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Case Report

A five year learning experience with sequence of events in a child with closed femur shaft fracture

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ABSTRACT

Femur shaft fractures are the most common fractures requiring hospitalization in children. Management of these fractures mainly depend on the age of the child. Associated injuries, fracture pattern, weight of the child and overlying soft tissue condition also influence the management. Still, the definitive treatment remains controversial in children between 5-16 years. We present our experience in management of 5 year old boy with mid shaft femur fracture and its complications. In his paper we want to highlight the importance of sticking to the basic principles and the recommendations in the management of the paediatric femur shaft fractures.

Keywords: Paediatric femur fracture, Titanium elastic nailing system, Deformity correction

INTRODUCTION

Paediatric femur shaft fractures constitute for less than 2% of all paediatric fractures. About 70% of femoral fractures involve the shaft. Even though uncommon, they are the most common fractures requiring hospitalization in children. They are typically caused by blunt trauma.[1,2] Management of paediatric femur shaft fractures is influenced by age of the child, associated injuries or multiple traumas, fracture pattern, weight of the child and condition of the overlying soft tissues. These factors help us decide the modality of treatment and the immobilization protocol in a widely varying spectrum of fractures. Non-surgical management usually with spica cast application is preferred in younger children and surgery is common for school age children considering the muscle forces across the fracture site causing loss of reduction and need for prolonged immobilization. The definitive treatment remains controversial.[3,4] When surgical fixation is chosen, elastic nailing with titanium elastic nailing system (TENS) is the preferred mode of treatment of femur shaft fractures in children. Other modalities of treatment are open reduction and internal fixation with dynamic compression plates, closed reduction and stabilization with locked plates using the minimally invasive plate osteosynthesis (MIPPO) technique and by external fixation.[1]

While in most cases, femoral fractures treated by standard methods heal uneventfully with children returning to full activity, occasionally treatment may be complicated. The case presented below attempts to capture the series of events in a 5 year old boy presenting with a closed femur mid shaft fracture. Through this case report, we made an attempt to present the various complications of treatment, challenges encountered and how we overcame them.

CASE REPORT

A 5-year-old boy presented to us with pain in right thigh, deformity and inability to bear weight on the right lower limb for four months. He had sustained a spiral fracture of the shaft of the femur four months ago while playing

with his friends. From the history there was nothing to suggest that it was a pathological fracture. He was operated at a peripheral hospital for the fracture with elastic nailing and circumferential stainless steel wiring. Two months into the treatment, the elastic nails were removed by the operating surgeon for unknown reasons and patient was immobilized with an above knee cast for a month. At three months, the cast was removed and the patient was mobilized with partial weight bearing. For the next one month, the child's parents noticed that there was a deformity in the thigh and shortening of the lower-limb. The child was unable to bear weight on the right lower limb due to pain. There was no history of another injury in the interim. With the above complaints, the child presented to our institution.

Figure 1: (A) X-ray of right femur AP and lateral views at presentation to us showing mal-uniting mid shaft fracture with cerclage wires in situ (B) Immediate post-operative X-ray of right femur AP and lateral views (C) X-ray of right femur AP and lateral views 5 months post-surgery showing stress fracture in the supracondylar area at the end of the plate (D) X-ray of right femur AP and lateral views post implant removal 15 months post-surgery.

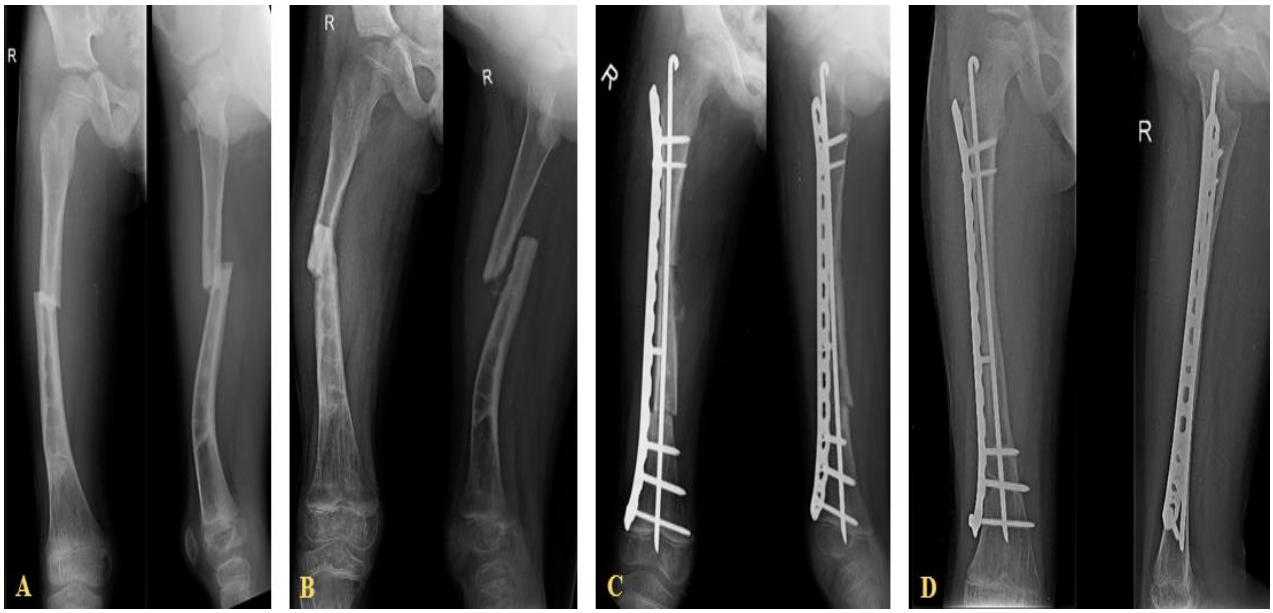

Figure 2: (A) Re-fracture of the right femur seen on the x-ray of right femur AP and lateral views 9 months post implant removal (B) X-ray after 8 weeks of hip spica showing unsatisfactory fracture healing (C) X-ray post open

reduction with distal femoral anterolateral wedge osteotomy and fixation (D) X-ray at 2 years post open reduction with distal femoral anterolateral wedge osteotomy and fixation.

Figure 3: (A) X-ray at 3 years post open reduction with distal femoral anterolateral wedge osteotomy and fixation (B) clinical pictures at 3 years follow-up.

On clinical examination at presentation the child had swelling in the right thigh, tenderness in the middle third of the thigh, abnormal mobility in both planes and 3 cm shortening of the right lower limb. X-rays showed angulation at the fracture site with two circumferential cerclage wires in-situ with sparse attempts at callus formation (Figure 1A). A preliminary diagnosis of mal-uniting femur fracture with cerclage wires in-situ was made and after informed consent the patient was taken up for removal of the wires and open reduction and fixation with 4.5 mm narrow (Figure 1B). Immediately after the surgery, correction of the shortening was noted. He was immobilized for six weeks after which, non-weight bearing mobilization was started since his knee was stiff due to prolonged immobilization from the time of injury. At twelve weeks, child had gained up to range of knee flexion and on observing good progress of healing on x-ray, weight bearing mobilization was started. At five months follow-up, it was noted that the child had in the interim, developed a distal femoral fracture just distal to the plate which was mal-uniting in flexion leading to a shortening of 2 cm in the lower limb (Figure 1C).

There was no history of injury to the lower limb during this period. The child however reported that he was made to perform some aggressive and painful knee flexion exercises at home by the parents in an attempt to regain full range of knee movements. At 6 months follow-up, both the fractures united, patient was full-weight bearing but walked with a limp due to shortening. Over the next 9 months, the shortening in the right lower limb gradually reduced from 2 cm to 1 cm and patient's limp reduced. Fifteen months after the fixation was removed (Figure 1D). An increased bowing at the distal one-third of the femur was noted suggesting an attempt at remodelling the flexion deformity in the supracondylar area.

The child was asymptomatic for 9 months post implant removal when he presented back to us with refracture at the original fracture site following a trivial trauma while playing with his friends. (Figure 2A). As the patient had already undergone multiple surgeries and also considering the financial constraints of the family this time it was decided to manage the fracture conservatively with hip spica. After 8 weeks on hip spica there was very little bridging callus with overriding of the fracture fragments suggesting no attempt at healing (Figure 2B). With no progress of union, over-riding of the fracture fragments once again leading to shortening of the limb, prolonged immobilization leading to knee stiffness, the parents were advised surgical management. In the same sitting, we also planned to correct the distal femoral flexion deformity by doing and extension osteotomy.

After informed consent with patient under general anaesthesia, open reduction of the fracture was done along with the distal femoral anterolateral wedge osteotomy and fixed with a rush nail of size 4×290 mm which was passed antegrade from the piriformis fossa and driven in distally into the epiphysis through the physis to achieve three-point fixation and greater stability. A long 4.5mm narrow LCP was used to reinforce the rush-rod fixation by bridging over the fracture site and the osteotomy site while taking care not to cross the distal femoral physis (Figure 2C). The child was immobilized with the above knee slab for 6 weeks post-operatively then started on physiotherapy with knee mobilization and partial weight bearing. At 3 months on noticing satisfactory progress of union at the osteotomy and the fracture sites, patient started full weight bearing. He had by then already achieved 0-110˚ range of knee flexion. During his follow-up at 2 years fracture and osteotomy site were completely healed (Figure 2D). Currently, at

three-year follow-up after the second surgery, the fracture and osteotomy sites have healed well, there is no limb-length discrepancy and the child is able to perform all his activities without a limp and with full range of movements of he left lower-limb (Figure 3 A, B).

DISCUSSION

Femoral shaft fractures are among the most common fractures of the long bones in children. The management of the paediatric femur fractures mainly depends on the age of the child. A number of other factors to be considered are the weight of the child, fracture configuration, experience of the treating surgeon, associated injuries/polytrauma and cost of treatment.[5]

The paediatric femur has a very high capacity of remodelling as compared to the adult femur. It can very well tolerate up to 25 degrees of angulation in any plane.[6] Rotational deformities are not well tolerated although studies have reported that 25% of malrotations can be acceptable and shortening of up to 1 cm in patients less than 10 years is also acceptable as the stimulation of periosteum with rich blood supply leads to overgrowth secondary to local injury.[5,7] The potential for remodelling and correction of deformities is maximum in infancy but decreases largely by the beginning of adolescence.[8]

Age of the child being the main predictor of the treatment (Table 1). Children below 5 years are usually managed non-operatively due to the excellent remodelling capacity. Various conservative modalities can be used which include Pavlik harness, Bryant`s traction, hip spica a functional bracing. Pavlik harness is recommended for infants up to 6 months of age and hip spica is preferred in older children. Treatment of fractures in age group 5-16 years is controversial as there are multiple options available and no clear consensus on preferred modality of treatment. External fixators, plating (conventional and submuscular bridge plating) and intramedullary nails (flexible and rigid interlocking) are various surgical options available. Many studies have recommended use of elastic nails for children between 5-10 years and locked intramedullary nails for children more than 10 years.[9,10]

Our patient was a school going boy, was initially managed with elastic nails and circumferential wiring at a peripheral hospital. Normally elastic nails retrieval should not be done before 6 months. Here it was removed at only 2 months post-operatively for unknown reasons, leading to the loss of reduction at the fracture site.[11]

Incidence of peri-implant fracture after compression plating is 1-3%. Difference in the stiffness between the patient's bone and the plate fixed bone segment is the important cause for these fractures. Supracondylar fracture following plate fixation by us was attributed to the mobilization of the child with the stiff knee, tight quadriceps and very rigid fixation of the fracture leading to excessive stress over the supracondylar area.[12,13]

Refracture at the same site after fracture union following a trivial trauma was possibly due to cerclage wiring strangulating the bone leading to the vascular insult, use of 4.5 mm DCP in a child lading to cortical necrosis secondary to excessive plate-bone contact interfering with the cortical perfusion, weakening of the bone due to multiple surgeries and immobilization, child was walking with a limp due to shortening of about 1 cm of the limb due to malunited supracondylar fracture.[14,15]

Finally, he was managed with open reduction and distal femur anterolateral wedge osteotomy and fixation with intramedullary rush nail and locking plate fixation, which healed uneventfully.[16]

Table 1: Treatment guidelines in children with femoral shaft fractures.[10]

Age	Preferred treatment	Alternate treatment*
<6 months	Pavlik harness	-
6 months–5 years	Hip spica casting	Traction and spica casting Elastic intramedullary nailing
5–11 years	Elastic intramedullary nail	Traction and spica casting Submuscular bridge plating
11 years-adult	Intramedullary nailing	Submuscular bridge plating
Any age (open fractures)	External fixation	

CONCLUSION

This was a very good learning experience for us with respect to the management of the paediatric femur shaft fractures. Most importantly we learnt what not to do, for instance, usage of cerclage wires unnecessarily, early retrieval of the elastic nails and very rigid fixation with extensive periosteum stripping. Hence, we would like to recommend sticking to the basic principles and recommendations in management of these fractures to avoid such complications and morbidity for the patients.

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