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Outcome of non-operative management of femoral shaft fractures in children

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ABSTRACT

Background: Femoral shaft fractures are common injuries in childhood. There is paucity of information on their presentation and outcome of the available treatment methods in the African population. This study evaluated the outcome of non-operative methods of treatment of femoral shaft fractures in our centre. **Patients and Methods:** A retrospective review of the database of children aged 14 years and below with femoral shaft fractures treated non-operatively over a 10-year period. **Results:** A total of 134 patients with 138 fractures met the study criteria. This consisted of 71 boys (mean age = 6.1 years ± SD) and 63 girls (mean age = 6.5 years ± SD). Pedestrian vehicular accident was the most common cause of femoral shaft fractures in the study population. The midshaft was the most common site of fractures. There were associated injuries to other parts of the body (especially head injury) in 34.3% of the patients. The commonest mode of treatment was skin traction only (87.7%). The mean time to fracture union was 4.9 weeks ± SD (range = 3–15 weeks). The mean length of hospitalisation was 6.7 weeks ± SD (range = 5 days–11 weeks). There was a fairly strong positive correlation between the length of hospitalisation and the presence of associated injuries, especially head injury, upper limb fractures and bilaterality of the fractures. The mean total cost of treatment was #7685 (Naira) or $51.2 (range = $14.2–$190). At the last follow up, 97.8% of the fractures united without significant angulation or shortening. **Conclusion:** The outcome of non-operative treatment of femoral shaft fractures in our setting is comparable to the results of other workers. Methods of treatment that shorten the length of hospitalisation without unduly increasing cost should be encouraged.

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INTRODUCTION

Femoral shaft fractures are common injuries in childhood, accounting for about 1.6% of all bony injuries in children[1] and about 33.7% of long bone fractures.[2] Various studies have estimated the incidence of femoral shaft fractures at approximately 1% of children under the age of 12 years.[3] These fractures heal rapidly and minimal angulation and overlap or shortening tend to correct with remodeling. Nonunion is almost unknown. There is still no consensus on the best method of managing these fractures in children. It is believed that neither conservative nor operative method gives better results, especially in the long term.[4] The costs of non-operative and operative treatments of paediatric femoral fractures have been compared by many authors, but no clear consensus has been reached.[4,5] The choice of management is influenced by age and size of the patient, location and site of the fracture (fracture personality), associated injuries or multiple trauma, social circumstances or family issues and cost.[6-8] The treatment options include non-operative management with home traction,[9,10] immediate spica cast application[11,12] or a short period of traction followed by spica cast[13,14] and operative management with external fixation,[15-17] flexible intramedullary nailing[18,19] and plate fixation.[20,21]

We treat paediatric femoral fractures with skin traction only or a short period of skin traction followed by plaster of paris hip spica cast in our centre. There is a paucity of data on the outcome of non-operative management of paediatric femoral shaft fractures in Africa. This study is aimed at evaluating the results of these non-operative methods of managing femoral shaft fractures in our setting and factors that influence outcome.

PATIENTS AND METHODS

Children aged 14 years or younger admitted and treated for femoral shaft fractures at the Orthopaedic and Trauma service of our hospital from January 1998 to December 2007 were the subjects of this study. The hospital is a 580-bed tertiary referral centre consisting of two hospital units serving a population of about 3 million people in a low income country. The Department of Orthopaedic Surgery and Traumatology is a 56-bed service, including a 20-bed Children's Orthopaedic Ward.

Excluded from the study were pathological femoral shaft fractures (from osteomyelitis, metabolic bone disorders or bone cysts) and open fractures. Information obtained from the case notes were the socio-demographic features like age, sex, parents' occupation and school status. Other informations were the cause of fracture and time from fracture occurrence to presentation in hospital. A documentation of any associated injuries to other systems was also made. After full resuscitation, an antero-posterior and lateral radiographs of the femur were taken to confirm the fracture and define the pattern (site of fracture, pattern, degree of comminution and displacement). Skin traction was then applied from the ankle to just above the knee, depending on the site of the fracture [Figure 1]. Weights were attached to the skin traction based on the weight and age of the patient. Each patient's weight was determined by first measuring the mother's weight (M) and the weight of the mother carrying the child in her arms (M + C) and then subtracting M from M + C. The exact amount of weight was determined clinically by measuring the length of the injured limb and comparing it with the uninjured leg. Progressively increasing weights were added to the traction until the limb lengths were equal.



Figure 1: A child with femoral shaft fracture in skin traction on Thomas' splint with weights attached

On some occasions we utilised a mobile X-ray to confirm reduction and adequacy of the traction. The limb, with traction, was usually rested on either Thomas' splint or Bohler-Braun frame depending on the level of the fracture. The pressure areas (ischial tuberosity, knee and malleoli) were checked regularly. Limb lengths were measured weekly and radiographs of the injured femur taken every 2 weeks to assess fracture healing and maintenance of reduction. Fracture union was confirmed clinically (palpable bony hard, non-tender mass with no demonstrable movement at the fracture site) and radiologically and limb lengths were measured and recorded. The patients were usually discharged to ambulate with crutches except in children 4 years or younger who could not use crutches. Every patient was followed up in the outpatient clinic at 4-weekly intervals until resumption of full weight bearing and full activities of daily living and thereafter every 6 months for 2 years.

Outcomes that were assessed were (1) length of hospitalisation, (2) duration of fracture union, (3) time to walking with aids, (4) time interval between discharge and commencement of walking with aids in those who could use them, (5) time interval between discharge by the surgeons and departure from hospital (after paying the bills), (6) time to full weight bearing, (7) cost of treatment and (8) complication(s) of fracture union (malunion-shortening and angulation). The cost of treatment was arrived at by using our Hospital Charges Assessment Sheet usually kept in each patient's file. The estimated cost of treatment only included those items in the assessment sheet, i.e., the cost of admission, physiotherapy, drugs, including skin traction kits and other accessories, X-rays and other laboratory tests, cost of treatment of any complications and the follow up in the outpatient orthopaedic clinic. The cost of transportation and other incidental expenses were not included because patients were referred to our centre from variable distances and locations in the country. In addition, the cost of treating other associated injuries like fractures of other bones other than the femur and head and thoracic injuries affected our accurate assessment of the cost of treatment of femoral shaft fractures in our study population.

Malunion was defined as (1) angular deformity of ≥10 on antero-posterior X-ray film or ≥15° on lateral X-ray film and (2) a limb length discrepancy of 1 cm or more. We regard the clinical end point as a healed femoral shaft fracture and a full return to full activity at the final follow-up visit. The collected data were analysed using the Statistical Package for Social Sciences (SPSS)

Version 16.0. Association between some variables and outcome was assessed using the Pearson correlation coefficient (*r*).

RESULTS

A total of 173 patients were treated for femoral shaft fractures during the study period. Out of these, 134 patients with 138 femoral shaft fractures satisfied the study criteria. These consisted of 71 males (53%) with a mean age 6.1 years ± SD (range = 40 days–14 years) and 63 females (47%) with a mean age of 6.5 years ± SD (range = 8 months–13 years). The peak incidence in males was in the 2–5 year age group (35/71) and 6–10 year age group in females (27/63) (P = 0.1100). Forty one (57.7%) of the male children and 44 (69.8%) of the female children were of school age. Seventy seven percent of the children were from parents of low socio-economic status (peasant farmers, petty traders and artisans). Pedestrian vehicular accident (caused by either a car or motorcycle knocking down a child as he/she crossed the road) was the commonest cause of femoral shaft fractures in the study population (56.7%). This cause was followed by falls during sports or from heights (33.6%). Other causes were heavy objects like collapsed walls or tables falling on the children's thighs (6.7%) and babies falling off the arms of their mothers (3%). The mean interval between injury and presentation for treatment was 3 hours (range = 10 minutes–6 days). Twenty six of the patients (19.4%) presented with packed cell volume less than 30%. The midshaft was the commonest site of fractures (53.6%), followed by the proximal third (38.4%) and distal third (8%). The fracture line was transverse [Figure 2] in 38.4%, oblique in 26.1%, spiral [Figure 3] in 24.6%, comminuted in 10.1% and greenstick in 0.7%. There was significant displacement and angulation in 50% of the fractures. Forty six children (34.3%) presented with associated injuries to other parts of the body. The commonest were abrasions or soft tissue injuries (19 patients) and head injury (18 patients). Four patients had a combination of head injury, rib fractures, and tibia and fibula fractures in addition to femoral shaft fractures. These were treated in conjunction with the neurosurgeons and cardiothoracic surgeons. Ipsilateral tibia and fibula fractures were usually immobilised in plaster of paris cast incorporating either a transtibial Steinmann's pin or the spreader and cords of a skin traction kit at the ankle (Chanley's traction) for the femoral traction.

The commonest method of treatment of femoral shaft fractures in our study population was skin traction only (87.7%) [Figure 1]. Other methods of treatment were skin traction for 3 weeks or less followed by spica cast (5.8%), Gallow's splint (3.6%), skeletal traction (2.2%) and spica cast only (0.7%). The mean time to fracture union was 4.9 weeks ± SD (range = 3–15 weeks). The fracture that took 15 weeks occurred in a patient with sickle cell disease who was knocked down by a motorcycle. The mean length of hospitalisation was 6.7 weeks ± SD (range = 5 days–11 weeks). The time to independent walking was 10.6 weeks ± SD (range = 8–16 weeks). The mean time from fracture union to obtaining walking aids was 0.9 week (range = 0–7 weeks). There was a fairly strong positive correlation between the length of hospitalisation and the presence of associated injuries especially head injury (r = 0.65), upper limb fractures (r = 0.72) and bilaterality of the fractures (r = 0.43). The mean time from fracture union to the patient leaving the hospital was 1.4 weeks ± SD (range = 0–7 weeks). This was influenced by the parents' socio-economic status (r = −0.63). The mean total cost of treatment was #7685 (Naira) or $51.2



Figure 2: Transverse femoral shaft fracture in an adolescent with marked displacement and overlap



Figure 3: Radiological union of a spiral fracture in a pre-school child, enough for patient to bear weight, after 4 weeks in skin traction

(range = $14.2–$190). Hospitalisation and traction was the costliest [mean = N7720 (N2858–N28,470)]. The mean cost of traction for 3 weeks followed by spica cast was N3798; outpatient spica cast was N2135 while the mean cost of Gallow's traction (home traction) was N2130. We could not compare the outcome and the cost of treatment among the different treatment methods because of the small number of forms of treatment other than skin traction. Two patients had a re-fracture which united after 3 weeks of further traction and two patients experienced allergic skin reaction to the skin traction kit. Significant angulation occurred in four fractures (2.9%) while 16 (11.6%) had shortening of 1.5–4 cm (eight fractures had ≥2 cm shortening).

The frequency of malunion, especially shortening, was related to the age of the patients [all the 16 fractures with a shortening of more than 1 cm were 7 years or older (range 7–12 years)], the degree of displacement of the fracture fragments at presentation and associated head injuries and ipsilateral tibia and fibula fractures. Overall, 118 fractures (85.5%) united without angulation or shortening at discharge from hospital [Figures 4 and 5]. This increased to 135 (97.8%) at the last follow up. Patients with persistent shortening were given a shoe raise to equalise the limb lengths.

DISCUSSION

Femoral shaft fractures in children have been managed by many methods (non-operative and operative) with none of the methods giving superior long-term outcome.[4,5] There is therefore no consensus on the preferred method of treatment, though operative method is increasingly becoming popular, especially in older children.[4,7,21] Internal fixation with flexible intramedullary nails is especially useful for skeletally immature children older than 6 years of age with transverse fractures in the middle 60% of the femoral diaphysis[22,23] Operative method of treatment of paediatric femoral shaft fractures is resource intensive, being one of the most expensive injuries to treat in childhood.[21,24] However, studies have shown that children whose femoral shaft fractures were treated with titanium elastic intramedullary nails achieved their milestones significantly faster than those that achieved by children whose fractures were treated with traction and cast.[7]

Many parents in resource-limited health care setting like ours find it difficult to finance operative methods of management of femoral shaft fractures as they may have to wait for weeks looking for funds, thereby increasing the length of hospitalisation before surgery.[25] This is because most parents have to pay for the treatment of their children as there is no health insurance for majority of the populace, including children.

Non-operative forms of management like early spica cast application and skin or skeletal traction remain the best and most cost effective methods in pre-school children.[4,10,12,26,27] Seventy-seven percent of our study population were children of parents of low socio-economic status who could not afford operative management. It is therefore not surprising that the most common modality of treatment of paediatric femoral fractures in our setting was skin traction (87.7%) [Figures 3–5]. We hardly needed to use skeletal traction, only when there was allergic reaction of the skin to the zinc oxide plaster or skin traction was technically difficult as a result of extensive abrasion in the leg. Hip spica casting, after a short period of skin traction (usually 3 weeks), was utilised in only 5.8% of our study population. This was limited by the level of



Figure 4: Same fracture as in Figure 3 showing good external bridging callus after 6 weeks in skin traction



Figure 5: Good radiological union of a femoral shaft fracture in a toddler after 4 weeks in skin

education and understanding of most parents and thus their ability to manage a child with hip spica at home. Early spica application has the advantage of shorter hospital stay and overall lower cost of treatment.[4,13,14] This modality is especially useful in children aged 1–6 years who sustain isolated low energy femoral shaft fractures.[7,11-14]

Home traction with Gallow's splint was another non-operative method used for the treatment of femoral shaft fractures in this study (3.6%). This was used for children below 2 years and weighing not more than 10 kg. The children were usually admitted for about 5 days to stabilise them and teach the parents what to observe (especially the neurovascular status of the limbs) in the child at home. Home traction treatment programmes have the shortest length of hospitalisation, and thus a rapid return of the child to his or her natural environment and the lowest cost.[9,10]

The duration of fracture union in our study (about 5 weeks) was not higher than the average in most reports, except in patients with co-morbidities, especially sickle cell disease. Union has really never been a problem in paediatric femoral fractures.[7] The main challenge is malunion, especially angular deformity, rotational malunion and leg length discrepancy. Though 11.6% of our study population had a shortening of 1.5–4 cm while 2.9% had significant angulation at discharge from hospital, the malunion rate reduced to 2.2% at the last follow up.

The major challenge and drawback of skin traction in hospital is the unduly long hospitalisation. The mean length of hospitalisation in this study was 6.7 weeks. This was further prolonged by the time it took for the patients to acquire and learn ambulation non-weight bearing with crutches and the presence of associated injuries. It took some of our patients a mean of 0.9 week to acquire crutches. Only children too young to use crutches and those of affluent parents departed home immediately after discharge from the hospital. The influence of associated injuries on the length of hospitalisation has been documented by Wilson *et al*.[24]

The length of hospitalisation in this study was rather quite long considering the fact that more than half of the patients were of school age. This means loss of about a third of a school year. In addition, the impact of hospitalisation of a child on the family as a whole during the period of hospitalisation may be unpleasant. Methods that shorten hospital stay like home traction for toddlers and a short period of traction followed by hip spica should be encouraged in our setting. Facilities for flexible intramedullary nailing, especially image intensifier fluoroscopy, should be made available in most centres that treat paediatric orthopaedic trauma cases in resource-constrained environments. Some surgeons have reported good results with the use of cheap materials like Kirschner wire for intramedullary nailing of femoral shaft fractures in children[28,29] Furthermore, a wider coverage for health insurance than it is at present would ensure that children who require operative treatment receive it promptly.

Though we could not compare the total cost of treatment among the different treatment methods due to the small number of patients treated with methods other than skin traction, the overall cost of treatment was lowest for children treated by a short period of traction before spica cast. The mean cost of treatment of US$ 51.2, though looks very low, is quite a significant cost in an environment with low per capita income. Furthermore, many studies[30,31] have shown that non-operative methods of treatment of paediatric femoral fractures are more expensive than operative methods when everything is taken into consideration.

In conclusion, the results of non-operative treatment of femoral shaft fractures in our setting are comparable with the results of other workers. Further studies are needed to compare the outcomes of non-operative with operative methods of treatment of femoral shaft fractures in our environment. For this, paediatric orthopaedic centres in underserved communities need to be adequately equipped. There is an urgent need to train more paediatric orthopaedic surgeons in our part of the world.

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