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Frequency of Shortening in Femur Shaft Fractures Treated by Hip Spica Casting in Children

Inam M[1], Orakzai RA[2], Kamal A[3*], Shabir M[4] and Ali MA[5]

[1,4,5]Department of Orthopedic and Trauma, Medical Teaching Institute Lady Reading Hospital Peshawar Pakistan

[2]Conslutant Orthopedic Surgeon, District Head Quarter Hospital Nowshera KP Pakistan

[3]Department of Peads Surgery, Medical Teaching Institute Lady Reading Hospital Peshawar Pakistan

[*]Corresponding author:

Dr Arshad Kamal,
Assistant Professor, Department of Peads Surgery, Medical Teaching Institute Lady Reading Hospital Peshawar Pakistan,
E-mail: drminamkhan71@gamil.com

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Femur shaft fractures; Length discrepancy; Spica casting

1. Abstract

1.1. Introduction: Femoral shaft fractures, typically caused by blunt trauma, are the most common major pediatric injuries treated by the orthopedic surgeon. Seventy percent of femoral fractures involve the shaft. Femoral shaft fractures reportedly occur at a rate of approximately 20/100,000 children in the USA, representing 1.6% of all fractures in the pediatric population.

1.2. Objective: To determine the frequency of limb shortening in femur shaft fractures in children treated by hip spica casting.

1.3. Material and Methods: This descriptive case series study has been conducted 129 patients in the department of orthopedic and trauma Medical Teaching Institute Lady Reading Hospital Peshawar from January 2018 to December 2018. Pre operative and post operative radiographs were taken for diagnosis and alignment of fracture site in spica cast. The assessment of shortening of femur was done at the time of removal of cast. Time of removal was calculated according to the formula (age in years + 3= number of weeks).

1.4. Results: In this study mean age was 5 years with standard deviation ± 2.04. Sixty eight percent were male and 32% patients were female.0 Shortening of limb length was found 14% while shortening limb length was not found in 86% patients.

1.5. Conclusion: Our study concludes that the frequency of limb shortening was 14% in femur shaft fractures in children treated by hip spica casting.

2. Introduction

Femoral shaft fractures, typically caused by blunt trauma, are the most common major pediatric injuries treated by the orthopedic surgeon. Seventy percent of femoral fractures involve the shaft. Femoral shaft fractures reportedly occur at a rate of approximately 20/100,000 children in the USA, representing 1.6% of all fractures in the pediatric population [1]. Femur shaft fracture occurs very frequently in children. The primary mechanisms of fracture are age-dependent and mostly include falls for children younger than 6 years old. Adverse socioeconomic conditions were significantly associated with higher rates of fractures [2]. Different options of treatment of pediatric femoral shaft fractures comprised of non surgical like pavlik harness, hip spica casting and surgical including plating, flexible nailing and external fixation etc [3,4]. In non operative methods, spica casting is a gold standard for children under 6 years of age because of excellent bone union and remodeling qualities. It is most commonly used method of managing pediatric femur shaft fractures [5]. Spica casting is a safe, simple and effective procedure, without possible complications of surgery and requires no specialized tools [3]. It allows early discharge allowing early return of child to his family [6]. Few problems related to spica casting are leg length discrepancy including shortening and lengthening, skin rashes, sores under the cast and loss of reduction in casting. Leg length discrepancy is one of the commonly faced problems with spica casting of femur shaft fracture in children [7]. The main disadvantage is unacceptable shortening during treat-

ment. In a study conducted by Shah FA et al had reported that at the time of cast removal shortening ranged from 0.32 cm to 2cm noted in 7(31%) cases [8]. Aim of this study is to determine the limb shortening in femur shaft fractures in children treated by hip spica casting. It is important to know the frequency of shortening of femur after spica casting as no such local study is available covering major issues or aspects on which to base problem solving. Moreover it will help structure guidelines for patient selection and counseling regarding prognosis following spica application. The results of this study will be used for self audit and also shared with other personnel involved in fracture rehabilitation and suggestions will be given regarding proper management and referral.

3. Material and Methods

This Descriptive case series was conducted in Orthopedics Department of Lady Reading Hospital, Peshawar Six months January 2018 to December 2020 on 129 patients, using 31% proportion of shortening [8], 95% of confidence level and 8% margin of error, under WHO software for sample size determination. Non-probability consecutive sampling technique was used. All patient of age upto 8 years of either gender having Closed femur shaft (proximal, middle and distal) fracture on one side with other side normal were included in the study while Pathological fractures associated with conditions like osteomyelitis, rickets, tumors or cysts, osteogenesis imperfecta detected by history, clinical and radiological examination, Patient presents 02 weeks after the fracture were excluded from the study.

After approval of the study from hospital ethical committee, all patients fulfilling the inclusion criteria was admitted through emergency or outpatient department for hip spica casting, Lady Reading Hospital, Peshawar. Diagnosis of the fracture shaft of femur was based upon history of trauma with break in the continuity of shaft as seen by x-ray

The guardians of patient were detailed about the procedure, care and follow up and patients were prepared for elective or emergency list. All the procedures were done by a consultant having experience of more than five years with the help of a senior postgraduate trainee in order to minimize the bias. Pre operative and post operative radiographs were taken for diagnosis and alignment of fracture site in spica cast. At 2 weekly follow ups the child was supervised for cast condition. The assessment of shortening of femur was done at the time of removal of cast. Time of removal was calculated according to the formula (age in years + 3= number of weeks). All these findings were observed by senior postgraduate trainee under the supervision of Consultant Orthopedics.

All the above information including name, age, gender, address & contact numbers and shortening was recorded on a predesigned proformas. Exclusion criteria had strictly followed to control any confounding factors and possible bias in the study results. The data was analyzed using SPSS version 19. Mean and standard deviation was computed for continuous variables like age, length of normal and fractured limb. Frequency and percentage were computed for categorical variables like gender, type of fracture, type of trauma, site of femur shaft and shortening. Shortening was stratified between age, gender and site of femur shaft to see the effect modifiers. Post stratification chi square test was applied in which P value ≤ 0.05 was considered as significant value. All the results were presented in the form of tables or charts.

4. Results

In this study age distribution among 129 patients were analyzed 23(18%) were in age group 1-2 years, 35(27%) patients were in age group 2-4 years and 71(55%) patients were less than 5-6 years. Mean age was 5 years with standard deviation ± 2.04 (Table 1). Gender distribution among 129 patients were analyzed as 88(68%) were male and 41(32%) patients were female (Table no 2). Site of femoral shaft among 129 patients were analyzed as 81(63%) had proximal femoral shaft fracture, 41(32%) had middle femoral shaft fracture and 7(5%) patients had distal femoral shaft fracture (Table no 3). Type of fracture among 129 patients were analyzed as 64(50%) had Transverse fracture, 43(33%) had Oblique fracture and 22(17) patients had Spiral fracture (Table no 4). Type of trauma among 129 patients were analyzed as 100(77%) had Fall, 23(18%) had RTA and 6(5) patients had Blunt trauma (Table no 5). In this study shortening of limb length was found 18(14%) while shortening limb length was not found in 111(86%) patients (Table no 6). Stratification of shortening was stratified between age, gender, site of femur shaft, type of fracture, type of trauma, is given in (Table7-11).

Table 1: Age Distribution (n=129)
Mean age was 5 years with standard deviation ± 2.04

Age	Frequency	Percentage
1- 2 Years	23	18%
2 - 4 Years	35	27%
5 - 6 Years	71	55%
Total	129	100%

Table 2: Gender Distribution (n=129)

Gender	Frequency	Percentage
Male	88	68%
Female	41	32%
Total	129	100%

Table 3: Site of Femotal Shaft Fracture (N=129)

Site of Femotal Shaft Fracture	Frequency	Percentage
Proximal	81	63%
Middle	41	32%
Distal	7	5%
Total	129	100%

Table 4: Type Of Fracture (N=129)

Type of Fracture	Frequency	Percentage
Transverse	64	50%
Oblique	43	33%
Spiral	22	17
Total	129	100%

Table 5: Type Of Trauma (N=129)

Type of Trauma	Frequency	Percentage
Fall	100	77%
RTA	23	18%
Blunt trauma	6	5%
Total	129	100%

Table 6: Status Of Shortening Of Limb Length (N=129)

Status Of Shortening	Frequency	Percentage
Yes	18	14%
No	111	86%
Total	129	100%

Table 7: Stratification Of Shortening Of Limb Length W.R.T Age (N=129)
Chi square test was applied in which P value was 0.9900

Shortening	1- 2 years	2-4 years	5-6 years	Total
Yes	3	5	10	18
No	20	30	61	111
Total	23	35	71	129

Table 8: Stratification Of Shortening Of Limb Length W.R.T Gender Distribution (N=129)
Chi square test was applied in which P value was 0.8789

Shortening	Male	Female	Total
Yes	12	6	18
No	76	35	111
Total	88	41	129

Table 9: Stratification Of Shortening Of Limb Length W.R.T Site Of Femoral Shaft Fracture (N=129)
Chi square test was applied in which P value was 0.9872

Shortening	Proximal	Middle	Distal	Total
Yes	11	6	1	18
No	70	35	6	111
Total	81	41	7	129

Table 10: Stratification Of Shortening Of Limb Length W.R.T Type Of Fracture (N=129)
Chi square test was applied in which P value was 0.9988

Shortening	Transverse	Oblique	Spiral	Total
Yes	9	6	3	18
No	55	37	19	111
Total	64	43	22	129

Table 11: Stratification Of Shortening Of Limb Length W.R.T Type Of Trauma (N=129)
Chi square test was applied in which P value was 0.9739

Shortening	Fall	RTA	Blunt Trauma	Total
Yes	14	3	1	18
No	86	20	5	111
Total	100	23	6	129

5. Discussion

Epidemiological studies of pediatrics femoral shaft fractures reveal a bimodal age distribution with peaks occurring at the ages of 2 and 7 years [9]. Fall in children younger than 6 years, while road traffic accident is the commonest in children older than 6 years and boys had >2.5 times the fracture rate of girls [10]. Similar findings were noted in this study as most of the patients 50% were in age group 5-6 years, 30% patients were in age group 2-4 years, 20% patients were less than 2 years. The management of femoral shaft fractures in children is controversial. Many surgeons advocate surgical modalities such as compression plates [11], flexible nails and external fixation. Some suggest a management algorithm based on age: conservative management for children aged one to 5 years, surgery for children older than 11 years. Children between 6 and 11 years belong to the controversial age-groups for which there is little consensus, but a shift towards surgical intervention is evident [12,13]. Surgical fixation of femoral fractures is not without risk of complications. 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 [14]. Other complications associated with intramedullary nailing include septic arthritis after nail removal [15]. Two common complications of plating are implant failure and periprosthetic fractures. For external fixation, the principal concern is pin tract infection [16]. Different treatment modalities for 81 patients with paediatric femoral shaft fractures were reviewed [17] 41% (9/22) treated with external fixation had pin tract infections, 9% (1/11) treated with flexible nails had nonunion, and 8% (1/13) treated with a reamed intramedullary rod had avascular necrosis of the femoral head. Early closed reduction and hip spica casting has gained popularity as an effective treatment modality. Many studies comparing early casting versus traction and casting did not show any significant difference in outcomes [18-20]. There were no rotational inequalities, leg length discrepancies, and gait abnormalities between patients treated with either treatment modality. However, an 18% incidence of unacceptable shortening (>2.5 cm) was reported in patients treated with early spica casting [21]. Shortening of >2 cm was the commonest complication of early (within 7 days of injury) spica casting in 43% (22/51) of the patients [22]. Patients with unacceptable shortening after spica casting required cast removal and traction for 2 weeks before recasting [23]. Similar results were observed in our study as shortening of limb length was found 14% in which 4% patients the limb length discrepancies was 1.5 cm, 8% patients the limb length discrepancies was 2.0 cm and 2% patients the limb length discrepancies was 2.5 cm.

Thus, surgeons should keep unacceptable shortening in mind when planning early spica casting for pediatrics femoral shaft fractures. Frequent follow-up with repeated radiographs is required in the first 3 weeks to detect shortening and displacement of the fracture in the spica cast. Many studies have shown good results when femoral shaft fractures were treated conservatively. Limb shortening, loss of reduction, peroneal nerve palsy, and angulation are potential complications of hip spica casting. Recovery of our patients was uneventful and with minimal complications. This may

be attributed to careful evaluation of fracture alignment during traction, proper spica casting techniques, and careful evaluation of fracture reduction during the healing period. For the 6 to 11 years' age-group in whom treatment of femoral shaft fractures remains controversial, we consider that surgical intervention is not indicated. Similarly, for adolescents of average stature, conservative management did not lead to a poor outcome, probably because of the smaller stature of our pre-adolescent children. The shortcomings of traction and spica casting are prolonged hospitalisation as well as the discomfort of immobilisation and psychosocial impact of spica casting, despite having been effective in our local population with a low rate of complications. Other surgical options often cost as much as or more than traction and spica casting despite patients on traction needing longer hospital stay [22]. Costs of complications requiring a second surgery are also added to treatment costs. We compared 2 patients with femoral shaft fractures treated in our institution: one treated conservatively by traction and spica casting, the other surgically (with flexible intramedullary nailing). Both were of the same age and admitted to the same ward class and had uncomplicated hospital stays. Treatment with a flexible intramedullary nailing cost 1.5 times as much as traction and spica casting [19-22].

Our study shows that incidence of shortening of limb length was found more in age range 5-6 years as 10 cases were observed followed by 5 patients in age range 2-4 years. Similarly incidence of shortening of limb length was found more in male patients as ten cases were recorded as male patients and 5 patients were female. More over our study shows that incidence of shortening of limb length was found more middle site of femoral shaft fracture as 9 cases were recorded followed by 6 cases of shortening of limb length were found in proximal femoral shaft fracture. Similar findings were observed in other studies [21,22, 23].

6. Conclusion

Our study concludes that the frequency of limb shortening was 14% in femur shaft fractures in children treated by hip spica casting.

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