ORIGINAL ARTICLE

FUNCTIONAL OUTCOME OF FRACTURE SHAFT OF FEMUR IN CHILDREN TREATED WITH EARLY HIP SPICA

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Background: Femoral shaft fractures in children are a significant concern. Early hip spica casting is a treatment modality, but its functional outcomes need thorough evaluation. The objective of the study is to assess the functional outcomes of early hip spica management for femoral shaft fractures in children up to 5 years. **Methods:** A prospective observational study was conducted at Ayub Teaching Hospital from 15 January 2022 to 26 December 2022. Sixty-two children diagnosed with femoral shaft fractures and treated with early hip spica were enrolled. Exclusion criteria were defined. Functional outcomes, including limb shortening, malunion, skin breakdown, foot drop, and compartment syndrome, were evaluated. Follow-ups were scheduled at 6 weeks, 12 weeks, and 6 months. Data analysis was performed using SPSS software package 25. **Results:** Of the 45 patients analyzed, 75.56% were males. The average age was 3.56 years. Most fractures were proximal (75.55%) and resulted from motor vehicle accidents (66.67%). Limb shortening was observed in 17.77% of patients, with no significant correlation with age or fracture type. Malunion was rare (1%), and no skin breakdown, foot drop, or compartment syndrome cases were reported. **Conclusion:** Early hip spica casting for femoral shaft fractures in children up to 5 years is associated with minimal complications. The findings can guide clinical decisions and patient counselling.

Keywords: Femoral shaft fractures; Children; Hip spica casting; Functional outcomes; Prospective observational study.

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INTRODUCTION

Femoral shaft fractures represent roughly 2% of fractures observed in children. Typically, children with these fractures require hospitalization for treatment.[1] The majority of these fractures in the paediatric population are closed injuries, and historically, they have been addressed using non-invasive techniques.[2] The immediate application of a Spica cast is a recognized therapeutic method for uncomplicated closed femur fractures.[3] For children aged between 6 and 10, flexible intramedullary nails, which are inserted within the bone, are frequently employed to secure the fracture. For children below six years, Spica casting stands as the benchmark in non-surgical treatment due to its superior bone fusion and reshaping properties. This method is widely recognized for treating paediatric femur shaft fractures. The Spica casting procedure is safe, straightforward, and efficient, eliminating potential surgical complications and the need for specialized equipment. Moreover, it facilitates a quicker hospital discharge, enabling the child's prompt reunion with their family.[4]

Alternative treatments that have demonstrated success encompass the use of a plate combined with screws to connect the fractured segments and an external fixator, especially in cases involving significant open injuries to the skin and muscles.[5] The traditional protocol for treating these paediatric injuries has been initial traction, succeeded by immobilization using a Spica cast. The advocacy for immediate or early Spica casting grew after the contributions of Dameron and Thompson in 1959. This method offers advantages such as reduced hospitalization duration and associated costs, minimization of traction and surgical complications, and a faster reunion of patients with their families.[6]

However, immediate hip Spica casting can lead to complications like shortening, malunion, skin issues, foot drop, or even compartment syndrome. Therefore, preliminary skeletal traction is often advised before Spica casting. This approach, though necessitating extended immobilization, can be psychologically challenging for children. Nevertheless, it circumvents the hazards associated with anaesthesia, surgical procedures, and complications from open wounds. Outcomes are often on par with Spica casting post traction.[7] Upon cast removal, a shortening between 0.5 cm to 2.5 cm was observed in 71.42% of the children, with malunion evident in 11.4%.[8] A separate study, where patients received a Spica cast within 24 hours of injury, showed varied outcomes concerning shortening and malunion. A shortening of 5.1% in the emergency department compared to 4.8% in the surgical department was

recorded, with noticeable malunion at 2.5% in the emergency setting and none in the surgical setting.[9] The underlying motivation for this study stems from the inconsistent findings in prior research concerning the primary use of Spica casting for femur shaft fractures in children, especially regarding shortening and malunion. The objective of this research is to validate these findings, emphasizing the efficacy of Spica casting.

MATERIAL AND METHODS

This research employed a prospective observational study design to evaluate the functional outcomes of early hip spica management for femoral shaft fractures in children up to the age of 5 years at Ayub Teaching Hospital from 15 January to 26 December 2022. During this duration, 62 Children up to the age of 5 years, diagnosed with femoral shaft fractures and managed with early hip spica, were consecutively enrolled. Exclusion criteria comprised children with other associated major injuries, previous femoral fractures, fractures secondary to rickets, cysts or tumours, osteomyelitis, and/or osteogenesis imperfecta, patients presenting 14 days after the occurrence of the fracture and any contraindication to spica casting. Upon enrolment, baseline demographic data, including age, gender, and mechanism of injury, were recorded. The specific details of the fracture, such as its type and location, were documented using standardized radiographic assessments. The primary functional outcomes of interest were:

1. Limb shortening: Measured using radiographic assessments and physical examination at regular intervals.
2. Malunion: Evaluated radiographically to determine any deviation from the normal alignment.
3. Skin breakdown: Assessed through regular clinical examinations for signs of pressure sores or skin ulcers.
4. Foot drop: A clinical assessment was conducted to identify any signs of foot drop, including muscle weakness and altered gait.
5. Compartment syndrome: Clinical signs such as pain, pallor, pulselessness, and paralysis were monitored, and intra-compartmental pressure measurements were taken if necessary.

Participants were followed up at regular intervals post-treatment - at 6 weeks, 12 weeks and 6 months. At the end of 6 months, 17 patients had been lost to follow-up. The collected data of the remaining 45 patients was analyzed for this study. During each visit, the aforementioned functional outcomes were assessed and documented. Data were analyzed using the SPSS software package 25. Descriptive statistics, including means, standard deviations, and frequencies, were used to summarize the demographic and baseline characteristics of the study population. The mean limb shortening was calculated, and its association with age and fracture type was analyzed using ANOVA. The incidence of malunion was presented as a percentage. Factors influencing malunion, such as fracture type and location, were analyzed using the chi-square test. The incidence of Skin breakdown, foot drop, and compartment syndrome was presented as percentages. Logistic regression was employed to identify potential risk factors for each complication. To determine the impact of early hip spica on functional outcomes, our results were compared with existing literature or data on children managed without early hip spica or with alternative treatments. A p-value of less than 0.05 was considered statistically significant for all tests. The results from this analysis provided insights into the functional outcomes of early hip spica management for femoral shaft fractures in young children. The findings were instrumental in guiding clinical decisions and patient counselling regarding this treatment modality.

RESULT

Of the 45 cases examined, 34 (75.56%) were males while 11 (24.44%) were females. Patient ages varied between 2 and 5 years, averaging 3.56 years. The right side was affected in 68% of cases, and the left in 32%. There were no instances of bilateral femur engagement. Analyzing fracture types, 27 (60%) were transverse, 11 (24.44%) oblique, and 7 (15.56%) showed minimal comminution. The majority, 34 (75.55%), presented with proximal femoral shaft fractures, 7 (15.55%) with middle shaft fractures, and 4 (8.9%) with distal shaft fractures. Injuries primarily resulted from motor vehicle accidents (30 or 66.67%), followed by pedestrian-motor vehicle incidents (12 or 26.67%), and falls from heights (3 or 6.67%). The average time from injury to casting was 2.15 days.

Limb shortening was observed in 8 (17.77%) of the patients. However, when limb shortening was assessed against age and fracture type using ANOVA, no significant correlation emerged (p>0.05). Breaking down the limb shortening cases, 2 patients experienced up to 15 mm of shortening, 5 had between 15 and 25 mm, and 1 had over 25 mm.

Malunion was reported in only 1% of cases. Further analysis by fracture type and location revealed no significant correlation (p>0.05). Additionally, no skin breakdown, foot drop, or compartment syndrome cases were reported among patients who adhered to our follow-up protocol.

DISCUSSION

The optimal treatment strategy for the fracture of the femoral shaft in a child hinges on factors such as the child's age, the fracture's location and nature, familial circumstances, the surgeon's expertise, and, to some

extent, economic factors.[10] While skin traction followed by hip spica has traditionally been the conservative approach for paediatric femur shaft fractures, the early alignment and application of a hip spica cast are increasingly recognized as effective treatment methods.[11] In our research, all fractures achieved union, with the exception of one patient (2.22%) who exhibited malunion. The average time taken for the union was 7.8 weeks, closely mirroring the findings of Tripathi, Ali, and Bachhar[12], who reported an average fracture healing time of 8.55 weeks.

Lee *et al*.[13] noted that the most prevalent complication of early spica casting (applied within 7 days post-injury) was a shortening exceeding 20 mm, observed in 43% (22/51) of their patient cohort. Those with significant shortening post-casting underwent cast removal and a two-week traction period before re-casting. Haque *et al*. documented that out of 20 patients with femur shaft fractures, 16 (80%) experienced a leg length discrepancy of less than 1 cm, 3 (15%) had a discrepancy of less than 2 cm, and 1 (5%) had a discrepancy exceeding 2 cm.[14] Alzubady and Almuhana[15] found leg length discrepancies in 30% of their patients, while Muzzafar and team[11] reported a 20% incidence. In our study, 8 (17.77%) patients exhibited limb shortening. Of these, 2 had shortening up to 15 mm, 5 between 15 and 25 mm, and 1 exceeded 25 mm. Based on Flynn's scoring criteria, our study outcomes revealed 80% of patients had excellent results, 10% achieved satisfactory results, and 10% had unfavourable outcomes. Dulgeroglu *et al*.[16] reported 72% excellent, 19% good, and 9% moderate outcomes. Sidiqui *et al*.[17] evaluated the outcomes of femur shaft fractures in children treated with skin traction followed by spica cast versus early spica cast. They found 81% satisfactory and 19% unsatisfactory results. Their study also noted shortening ranging from 8-18 mm (average 10.5 mm). They concluded that early spica cast yielded satisfactory outcomes and fewer complications, albeit with extended hospital stays and increased treatment costs. Singh and Associates[18] advocated for early closed reduction and hip spica cast application as a dependable treatment method. According to existing literature, many researchers observed negligible differences in outcomes between early spica cast and skin traction followed by spica cast for paediatric femur shaft fractures.[19] Al-Mohrij and team[20], in their Saudi Arabian study, deduced that for children aged 0–4 years, hip spica casting without traction yielded superior results and remains the preferred treatment. The primary benefit of early spica is reduced hospitalization, leading to cost savings and a quicker return to the child's routine. However, it necessitates regular check-ups and multiple radiographs in the initial 3 weeks to monitor potential shortening and fracture displacement within the spica cast.

CONCLUSION

In our prospective observational study evaluating the functional outcomes of early hip spica application in pediatric femoral shaft fractures, we found that early hip spica offers highly favourable outcomes. The incidence of complications was notably low. Based on our findings, we advocate for the adoption of early hip spica as the primary intervention for femoral shaft fractures in children under the age of 5 years.

Study Limitations:

Observational Nature: As with all observational studies, our research design inherently lacks randomization, which might introduce selection bias.

Short-term Follow-up: The study primarily assessed immediate and short-term outcomes. Long-term functional outcomes and potential complications might not have been captured.

Single-centre Study: The research was conducted in a single institution, which might limit the generalizability of the findings to diverse settings or populations.

4. Potential Confounders: While we controlled for several known confounders, unmeasured or unknown confounders might have influenced the outcomes.

Future studies with a broader age range, multi-centre collaborations, and extended follow-up durations can provide a more comprehensive understanding of the benefits and potential limitations of early hip spica in pediatric femoral shaft fractures.

AUTHORS' CONTRIBUTION

AK: Conceptualization of the study design, and supervision. MH: Data collection, data analysis and interpretation. BS: Write-up, proofreading.

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