

Use of immediate hip spica in the emergency room and out patient clinic in treating closed femoral fractures in children

Mohammed Radhi Obaid*

الخلاصة

عشرون طفلاً مصابون بكسر ساق عظم الفخذ المغلق تم شمولهم بدراسة مستقبلية في طوارئ مستشفى الرميثة العام ومستشفى السماوة التعليمي للفترة من شباط 2009 إلى تشرين الثاني 2010. أعمار الأطفال المشمولين تتراوح من 10 أشهر إلى 6 سنة في هذه الدراسة تم وضع خصائص لاختيار الأطفال وهي كالآتي:
العمر اقل من أو 6 سنة، الإصابة بكسر ساق الفخذ المغلق وغير المعقد.
تحت تأثير دواء (الديازبام) الوريدي المسكن تم علاج جميع الحالات بواسطة قولبة العصابة السنبلية الفورية للورك في غرفة الطوارئ أو في العيادة الخارجية. بالاعتماد على المواد المتوفرة والبسيطة وبدون استخدام التخدير العام أو تعريض المريض إلى الإشعاع.
والنتائج كانت الالتئام العظمي للكسر حصل خلال 3-10 أسابيع (معدل 6 أسابيع).
لم تحصل مضاعفات الكسر مثل عدم الالتئام أو الالتئام بصورة غير صحيحة.
من خلال متابعة المرضى فان النتائج النهائية تشير إلى انه لا يوجد مريض يعاني من قصر في الطرف السفلي أو وخلل في المشي. تيبس مفصل الركبة البسيط والمؤقت لوحظ بعد إزالة العصابة السنبلية من الورك في كل المرضى ولكن تم علاجه من خلال مجموعة قصيرة من التمارين البسيطة في البيت.
استنتج من هذه الدراسة أن علاج كسر ساق الفخذ الغير معقد في الأطفال في الست سنوات الأولى من العمر بواسطة قولبة العصابة السنبلية الفورية للورك و دون الحاجة إلى السحب الجلدي أو العظمي المطول في المستشفى هو علاج فعال ورخيص وبسيط ومؤثر.

Abstract

Twenty children with closed diaphyseal fracture femur were included in a prospective study at emergency department of Al-Samawa and Al-Rhumaitha hospitals from February 2009 to October 2010. There were 15 boys (75%) and 5 girls (25%). Their age ranged from 10 months to 6 years. Left femur was fractured in 13 (65%) and the right one in the remaining 7 (35%).

* Diploma, Orthopedic Surgeon, Al-Samawa teaching hospital.

Oblique fractures were the most frequently reported 12 (60%), followed by spiral fractures in 6 (30%), and transverse fractures in the remaining two (10%).

The mechanism of injury was fall at play in 10 patients (50%), road traffic accident (RTA) in 8 (40%), and bicycle accidents in the remaining 2 (10%). Associated soft tissue injuries to other parts of the body had occurred in 4 (20%), all of these were of minor degrees and were treated conservatively.

The inclusion criteria used in this study were a patient with a 6 years or less of age with traumatic closed, uncomplicated diaphysal fracture of femur. All cases were treated by immediate hip spica casting under the sedative effect of intravenous diazepam in the emergency room (ER) and outpatient clinic depending on simple, available facilities without using general anesthesia nor C-arm. The duration of the spica was less than or 45 days in 14 patients, more than 45 days in 6 patients. Bony union was achieved in about 3 to 10 weeks (median 6). There were no instances of malunion, nonunion, or rotational deformities.

At final follow-up, limb length discrepancy was noted in 5 children (25%). Shortening of the fractured limb was 0.5cm in 2 patients, 1cm in 2, and 1.5cm in 1, but none had a discrepancy of greater than 1.5cm or a 'short-legged' gait. Mild degree of temporary knee joint stiffness was noted in all patients immediately following spica removal which had responded fully to a short course of home exercises programs.

The study concluded that immediate hip spica casting in the emergency room without prolonged traction in hospital and without the need of general anesthesia with its known adverse complications is a simple, feasible and cheap method in treating uncomplicated femoral shaft fractures in children in the first six years of age.

Introduction

Femoral shaft fracture in children is one of the common problem facing the orthopedist in our locality since the treatment of these fractures presents special challenges. In addition to smaller size, and the presence of open physes ,the immature vascular patterns must also be considered. Although the potential for rapid healing and remodeling during growth are helpful, the potential of interference with that growth introduces special hazards.

Psychological and social effects play a role in selecting optimal treatments. Both the injury and treatment affect the family unit as a whole in ways that an adult femur fracture may not and a variety of treatment options are now present⁽¹⁾.

Objectives

This study was designed to evaluate the efficacy and safety of immediate hip spica casting in the treatment of femoral shaft fractures in children less than or 6 years old under conscious sedative effect of the diazepam in the emergency room (ER) and outpatient clinic without general anesthesia nor C-arm depending on simple, available facilities and to evaluate the effect of discharge from the emergency room on short term complications.

Patients and methods

20 children with acute traumatic femoral shaft fractures were included in a prospective study. All patients were seen and treated at emergency department of Al-Samawa and Al-Rhumaita hospitals in the period from February 2009 to October 2010. Age ranged from 10 months and up to 6 years.

The inclusion criteria were a patient with a 6 years or less of age with traumatic closed femoral shaft fracture which was diagnosed by history, physical examination and confirmed by radiological studies.

The exclusion criteria include patient's age more than 6 years, multiple fractures, pathological fractures, compound fractures, nondisplaced fractures (buckling or greenstick fractures) , fractures complicated by vascular or neurological injury or femoral shaft

fractures that were associated with another serious injuries that would require operative intervention or monitoring in the intensive care unit.

After initial assessment and resuscitation in emergency room (if needed) ,the child was sent to x-ray department on a Thomas splint. Good quality radiographs of the injured limb and to any other relevant areas in the body to exclude other associated injuries were obtained. The amount of fragment overlap on plain x-ray of the femur was taken into consideration as an indicator of limb shortening.

For fracture manipulation and spica application, in the emergency department an intravenous line was inserted through which diazepam was injected slowly. Sand bags were used under the child buttock to elevate his or her trunk. Two assistants were needed, one to hold the lower limbs straight through continuous traction and the other to stabilize the patient's chest and shoulders .Without fluoroscopy or C-arm, the surgeon would then perform gentle closed reduction using manual traction to restore the general alignment and length of the injured limb to match exactly the non injured limb. The injured limb was kept straight at hip and knee with the ankle in neutral position, it was abducted to 30-40° and a hip spica was then applied from just below the nipples to foot keeping the limb in neutral rotation throughout the whole procedure.

The average time needed to complete the procedure is about 20 minutes. When the child becomes awake and alert, the neurovascular status of the injured limb was assessed and if everything was normal he was discharged home.

The parents were instructed on appropriate cast care. Patients were followed-up in outdoor department at a weekly interval for the 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. If spica had become weak or broken it was reinforced or changed.

Radiographs were taken to note overlapping and angulations at the fracture site. The radiological criteria used to judge the acceptability

of reduction were those described in the standard pediatric fracture textbooks.(Table 1)⁽²⁾describes the parameters based on patient age. The reduction was considered unacceptable if any one of these parameters studied were out of the acceptable range for the patient’s age.

In the second week visit, if the acceptable radiographic appearance was judged, the foot piece of the spica was removed from above the ankle joint to make the foot freely mobile and to prevent further displacement at the fracture site within the cast particularly in spiral fractures . If acceptable alignment was not obtained ,wedging of the cast is performed to correct each specific deformity.

Table 1. Radiographic Criteria for acceptable angulations. Based on patient’s Age.

Age (year)	Varus / Valgus (degrees)	Anterior / posterior (degrees)	Shortening (mm)
Birth-2 years	30	30	15
2-6	15	20	20

At last visit if radiographs showed abundant callus formation bridging and binding the fracture site, the spica was removed and the fractured limb was examined to confirm fracture union clinically. The range of active movements at hip and knee joints were also assessed, together with estimation of the length of the limb by using tape measure. In most cases the shortening was about 0,5cm only. An exercises program to flex the knee gently was taught to the parents to be regularly practiced at home and partial weight bearing started gradually .

All patient's parents had accepted this method of treatment and in one instance a family of a hyperactive child had insisted to extend the duration of the spica for additional 2 weeks to make fracture union too strong to prevent refracture from possible further falling on ground in their child.

Results

Twenty children with closed diaphyseal femoral fractures were evaluated and treated. Male affection in 15 (75%) was greater than the female 5 (25%). In the majority 13 (65%) the left femur was fractured and the right one in the remaining 7 (35%). Site of femoral fracture was in the middle of the shaft in 17 (85%), junction of the middle and proximal thirds in 2 (10%), and junction of the middle and distal thirds in 1 (5%). The fracture line was oblique in 12 patients representing (60%), spiral in 6 (30%), and transverse in 2 (10%). The mechanism of injury was a fall at play in 10 (50%), either from a height in 8 or on the ground in 2, road accidents in 8 children (40%), and bicycle accidents in the remaining 2 (10%). Associated injuries occurred in 4 patients, 2 (10%) with buckle fracture of ipsilateral radius, one (5%) with fracture of the ipsilateral humerus, and the last one (5%) with green stick fracture of ipsilateral distal tibia. All of these were treated successfully by conservative treatment in form of plaster of pairs splinting. Duration of the spica less than or 45 days in 14 patients, more than 45 days in 6 patients. Complications related to spica cast were insignificant soakage and breakage of spica was reported in 5 patients (25%) from whom spica cast was reinforced in 3 (15%) but no patient had required change of spica. None of patients needed wedging. Bony union was achieved at 3 to 10 weeks (median 6). There were no instances of malunion, nonunion, rotational deformities. Angulations was within acceptable limits in all patients at time of the spica removal (table1). No case developed pressure sores or nerve palsies. At final follow-up, limb length discrepancy was noted in 5 children (25%) Shortening of the fractured limb was 0.5cm in 2 patients (10%), 1cm in 2 (10%), and 1.5cm in 1 (5%) (Table 2), but none had a discrepancy of more than 1.5cm or a 'short-legged' gait. Mild degrees of knee joint stiffness was reported initially in all patients which had responded fully to home exercises. The majority of children were back to their pre-injury level of function within 1 to 2 months after spica cast removal. It was not possible to study long-term outcomes in this patient population included in this study.

Table 2 describe the results at time of spica removal.

<i>Clinically after removal spica</i>	Number	%
Limping	20	100
Shortening <2cm	5	25
Knee stiffness	20	100

Discussion

Epidemiological studies of pediatric femoral shaft fractures reveal a bimodal age distribution with peaks occurring at the ages of 2 and 7 years. Fall is the commonest cause of femoral shaft fractures in children younger than 6 years, and boys had >2.5 times the fracture rate of girls⁽¹⁻³⁾ Similar findings were noted in this study.

The management of femoral shaft fractures in children is controversial. Optimal treatment selection requires consideration of fracture, patient, age and family factors.⁽¹⁾ The aim of treatment is to restore length and alignment, and to encourage union and early rehabilitation.⁽⁴⁾ So it is either surgical or conservative treatment, Over the past decade, there has been a shift towards surgical fixation and early spica casting,⁽⁵⁾the choice of treatment in children should include a simple method of immobilization which is comfortable for the child and the family, have fewer complications and inflict minimal psychological trauma for the child and his or her family.⁽⁶⁾

Surgical fixation of femoral fractures is not without risk of complications With plating ,two common complications are implant failure and infection in addition to risk of hardware removal^(7,8). While with flexible intramedullary nails, prominent nail-ends at the entry points are often the source of discomfort, and implant removal is indicated after fracture union. Flexible nails do not control rotation and a hip spica is sometimes used to prevent such rotation at the fracture site. Rigid interlocking intramedullary nails risk producing femoral neck fractures and femoral head osteonecrosis, if inserted antegradely using the standard piriformis fossa entry point. Other complications associated with intramedullary nailing include septic arthritis after nail removal. ^(9,10,11) For external fixation, the principal concern is pin tract infection, delayed or non union and

knee joint stiffness⁽¹²⁾, all these in addition to the risk of general anesthesia.

Many studies have shown good results when pediatric femoral shaft fractures were treated conservatively, and almost any such fracture can be treated without an operation.^(8,9,13)

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.⁽¹⁴⁾ The shortcomings of traction and spica casting are prolonged hospitalization as well as the discomfort of immobilization and psychosocial impact of skin or skeletal tractions and to the lower extent the financial and economic reasons.⁽¹⁵⁾

Many studies comparing early casting versus traction and casting did not show any significant difference in outcomes. There were no rotational inequalities, leg length discrepancies, and gait abnormalities between patients treated with either treatment modality. ^(13,14) Early 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.^(5,2)

Illgen et al ⁽¹⁵⁾ reviewed their results of early sitting spica casting in children younger than age 7 years and reported a 20% loss of reduction and a 15% incidence of significant skin complications.

Thompson et al ⁽¹⁶⁾ reported a 19% unacceptable outcome in 100 patients treated with early spica casting in the operating room. In this study these complications didn't occur.

Martinez et al⁽¹⁷⁾ reported a 43% incidence of shortening greater than 20 mm, while in this study no single child had presented with such shortening, although their study population had an average age of almost 6 years. In all of the aforementioned studies, the casts had been placed in the operating room under general anesthesia, but in this study hip spica was applied immediately under simple conscious sedation. In other descriptive study for treatment of femoral shaft fractures by early spica casting, Basher Ahmed et al⁽¹⁸⁾ found that at removal of spica cast, shortening of fractured

limb in the average of 0.5cm to 2.5cm was seen in 71.4% of cases. In this study shortening less than 2cm had occurred in only 5% of cases which was acceptable.

Weiss et al⁽¹⁹⁾ had identified peroneal nerve palsy in 4 patients in a series of 110 paediatric femoral shaft fractures treated with early spica cast application. All four had 90° /90° cast placed and underwent cast wedging for alignment. Peroneal nerve palsy occurred probably because of pressure on peroneal nerve while doing wedging. In this study no neurological deficit was seen. This probably was because the hip and knee were kept in neutral flexion and none of patients underwent wedging of cast.

In our series and as in others, 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.^(20,21,22) This overgrowth phenomenon following femur fracture has allowed acceptance of shortening up to 2cm at time of fracture healing and accurate anatomical reduction of these fractures is usually not achievable, if possible then it results in an increase in the length of the injured limb , hence end to end apposition should be avoided . Moreover, shortening up to 6 - 13mm is not noticeable⁽²³⁾ . Growing children also have ability to remodel malunited fractures. Spontaneous correction of up to 25 degrees of angular deformity has been reported.⁽²⁴⁾ Though rotation deformity usually does not correct, but up to 25 degrees of rotation is well tolerated.⁽²⁵⁾

Compartment syndrome also is a rare complication and has been described after various treatment methods used for pediatric femur fractures, including both skin and skeletal traction.^(26,27) Large and Frick ⁽²⁸⁾ reported the only 2 cases of compartment syndrome developing after spica casting for pediatric femur fractures . In both cases, spica placement was performed in the operating room under general anesthesia. The authors concluded that compartment syndrome developed especially from excessive pressure on the posterior calf by the below the knee aspect of the cast. Ezequiel H. Cassinelli et al⁽²⁹⁾ believe that educating the caregiver about the

signs and symptoms of both of these syndromes should be undertaken, and inpatient monitoring should be performed for those with suspicious clinical findings on presentation (asymmetric pulses, significant swelling). No patient in this study developed compartment syndrome. The author of this study thinks that because of careful choosing of the child with or less than 6 years age with un-complicated fracture shaft femur and closed follow up and repeated clinical and radiological examination specially during the first three weeks, such major complications can be avoided. In conclusion, by using immediate hip spica casting in the treatment of the diaphyseal fractures of femur in children less than 6 years old, satisfactory results can be obtained, and at the same time avoiding the longer hospital stay, specially in our locality where there is a shortage of hospital beds. All complications of prolonged traction, risks of general anesthesia and risks of the radiation specially on this age group are also avoided.

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