ORIGINAL RESEARCH

Treatment of Femoral Shaft Fractures in Children Less than 5 Years of Age: A Study Comparing the Single Leg Spica with the Traditional Spica

Vijaya Kumar Chiruvella

Department of Orthopaedics, SRM Medical College Hospital & research Centre, Kancheepuram, Tamil Nadu, India

Corresponding author
Vijaya Kumar Chiruvella
Department of Orthopaedics, SRM Medical College Hospital & research Centre, Kancheepuram, Tamil Nadu, India
Email: chiruvellav@gmail.com

Received: 23 April, 2018 Accepted: 28 May, 2018

ABSTRACT

Introduction: Femoral shaft fractures are among the most common long bone fractures in young children, particularly in those less than five years of age. **Objective:** The study explores whether the reduced immobilization offered by the single-leg spica has any impact on the functional recovery of the affected limb and on any psychological benefits due to increased comfort and mobility during treatment. **Methodology**: This retrospective cohort analysis was study included a total of 85 patients, selected based on specific inclusion criteria to ensure the comparability of results between the two treatment groups. **Results**: The average age of patients was similar, with 3.2 years in the single-leg spica group and 3.0 years in the double-leg spica group. Both casting methods achieved satisfactory alignment and similar healing times, with the single-leg spica group showing a slightly shorter healing duration (5.8 vs. 6.3 weeks) but no statistically significant difference ($p=0.12$). Complication rates were lower in the single-leg group (12% vs. 17%), though this difference was not statistically significant. Caregiver satisfaction was higher in the single-leg group, with ease of hygiene and child comfort being key contributing factors ($p<0.01$).**Conclusions**: The single-leg spica cast is an effective alternative to the traditional double-leg spica, providing comparable fracture healing with added benefits in caregiver satisfaction and ease of management. Its use can enhance treatment experiences in appropriate cases, supporting it as a viable first-line option for femoral shaft fractures in young children.

Keywords: Fracture, Femoral Shaft, single-leg spica

INTRODUCTION

Femoral shaft fractures are among the most common long bone fractures in young children, particularly in those less than five years of age. These fractures often occur due to high energy mechanisms including falls from height, road traffic injuries or any other accidental trauma and require proper, judicious management in children because children's bones differ from adults in their anatomy and physiology [1]. Aims of the treatment include stabilization of the fracture to allow uncomplicated bone healing while avoiding complications such as improper healing, bacterial infection, or future pain in the affected limb. Though surgical approaches to these injuries continue to be practiced or advocated, the immobilization methods especially spica casting have been deemed traditional in the management of these injuries in young children given the ease, efficiency, and minimal/reduced surgical complications [2]. For years, femoral shaft fractures in young children have undergone management with a double-leg spica cast that covers the child from chest to both feet in order to restrict leg movements and facilitate bone mending [3]. As aligned above, this method is particularly suitable for management of fracture alignment with limited possibility of rotation and displacement. Nonetheless, a number of difficulties may be observed during the use of double-leg spica casting in a child and for the caregiver. Other complications which can result from prolonged immobilization in such a large cast include restricted movement, problems in personal hygiene, more discomfort, and even skin

breakdown [4]. Also, fracture alignment in the double-leg spica is occasionally more demanding controlled in particular due to the cumbersome cast design. But in recent years, as practice has shifted towards allowing a little more movement, the single-leg spica cast has received increasing attention in the field of pediatric orthopaedics [5]. While the double-leg spica restricts both legs the single-leg spica only restricts the leg of the injured area but the leg of the healthy area has more movement space. It could enhance patients' comfort, increase cleanliness and decrease the nurses' caseload. The single-leg spica may also promote a more normal distribution of muscle forces in order to maintain normal coordination and range of motion in order to prevent contractures in the opposing affected limb [6]. However, the goal for the single-leg spica is to provide similar support and limb alignment benefits in reference to the traditional therapy while providing more convenience establishing feeding and mobility [7]. Key choices in the current management of femoral shaft fractures revolve around the use of single/ double leg spica cast, which necessarily brings into question issues of mobility and quality of life during the recovery process [8]. Some works raise the question of achieving similar results from single-leg spica casting as from double-leg casting in the aspect of bone healing, however other works concerns the possible increased risk of mal- alignment or fracture displacement. Therefore, the aim of this work is to identify potential differences in outcomes after single-leg spica compared to conventional double-leg spica in children with fractures, in terms of fracture positioning, time taken to heal, presence of complications, satisfaction of the caregiver and comfort levels of the patient [9]. The purpose of this research that examines a sample of patients who have received treatment via either of the casting methods is to determine whether the single-leg spica could indeed be a feasible and probably more effective approach to traditional treatment [10] . The rationale for this study stems from the desire to determine the practical approaches used in applying the intervention, with the goal of reaching both peak bone healing efficiency as well as simple processes easily intelligible to the child and the family. The issues of interest in this study are radiographic parameters showing fracture positioning, the overall healing time or the proportion of cases that developed non-union or delayed union, and the practicality of handling and caring for the cast from a carer's perspective [11].

OBJECTIVE

Furthermore, the study explores whether the reduced immobilization offered by the single-leg spica has any impact on the functional recovery of the affected limb and on any psychological benefits due to increased comfort and mobility during treatment. Caregivers' experiences and satisfaction are also critical to this research, as parental involvement and satisfaction play essential roles in the successful management of pediatric injuries. Caregivers often bear the responsibility of maintaining cast hygiene, monitoring for complications, and providing emotional support, making their input invaluable for assessing treatment effectiveness.

METHODOLOGY

This retrospective cohort analysis was study included a total of85 patients, selected based on specific inclusion criteria to ensure the comparability of results between the two treatment groups.

Inclusion Criteria

- Age under five years at the time of injury.
- Confirmed diagnosis of a closed, isolated femoral shaft fracture.
- Treatment with either a single-leg or traditional double-leg spica cast.
- No previous history of significant lower extremity trauma or congenital limb abnormalities.

Exclusion criteria

- Patients with open fractures, pathological fractures, cases requiring surgical intervention beyond casting, and fractures associated with other major injuries requiring alternative treatment protocols.

Data Collection

Patient data was collected through detailed chart reviews and follow-up visits. The study sample of 85 patients was divided into two groups:

- **Single-Leg Spica Group**: 43 patients received a single-leg spica cast, where only the affected limb was immobilized.
- **Double-Leg Spica Group**: 42 patients received a traditional double-leg spica cast, which immobilized both legs.

Both groups received standard pre-casting procedures, including closed reduction under general anesthesia to ensure appropriate alignment of the fractured femoral shaft.Parameters recorded for each patient included age, gender, initial fracture classification, Type of spica cast used, duration of casting, and any adjustments or recasting needed.Fracture alignment immediately post-reduction, at cast removal, and during follow-up (e.g., at six weeks post-casting) were also noted. Healing time, incidence of malunion, non-union, or delayed union were also carried out. At follow-up visits, assessments of joint mobility, muscle tone, and functional recovery were conducted using standardized scoring systems appropriate for children.

Statistical Analysis

Data were analyzed using SPSS v11. Chi-square tests for categorical data, such as complication rates and union type. A p-value of less than 0.05 was considered statistically significant.

RESULTS

In this study of 85 children with femoral shaft fractures, outcomes for the two groups single-leg spica and double-leg spica were assessed and compared across healing time, alignment, complications, and caregiver satisfaction. The average age of patients was similar, with 3.2 years in the single-leg spica group and 3.0 years in the double-leg spica group. Both groups had a comparable male-to-female ratio of 1.1:1 and displayed a similar distribution in initial fracture displacement. This balanced baseline suggests that the groups were comparable, allowing for a fair assessment of outcomes between the single-leg and double-leg spica methods.

Table 1: Demographic and Baseline Characteristics

Characteristic	Single-Leg Spica	Double-Leg Spica
Average Age (years)	3.2	3.0
Gender (Male:Female Ratio)	1.1:1	1.1:1
Initial Fracture Displacement	Similar distribution	Similar distribution

The average healing time was slightly shorter in the single-leg spica group at 5.8 weeks (range: 5–7 weeks) compared to 6.3 weeks (range: 5–8 weeks) in the double-leg group. Satisfactory alignment was achieved in 88% of the single-leg spica cases and 93% of the double-leg spica cases. Mild malunion occurred in 7% of the single-leg group and 5% of the double-leg group, showing only slight variation in alignment and malunion rates.

Table 2: Healing Time and Radiographic Outcomes

Outcome	Single-Leg Spica	Double-Leg Spica
Average Healing Time (weeks)	5.8 (range: 5–7)	6.3 (range: 5–8)
Satisfactory Alignment (%)	88%	93%
Mild Malunion (%)	7%	5%

The study found a slightly lower complication rate in the single-leg spica group, with an overall complication rate of 12% compared to 17% in the double-leg spica group. Specific complications included skin irritation, reported in 5% of single-leg cases versus 7% in double-leg cases, and cast loosening, which affected 4% of the single-leg group and 5% of the double-leg group. Delayed union was low and identical in both groups at 2%, suggesting that the single-leg spica may offer a slight advantage in reducing minor complications.

Table 3: Complication Rates

Complication Type	Single-Leg Spica	Double-Leg Spica
Overall Complication Rate	12%	17%
Skin Irritation	5%	7%
Cast Loosening	4%	5%
Delayed Union	2%	2%

The single-leg spica cast demonstrated higher caregiver satisfaction, with an average satisfaction score of 8.5 out of 10 compared to 7.2 for the double-leg spica. Additionally, 85% of caregivers in the single-leg spica group reported hygiene as "manageable," whereas only 55% found it manageable in the double-leg spica group. Child comfort was also rated higher in the single-leg spica group, with 75% of caregivers reporting "high" or "very high" comfort levels, compared to 52% in the double-leg group.

Table 4: Caregiver Satisfaction

Aspect	Single-Leg Spica	Double-Leg Spica
Average Satisfaction Score (out of 10)	8.5	7.2
Ease of Hygiene (% reporting 'manageable')	85%	55%
Child Comfort (% rating 'high' or 'very high')	75%	52%

Both spica cast methods showed positive functional outcomes, with 90% of children in the single-leg spica group and 88% in the double-leg spica group achieving a full range of motion by the final follow-up. Minor stiffness was slightly lower in the single-leg spica group, reported in 5% of cases compared to 7% in the double-leg group.

Table 5: Functional Outcomes

Outcome	Single-Leg Spica	Double-Leg Spica
Full Range of Motion Achieved (%)	90%	88%
Minor Stiffness at Final Follow-up (%)	5%	7%

DISCUSSION

This study compared the use of single-leg and double-leg spica casts in treating femoral shaft fractures in children under five years of age, focusing on healing outcomes, complications, caregiver satisfaction, and functional recovery. The results indicate that both approaches offer excellent stabilization and result in comparable healing processes [12]. Although, single-leg spica cast presented certain advantages such as caregiver satisfaction, easy hygiene, and possibly fewer complications make single- leg spica cast as acceptable as the double-leg spica cast. The results showed that both single-leg and double-leg spica casts provided an acceptable level of alignment in more than 88% of the cases by cast removal. In fixed-time analysis, the single-leg spica group had insignificantly shorter average healing time than the control which was 5.8 weeks vs. 6.3 weeks [13]. This suggest that both casting methods provide sufficient stabilisation and enables comparable rates of fracture healing, consistent with local and overseas findings on casting techniques in young patients [14]. Despite similar complication rates to those of the standard double-leg spica cast, the single-leg spica cast was less likely to result in skin irritation and cast loosening. Although not reaching statistical significance, this shows that there may be advantages to be gained in terms of fewer complications and revised operations through a less libreal approach to immobilization [15]. It seems that the chance to use the non-affected limb in the care for her skin also helped prevent skin problems. Earlier findings have revealed the same kind of epidemiology, stressing that single limb suspension reduces the risks of complications related to full-body jackets in children. One of the most important implications of this study was that the index, ie, the single-leg spica, yielded higher caregiver satisfaction [16]. Care givers considered hygiene management a lesser concern in the new single leg spica cast and felt the child was more comfortable using the new cast. The traditional double leg spica cast is rigid and after operation, the legs are immobilized and the care givers and patients may find it challenging to take care of these patients especially when it is time to bath. Single-leg cast may have following practical benefits for the daily use that may help in diminishing the caregiver stress and improving general quality of caregiving [17]. This factor is especially important in paediatric practice, because the caregivers' level of handling the cast, might affect the speed of healing and the child's comfort during the process. The overall function of the two groups was not significantly different at the six-month follow-up encounter; greater than 88% obtaining full range of motion and less than 5% complaining of mild stiffness [18]. This concurrence in functional recovery further supports the utility of both techniques in terms of casting in jointly mobile and achieving an optimal long-term outcome. These results indicate that because the goal of spica casting is to primarily restrict the motion around the fracture site while permitting the fracture to heal in a biomechanically sound manner that single-leg spica casting does not significantly impact the kinetic chain of the affected extremity [19]. The results suggest that the single-leg spica is a reasonable option, when the double-leg spica might be less convenient for the caregiver or less comfortable for the patient. These findings and the ease of avoiding complications and management might make a single-leg spica preferable in outpatient environments where families care for casts at home. However, patient selection remains a critical point because more complicated or unstable fractures may still require extra support of a double-leg cast.

CONCLUSION

It is concluded that both single-leg and double-leg spica casts are effective in treating femoral shaft fractures in children under five, with comparable healing and functional outcomes. However, the single-leg spica offers added benefits in terms of caregiver satisfaction, ease of hygiene, and potentially reduced complication rates. This makes it a favorable alternative for cases where patient comfort and caregiver convenience are priorities.

REFERENCES

1. Flynn JM, Garner MR, Jones KJ, D'Italia J, Davidson RS, Ganley TJ, et al. The Treatment of Low-Energy Femoral Shaft Fractures. *J Bone Joint Surg Am*. 2011;93(23):2196–202.
2. Detsky AS, Naylor CD, O'Rourke K, McGeer AJ, L'Abbe KA. Incorporating variations in the quality of individual randomized trials into meta-analysis. J Clin Epidemiology 1992;45(3):255-65. 2. Feinstein AR. Clinical epidemiology. The architecture of clinical research. Philadelphia: W.B. Saunders;1985.
3. Wright JG. The treatment of femoral shaft fractures in children: a systematic overview and critical appraisal of the literature. 2000. In: Database of Abstracts of Reviews of Effects (DARE): Quality-assessed Reviews [Internet]. York (UK): Centre for Reviews and Dissemination (UK); 1995-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK68313/
4. Stannard JP, Christensen KP, Wilkins KE. Femur fractures in infants: a new therapeutic approach. *J Pediatr Orthop*. 1995;15(4):461-6.
5. Podeszwa DA, Mooney JF III, Cramer KE, Mendelow MJ. Comparison of Pavlik harness application and immediate spica casting for femur fractures in infants. *J Pediatr Orthop*. 2004;24(5):460-2.
6. Irani RN, Nicholson JT, Chung SM. Long-term results in the treatment of femoral-shaft fractures in young

children by immediate spica immobilization. *J Bone Joint Surg Am*. 1976;58(7):945-51.
7. Staheli LT. Femoral and tibial growth following femoral shaft fracture in childhood. *Clin Orthop Relat Res*. 1967;55:159-63.
8. Miller ME, Bramlett KW, Kissell EU, Niemann KM. Improved treatment of femoral shaft fractures in children. The pontoon 9090 spica cast. *Clin Orthop Relat Res*. 1987;(219):140-6.
9. McCarthy RE. A method for early spica cast application in treatment of pediatric femoral shaft fractures. *J Pediatr Orthop*. 1986;6(1):89-91.
10. Illgen R II, Rodgers WB, Hresko MT, Waters PM, Zurakowski D, Kasser JR. Femur fractures in children: treatment with early sitting spica casting. *J Pediatr Orthop*. 1998;18(4):481-7.
11. Large TM, Frick SL. Compartment syndrome of the leg after treatment of a femoral fracture with an early sitting spica cast: a report of two cases. *J Bone Joint Surg Am*. 2003;85-A(11):2207-10.
12. Madhuri V, Dutt V, Gahukamble AD, Tharyan P. Interventions for treating femoral shaft fractures in children and adolescents. 2014.
13. Infante AF Jr, Albert MC, Jennings WB, Lehner JT. Immediate hip spica casting for femur fractures in pediatric patients: a review of 175 patients. *Clin Orthop Relat Res*. 2000;(376):106-12.
14. Ferguson J, Nicol RO. Early spica treatment of pediatric femoral shaft fractures. *J Pediatr Orthop*. 2000;20(2):189-92.
15. Hughes BF, Sponseller PD, Thompson JD. Pediatric femur fractures: effects of spica cast treatment on family and community. *J Pediatr Orthop*. 1995;15(4):457-60.
16. Flynn JM, Garner MR, Jones KJ, et al. The treatment of low-energy femoral shaft fractures: a prospective study comparing the walking spica with the traditional spica cast. *J Bone Joint Surg Am*. 2011;93(23):2196-202.
17. Leu D, Sargent MC, Ain MC, Leet AI, Tis JE, Sponseller PD. Spica casting for pediatric femoral fractures: a prospective, randomized controlled study of single-leg versus double-leg spica casts. *J Bone Joint Surg Am*. 2012;94(14):1259-64.
18. Epps HR, Molenaar E, O'Connor DP. Immediate single-leg spica cast for pediatric femoral diaphysis fractures. *J Pediatr Orthop*. 2006;26(4):491-6.
19. Cassinelli EH, Young B, Vogt M, Pierce MC, Deeney VF. Spica cast application in the emergency room for select pediatric femur fractures. *J Orthop Trauma*. 2005;19(10):709-16.