Original Article

Diaphyseal femoral fractures below the age of six years: Results of plaster application and long term followup

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Abstract

Background: In children less than 6 years, the treatment of femoral shaft fracture is often non surgical, using closed reduction and casting. The literature reports many experience about this type of trauma but none of these has a long term followup. We present a retrospective study on a group of femoral diaphyseal fractures treated nonsurgically in children up to 6 years of age, with a minimum of 10 year followup.

Materials and Methods: 48 cases (36 males/12 females) with femoral diaphyseal fractures treated between January 1988 and December 1998 were reviewed. Patients with fractures due to obstetrical trauma and pathologic fractures were excluded. The mean age of the patients was 3.3 ± 1.1 years (range 5 months-6 years). Right side was involved in 21 cases (44%), and left side in 27 cases (56%). In 34 cases (71%), closed reduction was performed and hip spica was applied with the hip and knee flexed to 45°. In 8 cases (17%), skeletal traction was applied to perform fracture reduction and the traction pin was embedded in plaster while in the remaining 6 cases (12%), the Delitala pressure apparatus was applied after casting.

Results: All fractures healed in our study. There were no complications (infection or vascular nervous issues, axial deviations, consolidation delays, or pseudoarthrosis). In 13 cases (27%), followup examinations showed mean lengthening of 1.3 ± 0.75 (range 0.5-2.5 cm) of the fractured lower limb. All these patients were treated with skin traction before treatment and presented with 2.08 ± 0.28 cm mean initial femoral shortening. In 1 case (2%) with 2.5 cm lengthening, epiphysiodesis of the ipsilateral knee was performed. No patients showed prolonged difficulty with gait disorders.

Conclusion: On the basis of our results conservative treatment of femoral shaft fractures in children can be considered less invasive and safe procedure.

Key words: Cast treatment, pediatric femoral fractures, long term results

Introduction

Diaphyseal fractures of lower limb long bones are a frequent occurrence in paediatric traumatology. In particular, femoral fractures more commonly require hospitalization and therefore represent one of the most expensive types of injury in paediatric patients. Treatment depends on the age of the child, type of fracture and the patient's physical characteristics like age, weight and length of the child.[1] In children less than 6 years of age, fractures of the femur are treated with different nonsurgical methods like casting, skin traction, Pavlik harness. These methods are well documented in literature.[2-5] Nondisplaced fractures can be treated without sedation, whereas, displaced fractures require general anaesthetic and treatment in the operating theatre.

We present a retrospective study on a group of femoral diaphyseal fractures treated nonsurgically in children up to 6 years of age, with a minimum of 10 years followup.

Materials and Methods

We reviewed 48 cases (36 males/12 females) with femoral diaphyseal fractures [Figure 1] treated between January 1988 and December 1998. Patients with fractures due to obstetrical trauma and pathological fractures were excluded from the study. We used four types of treatment namely; immediate casting, delayed casting after a period of skin traction, skeletal traction and pin incorporation into the cast and use of Delitala pressure after casting. The criteria of treatment were determined by a single operator.

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Parents of all patients gave informed consent prior to being included in the study. The study was performed in accordance with the Ethical standards of the 1964 Declaration of Helsinki as revised in 2000.

Four patients (8%) were treated immediately, whereas the remaining 44 patients (92%) previously underwent longitudinal skin traction for a mean 4.8 ± 1.6 days (range 2 days to 8 days). All patients were treated in the operating theatre under general anaesthesia.

In 34 cases (71%), closed reduction was performed and hip spica cast was applied with the hip and knee flexed to 45°. In 8 cases (17%), skeletal traction was applied in the distal methaphysis of femur (avoiding damage to the growth plate) to perform fracture reduction and the traction pin was embedded in the plaster while in the remaining 6 cases (12%), Delitala pressure apparatus was applied after casting [Figure 2].[6]

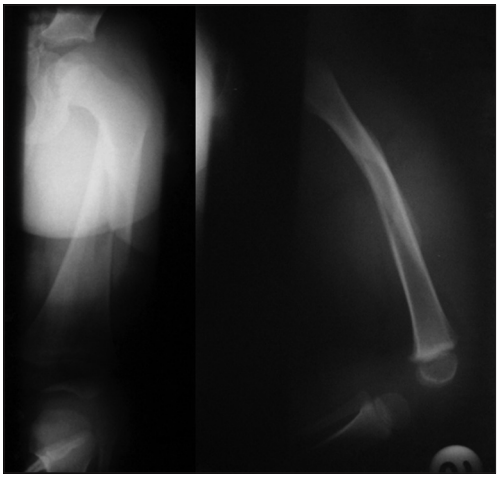

Figure 1: X-ray of thigh with hip and knee joints anteroposterior and lateral views showing femoral fracture in 3 years old child

This method, which is named after the Italian orthopedic surgeon Francesco Delitala, is a device for correcting residual femoral deformities after closed reduction. This is a simple device, composed of a short Kirschner wire and a spring system that permits to increase the pressure of the Kirschner wire tip against the proximal femoral fragment that tends to dislocate. Since its application should be performed after the fracture correction, opening a window in the cast, this was the method that was used in unstable fractures, especially in the older children, in which a more precise correction would have been required.[7,8]

The patients were subjected to a followup physical examination (mainly focused on pelvic asymmetries, limb length discrepancies, axial deviations or rotation defects) The internal or external rotational deformity of the limb was also recorded, evaluating the axial alignment of femur, patella, tibia and foot, both in the supine and standing position and also during walking. We have considered varus/valgus angulation over 10°, internal or external rotation over 5° and shortening over 1 cm as pathological. We examined the patients with X-rays only in case of major limb lenght difference. In case of frontal or sagittal deformities; the grade of deformity were measured using the malalignment test.[4]

The initial deformity at the fracture site and the length of the femur bone were measured by X-rays and clinically. The angle derived from the displacement of fractured fragments and the shortening of the injuried limb was recorded, taking also into account the rotational deformity. Evaluating the axial rotation, we always compare it to the contralateral limb. For measuring the length, we simply adopted a tape measurement, recording the length in centimetres in comparison with the contralateral lower limb.

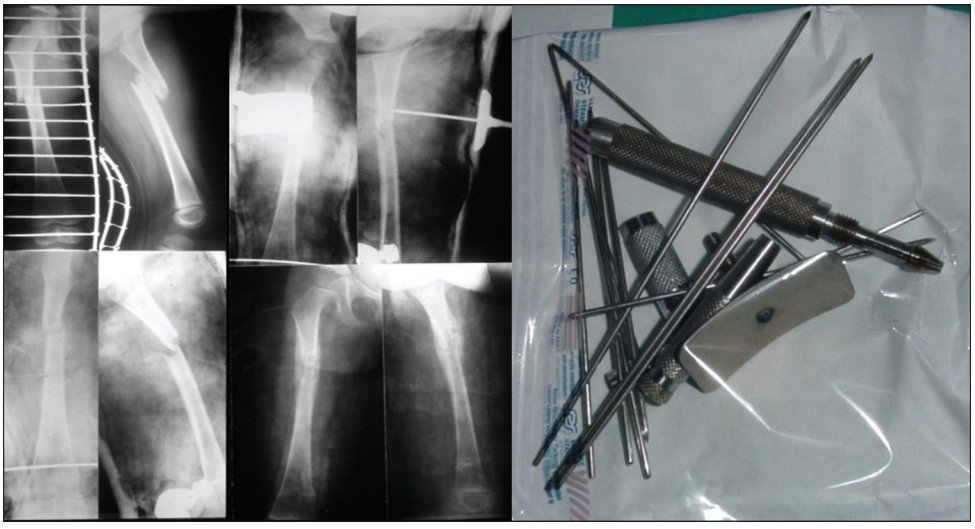

Figure 2: Use of Delitala pressure apparatus after casting

Results

The mean age of the patients was 3.3 ± 1.1 years (range 5 months-6 years). Right side was involved in 21 cases (44%), whereas, left side was affected in 27 cases (56%). The causes of fracture were: road accident trauma; (n = 6), accidental trauma while play (n = 29) and sports trauma (n = 13). The mean theatre time was 46.7 ± 21.7 min (range 30-120 min). The mean followup was 14.3 ± 4.7 years (range 11-21 years). The plaster cast was maintained for an average of 42.05 ± 5.15 days (range 40-60 days).

Fractures healed in all cases [Figure 3]. There were no complications due to infection or vascular nervous lesions, axial or rotational deviations, consolidation delays, or pseudoarthrosis.

In 4 cases (8%), the immediate followup showed valgus deformity of the distal stump, treated with corrective gypsotomy. At subsequent check ups, this deviation had corrected. In 13 cases (27%), followup examinations showed lengthening of the fractured lower limb (mean length 1.3 ± 0.75 cm, range 0.5 cm to 2.5 cm). All these patients were treated with skin traction before treatment and had presented with a mean shortening of 2.08 ± 0.28 cm.

Figure 3: (a) X-ray left thigh with hip and knee joints anteroposterior and lateral views showing femural shaft fracture; (b) X-ray after 7 days showing nonoperative treatment (c) Healing bone callus after 40 days; (d) X-ray results after 17 years

In 1 case (2%) we observed 2.5 cm lengthening of the femur. The limb length increase was found out at 12 months followup and initially was of 1.2 cm; during the next examinations (at 18 and 24 months), we observed an increase up to 2.5 cm. The length was static 2 years after trauma. Epiphysiodesis of the ipsilateral knee was performed using staples; the procedure was performed during the last period of growth to compensate the length discrepancy.

Discussion

Femoral fractures account for about 1.6% of all skeletal lesions in children, with a 2.6:1 male to female ratio and a bimodal distribution with an initial peak in early infancy. According to age, these fractures can occur as a result of the following: newborns: obstetrical trauma, children up to 4 years of age: different types of trauma (30% to 80% due to abuse)[9,10] children over 4 years of age: most frequently, sports trauma, high energy trauma and road accident trauma

The most frequent and disabling long term complications are angular rotational deformities; more rarely, late consolidation, pseudoarthrosis and infections can occur.[11]

There is no concurrence on the limits of tolerance of angular and rotational deformities and femoral shortening in paediatric femoral fractures.[12] 30° malalignment on both planes and 15 mm shortening are generally accepted from birth to the age of 2 years while 10°-15° angular malalignment, 15°-20° rotational malalignment and 20 mm shortening are acceptable up to the age of 6 years.[13] Another parameter to be taken into account and on which there is no consensus is initial fracture shortening. In the opinion of some authors, even fractures initially presenting with >2.5 cm shortening can be successfully treated conservatively,[14] but according to others[15] the risk of limb shortening is 20.4 times as high as in cases presenting >30 mm overlap at the fracture site.

There is considerable agreement on the non surgical treatment of diaphyseal femoral fractures in children up to the age of 6 years who present without any important metabolic disorder since these fractures are frequently stable due to thick periosteum. The application of a spica cast is indicated only for isolated fractures of the femoral diaphysis for children less than 6 years of age, not presenting with >2 cm limb shortening or associated lesions.[16,17] Many reports consider this a reliable means to obtain good fracture stability and to reach fracture healing with correct skeletal alignment, in the absence of major complications (reported case of compartment syndrome) and with a reduced use of the anaesthetic.[18-20]

Some authors recommend considering the characteristics of the fracture (displacement degree, possible comminution) and the child's weight (higher or lower than 80 pounds/35 kg) as the implicating factors when deciding on the type of fracture treatment, be it conservative or surgical. Only in the event of mildly displaced fractures with <2 cm limb shortening, in children weighing less than 80 pounds, should non surgical treatment be adopted.[21]

According to the type of fracture, plaster cast can be applied both in the emergency room and in the operating theatre. The comparison of two homogeneous groups of patients with femoral fracture aged between 6 months and 5 years have shown similar results in terms of quality of fracture reduction and complications. The authors therefore suggest considering plaster cast application in the emergency room, in order to reduce hospital charges.[22] In our series, only four children were treated on an emergent basis. In our opinion it is not possible to compare the two methods in terms of quality and the overall cost of the health care service.

In preschool aged children, plaster cast application allows for a reduction in the length of the hospital stay and a less frequent use of anesthetic in comparison to intramedullary nailing, which obtains similar results in terms of fracture healing and complications.[23]

Over the last few years, there has been an increasing interest in elastic nailing of femoral fractures thus some authors consider it as the treatment of choice for diaphyseal fractures in children from the age of 5 years to puberty. Better results are reported compared to non surgical treatment in terms of reduced healing time, resumption of weight bearing, reduced incidences of complications and a better long term functional outcome.[24-26]

In our study there were no major complications in terms of post treatment limb length discrepancies related to the initial limb shortening, which in patients who developed lengthening, was on average below 2.5 cm (2.08 ± 0.28). In these cases, the application of pre operative skin traction can favour reduction manoeuvers, reducing stress at the fracture site with a lower risk of limb length discrepancies at the end of the development period.

In our opinion, the child's age is an important factor to be taken into account. Although some authors suggest a lower threshold age of 4 years, we consider 6 years as the threshold age for plaster cast application.[27] As in the case of all patients treated at pre school age, the family showed a good level of compliance while the children were equally tolerant of the plaster cast.

In conclusion, albeit the fact that there are still some bones of contention regarding the treatment of femoral fractures in preschool children[28] while some surgeons have recently reported encouraging results of the use of a more aggressive approach, our study allows us to confirm that the treatment of femoral fractures can be carried out non surgically, with a positive long term outcome in children aged from early infancy to the age of 6 years.

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