ORIGINAL ARTICLE

Management of Femoral Shaft Fractures in Children with Skeletal Traction Followed by Hip Spica Cast Versus Flexible Intramedullary Nailing

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ABSTRACT

Background: The treatment of femoral shaft fractures has always been a focus of interest especially in children, but may still remain a clinical problem and a subject of controversy.

Objective: To compare the post-operative outcomes of hip spica and flexible intramedullary nails in treatment of femoral shaft fractures in children.

Material & Methods: Randomized controlled trial conducted for six months at Department of Orthopaedics Bahawal Victoria Hospital Bahawalpur. A total of 112 children, 6–12 years old, with simple femoral-shaft fractures were randomized to receive skeletal traction followed by hip spica cast (*n* = 56) or FIN (*n* = 56). Length of hospital stay, time to start independent walking, and range of knee motion were compared between the two groups 4 months after injury.

Results: The two groups were similar in background characteristics. Compared with the children treated with spica cast, those treated with FIN achieved their recovery milestones much earlier. Children treated with FIN had shorter hospital stay (6.25+_2.41days) as compared to hip spica group (22.71+_3.17 days) and took a shorter time to start walking independently (37.23+_7.22) as compared to hip spica group (73.04+_10.24). Range of knee motion was 131.73 ± 5.2° in the spica cast group and 135.84 ± 5.39° in the FIN group at the end of 4 months. Complication rate was much less with FIN and overall patients and parents satisfaction rate was higher.

Conclusion: The results showed significant benefits for FIN compared with traction and hip spica cast and complication rates associated with hip spica cast was also higher than that associated with FIN.

Keywords: Spica cast, flexible intramedullary nailing, Femoral-shaft fracture, Pediatrics.

INTRODUCTION

The femur (thigh bone) is the longest, strongest, largest and heaviest tubular bone in the human body, and one of the principal load-bearing bones in the lower extremity. Femoral shaft fractures are among the most common major injuries that an orthopedic surgeon will be required to treat and these fractures often result from high-energy forces associated with possible multiple system injuries.[1] Femoral shaft fractures accounts for up to 62 % of all femur fractures in children[2]. The annual incidence is 19 fractures per 100,000 children in the United States. Automobile accidents account for 90% of femoral shaft fractures in children.[3]

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Femoral shaft fractures can lead to a major physical impairment, not because of disturbed fractured healing, but rather due to fracture shortening, fracture malalignment, or prolonged immobilization of the extremity. Even minor degrees of shortening and malalignment can eventuate in a limp and posttraumatic arthritis. The art of femoral fracture care is a constant balancing of the often-conflicting goals of anatomic alignment and early functional rehabilitation of the limb.

Until now, a variety of treatment methods have been used, but none of them is the standard method. In the past, almost all of these fractures have been treated conservatively by traction and spica cast.[4] Fractures in infants (0–18 months) may be treated successfully in a Pavlik Harness. Spica casting is safe and effective in children up to about 6 years or 100 pounds.[5] For children more than 11 years age it is by surgery, but there is no agreement on definite method of treatment

between ages 6-12 years and both non operative and surgery with internal or external fixation can be used.[6]

Traction followed by casting has historically been very successful in managing fractures of the femoral shaft in children but it has lot of undesired outcomes in the form of longer hospital stay, leg length discrepancy, and unacceptable angulations which may not be tolerated by agitated child or parents.[7]

Currently, with the development of new fracture implants and systems, the management methods have created a shift in the care of femoral shaft fractures from strictly nonsurgical care to surgical stabilization. During the last ten years, flexible intramedullary nailing has become a popular method of fixation of pediatric femoral fractures.

Operative management of fracture shaft of femur in children is becoming a preferred option because of the fact that there is decrease incidence of malunion, shorter hospital stay, lesser surgical cost, better nursing care and early ambulation.

Literature review indicates that hospital stay is more with traction and casting (20.5 ± 5.8 days) and is much less with flexible intramedullary nailing (6.9 ± 2.9 days). Children treated with flexible intramedullary nails walked sooner (35.2 ± 13.2days) as compared to traction and casting (80.0 ± 10.1 days). The range of knee motion was 138.7 ± 3.4° in the spica cast group and 133.5 ± 13.4° in the flexible intramedullary nailing group.[8] This shorter hospitalization and early mobility due to operation has psychological, social, educational, and economic advantages over conservative treatment.

MATERIAL AND METHOD

Study Design: Randomized controlled trial.

Setting: Orthopedic Complex in Bahawal Victoria Hospital Bahawalpur.

Duration of Study: 6 months after approval of synopsis.

Sample Size

A total of 112 Patients with femoral shaft fracture were divided into two groups A (hip spica group) and group B (FIN) comprising of 56 patients each. $\alpha = 0.05$ and a power of 80% with the consideration of range of knee motion was 138.7 ± 3.4° in the spica cast group and 133.5 ± 13.4° in the flexible intramedullary nailing group.

Sampling Technique: Non-probability purposive sampling.

Patients of both gender, age range from 6 to 12 years, patients with fracture location from a point 5cm distal to lesser trochanter and 5cm proximal to distal epiphysis, patients with fracture pattern (simple, transverse, oblique or spiral) and close and grade 1 fracture according to Gustillo classification were included in this study.

Patients with pathological fractures, fractures with preexisting neuromuscular conditions, associated injuries (head injury, abdominal injury and other limb injury), patients with fracture more than two weeks and failed hip spica treatment were excluded from the study. Total 112 patients with femoral shaft fracture was included in this study. All the patients received general resuscitation and underwent temporary stabilization of the femur fracture through non-invasive traction. Patients were equally divided into two groups. Patients of Group A managed with hip spica and patient of Group B managed with flexible intramedullary nailing.

Group A (Hip Spica Group) management

In the operating room, under local anesthesia after the insertion of a 3 or 4 mm Steinman pin into proximal tibia by an Orthopaedic surgeon who had post fellowship experience of three years, then 90-90 skeletal traction and leg support with sling was applied. Serial radiographs determined proper reduction status. Following primary callus formation and early union that was characterized by loss of pain, tenderness and motion at the fracture site, pin was removed and $1\frac{1}{2}$ spica cast was applied (after three weeks). Cast was applied for six weeks then three weeks course of physiotherapy was done.

Group B (Flexible Intramedullary Nailing Group) management

In the operating room under G/A on a fracture table, traction was applied under image intensifier to reduce the fracture. Two nails were used in each patient. Nails were inserted retrograde (1 cm proximal to distal growth plate of femur from medial as well as lateral surface), and ante grade way (both nails were inserted on lateral surface of femur 1 cm below the greater trochanter). An orthopedic surgeon having more than three years post fellowship experience performed procedure. Post-operatively, all patients had antero-posterior (AP) and lateral radiographs prior to discharge from hospital. Patients were followed in OPD after every 15 days by a consultant.

Final outcome of both groups was assessed and entered in pre-designed proforma at twelve[12] weeks in

the form of mobility with full weight bearing and knee ROM.

All the data were entered in SPSS version 17 and analyzed. Mean and standard deviation was calculated for numerical data. Frequencies and percentages were calculated for categorical data. T test was used to compare the means of outcome variables of both groups. P values ≤ 0.005 was as considered significant.

RESULTS

Mean age of the patients in Group A was 8.32 ± 1.78 and in Group B was 8.54 ± 1.93 years while minimum age was 6 years and maximum age was 12 years in both groups.

Out of 56 patients of Group A, male were 40(71.4%) and female were 16(28.6%). Out of 56 patients of Group B, male were 36(64.3%) and female were 20(35.7%). (Table No.1)

Both groups were similar in background characteristics. Mean hospital stay In Group A was 22.71 ± 3.17 days. Mean hospital stay in Group B was 6.25 ± 2.41 days. Significant difference in mean hospital stay was found in both groups. P. values 0.00. (Table No.2)

Table No.1: Group wise gender distribution

Group	Gender		Total
	Male (%)	Female (%)	
Group A	40 (71.4%)	16 (28.6%)	56
Group B	36 (64.3%)	20 (35.7%)	56
Total	76	36	112

Table No.2: Comparison of means of outcome variables

Outcome	Group A	Group B	P value
Hospital stay	22.71±3.17	6.25±2.41	0.00
Mobility	73.04±10.24	37.23±7.22	0.00
Range of motion	131.73±5.20	135.84±5.39	0.00

Patients who were treated with FIN walked sooner as compare to the hip spica group. Mean mobility duration was 73.04 ± 10.24 in hip spica group and there was much shorter time required to the patients who were treated with FIN i.e 37.23 ± 7.22. Significant difference was found in mean duration of mobility. $P < 0.00$. (Table No.2)

Range of knee motion was 131.73 ± 5.2° in Group A and 135.84 ± 5.39° in Group B, at the end of 4 months and significant difference between mean range of knee motion was fond in both groups. $P < 0.00$. (Table No.2)

DISCUSSION

Femoral shaft fractures in children are common being third commonest (21.7%) in order of frequency after forearm (33.23%) and supracondylar area of humerus (31.18%). [9] It is found to comprise 15.15% of all fractures in a study conducted and published in 2008.[10] Epidemiological studies of pediatric femoral shaft fractures reveal a bimodal age distribution with peaks occurring at the ages of 2 and 7 years. Boys have 2.5 times the fracture rate of girls[11] and similar findings were noted in this study.

The management of femoral shaft fractures in children is controversial. Some suggest a management algorithm based on age: Conservative management for children aged one to 5 years, surgery for children older than 11 years.[11] Children between 6 to 12 years belong to the controversial age group for which there is little consensus, but a shift towards surgical intervention is evident.[12] Traditionally, femur fractures in children of all ages had been treated by an initial period of traction, often until the appearance of callus on the radiograph, followed by a spica cast until solid union is achieved. In 1959, Daameron and Thompson reported use of an immediate spica cast, without traction for femur fracture in 100 patients aged 6 weeks to 14 years.[13]

Although spica casting with skeletal traction is traditionally used for femoral-shaft fractures in children, recent studies have shown its possible effects on social, economic, educational, and emotional costs. In contrast, flexible intramedullary nailing of femoral-shaft fractures has gained extensive popularity because of its better clinical and psycho-socioeconomic outcomes with lower risk of complications.[14] In our study, we showed the benefits of the FIN surgical method versus traction and spica casting with respect to hospital stay, time to start walking independently, and knee range of motion. Our findings were in agreement with the results of many studies that showed the efficacy and benefits of flexible nails for treating femoral-shaft fractures. Ligier et al[15] used elastic intramedullary nail (anterograde or retrograde) with Kirschner wires or pins. They reported more desirable outcomes in >120 femoral-shaft fractures

treated with TEN. In Reeve et al.'s study[16] 41 patients with femoral fractures were treated with traction and casting, and 49 cases underwent intramedullary-nailing surgery. They showed complications were higher in the traction and casting group in comparison with the group undergoing surgery.

In our study, the duration of hospital stay was significantly longer in the traction and spica cast group than in the FIN group. This is in conformity with other studies[16-18], which reported shorter hospital stays with FIN/TEN.

Our findings showed shorter time to start walking with support or independently in the FIN group compared with the spica-casting group. It is probably because of better contact of the fracture surfaces and anatomical reduction in patients who underwent FIN surgery. Such earlier recovery milestones have also been shown by Greisberg et al and Flynn et al.[18]

There was slight restriction of knee range of motion initially in FIN group but at the end of 4 months it was better than hip spica group. Another complication we had in FIN group was pin tract infection at the nail entry site. Again this was minor and settled with one-week course of oral antibiotic (augmentin).

Our study had certain limitations. Treatment cost, limb length discrepancy, and angulations degree were not measured in either group. We did not come across any case of non-union and majority of our patients had solid union by 4 months.

CONCLUSION

In children 6-12 years of age, flexible intramedullary nailing for simple close or grade 1 open femoral shaft fractures is a safe and cost effective method with excellent results in term of hospital stay, early mobility and better knee range of motion as compare to the traction followed by hip spica cast. In children of this age group hip spica also has good results in terms of union and cost effectiveness but such prolonged immobilization stresses the child and the family with missed school and interrupts social and educational development.

REFERENCES

1. Iqbal M, Manzoor S, Cheema GM, Ahmed E. Comparative study of fracture shaft of femur in children treated with titanium elastic nail and early external fixator Ann King Edward Med Uni. 2010;16(2):82-6.
2. Rewers A, Hedegaard H, Lezotte D. Childhood femur fractures, associated injuries, and sociodemographic risk factors: a population-based study. Pediatrics. 2005;115:543-552.
3. Loder RT, O'Donnell PW, Feinberg JR. Epidemiology and mechanisms of femur fractures in children. J Pediatr Orthop. 2006; 26:561-566.
4. Ferguson J, Nicol RO. Early spical treatment of pediatric femoral shaft fractures. J Pediatr Orthop. 2000;20:189-92.
5. Anglen J, Choi L. Treatment options in pediatric femoral shaft fractures. J Orthop Trauma.2005;19:724–733.
6. Flynn JM, Luedtke LM, Ganley TJ, Dawson J, Davidson RS, Dormans JP, et al. Comparison of titanium elastic nails with traction and a spica cast to treat femoral fractures in children. J Bone Joint Surg Am. 2004;86-A:770–7.
7. *Mehdinasab SA, Nejad SAM, Sarrafan* . Short term outcome of treatment of femoral shaft fractures in children by two methods: Traction plus casting, Versus intramedullary pin fixation – A comparative study Pak J Med Sci.2008;24:147-51.
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. Santavirta S, Konttinen YT, Nordstrom D, Makela A, Sorsa T, Hukkanen Ma et al. Immunologic studies of nonunited fracturs Acta Orthop Scand. 1992;63:579-586.
10. Canale ST. Fractures & Dislocations in children. In: Canale ST, James HB, Campbell's operative orthopaedics. 11th Ed. Philadelphia: Elsevier 2008;1651-66.
11. Aziz A, Haider T. Treatment of Closed Femoral diaphyseal fractures in children by pins and plaster technique: A prospective study. Pakistan postgrad Med J.2001;12:12-4.
12. Dameron TB, Thompson HA. Femoral Shaft fractures in children treated by close reduction and double spica cast immobilization. J Bone Joint Surg Am. 1959;41-A:1201-12.
13. Wright JG. The treatment of femoral shaft fractures in children: a systematic overview and critical appraisal of the literature. Can J Surg. 2000;43:180–189.
14. Ligier JN, Metaizeau JP, Prevot J. Closed flexible medullary nailing in pediatric traumatology. Chir Pediatr.1983;24:383–385.
15. Reeves RB, Ballard RI, Hughes JL. Internal fixation versus traction and casting of adolescent femoral shaft fractures. J Pediatr Orthop. 1990;10:592–595.

16. Herndon WA, Mahnken RF, Yngve DA, Sullivan JA. Management of femoral shaft fractures in the adolescent. J Pediatr Orthop. 1989;9:29–32.
17. Greisberg J, Bliss MJ, Eberson CP, Solga P, d'Amato C. Social and economic benefits of flexible intramedullary nails in the treatment of pediatric femoral shaft fractures. Orthopedics. 2002;25:1067–1070.