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MANAGEMENT OF PAEDIATRIC FEMORAL SHAFT FRACTURE BY THIGH BRACE FOLLOWING TRACTION IN THE AGE GROUP OF 1-6 YEARS

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ABSTRACT

Pediatric femoral shaft fractures are common occurrences and frequently require hospitalization for management and thereby add to the economic burden. Child's age, height, weight and the fracture type dictates the treatment strategy and includes casting, skin traction, Pavlik harness etc. Currently, thigh brace following traction in treatment of shaft femur fracture in the age group of 1 to six years is gaining popularity. Therefore aim of this study was to evaluate the outcome when femur shaft fractures in the age group of 1-6 years were treated with traction followed by thigh brace. This prospective observational study was conducted in NITOR from July 2017 to June 2019 on 62 children, enrolled by inclusion and exclusion criteria, with fractured femoral shaft. Clinical, radiological and functional outcomes were assessed to derive conclusion at final follow-up. Mean age of the cases was 4.09±1.55 year with a male-female ratio of 5.2:1. Mean bridging callus formation time was 2.45±0.53 weeks. Thigh brace was applied after appearance of bridging callus. The mean duration of radiological union time was 6.6±1.47 weeks. At last follow up, the mean LLD was 0.15±0.37 cm and notable complications were pain (4.8%), skin irritation (4.84%) and muscle wasting (3.23%). The mean coronal, sagittal & rotational mal-alignment were 0.81±1.85 degree, 3.23±4.26 degree and 1.13±2.47 degree respectively. As per Flynn criteria at last follow up, 54 (87.1%) were scored excellent, 8.06% patients were found satisfactory and 4.84% had poor outcome. So it is concluded that the application of thigh brace is safe and effective method in treating pediatric femoral shaft fractures in age group of 1 to 6 years.

KEYWORDS: Paediatric trauma, Fracture Shaft of Femur, Traction, Thigh Brace.

INTRODUCTION

Trauma is an important cause of morbidity and mortality worldwide. Traumatic injury in pediatric population is the leading cause social, economic and health care burden. The burden is predominantly seen in lower to middle income (LMICs) countries, where 95% of all childhood injury deaths occur.[1,2] It is only within the last decade that pediatric trauma has become recognized and begun to be addressed as significant public health issue.

Femoral-shaft fractures are among the most common injury of the lower extremity in pediatric trauma[3], with an annual incidence of 0.25 per 1 000 children per year. The commonest mechanism of injury are a fall (39%) with a peak at 2 to 3 years of age, followed by motor vehicle accident (MVA) (33.7%), of which 88% were pedestrian (PVA). Majority of the patients were from the lowest two socioeconomic classes. The peak incidence at four to five years due to a PVA was younger than the >6 years reported from developed countries.[4] Treatment of the fracture shaft of femur is dependent on the patient's age, weight, fracture configuration, soft-tissue injury & presence of other injuries. Treatment by Pavlik harness is preferred during the first 3 months of life and can be utilized up to 1 year of age. Another modality is spica casting, is most commonly used from 3 months to 5 years of age. Flexible intramedullary nailing has revolutionized the treatment of pediatric fractures and is most commonly used in the west for pediatric femur fractures in patients 5–12 years of age.[5]

The injury requires prolonged immobilization or surgery that can result in significant morbidity.[6] In normal children a significant force is required to sustain this injury and consequently displaced fractures are

common.[7] Automobile accidents accounts for 90% of femoral shaft fractures in children.[8] Commonly reported other mechanisms of injury are falls, sports injuries, fall of object on limb, child abuse and pathological fracture (rarely).[7, 8]

Union occurs rapidly in a fractured shaft of femur in children and these injuries have a good remodeling potential, whereby the bone naturally returns to its normal shape.[9] For example, acceptable angulation in the coronal plane and in the sagittal plane ranges from-birth to 2 years up to 30º; 3 to 5 years 15-20º; 6 to 10 years 10-15º; 11 years to maturity 5-10º respectively.[9] Similarly, remodeling can be compensated in children birth 2 years 1.5 cm; 3-5 years 2.0 cm; 6-10 years 1.5 cm; 11 years to maturity 1.0 cm by growth acceleration.[10] In younger children, non-operative methods such as casting or traction and those supporting a more operative approach like elastic stable intramedullary nailing, external fixation or plate osteosynthesis has debate.[11] The rationale for the nonoperative approach is the high remodeling potential of the femoral shaft, which can be included in the treatment strategy.[12] As a consequence, the guidelines of the American Academy of Orthopaedic Surgery (AAOS) recommend conservative approach, mostly hip spica for children aged 6 months to 5 years.[13] On the other hand, the literature describes some major short and long term complications such as compartment syndrome, rotational deviations, nerve paresis or severe skin lesions following spica casting or traction.

Safe form of treatment has some draw backs: limb length discrepancy, angulations, loss of reduction, prolonged bed rest separates the child from his normal environment, maternal duties overload, redistribution of task among family members, difficulty in transporting child and high cost of bed for hospital for long period which might be able to serve other patients.[8] Evidence suggested that surface traction following application of thigh brace is safe and less technical method used to treat pediatric shaft of femur. In the early 80s, work of Hardy[14] revealed positive results in favor of using a thigh brace for treating pediatric femoral shaft fractures. But later, this method is not popularized due to lack of orthopedists interest as well as ecumenical use of hip spica from before. The common notion of immobilization of both proximal and distal joint of the fracture also demoted the use of thigh brace. But the work of Hardy[14] and Meggitt et al[15] has provided optimistic review in regards of thigh brace and found similar results comparable to hip spica in regard of LLD, mal-alignment and rotational deformity. But thigh brace is free from hip and knee stiffness, skin excoriation. Moreover it also enables easy hygiene care which improves parent satisfaction. But due to the lack of data in Bangladesh as well as worldwide in this regard, the present study was aimed to evaluate the results of treatment by traction followed by thigh brace application in children (1–6 years) diagnosed with closed femoral shaft fracture.

METHODOLOGY

This prospective observational study was conducted in National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, to evaluate the outcome of fracture shaft of femur of age group 1-6 years treated with traction followed by thigh brace. A total of 62 cases of fracture shaft of femur, age group 1 to 6 years irrespective of gender and fractures aging less than two weeks were taken for this study. Obese child (BMI ≥ 30 kg/m^2), pathological fractures, patient with neuromuscular disorder and cerebral palsy, patient with metabolic bone disorder and patient with osteomyelitis were excluded. Institutional approval Prior permission was taken from Institutional Review Board (IRB), and written Informed consent was taken from each patient. Prior to consent they were explained the aim and purpose of the research. Confidentiality was assured and maintained.

Management of the patients: A complete history regarding the cause and mechanism of injury with duration was taken. After initial resuscitation like nonsteroidal analgesics, antibiotics and in cases with associated injuries, all cases were admitted in the ward. X-ray of the affected thigh including hip and knee was done in antero-posterior and lateral views, X-ray pelvis including both hip antero-posterior views. Gallows traction given for 1-2 years patient's and surface traction was applied for 3-6 years patients after admission. After counseling with patient's parents about the treatment schedule and informed written consent was taken. Once stickiness appeared clinically and breezing callus appeared radiologically thigh brace was applied. This usually took 2 to 3 weeks.

Follow-up & post procedure care: Isometric quadriceps exercise was started day after procedure. Thigh brace was kept for 6 to 8 weeks depending upon radiological union of the fracture. Once radiological union was seen in skiagrams, brace was removed. After removal, non-weight bearing hip, knee and ankle mobilizing exercises were advised for 3 to 4 weeks. After 1 week, protected weight bearing was allowed. During discharge, regular quadriceps exercise and toes movement, active movement of hip and knee joints were taught. After discharge all patients were advised to attend the follow up sessions at 2nd, 6th and 12th weeks and then every 3 months up to 1 year. Each of the patients was evaluated clinically, radiologically and functionally. Final assessment in both groups was done at last follow up with Flynn criteria

Data collection procedure: A structured data collection form containing history and examination findings of the patient, operative procedure and follow-up all the variables of interest was used. Data were collected by interview, observation and clinical examination.

Statistical analysis: Data was collected with a pre-tested structured questionnaire containing history, clinical,

radiological findings, peri-operative and follow up findings in a formulated sheet. Data was processed and analyzed. Qualitative data had been expressed as frequency and corresponding percentage, while the quantitative data as mean and range. Postoperative final outcome was evaluated.

RESULT AND OBSERVATION

Table I: Demographic characteristics study population (n=62)

Variables	Frequency	Percentage
Age (yr.)		
1.0-3.0	29	46.7
3.1-6.0	33	53.3
Mean±SD	4.09±1.5	
Sex		
Male	52	83.9
Female	10	16.1

Demographic features mentioned in Table I. Mean age of patients were 4.09±1.5 years. Among 62 cases 52 cases (83.9%) were male and 10 cases (16.1%) were female. The male and female ratio was 5.2:1.

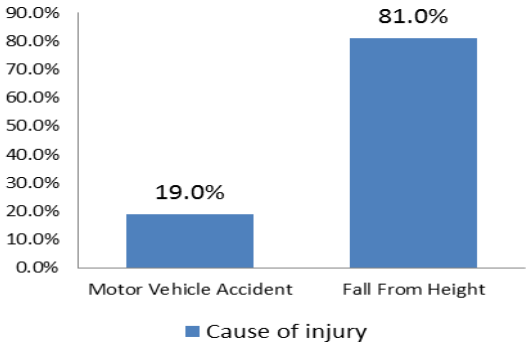

Figure I: Distribution of cases according to mode of injury (N=62)

Figure I show the mode of injury. Among 62 cases Motor Vehicle Accident was 19.0% cases, fall from Height was 81.0% cases. Time required for radiological union revealed that maximum (53.2%) of patients required 6-7 weeks with mean duration 6.6±1.4 weeks (Table II).

Table II: Distribution of cases according to duration of radiological union & pain status (N=62)

Variables	Frequency	Percentage
Radiological union (weeks)		
4-5	10	16.1
6-7	33	53.2
8-9	16	25.8
>9	3	4.8
Pain status (mild pain)		
After 2 wks	51	82.2
After 4 wks	6	9.6
After 6 wks	3	4.8
After 12 wks	3	4.8

Although 82.2% patients had mild pain after 2nd weeks of follow up, end of 12th weeks shows only 4.8% noticed pain. But in majority patient's pain subsided (Table II).

Table III: Evaluation of malalignment of the cases (N=62).

Malalignment (In degree)	Frequency	Percentage
Coronal malalignment		
No	52	83.8
1-5°	10	16.1
Sagittal malalignment		
No	34	54.8
1-5°	20	32.2
6-10°	6	9.6
>10°	2	3.2
Rotational malalignment		
No	50	80.6
1-5°	10	16.1
6-10°	2	3.2

Coronal malalignment (1-5°) was found in 16.1% cases, sagittal malalignment (1-5°) in 32.2% patients and rotational malalignment in 16.1% cases (Table III). Functional outcome was assessed according to Flynn's criteria (Table IV). Among the 62 cases, 54 (87.1%) were scored excellent, five (8.06%) were found satisfactory and 3 (4.84%) were found poor.

Table IV: Functional outcome according to Flynn's criteria (N=62)

Parameters	Excellent	Satisfactory	Poor
Limb Length Discrepancy	0-1 cm	1.1-2 cm	>2 cm
Malalignment	0-5°	6-10°	>10°
Pain	Absent	Absent	Present
Complication	Absent	Mild	Extended Period for resolveable morbidity
Number of Patients	**54**	**5**	**3**

DISCUSSION

In this study, the mean age was 4.09±1.55 year, ranging from 1 to 6 years. Out of 62 patients 52 (84%) were male and 10 (16%) were female. Male-Female ratio was 5.2:1. This data supports the studies of Flynn, et al., (2004)[16] and Hwaizi, et al., (2018).[17]

Regarding the causes of injury, out of 62 patients 50 (81%) had a history of fall from height. In 12 (19%) cases, motor vehicle accident was the cause of fracture. High energy trauma is the leading cause of femoral fractures.[9] Although in literatures carried out in economically developed world showed 90% of the cause is MVA, but in the present study, fall from height has shared a major part.

In this series, out of 62 fractures, 31 (50%) was spiral, 26 (41.94%) were transverse, 4 (6.45%) were short oblique and 1 (1.61%) was oblique fracture. In the study of

Hwaizi, et al., (2018)[17] they found 70.83% transverse, 25% oblique and 4.17% minimally comminuted fractures. In this study, bridging callus appeared in between 2 to 4 weeks with a mean 2.45±0.53 weeks. In 35 (56.45%) cases, bridging callus has appeared after 2 weeks. Bridging callus has appeared after 3 weeks in 26 (41.94%) cases in rest 1 (1.61%) case, it has appeared at 4 weeks. In case of paediatric shaft of femur fracture, bridging callus usually forms within 2 to 6 weeks.[9]

In all fractures, radiological union has occurred in between 4 to 10 weeks with a mean union time was 6.6±1.47 weeks. There was no instance of delayed or non-union. In the series of Lohiya, et al., (2011)[18] the mean radiological union time was 11 weeks (range 6-18 weeks). As the study population in the present series was younger, radiological union has also occurred earlier.

The mean coronal malalignment (varus-valgus) was found in this study was 0.81±1.85 degree. In 52 (83.87%) cases there were no coronal malalignment found at last follow up. Five degree malalignment found in 10 (16.16%) cases. The chance coronal malalignment is happened to be more in conservative treatment as showed in different literatures and text books.[9] But in 1-6 years age group, coronal angulation up to 150 is acceptable.[9]

In this study total incidence of complication was 5 (8.06%). Muscle wasting was present in 2 (3.23%) cases. There was 3 (4.84%) incidence of skin irritation. In 57 (91.94%) cases, there were no complications has occurred. There was no instance of nerve palsy, fracture displacement, non-union or delayed union. The mean time taken to start walking with aids was 7.10±1.43 weeks ranging from 4 to 9 weeks. Time taken to start walking with aids within 4 to 5 weeks was in 11 (17.74%) cases, within 6 to 7 weeks in 24 (38.71%) cases and within 8 to 9 weeks in 27 (43.55%) cases. All findings were accordance with result of other previous study.

In this study among the 62 cases, 54 (87.1%) were scored excellent as per Flynn criteria at last follow up. Five (8.06%) were found satisfactory and 3 (4.84%) were found poor. The most common cause of poor score was presence of mild pain at last follow up. Although femoral fractures in children have been safely and traditionally treated with traction followed by spica casting, the psychological and social difficulties resulting from such treatment has been of much concern recently.[19, 20] As patients with thigh brace can simply be handled, maintenance of personal hygiene is easier, chance of skin problems arising from hip spica are less, thigh brace could be an safer alternative to treat pediatric femoral shaft fractures in age group of 1 to 6 years.

CONCLUSIONS

From the study, it can be concluded that Gallows / Surface traction, followed by application of thigh brace is a safe and effective method in treating fracture shaft of femur in age group of 1 to 6 years. Moreover, this procedure can easily be administered and the learning curve is not steep.

Ethical Issue

A well-informed, voluntary, signed written consent was taken in Bangla from the study subjects before enrollment after convincing them that privacy, anonymity, and confidentiality of data information identifying any patient would be maintained strictly. Each patient enjoyed every right to participate or refuse or even withdraw from the study at any point in time. The protocol was approved by the Ethical Review Board of NITOR.

Conflict of Interest

Authors declare no conflict of interest.

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