

FEMORAL SHAFT FRACTURES IN CHILDREN TREATED BY EARLY SPICA CAST

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ABSTRACT

Objective To find out the advantages of early spica cast as a treatment for isolated, uncomplicated femoral shaft fracture in children.

Study design Descriptive study

Place & Duration of study Department of Paediatric Surgery, National Institute of Child Health Karachi, for one year period.

Patients and Methods All patients under the age of 12 years, who presented during the study period with femoral shaft fracture were included in the study. Patients having compound fractures and those with associated injuries were excluded. All patients had radiological evaluation of the injury. They were prepared for spica cast under general anesthesia. Following recovery check x rays were taken to assess the reduction. Follow up done in outpatient clinic at weekly intervals for initial 3 weeks and then at longer intervals.

Results A total of 30 children with femoral fractures were treated with early spica cast. Age ranged from 2 year to 11 years. Male to female ratio was 2.75:1. Majority of children were under 5 years (n 20). In most of the children spica cast was applied on the day of presentation within few hours and were sent home on the same day. Twenty one children were followed till removal of spica cast. Period of immobilization in spica cast ranged from 4 weeks to 7 weeks with average of 5.73 weeks. Common problems related to spica cast were soakage and breakage of spica which occurred in 9(42.85%) children. At the time of cast removal shortening ranged from 0.5cm to 2.5 cm in 15 out of 21 (71.42%) children. Angulation was found in 3/21 (14.28%) children. It ranged from 15 degree to 30 degree in anterior and 10 degree to 20 degree in lateral position. Three children were followed for longer period. A three year old girl presented at 6 months with 2 cm of lengthening of fractured limb. Three children had equal limbs at one year after injury while a five year boy had 0.5 cm shortening of limb.

Conclusions Early spica cast is simple, effective and definite method of treatment with minimal complications and acceptable results in paediatric age group. It allows rapid return of child to family environment, thus avoiding prolonged separation from parents.

Key words Children, Femoral shaft fractures, Hip spica.

INTRODUCTION:

Femoral shaft fractures in children are common and frequently

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require hospitalization.^{1,2} Traditionally femoral shaft fractures in children have been treated by some form of initial traction followed by spica cast immobilization. Since reported in 1959 by Dameron and Thompson,³ interest in use of immediate or early spica cast has increased.^{4,5,6} The advantages of this approach are decreased hospital stay and cost of treatment, avoidance of complications of traction and surgical fixation and rapid return of patients to their families.⁷

The problem with early spica cast treatment is shortening and deformity of limbs.⁵ Overgrowth of fractured limb and spontaneous correction of angulations at fracture site have been reported.^{8,9} Perfect anatomical reduction is therefore not essential. Because of these characteristics in children, use of early spica cast seems to be an attractive treatment option. This study was conducted to establish the advantages of early spica cast as a treatment for isolated, uncomplicated femoral shaft fracture.

PATIENTS AND METHODS:

Thirty children from 2 years to 11 years of age with femur shaft fracture were studied in the Department of Paediatric Surgery, National Institute of Child Health, Karachi. The study lasted for one year. Children with isolated uncomplicated femur shaft fractures were included. Those with pathologic, subtrochanteric, supracondylar and bilateral femoral shaft fractures and patients with multiple injuries, were excluded. After emergency management and radiological examination, the patients were admitted to ward and put on straight leg skin traction until spica cast was applied or were taken to operation theater, after 3 or 4 hours of fasting for the same. Traction was applied to those children who presented in late night or admitted in another surgical unit and then sifted to our ward.

One and half hip spica cast was applied under general anaesthesia. Traction was applied on fractured limb to overcome over riding. Both hips and knees were kept straight with ankle in neutral position. Hips were abducted about 30-40 degrees and kept neutral in rotation. After spica radiographs were taken in 2 planes to measure shortening and angulation. Children were usually discharged on same day. Patients were followed in out door department weekly for first 3 weeks. Fourth visit was arranged after 6 to 8 weeks depending upon age of the child. At every visit hip spica was examined to note soakage, weakness or breakage of cast and pressure symptoms. Radiographs were taken to note overlapping and angulation. If spica had weakened or broken it was reinforced or changed. In follow-up visit if x-rays showed more than 2cm overlap or more than 20 degree angulation in antero-posterior plane and more than 15 degree angulation in medial and lateral planes, spica was removed and patient was put on traction or re-manuplation under general anaesthesia was done spica re-applied. Statistical analysis was done with Chi-square test and p. value of < 0.05 was considered significant.

RESULTS:

In one year period a total of 561 fractures in children were managed. Out of these, 85 were femur fractures, comprising 15.15% of all fractures. Thirty children with 30 femur shaft fractures who met criteria were enrolled for this study. The mean age of patients was 4.96 years (range 2 years to 11 years - table 1). There were 22 males and 8 females with

M: F ratio of 2.75:1. The most common mode of injury was fall from height. This observation was statistically significant (p>0.001). Other modes of injury are shown in table 2.

Sixteen fractures were on right and 14 on left side. There were 18 oblique, 10 transverse and 2 spiral fractures. Seven fractures involved the proximal third, 19 the middle third and 2 distal third of shaft of femur. In 22 children immediate hip spica cast was applied after 3 hours of fasting, while 8 children were admitted and put on traction and then hip spica cast was applied. Usually children were discharged on the day of application of spica cast. Ten children (including 8 to whom traction was applied) required stay in hospital for median of 7 days (range 1day to 20 days).

Nine children were lost to follow up at some stage of treatment after application of hip spica, leaving 21 children who were followed till union of fracture and removal of cast. Period of immobilization in spica cast ranged from 4 weeks 7 weeks with average of 5.73 weeks. Commonest problem with spica cast was soakage and breakage, which occurred in 9 out of 21 children (42.8%). Spica cast was reinforced in 6(28.5%) children and changed in 2 (9.52%). None of the children required wedging. At the time of fracture healing i.e. at

Table 1: Age and Sex Distribution

Age	Male	Female	Total
< 5 years	12	08	20
> 5years	10	00	10
Total	22	08	30

Table 2: Mode of Injury

Mode of Injury	No of Patients	Percentage
Hit by vehicle/Motor cycle	06	20
Fall	15	50
Fall of object on patient	05	17
Sports Injury	03	10
Hit by animal	01	3

Table 3: Shortening at the Time of Fracture Healing

Shortening	No. of patients
0.5cm	02
1.0cm	06
1.5cm	04
2.0cm	02
2.5cm	01

removal of spica cast, shortening of fractured limb was seen in 15 out of 21 children. Shortening ranged from 0.5cm to 2.5cm (table-3). Most children had shortening of 2cm or less, which was acceptable. Angulation of femur was seen in 3 children at the time of removal of spica cast. An eleven years old male child had 20 degree of lateral angulation. This child had 1.5cm of overlap of fracture fragments, but no angulation at time of spica cast application. At one week follow up visit he had 2cm of overlap, but no angulation. At 3rd week visit he had 15 degree of lateral angulation. This angulation was accepted in the hope that it will be corrected by remodeling. At 7th week visit his spica was completely broken. There was 2.5cm of overlap and 20 degree of lateral angulation. Application of traction was advised, but parents refused.

After removal of cast parents were asked to bring their child after one year with fresh x-ray. Only 5 children could be followed for longer duration. A Three years child presented after 6 months with 2cm lengthening of injured limb. One child had 0.5cm shortening of injured limb, while three children had equal limbs at one year follow up. There was no limping or any functional problem. Clinically both limbs remained equal.

DISCUSSION

Femoral shaft fractures in children are common, comprising 15.15% of all fractures in our study. At the time of our study no published literature could be found in Pakistan regarding femoral shaft fractures in children and their management except a case report of operative treatment of malunited fracture of femoral shaft in a 65 days old infant.¹⁰ Search was made on MEDLIP. Recently three studies have been published in Pakistani literature.^{11,12,13} One study was conducted in Iran and published in Pakistani journal.¹² Treatment of femoral fractures in children is controversial. Many surgeons have been quoted to advocate surgical modalities such as compression plates, flexible nails, and external fixators.⁶ Traditionally fractures in children are treated by initial traction for 3 to 4 weeks followed by hip spica cast till union occurs. Since the report in 1959 by Dameron and Thompson interest in use of early spica cast in the treatment of femoral shaft in children has increased.³⁻⁶

Spica cast is simple, safe, effective and definitive method of treatment. It is cheap and associated with short hospital stay. The problem with early spica cast treatment is shortening and deformity of limbs.^{5,14} Results of our study are comparable with others.^{4,5,15-17} Ali and Raza¹¹ have treated 100 children, aged 2 year to 12 years, with closed unilateral femoral shaft fractures by two methods. A) Thomas splint and B) early hip spica cast, fifty children in each group. They have compared results of two methods in terms of time of union, degree of shortening and angulations in coronal and sagittal plane and found no significant difference between the two groups. Duration of stay in hospital was 3.68 ± 2.11 days in early hip spica cast group. Average shortening at 1 year in their study was 0.36 cm in group B. Results of our study are comparable.

Spinner et al have treated 32 children with femur fracture over 7 year period by primary closed reduction and maintenance in double spica cast.¹⁶ For children over 3 years skeletal pin was passed through proximal tibial metaphysis and horse shoe spreader was incorporated in plaster. After one year almost all fractures were within 0.6cm of shortening. Angulation was a problem. There was no restriction of motion at the knee. No pin tract infection occurred. In our study we did not find it necessary to apply double spica and incorporate tibial pin horse shoe spreader in plaster. In our series only four children were followed for about one year, of whom only one child had 0.5cm of shortening as compared with 0.6cm shortening in all children of Spinner et al series. Irani et al have treated 85 children ranging in age from birth to 10 years by immediate reduction and immobilization in spica cast without anaesthesia.¹⁵ The hip and knee were flexed at 40 degree to 60 degree. They have removed sole of cast beneath the foot in all children in order to avoid shortening. Up to two centimeters of overriding, 30 degrees of anterior angulation, and 15 degrees of medial angulation were accepted. They have re-examined 75 children out of 85 for two to eighteen years after initial treatment. None of the children had any residual skeletal deformity or joint stiffness. The length discrepancies ranged from 1.7 cm of shortening to 0.9 cm of overgrowth of the fractured limb.

Sugi and Cole have treated 191 children up to 10 years of age by early spica method.¹⁷ They have included fractures of middle third of femur. They have kept knee and hip flexed at 40 degree to 60degree. They accepted up to 20mm of shortening 20degree of anterior angulation and 15degree of valgus angulation, but no posterior angulation or varus. Plaster under the sole of foot was removed so that planter flexion against it can not cause shortening as Irani et al did. 180 children were reviewed four and half to eight years later. Shortening at removal of cast was seen in all children of 9mm to 20mm (ranged from 0 to 10% of femoral length). At late review only seven children had from 6 to 13mm of shortening. Angular malalignment was not seen at late review, while 13 children had 10 degree to 15 degree of medial rotation of the leg that was not noticed by parents or children. Nine children had complication due to spica, including pressure effects, malalignment of fracture and breakage of spica. In our patients we did not remove sole of cast underneath foot and found that shortening was not affected with presence of sole cast. In our patients shortening occurred in only 15 out of 21, as compared with all patients of Sugi and Cole at time of removal of spica. We do not have follow-up, therefore long term results can not be compared.

Sugi and Cole have included only fractures of middle third of femur for fear of malunion. We treated fractures at all levels of shaft of femur and found no difference in rate of malunion. Martinez et al have reviewed retrospectively 51 children aged 3 year to 11 years with femoral shaft fractures treated with early spica cast.⁴ They have reviewed children till union of

fracture. They applied 1½ spica cast under general anaesthesia. Hip and knee were placed in 40 degree of flexion. Less than 15 degree of angulation in antero posterior and lateral plane, and = 20 mm of shortening were accepted at time of spica cast application. Shortening >20 mm was the most common problem occurring in 22 (43%) patients. Angulation >15 occurred in only four patients, which was corrected with wedging. No problem related to cast or cast wedging, or to initial traction occurred. In our series, as in Martinez, the most common problem was shortening which occurred in 15 (71.42%) out of 21 patients at time of fracture healing. However, except one patient shortening was within acceptable limits, which is expected to be over come by overgrowth phenomenon.

Next most common problem was angulation which occurred in 3 (14.28%) out of 21 patients. Except in one patient angulation was within acceptable limits. Jamaluddin has prospectively studied 24 children aged 3 months to 10 years having femoral shaft fracture, treated by early spica cast.⁵ He applied spica cast under sedation. Knee and hip were kept in 40-45 degrees of flexion. Foot part of cast was removed after about 3 to 4 weeks. The average hospital stay was 3.5 days. Shortening was the main problem and seen in all patients with an average of 15mm shortening at time of fracture union. Angulation was within acceptable limits in all patients. No complication related to spica cast was found. We did not remove the foot part of cast, yet the results are comparable.

Many authors have kept knee and hip in 40 degree-60degree of flexion in spica cast in order to over come tendency of forward flexion of proximal fragment.^{4,5,15,17} In our set up it was not possible to keep knee and hip in flexed position. Moreover, in our study position of knee and hip did not affect fracture position. Early spica cast allows rapid return of child to home. Twenty of our 30 patients were sent home on same day after application of spica cast and only 10 patients hospitalized for median seven days. In Jamaluddin's series average hospital stay was 3.5 days.⁵ In series of Ali and Raza duration of stay in hospital was 3.68± 2.11 days in early hip spica group,¹¹ while in series of Newton and Mubarak average hospital stay was 2.5 days.¹⁸

The main concern in the treatment of femoral shaft fracture in children is shortening and deformity of the limb. In children, after fracture, femur grows at an increased rate. Overgrowth ranging from 1cm to 2.5cm has been reported by many authors.^{8,19-21} This overgrowth phenomenon following femur fracture has allowed acceptance of shortening up to 2cm at time fracture healing. Moreover, shortening up to 6 to 13 mm is not noticeable.¹⁷ Growing children also have ability to remodel malunited fractures. Spontaneous correction of up to 25 degrees of angular deformity has been reported.²² Though rotation deformity usually does not correct, but up to 25 degrees of rotation is well tolerated.²³ In our series, as in others most common problem was shortening of fractured

limb.^{4,5,15,17} Fifteen out of 21 of our patients had shortening of fractured limb, ranging from 0.5 cm to 2.5 cm. Except one patient all had shortening within acceptable limits. Long term results rarely reveal limb length discrepancy.^{15,17} We did not follow the patients properly but hope that shortening will be compensated by overgrowth in the following years.

Complications related to spica cast are rare and insignificant.^{4,17} Nine out of 21 (42.85%) patients had soakage and breakage of spica, but only 2 required change of spica. None of patients needed wedging. Weiss et al have identified peroneal nerve palsy in 4 patients in a series of 110 paediatric femoral shaft fractures treated with early spica cast application.²⁴ All four had 90o/90o cast placed and underwent cast wedging for alignment. Peroneal nerve palsy occurred probably because of pressure on peroneal nerve while doing wedging. In our series no neurologic deficit was seen. This probably was because we kept hip and knee in neutral flexion and none of our patient underwent wedging of cast.

Because of compensatory overgrowth and potential correction of angulation by remodeling process of fractures in children and minor complications related to spica cast, the use of early hip spica immobilization for the treatment of femoral fracture is an attractive alternate to the conventional method of treatment in children up to 11 years of age.

CONCLUSIONS:

Early spica cast is simple, effective and definite method of treatment. Children up to 11 years of age can be safely treated with early spica cast. Early spica cast allows rapid return of child to family environment, thus avoiding prolonged separation from parents. Early spica cast also avoids complications related to traction and operative treatment methods.

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