.* 2018;52(5):501.
2. Bimmel R, Bakker A, Bosma B, Michielsen J. Paediatric hip fractures: a systematic review of incidence, treatment options and complications. *Acta Orthop Belg.* 2010;76:7–13.
3. Patterson JT, Tangtiphaiboonana J, Pandya NK. Management of Pediatric Femoral Neck Fracture. *J Am Acad Orthop Surg.* 2018;26(12):411–9.
4. Wang WT, Li YQ, Guo YM, Li M, Mei HB, Shao JF, et al. Risk factors for the development of avascular necrosis after femoral neck fractures in children. *Bone Jt J.* 2019;101-B(9):1160–7.
5. Fallatah SM, Daghiri YA, Afifi AA, Alghamdi FA, Zein AF. A Rare Case of Femoral Neck Fracture in a Six-Year-Old Girl. *Cureus.* 2021;13(8):6–12.
6. Hoffmann C, Traldi E, Posser A. Epidemiological study of children diaphyseal femoral fractures. *Rev Bras Ortop.* 2012;47(2):186–190.
7. Salonen A, Laitakari E, Berg HE, Felländer-Tsai L, Mattila VM, Huttunen TT. Incidence of femoral fractures in children and adolescents in Finland and Sweden between 1998 and 2016: A binational population-based study. *Scand J Surg.* 2022;111(1).
8. 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;(January):639–44.
9. Spence D, Di Mauro JP, Miller PE, Glotzbecker MP, Hedequist DJ, Shore BJ. Osteonecrosis After Femoral Neck Fractures in Children and Adolescents: Analysis of Risk Factors. *J Pediatr Orthop.* 2016;36(2):111–6.
10. Yerosian M, Horneff JG, Baldwin K, Hosalkar HS. Factors affecting the outcome of fractures of the femoral neck in children and adolescents: A systematic review. *J Bone Jt Surg - Ser B.* 2013;95 B(1):135–42.
11. Wu C, Ning B, Xu P, Song J, Wang D. Efficacy and complications after delayed fixation of femoral neck fractures in children. *J Orthop Surg.* 2020;28(1):1–6.
12. Dai ZZ, Zhang ZQ, Ding J, Wu ZK, Yang X, Zhang ZM, et al. Analysis of risk factors for complications after femoral neck fracture in pediatric patients. *J*

“A Rare Case of Femoral Column Fracture in Children with Closed Reduction and Spica Cast: A Case Report”

- Orthop Surg Res. 2020;15(1):1–6.
13. Barreto Rocha DF, Horwitz DS, Sintenie JB. Femoral Neck Fractures in Children: Issues, Challenges, and Solutions. *J Orthop Trauma*. 2019;33(12):S27–32.
  14. Medda S, Snoap T, Carroll EA. Treatment of Young Femoral Neck Fractures. *J Orthop Trauma*. 2019;33(1):S1–6.
  15. Pinto DA, Aroojis A. Fractures of the Proximal Femur in Childhood: A Review. *Indian J Orthop*. 2021;55(1):23–34.
  16. Varshney MK, Kumar A, Khan SA, Rastogi S. Functional and radiological outcome after delayed fixation of femoral neck fractures in pediatric patients. *J Orthop Traumatol*. 2009;10(4):211–6.
  17. Ghaffari S, Razavipour M, Shayestehazar M, Ghadiri A. Case Report Femoral Neck Fracture in a Three-Year-Old Child; Case Report. *Int J Med Invest*. 2019;8(3):112–20.
  18. 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):302–8.
  19. AlKhatib N, Younis MH, Hegazy A, Ibrahim T. Early versus late treatment of paediatric femoral neck fractures: A systematic review and meta-analysis. *Int Orthop*. 2019;43(3):677–685.
  20. Gopinathan N, Chouhan D, Akkina N, Behera P. Case report: Bilateral femoral neck fractures in a child and a rare complication of slipped capital epiphysis after internal fixation. *Clin Orthop Relat Res*. 2012;470(10):2941–5.
  21. Bukva B, Abramović D, Vrgoč G, Marinović M, Bakota B, Dučić S, et al. Femoral neck fractures in children and the role of early hip decompression in final outcome. *Injury*. 2015;46:S44–S47.