

## Original Research Article

# Closed diaphyseal fractures of femur in children treated by hip spica: early result of a clinical study

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### ABSTRACT

**Background:** Diaphyseal fracture of femur is a common injury in children with bimodal age distribution. The treatment modality of these fractures depend on several factors such as age of the patient, characteristics of the fracture— degree of displacement, location of fracture in femur, comminution, and open or closed injury. With the invention of titanium elastic nails, the recent trend in treating these fractures is by closed reduction and TENS, but the surgical management is not without complications hence we share our experience to reemphasize the role of hip spica cast immobilisation in treating these injuries.

**Methods:** This is a prospective study of 30 cases of diaphyseal fractures of femur in children between the ages of 6 month to 6 years. History and mode of injury were recorded and complete physical examination was done. Plain anteroposterior and lateral radiographs confirmed diagnosis. Hip spica cast was applied under sedation or short general anesthesia. One and half spica was applied over thick padding with hip flexed 45 degrees abducted 30 degrees and external rotation of 10 degree. No attempt was made to obtain an end to end reduction. Patients were allowed to go home the same day after giving instructions regarding spica care. Follow up was done and radiographs were taken at 1, 2, 4 and 12 weeks. Any malunion— LLD, angulation or rotation were recorded.

**Results:** The mean age of patients was 3.5 years (range 0.5 to 6 years). Of these 12 (40%) were male and 18 (60%) were female. The commonest mode of injury was fall while play in 73.33% (n=22) of patients. Mid shaft fractures are more common 53.33% (n=16) followed by upper third 40% (n=12). Average time for fracture union was 6 weeks (range 4-10 weeks). At one year all fractures healed in a satisfactory position without any LLD. Two patients had minor skin problems which were easily treated and cast continued. No stiffness of hip, knee or ankle was noted.

**Conclusions:** Hip spica casting is an effective and reliable method for treating femoral shaft fractures in children with a union rate of 100%. The advantages of conservative treatment such as the avoidance of general anaesthesia on two occasions and the avoidance of surgery make a compelling argument in favour of this form of treatment.

**Keywords:** Femur fracture, Hip spica cast, Paediatric fractures

### INTRODUCTION

Fractures of the shaft of femur account for about 1.6% of all paediatric injuries.<sup>1</sup> The Male to female ratio is 2.6:1. It has a bimodal age distribution with peaks of occurrence in early childhood and mid-adolescence. The femoral diaphysis has extensive blood supply and therefore good fracture healing potential but because of the thick

musculature surrounding it, there is always gross displacement of the fracture fragments.

The treatment modality of these fractures depend on several factors such as age of the patient, characteristics of the fracture— degree of displacement, location of fracture in femur, comminution, and open or closed injury. Pavlik harness is best used in children aged less

than 6 months, spica cast in children aged 6 months to 6 years, titanium elastic nailing or biological plating has good results in 6 to 14 years of age and interlock nailing for children more than 14 years of age.<sup>2</sup> With the invention of titanium elastic nails, the recent trend in treating these fractures is by closed reduction and TENS, but the surgical management is not without complications of infection, implant failure and resurgery for implant removal. Hence fracture shaft of femur in children have been traditionally managed conservatively.<sup>3</sup> It also dramatically decreases the hospital stay, cost of treatment and allows rapid return of patients to their home.<sup>4</sup>

## METHODS

This is a prospective study of 30 cases of diaphyseal fractures of femur in children between the ages of 6 month to 6 years. The patients were included in the study after explaining the parents the treatment protocol and their due consent obtained.

### Exclusion criteria

The patients with obstetric trauma, pathological fracture, age <6 month and >6 years, polytrauma, open fracture, past history of fracture in the same limb were excluded from the study.

History and mode of injury were recorded. Complete physical examination was done to assess any associated injury. Immediate pain, obvious deformity, inability to bear weight and instability of limb are common clinical features. Delayed presentation if any may be an indication of non-accidental trauma or child abuse which needs to be evaluated by parent counselling.

Plain anteroposterior and lateral radiographs of femur including both knee and hip joints were obtained.

### Management

Hip spica cast was applied within hours after admission under sedation or short general anesthesia.

### Padding

A folded towel is placed on anterior thorax and abdomen and all padding and casting material is applied over this towel. Towel is removed after cast application; this will create space between the cast and the thorax/abdomen and will avoid cast tightness and difficulty in breathing. Soft wrap is placed with care to evenly spread the cotton across the back and buttocks to cover the sacrum, posterior and anterior superior iliac spines.

### Reduction and casting technique

In case of displaced fracture, flouro is used to determine the optimal position of reduction. A long leg cast was

applied with the knee at about 40-45 degrees of flexion as the fracture is held reduced by an assistant. When the cast has set, a single hip spica was then completed while maintaining the alignment of the shaft of femur. The hip was flexed to about 45 degrees, abducted to about 25 degrees to facilitate perineal hygiene and about 15 degrees of external rotation (Figure 1). No attempt was made to obtain an end to end reduction. The limb is placed in relaxed position to decrease the muscle forces and to minimize the amount of shortening. A diaper is always applied to the perineum to prevent soiling of the cast. In some patients the foot part of the cast was not applied leaving the ankle free to move. Patients were allowed to go home the same day after giving instructions regarding spica care.



Figure 1: Patient in hip spica.

### Follow-up

At 1, 2, 4, 6 and 12 weeks, during each visit child was examined for its skin condition and soiling or breaking of the cast. Radiographs were taken at 1, 2, 4 and 12 weeks to rule out secondary fracture displacement and to evaluate for maintenance of fracture reduction with respect to limb length, varus/valgus angulation, procurvatum/recurvatum angulation and bony union.

Spica cast was removed after a period of 4-6 weeks, depending on the presence of callus as assessed on follow-up radiographs. Range of motion at hip and knee joints and quadriceps wasting was evaluated. The patients were then allowed gradual mobilization and weight bearing. No formal physiotherapy was given to any of the patients.

### Criteria for evaluation of results

Primary outcome was evaluation of malunion 12 months after trauma. Malunion was defined as a visible deformity of lower leg, which could be secondary to more than 10° of rotational deformity by means of clinical evaluation, clinically visible angulation when compared with the normal leg or more than 2 cm of limb length discrepancy.

**RESULTS**

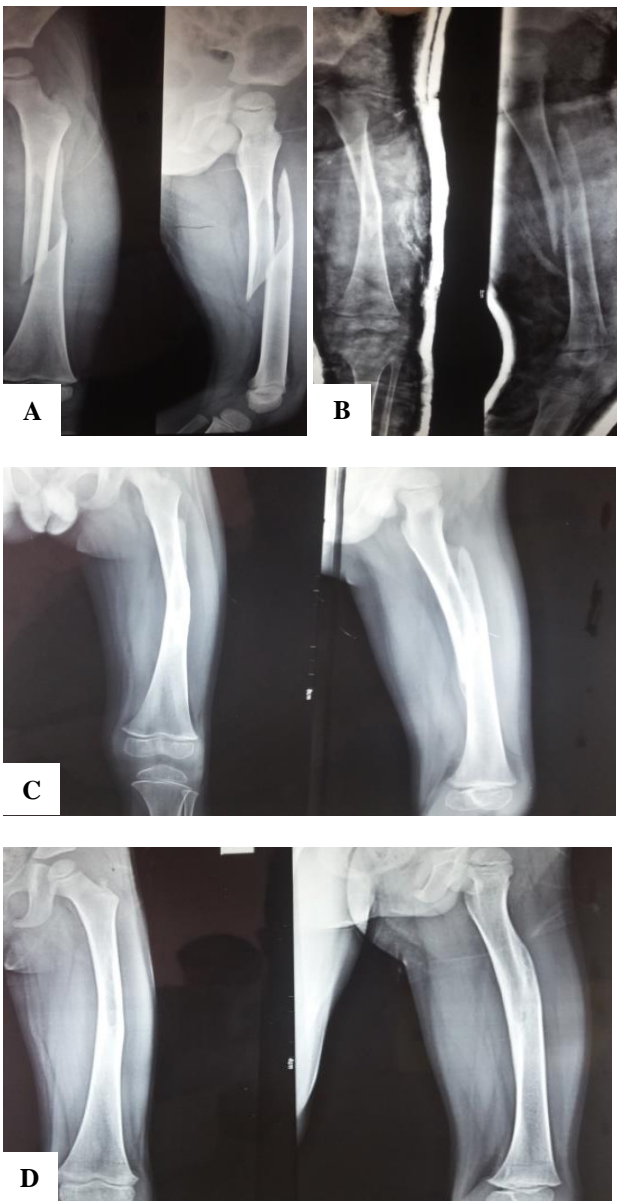
This is a prospective study of 30 patients of fracture shaft of femur, with mean age of 3.5 years (range 0.5 to 6 years). Of these 12 (40%) were male and 18 (60%) were female. The age and sex distribution of the study population is shown in Table 1. 13 (43.33%) patients had injury of the right femur and 17 (56.67%) had injury of left femur (Table 2). The mode of injury was fall while child was playing in 22 (73.33%) patients, RTA in 6 (20%) and child abuse in 2 (6.67%) patients. There were 16 (53.33%) midshaft fractures, 12 (40%) upper third and 2 (6.67%) lower third fractures. 14 (46.67%) patients had spiral, 6 (20%) transverse and 10 (33.33%) oblique fractures.

**Table 1: Distribution of age and sex.**

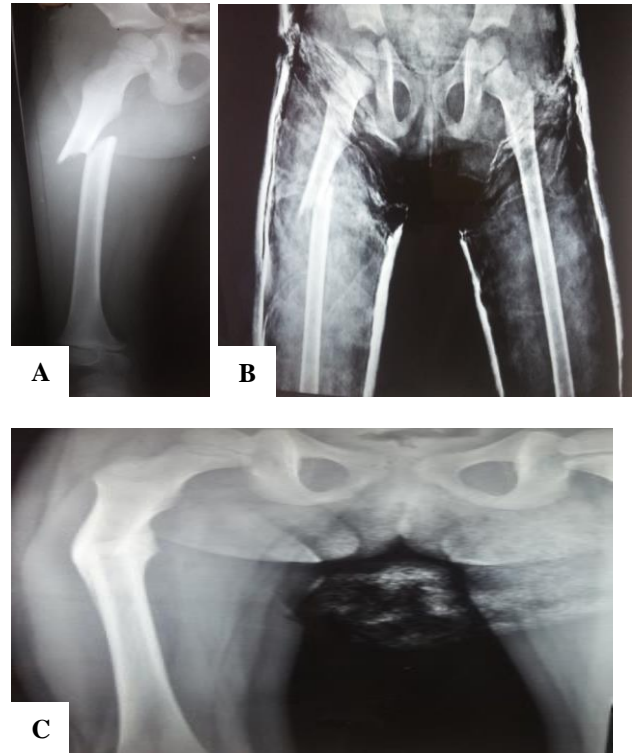
Age(yrs)	Male	Female	Total
<2	03	04	07
2-4	05	09	14
4-6	04	05	09
<b>Total (%)</b>	<b>12 (40.0)</b>	<b>18 (60.0)</b>	<b>30 (100)</b>

**Table 2: Side distribution.**

Side	Male	Female	Total (%)
<b>Right</b>	05	08	13 (43.33)
<b>Left</b>	07	10	17 (56.67)
<b>Total</b>	12	18	30 (100.0)



**Figure 2: Patient treated with hip spica cast: (A) Spiral fracture; (B) In cast at 2 weeks; (C) After cast removal at 6 weeks; (D) After remodelling at 18 months.**



**Figure 3: Upper third oblique fracture. (A) Oblique fracture; (B) In cast at 2 weeks; (C) At 8 weeks.**

Average time for fracture union was 6 weeks (range 4-10 weeks). At follow-up of one year all fractures healed in a satisfactory position (Figures 2 and 3). None of the patients had a LLD of >2 cm, while 2 (6.67%) had a LLD of >1 cm, 12 (40%) had LLD of <1 cm and 16 (53.33%) had no LLD. 3 (10%) of the patients required wedging of the cast at second week of follow up for correcting malalignment of fragments. Two patients got the cast soiled at 4 weeks and 5 weeks which required changing of cast. One had clinically significant skin excoriation around the perineal region and one had local skin break down over a wet cast. No permanent skin damage was observed in these patients who healed completely after local skin care and cast change. Follow-up period ranged from minimum of 12 months to 24 months. No patient developed hip, knee or ankle stiffness.

## DISCUSSION

Pediatric femoral diaphyseal fractures are significantly different from those in adults in capacity of remodelling. Children are capable of remodelling malaligned fractures through bone deposition in accordance with Wolff's law, depositing bone in areas of high stress and also by the mechanism of reorienting the physes. In adults any shortening would be permanent, but it is not so in children. Perfect anatomical reduction is not essential for good function.<sup>5</sup> The post traumatic overgrowth phenomenon following fracture in children has allowed acceptance of shortening of up to 2 cm at the time of fracture union. In fact some overriding is usually desirable at the time of fracture union. Remodelling is also expected to correct moderate amount of angulation more so in the plane of movement of distal joint.

AO (Arbeitsgemeinschaft für Osteosynthesefragen) classified closed diaphyseal fractures of femur in to simple, wedge and complex fractures.<sup>6</sup> The mechanism of injury for pediatric femoral shaft fractures is direct injury in case of transverse fracture whereas spiral or oblique fractures are produced by indirect or rotational force.<sup>7</sup>

With surgical treatment complications such as infection, growth plate disturbances and implant failure have been reported.<sup>8</sup> Spica cast has been used successfully for paediatric femur fractures and is proven to be very effective and safe by literature.<sup>9</sup>

Depending on the extent, spica cast can be of three types—single leg walking spica, used in elderly children to allow ambulation after cast application; one and a half spica and double leg spica.<sup>10</sup> While others have used double hip spica for children below 5 years we did not find it necessary.<sup>11</sup> All our patients were treated with single spica (one and half spica).

Results of present study are comparable with other similar studies. We have used this method of treatment at all levels of shaft fracture. Some have excluded patients with proximal femoral shaft fracture for fear of development of coxa vara. We were able to observe a reasonable amount of angular correction by remodelling in our patients. Anterior angulation is the most easily corrected of all angulations followed by medial angulation. Sugi and Cole evaluated 191 children aged 10 years or less with early spica cast.<sup>12</sup> They selected fractures only in the middle 3rd of bone. They concluded that the leg length discrepancy was rare and clinically insignificant. Rarely complications like leg length discrepancy, malunion, skin breakdown by local irritation or infection, foot drop or even compartment syndrome have been described.<sup>13,14</sup>

The AAOS (American academy of orthopaedic surgeons) clinical practice guideline for the treatment of paediatric diaphyseal femur fracture recommends early hip spica cast immobilisation or traction with delayed hip spica

cast in children aged 6 months to 5 years.<sup>15</sup> This method is a simple, effective and safe treatment for a femoral shaft fracture in children. It remains universally used in all age groups, but is especially suited for children under the age of 6 years, when there is still significant potential for remodelling and the weight of child and cast allows for easy carrying and transfer of the patient.<sup>16</sup> Although in today's busy society where children are going to kindergarten at a very young age and often both parents are working, applying flexible intramedullary nail to children to avoid constant care of the spica cast appears attractive and feasible but its advantages over hip spica cast immobilisation have yet not been evaluated.

Although we did not compare different treatment modalities and cost of the treatment was not calculated, but we believe that early spica cast treatment is the cheapest of all and allows rapid return of a child to preinjury activity status.

## CONCLUSION

Our experience is that hip spica casting is an effective and reliable method for treating femoral shaft fractures in children with a union rate of 100%. The advantages of conservative treatment such as the avoidance of general anaesthesia on two occasions and the avoidance of surgery altogether make a compelling argument in favour of this form of treatment.

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## REFERENCES

1. Hinton RY, Lincoln A, Crockett MM, Sponseller P, Smith G. Fractures of the femoral shaft in children. Incidence, mechanisms and sociodemographic risk factors. *J Bone Joint Surg Am.* 1999;81:500-9.
2. Anglen J, Choi L. Treatment options in pediatric femoral shaft fractures. *J Orthop Trauma.* 2005;19:724-33.
3. Ferguson J, Nicol RO. Early spical treatment of pediatric femoral shaft fractures. *J Pediatr Orthop.* 2000;20:189-92.
4. Wright JG: The treatment of femoral shaft fractures in children: a systematic overview and critical appraisal of the literature. *Can J Surg.* 2000;43:180-9.
5. Demeron TB and Thomson HA. Femoral shaft fractures in children. *J Bone Joint Surg.* 1959;41:1201-12.
6. Fractures of the femur & injuries above the knee In: Ronald Mc Rae (eds.) *Practical fracture treatment (4thedn)* UK: Churchill Livingstone; 2003: 308-327.
7. Cusick L, Thompson NW, Taylor TC, Cowie GH. *Paediatric femoral fractures-the Royal Belfast*

- Hospital for Sick Children experience. *Ulster Med J.* 2005;74:98-104.
8. Lascombes P, Haumont T, Journeau P. Use and abuse of flexible intramedullary nailing in children and adolescents. *J Pediatr Orthop.* 2006;26:827-34.
  9. Wright JG. The treatment of femoral shaft fractures in children: a systematic overview and critical appraisal of the literature. *Can J Surg.* 2000;43:180-9.
  10. Splain SH, Denno JJ. Immediate double hip spica immobilization as the treatment for femoral shaft fractures in children. *J Trauma.* 1958;25:994-6.
  11. Irani RN, Nicholson JT, Chung SMK. Long term result in the treatment of femoral shaft fractures in young children by immediate spica immobilization. *J Bone Joint Surg.* 1976;58:945-51.
  12. Sugi M, Cole WG. Early plaster treatment for fractures of the femoral shaft in childhood. *J Bone Joint Surg Br.* 1987;69:743-5.
  13. Berne D, Mary P, Damsin JP, Filipe G. Femoral shaft fracture in children: treatment with early spica cast. *Rev Chir Orthop.* 2003;89:599–604.
  14. Th D'Ollonne, Rubio A, Leroux J, Lusakisimo S, Hayek T, Griffet J. Early reduction versus skin traction in the orthopaedic treatment of femoral shaft fractures in children under 6 years old. *J Child Orthop.* 2009;3(3):209–15.
  15. Kocher MS, Sink EL, Blasier RD, Luhmann SJ, Mehlman CT, Scher DM, et al. Treatment of pediatric diaphyseal femur fractures. *J Am Acad Orthop Surg.* 2009;17:718–25.
  16. Flynn JM, Schwend RM. Management of pediatric femoral shaft fractures. *J Am Acad Orthop Surg.* 2004;12:347–59.

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