Global Journal of Medical Research: H
Orthopedic and Musculoskeletal System
Volume 16 Issue 2 Version 1.0 Year 2016
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

Management of a Paediatric Femoral Neck Fracture with Infection and Early Loss of Fixation with Closed Reduction with Cancellous Screws and Fibular Grafting: A Rare Case Report and Review of Literature

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Keywords: failed paediatric femoral neck fracture fixation, infection, collapse, revision, non-vascularised fibular graft, union.

GJMR-H Classification: NLMC Code: WE 175



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Management of a Paediatric Femoral Neck Fracture with Infection and Early Loss of Fixation with Closed Reduction with Cancellous Screws and Fibular Grafting: A Rare Case Report and Review of Literature

Dr. Mihir Desai [α] & Dr. Shivanand Bandekar [σ]

Abstract- Fractures of neck in paediatric population is a rare variety. It comprises less than 1% of all paediatric fractures. Fractures of neck occur in paediatric population as a result of high energy trauma or in a weakend bone due to pre-existing pathologic process in the proximal femur. Early Anatomical reduction and internal fixation in Delbet Type 2 fractures is recommended in literature to avoid complications in a growing child like avascular necrosis, coxavara, non-union and chondrlysis. Infection in a hip fracture in a child is a very rare complication accounting for only 1% of complication rate according to James McCarthy and Kenneth Noonan et al. Infecton can also lead to loss of reduction and subsequent collapse as in this case. There are various treatment options available for non-union fracture neck in children which includes use of vascularized or non-vascularised fibular bone graft combined with or without a subtrochanteric valgus osteotomy, use of muscle-pedicle bone graft or in some cases use of iliac crest grafts.

We present a case of type 2 Delbet femoral transcervical fracture in a 12 year old girl child treated within 24 hours with Closed Reduction and Internal Fixation with cannulated 6.5mm cancellous screws and washers. Patient developed a delayed infection after 2 weeks with subsequent loss of reduction and collapse at fracture site. This was again revised with closed reduction and internal fixation with 6.5mm cancellous screws along with non-vascularised fibular grafting which went to unite well in an acceptable varus position and excellent functional outcome.

Keywords: failed paediatric femoral neck fracture fixation, infection, collapse, revision, non-vascularised fibular graft, union.

I. Introduction

Fractures of the neck of femur are rare injuries in children accounting for less than 1% of total paediatric trauma. Most of them are due to high-energy trauma. If the fracture has occurred due to a trivial trauma, it might be due to a pre-existing pathology which has weakened the proximal femoral bone.[1,2,16]. The blood supply to the head of femur is precarious and varies according to the age of the patient. Majority of the blood supply comes from medial circumflex branches of lateral epiphyseal arteries and in this patient according to her age, some part of blood supply will also come through ligamentum teres.[8,16]. It forms a very important factor for development of non-union and avascular necrosis of head of femur.[5,6]. Delay in reduction and inappropriate Fixation Technique to get an anatomical reduction results in known complications like Avascular necrosis, Coxa-Vara, non-union.[3,4]

This patient was operated within 24 hours of presentation with closed reduction and internal fixation. Stable reduction was achieved. Delay in diagnosis or delayed in anatomical fixation has been the consistent factor for development of Avascular necrosis an non-union.[5,8]. Anatomical reduction is the key to prevent nonunion and resultant deformities. Closed reduction is the preffered treatment of choice but the surgeon should not hesitate for doing an open reduction for non-reducible fractures.[12]

Inspite of early reduction and internal fixation, unfortunately the patient developed delayed infection and loss of reduction within the first 3 weeks. Infection after fixation is not a common complication in paediatric hips.[16]. There are various techniques described in literature for treating infection and failure of fixation. These include revision surgery with complete debridement of infected tissues, use of a non-vascularised or vascularized fibular grafts, use of Meyer's muscle-pedicle bone-grafting. These procedures can be combined with subtrochanteric valgus osteotomy if the patient has a residual varus deformity along with non-union.[9,14]

We used a non-vascularised fibular graft along with two 6.5mm cancellous screw[9,11]. Patient was kept nonweight bearing and a de-rotation boot for 8 weeks. Fracture went to unite well in about 3 months with excellent range of motions and an acceptable varusdeformity. According to Ratliff's criteria, the patient had good functional outcome.[2,7]. There was complete range of motions possible including squatting and sitting cross-legged.(fig 8,9,10).

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Figures 8,9,10: The child able to squat and sit cross legged.

Case report-We present a case of 12 year old girl with self-fall at school with Delbet type 2 transcervical fracture of left femoral neck(fig1). Patient was taken up for surgery within 48 hours of injury at our institute.



Figure 1: Pre-operative x-ray showing Type 2 Delbet femoral neck fracture.

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Primary surgery was done with Closed Reduction and Internal Fixation. Reduction was achieved under Fluoroscopic guidance and then fixed with with 2 Titanium Cannulated Cancellous 6.5mm screws over guidewires. A lateral approach was taken. And the screws were inserted with a small incision just below the greater trochanter using a cannulated cancellous system. (fig 2)



Figure 2: Postoperative x-ray after primary surgery on day 2.

This patient had an uneventful hospital stay and was later on discharged and followed up after 10 days. Within first 3 weeks of primary surgery, patient had developed serosanguineous discharge. Total count was normal. But laboratory markers of infection like ESR and C-Reactive Protein were elevated. X-Ray taken at this stage revealed loss of reduction and collapse at fracture site (fig3).



Figure 3: Xray taken at 3 weeks postoperative period after primary surgery showing loss of reduction and collapse.

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Patient was re-admitted and started on intravenous antibiotics. A swab from the discharge was sent before starting antibiotics. But the report of the swab culture and sensitivity was non-significant. Therefore Empirical therapy in the form of 3rd generation cephalosporins were continued for 3 weeks. At the end of this period, discharge was completely stopped.

Laboratory Blood markers of infection in the form of Total count, ESR (Erythrocyte Sedimentation Rate) and C-Reactive Protein were negative. Patient was planned for repeat Surgery with implant removal and use of a Fibular graft. Patients relatives were explained the prognosis and a formal Bone graft consent was taken from parents.

Intra-operative findings-Lateral Approach and Same incision as primary surgery was used. Previous implants were removed. Adequate wash was given. All the fibrous tissue in the Sub-muscular plane was debrided. Fortunately for the patient, A repeat closed reduction at the fracture site was achieved under Fluoroscopic guidance and the capsule was not incised. This prevented further microvascular injury of head of the femur by preventing the cutting of the anterior capsule.

Guidewires were then inserted as planned.1st guidewire was inserted in the inferior quadrant in the Antero-posterior plane and posterior in the Lateral view under Fluoroscopic guidance. 2nd guidewire was inserted in the Central quadrant in both Anterior and Lateral views. 3rd guidewire was inserted in the Superior quadrant in the Antero-posterior view and in the Anterior plane in the Lateral view. All the 3 guidewires were inserted upto the physis taking care not to penetrate the physis. Using a similar length guidewire and under fluoroscopic guidance, accuarate length of the screws were taken which were to be inserted. A non-vascularised fibular graft was taken from the ipsilateral leg. The length of the graft was according to the 3rd guidewire placed in the Supero-Anterior quadrant. (fig4)

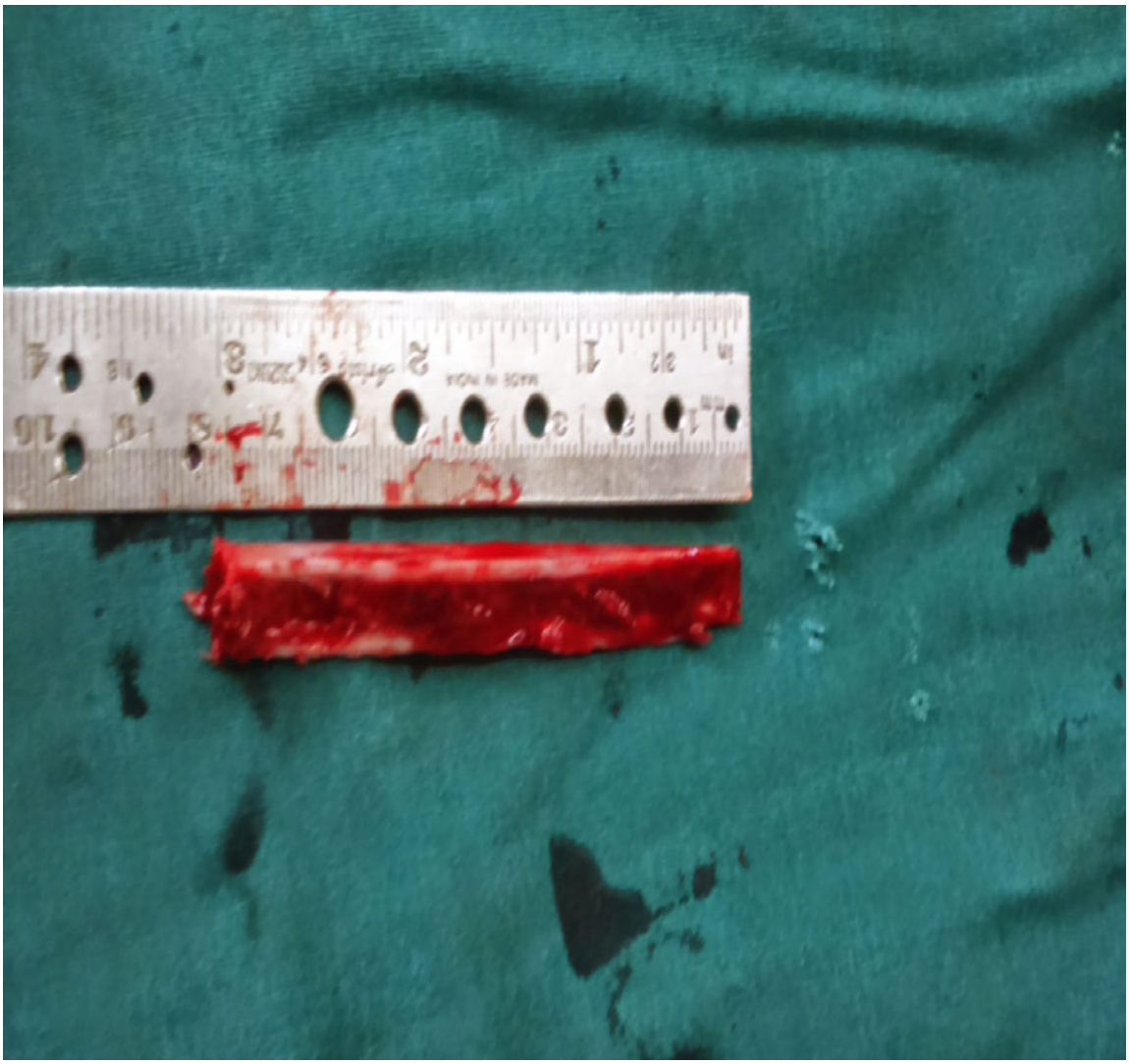


Figure 4: The appropriate length of non-vascularised fibular graft being measured according to the length of the guide-wire.

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The medullary canal of the graft was reamed with a 3.5mm drill-bit before insertion.

As per the measured sizes of the screw, cannulated 6.5mm screws were inserted over the guidewires. At the same time, reduction was being checked continuously under fluoroscopy. As per the literature, central compression screw was first tightened. Then, the infero-posterior screw was inserted and tightened. Both the screws were inserted well below the physis. Then the well-prepared fibular graft was inserted in the Supero-anterior Quadrant. This position of the graft acted as a de-rotation screw as well as provided a graft for the non-union part.

The reduction and the position of the screws as well as the graft was confirmed again before closure. No drains were kept. A sterile dressing was put and patient was given a Long-Knee Brace and a De-Rotation Boot. Immediate post-operative period was uneventful in the hospital. Intravenous antibiotics in the form of 3rd generation cephalosporins were administered for 72 hours. Patient was put on oral Cefuroxime and discharged on the 7th post-operative day after confirming healthy wound status.

II. Post-Operative Period

Long knee brace and a de-rotation boot for a period of 8 weeks. Isometric Quadriceps and hamstring exercises were started immediately. However, patient was kept complete Non-Weight bearing for 8 weeks. Stitches were removed at 2 weeks. Knee mobilization and CPM exercises were started after 4 weeks. Serial Radiographs were taken every 3 weeks. There were signs of union after 8-10 weeks of follow-up period. After 10 weeks patient was started on Partial-Weight bearing. By this time, she had got good range of motion at hip and knee.

Complete union was visible on x-rays in both Antero-Posterior and Lateral views after about 14 weeks postoperative period (fig 5, 6).



Figure 5: Postoperative antero-posterior x-ray taken at 14 weeks showing signs of union.



Figure 6: Postoperative lateral view at 14 weeks showing good alignment and signs of union.

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Patient was made to fully weight bear by then. There was residual varus angulation after union. But that was an acceptable degrees of Varus considering the age of the patient and the fact that it was a second surgery after infection. Butclinically, patient had no residual deformities. She was able to walk without an Abductor lurch. Squatting and Sitting cross-leg was also possible. (fig 8,9,10). Patient is still under follow-up since 15 months and has no clinical syptoms. (figure7)



Figure 7: Postoperative x-ray at 15 months followup.

Since, clinically patient had excellent range of movements and good union and considering the age of patient, decision to perform a Valgus osteotomy to correct residual varus was deferred. (video1)



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Video 1: Patient followup at 15 months showing gait pattern and excellent range of movements.

III. Discussion

Fractures neck of femur in paediatric age group are rare but serious injuries. Majority of them are high-energy traumas. If there is no history of significant trauma, then a thorough search should be made to rule out pathological causes that can weaken the proximal femoral architecture.[1,16] like a bony cyst or osteomyelitis. Delbet classification is a helpful classification for providing a diagnostic as well as prognostic classification.

Delbet classification of hip fractures in children.

1. Transepiphyseal with (IB) or without (IA) dislocation from the acetabulum;
2. Transcervical;
3. Cervicotrochanteric;
4. and Intertrochanteric.[16]

Prognosis wise type 1 and type 2 fractures have a poorer prognosis for the development of osteonecrosis, non-union and consequent varus collapse and deformities. Precarious blood supply around the head of femur makes it highly vulnerable for these complications. Before the age of 8 years, vessels through ligamentum teres provide very little blood supply. Majority of the blood supply is by medial circumflex branches of Lateral Epiphyseal vessels.[5,6]. Inadequate reduction or loss of fixation like in this case leads to complications like non-union, osteonecrosis with or without resultant varusdeformity. Most of these complications are due to capsular tear and resultant injury to the capsular and retinacular vessels and over-enthusiastic manipulation techniques during fixation.[3,8] Therefore Early and accurate reduction within 48 hours is recommended.[2,3].

Osteonecrosis is the most dreaded complication of delbet type2 fractures. The reported incidence in literature varies from 17-47%. Although the contributing factors remain inconclusive, contributing factors include type and degree of displacement in

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fractures, age of the child, timing of surgery and type of fixation.[1,2,5], According to Lam and Ratliff, major complication is developmental coxa vara.[2] leading to poor functional outcomes. In modern orthopaedic practice, conservative treatment in the form of hip spics is hardly practiced for the treatment of paediatric neck fractures. It carries a high risk of loss of reduction and resulatantvarus deformity.[3]. Incidence was higher in type 2 fractures according to the study by Moon and Melhman.[5]. Infection is a rare complication and the reported rate of infection is 1% in postoperative cases in femur neck fractures.[2] Unfortunately, our case fell in that 1% and got a delayed infection in 3weeks postoperative period.

In our case, there was an early loss of reduction due to infection. We revised the fixation using a non-vascularised fibular graft and internal fixation using 6.5mm cancellous screws. The results of a non-vascularised fibular graft are widely studied in literature. It provides a strong bony support at the fracture site. It also acts as a graft material and starts the process of osteoconduction and acts as a bed for neo-vascularisation. According to recent series, reported success of using a fibular grafting is as high as 70% in adult patients.[9,11]. Nagi, et al reported union rates of as high as 90% with this technique.[11]. According to reports, free fibular grafting provides good union rates and prevents osteonecrosis and improves functional recovery.[10], A vascularized fibular graft provides better success rates and is superior to free fibular graft but it is still highly technically demanding procedure and is limited by other limiting factors like microsurgical instruments and economy of time.[11,15]. Major studies are done with the use of fibular graft for non-union neck of femur in adult age group. But the results for use in paediatric population are also equally encouraging. [11,13,15]. Fibular grafting acts as a structural support and "biological implant" which later on incorporates well with the head of femur.[11,13]

In our case, the graft incorporated well in 12-14 weeks. There was no collapse or no fracture of the fibular graft.

Major cause of non-union in children is presumed to be due to thick functional periosteum and in-adequate reduction in a severely displaced type2 fracture.[2]. This leads to Coxa-Vara which is the most disabling complication and it also leads to early closure of physis. Both these complications lead to shortening and a gait with an Abductor Lurch. Shortening appears to be independent of fracture type or osteonecrosis in some studies.[1]. According a long-term study published by Nagi et al, Functional outcome was studied according to the following criteria,[15]

Table I: Criteria for grading the results

Clinical features						Radiological features	
Grade (degrees)	Pain	Shortening (cm)	Hip ROM*	Walking ability	AVN	Nonunion	CoxaVara
Excellent	None	<1	Full	Full	No	None	None
Good	None	1 to 2	Rotation/flexion restricted by 15°	Full	No or healed	None	<10
Fair	Intermittent	2 to 3	Rotation <50% Flexion 90° only	1 km without aids	AVN No segmental collapse	None	11 to 20
Poor	Constant	>3	Marked restriction	None without aids	AVN with collapse	Present	>20

**ROM- range of movement*

IV. Avn-Avascular Necrosis

According to this criteria, our case has good functional outcome with only limiting factor was resulatant varus deformity which was less than 10 degrees. But the patient had no shortening or no defective gait. According to Ratliff's criteria also, our case had Good outcome.[2]

In Postoperative period, patient was kept non-weight bearing but was mobilized on crutches. Early static quadriceps and hamstring exercises are very important to initiate to prevent quadriceps atrophy .Adequate time of 8-12 weeks have to be given for incorporation of fibular graft.[1,10]. Anderson et al reported minor complications at the fibular graft donor site like mild tenderness and occasional ankle swelling which presumably occurred due to the loss of origin of long muscles.[11]

V. Conclusion

Paediatric neck fractures are rare injuries and associated with disabling complications. Early Fixation is recommended within first 48 hours. Even if it is treated early, there are rare chances like in this case which can have complications like Infection and Early loss of Reduction. Non-Vascularised Fibular grafting along with cancellous screw fixation provides a technically less demanding option and is a very reliable procedure with encouraging union-rate and functionaly recovery.

Conflicts of interest-None

Written Informed consent of the patient-Taken

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