

Case Report

Management of pediatric subtrochanteric femur fracture with hip spica cast and external fixator device: two case reports

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Pediatric subtrochanteric femur fractures are uncommon. Methods for management include hip spica cast after closed reduction, external fixation, open reduction with plate fixation, flexible intramedullary nailing, and rigid intramedullary nailing. Here we report our experience of two cases of pediatric subtrochanteric femur fracture. The first case was treated with closed reduction followed by hip spica cast. The second case was treated with hip spica cast initially, then with external fixator device. In both cases, the fractures healed well without complications. Further studies are necessary to determine the optimal treatment of such fractures.

Keywords: pediatric subtrochanteric femur fracture, hip spica cast, external fixator device

1. Introduction

Subtrochanteric femur fractures are uncommon in pediatric patients, representing only 4% to 10% of all pediatric femur fractures^[1]. In children, subtrochanteric fracture is defined as fracture of the proximal one-quarter of the femur^[2], up to 2 cm or 3 cm^[12] distal to the lesser trochanter. Subtrochanteric fractures in children are distinct from those in adults due to less comminution, less complicated fracture pattern, and significantly higher union rate^[13]. It is difficult to maintain reduction because of muscle pull on the proximal fragment^[1]. Therefore, finding an optimal treatment is challenging and due to the low incidence of such fractures, treatment methods have not been well established^[5].

Several methods for managing these fractures have been proposed, with varying degrees of success. They include hip spica cast after closed reduction, external fixation, open reduction with plate fixation,

flexible intramedullary (IM) nailing, and rigid IM nailing^[3,7,8,9,10]. In order to identify the appropriate methods of management, we present our experience of two cases of pediatric subtrochanteric femur fracture that were successfully treated.

2. Case Report

Case 1 Report

A 3-year and 4-month-old girl, who was healthy without history of medical disease, jumped from a height of one meter onto a hard floor. She was brought to our emergency room for management. Roentgenogram revealed a right subtrochanteric femur fracture just below the lesser trochanter (Fig. 1a).

Closed reduction was carried out, followed by placement of hip spica cast, under general anesthesia. The fractured right femur was flexed nearly 90 degrees, with the maximal abduction allowed by her musculature. The cast extended from the waist all the way down to the mid-calf area, fixing the knee joint in 90 degrees of flexion, in order to control the rotation of the right femur (Fig. 1b). The uninjured left leg was fixed down to mid-thigh only, leaving the left knee free to move.

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Figure 1a Initial presentation. Roentgenogram revealed right subtrochanteric femur fracture just below the lesser trochanter.



Figure 1c The subtrochanteric fracture healed with relatively good stability and removal of spica cast at 3 months.

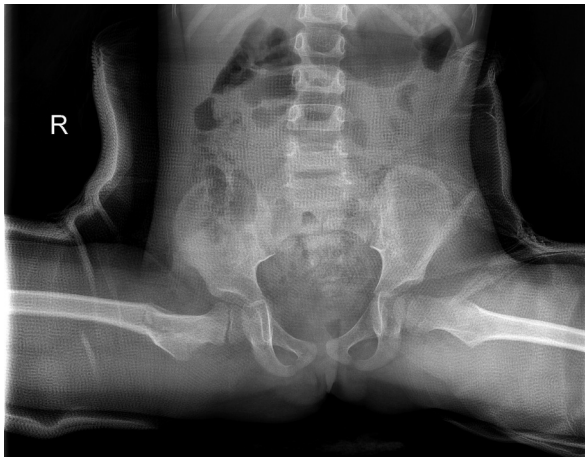


Figure 1b Closed reduction followed by placement of hip spica cast. The fractured right femur was flexed nearly 90 degrees, with maximal abduction allowed by her musculature.

The patient was discharged from our hospital the next day. Close monitoring of fracture healing was achieved with serial roentgenography. Reduction was well maintained by the hip spica cast. The subtrochanteric fracture healed with relatively good stability and hip spica cast was removed 3 months

after initial injury. At subsequent follow-up, she showed good range of motion (ROM) of the right hip and knee joints, compared to that of the uninjured left lower limb. She also demonstrated good lower limb strength with normal walking and running gaits. (Fig. 1c).

Case 2 Report

A 3-year and 4-month-old boy, who was previously healthy, complained of the same symptoms as Case 1 after jumping from a height of one meter onto a hard floor. Roentgenogram revealed a right subtrochanteric femur fracture. Similarly, the fracture was just below the lesser trochanter (Fig. 2a).

Closed reduction was followed by hip spica cast placement under general anesthesia. Unfortunately, reduction of the right femur was not maintained with 90 degrees of knee flexion and maximal abduction. Post-reduction and hip spica cast placement roentgenogram revealed varus deformity of the femur with slight anterior bending near the subtrochanteric area (Fig. 2b). After discussing treatment options with the child's parents, we carried out repeated closed reduction followed by placement of external



Figure 2a Roentgenogram revealed a right subtrochanteric femur fracture just below the lesser trochanter.

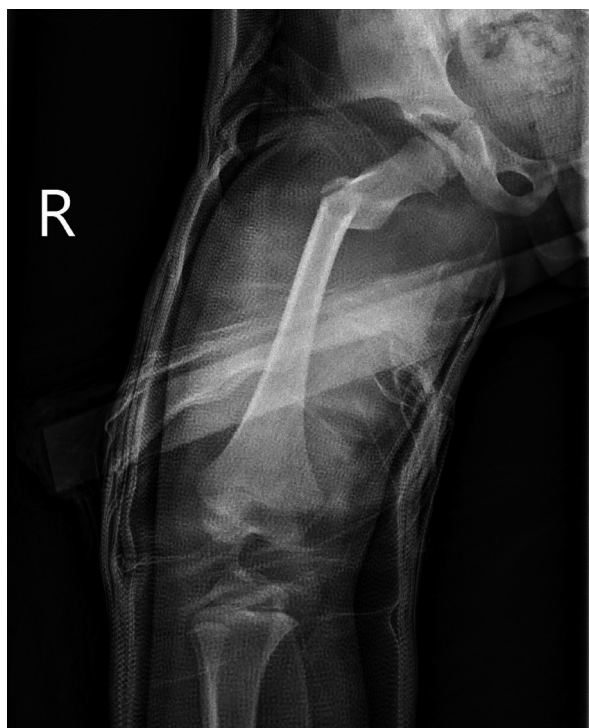


Figure 2b After initial closed reduction and hip spica, roentgenogram revealed a varus deformity of the femur with slight anterior bending near the subtrochanteric area.

fixator device on the lateral aspect with two Schanz screws above and two below the fracture (Fig. 2c).

After the procedure, the femoral bone was well aligned and gentle ROM exercise was allowed. We advised protected weight-bearing at 6 weeks following injury. The external fixator device was removed at 12 weeks. At subsequent follow-up, he showed full ROM of the right hip with normal

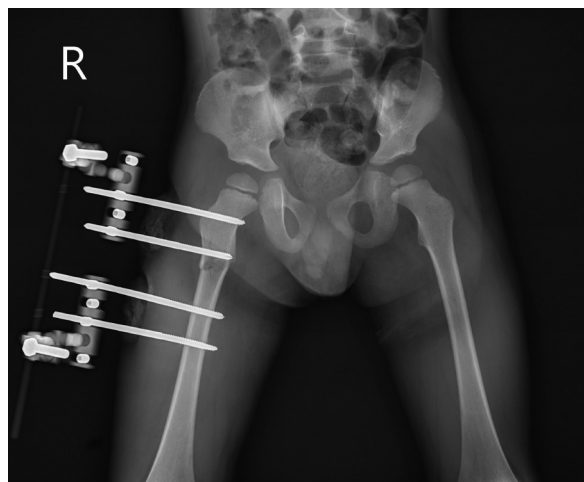


Figure 2c Repeated closed reduction was carried out followed by placement of external fixator device on the lateral aspect with two Schanz screws above and two below the fracture.

walking and running gaits. There were no obvious signs of physeal injury (Fig. 2d).

3. Discussion

There are several factors that make management of subtrochanteric femur fracture difficult, including the tendency for displacement of the proximal fragment during flexion, abduction, external rotation secondary to forces from the iliopsoas, hip abductors, and external rotator muscles in the subtrochanteric region of the femur, decreased soft-tissue constraint of the proximal fragment, and high compressive forces on the medial aspect and high tensile forces on the lateral aspect of the proximal femur^[4].

Various treatment options have been proposed for the management of subtrochanteric fractures in adults. IM nailing has been reported to be the most biomechanically sound treatment^[4]. Wiss and Brien^[15] suggested that the Grosse-Kempf interlocking nail be utilized regardless of fracture pattern and degree of comminution, whereas Wu et al.^[16] and French and Tornetta^[18] advocated the use of IM nails in all cases with the exception of proximal subtrochanteric fractures, for which they recommended reconstruction nails.

However, treatment of subtrochanteric femur fracture in skeletally immature adolescents requires

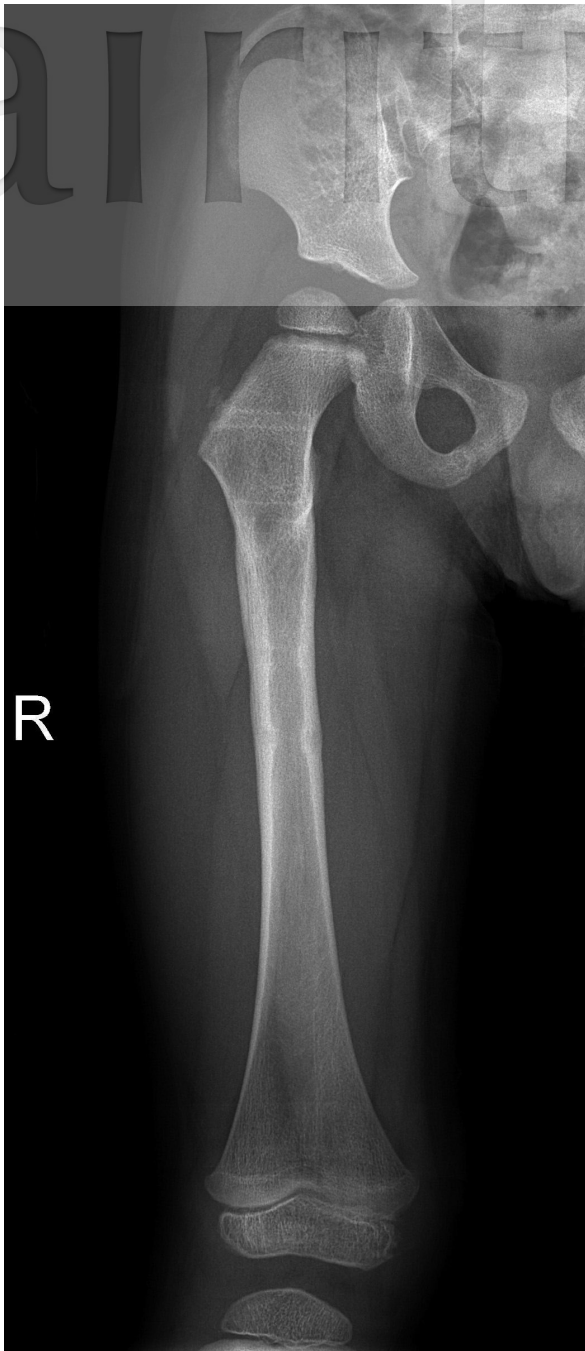


Figure 2d External fixator device was removed at 12 weeks. The patient showed good range of motion of the right hip and good lower limb strength.

a different approach. With relatively high union rate, less comminution, and less complicated fracture pattern, better outcomes are expected in younger patients. Treatment selection bias exists for very young children compared to adolescents near skeletal maturity, for whom operative treatment is

preferred.

As our two cases were relatively young, closed reduction under general anesthesia followed by hip spica cast application remained the first choice mainly due to the relatively quick union time and greater remodeling potential. However, reduction is not always well maintained, as in Case 2. Care must be taken to counteract the various muscle pulls near the proximal femur region while applying the hip spica cast, in order to avoid loss of reduction when the child wakes from general anesthesia. After initial successful hip spica cast application, frequent follow up is needed to ensure reduction maintenance. Challenges that the child and the family may encounter include transportation problems, cast intolerance by the child, and hygiene problems.

In older adolescents, treatment options include rigid IM nailing, flexible IM nailing, open reduction with plate fixation, and external fixation. Lateral entry IM locked nail provides the same benefits as for adult fractures^[6], with a quicker return to ROM exercise and partial or full weight bearing. Complications include prolonged recovery time, femoral overgrowth, scar tissue, implant irritation, and possible need for future implant removal. Flexible IM nails reduce scar tissue by limiting soft tissue dissection. Trochanteric nail entry can also be avoided by retrograde insertion of elastic nail, with entry points near the distal femur just above the physal growth plate, thus avoiding physal injury. However, flexible IM nails are associated with residual angulation and loss of reduction due to poorer control of rotation and angulation compared to rigid IM nails. Flexible IM nails may not be suitable for older adolescents nearing skeletal maturity.

Open reduction with plate fixation may be considered for treating pediatric subtrochanteric fracture. During the procedure, reduction can be well maintained and fixed by direct fracture site exposure. Fixation can be achieved with 4.5 mm AO dynamic compression plate, 4.5 mm contoured reconstruction plate, or locking compression plate. El-Sayed et al. reported fracture union with anatomical alignment in 18 children with an average age of 8.2 years. There were no deep infections and only two superficial wound infections that responded

well to antibiotics and wound care. Extensive soft tissue dissection and periosteal stripping during plate application may lead to deep infection [3]. Disadvantages of plating include the need for plate removal, unsightly scars, blood loss associated with exposure and reduction of the fracture, and higher degree of overgrowth induced by the plates when compared with IM fixation.

External fixation is another viable option when treating subtrochanteric fracture. Compared to open reduction and internal fixation, external fixation requires minimal soft tissue dissection, resulting in minimal blood loss. Care must be taken when placing the fixation pins in the proximal fragment to avoid physeal injury and vessel injury which may lead to future avascular necrosis. Compared to other fixation methods, for which initial reduction must be well aligned and maintained before fixation of implants, adjustments can be easily made to better align the fracture after pin placement by manipulating the external fixator before locking it down, separating the procedure into two steps. Galal reported no implant failure with external fixators for subtrochanteric femur fracture. Four out of 14 patients had pin site infections that responded well to oral antibiotics and pin site care. There were no incidences of refracture or avascular necrosis of the femoral head [11]. The problem with using external fixation in subtrochanteric femoral fractures is the limited room for application of the pins to the proximal femoral fragment [11]. Galal avoided this problem by adopting the calca fixation (rather than the neck fixation) technique [11]. In our Case 2, one pin was placed at the calcar region while a second proximal pin was placed in the neck region. The femoral head did not suffer from avascular necrosis at the last follow-up.

4. Conclusion

A good understanding of the musculature around the trochanteric region is required when dealing with pediatric subtrochanteric fracture, to achieve good reduction with hip in 90-degree flexion and maximal abduction allowed by the patient's musculature. This can be followed by hip spica cast placement. If this fails to hold the reduction, then other treatment

methods including external fixation device and open reduction with internal fixation can be considered. Drawbacks of external fixation include lack of familiarity with the external fixator device, lack of availability of children's sizes, and pin site-related problems.

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