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Original Research Paper

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FRACTURE UNION IN HIP SPICA CAST IN FEMORAL SHAFT FRACTURE IN CHILDREN

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ABSTRACT

Introduction: Fracture shaft femur is a major cause of morbidity and hospitalization in children with lower extremity injuries. Although surgical methods are increasingly used, conservative treatment remains relevant in younger children. **Objective:** The objective of this study was to evaluate the outcome of hip spica casting in children with femoral shaft fractures. **Methods:** A prospective study was conducted in the Department of Orthopedic Surgery between January 2022 and January 2025. Sixty-eight children with closed femoral shaft fractures were treated with hip spica cast application and followed up for 12 months. Patients were evaluated clinically and radiologically for union, malunion, delayed union, or nonunion. **Results:** Out of sixty-eight patients, sixty-four achieved union within 50 to 75 days (mean 67.58 days). Four patients had delayed union, nine had limb shortening up to 10 mm, and six developed varus angulations of less than 12°. Overall, results were excellent in 94.1% and good in 5.8% of patients. No cases of nonunion or permanent disability were reported. **Conclusion:** Hip spica casting remains a safe, economical, and effective treatment method for femoral shaft fractures in children, with the advantages of early mobilization, minimal complications, and satisfactory functional outcomes.

KEYWORDS : Femoral shaft fracture, hip spica cast, fracture union, pediatric orthopedics, early mobilization.

INTRODUCTION:

Fractures of the femoral shaft are among the most common pediatric orthopedic injuries requiring hospitalization. They are also one of the costliest fractures to treat in children [1]. With the advent of new implants, there has been a trend toward surgical management, yet operative treatment is not without risks such as infection, implant failure, and the need for subsequent implant removal [2].

Traditionally, pediatric femoral shaft fractures have been treated with traction for 1–3 weeks followed by hip spica casting until fracture union [3]. This method, however, is associated with prolonged hospitalization, increased healthcare costs, prolonged separation of children from their families, and psychosocial stress [4].

Early application of hip spica cast is an effective alternative, allowing for reduced hospital stay and early mobilization. The present prospective study was conducted to evaluate the clinical outcomes of closed reduction and hip spica casting in children with femoral shaft fractures [5].

MATERIALS AND METHODS:

Study Design And Population

This prospective study was conducted in the Department of Orthopedic Surgery from January 2022 to January 2025. A total of 68 children younger than 10 years of age, weighing between 11–70 pounds, with closed femoral shaft fractures between the subtrochanteric and supracondylar regions, were included.

Exclusion Criteria:

- Fractures of the proximal femur (risk of coxa vara)
- Children older than 10 years or weighing >70 lbs.
- Patients with multiple injuries or ipsilateral tibial fracture
- Previous history of femoral fracture in the same limb

Grouping:

Patients were classified into two groups based on weight rather than age:

- Group 1: 3 months–5 years, weight 11–35 lbs. (35 patients)
- Group 2: 5–10 years, weight 35–70 lbs. (33 patients)

Fracture reduction and maintenance in hip spica were noted to be more challenging in Group 2.

Ethical Considerations:

The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from parents, who were counseled regarding treatment protocol, costs, hospital stay, and potential complications.

Pre-Casting Management:

On admission, all patients were placed in a Thomas splint with skin traction. This helped in maintaining reduction and relieving pain. Traction was used when:

- Shortening was >3 cm,
- There was extensive swelling, or
- Early spica casting was not feasible due to unstable fractures.

Once swelling subsided and the fracture site became non-tender with palpable callus, spica casting was applied within one week.

Hip Spica Technique:

Hip spica casting was performed under sedation using oral chloral hydrate (25–50 mg/kg). Twelve older children (>7 years) required an additional dose for adequate sedation.

The child was placed on a small spica table. A long leg cast including the foot was applied, with the knee in 40–45° flexion. The hip was positioned in approximately 45° flexion, 25° abduction, and neutral rotation. Alignment was verified intraoperatively with an image intensifier.

Plaster of Paris was used for all casts.

Acceptable Reduction Criteria Were:

- Varus/valgus angulation <15°
- Anterior/posterior angulation <20°
- Malrotation <30°
- Shortening <2 cm

Follow-up:

Patients were discharged on the day of cast application. Weekly follow-up for the first three weeks included clinical and radiological assessment. Hip spica was typically removed between 6–9 weeks, depending on union. Children were allowed gradual mobilization and weight bearing thereafter.

Union was defined as painless clinical stability with bridging callus on radiographs.

Delayed Union: union between 8–16 weeks
Nonunion: absence of union beyond 24 weeks

Outcomes Were Graded As:

- **Excellent:** union within 10 weeks, no complications
- **Good:** union within 16 weeks with minor complications (e.g., stiffness, superficial sores)
- **Poor:** delayed/nonunion or permanent complications

RESULTS & DISCUSSION:

Table 1: Demographic Characteristics Of The Study Population

Variable	Number of Patients (n=68)	Percentage (%)
Gender		
Male	42	61.8
Female	26	38.2
Age		
Mean Age (years)	4.4	–
Range	3 months – 10 years	–
Weight		
Range (lb)	11 – 70	–

Most patients were male (61.8%), with a mean age of 4.4 years. Most cases fell within the preschool to early school-going age, which corresponds with the high activity level and risk of falls or trauma in this age group.

Table 2: Side Of Fracture And Mode Of Injury

Variable	Number of Patients (n=68)	Percentage (%)
Side of Fracture		
Left-sided	30	44.1
Right-sided	38	55.9
Mode of Injury		
Road Traffic Accident	44	64.7
Fall from Height	24	35.3

Right-sided fractures were slightly more common (55.9%). The predominant cause was road traffic accidents (64.7%), followed by falls (35.3%), highlighting trauma as the main etiology in pediatric femoral fractures.

Table 3: Types Of Fracture

Type of Fracture	Number of Patients (n=68)	Percentage (%)
Transverse	47	69.1
Oblique	8	11.8
Spiral	5	7.4
Comminuted	7	10.3
Segmental	1	1.4

The most frequent fracture pattern was transverse (69.1%), followed by oblique and comminuted fractures. Spiral and segmental fractures were less common.

Table 4: Location Of Fracture

Location of Fracture	Number of Patients (n=68)	Percentage (%)
Proximal 1/3	12	17.6
Middle 1/3	42	61.8
Distal 1/3	14	20.6

The mid-shaft (61.8%) was the most common site of fracture, consistent with the biomechanical vulnerability of the femoral diaphysis in children.

Table 5: Comparison Between Group 1 and Group 2

Parameter	Group 1 (n=35)	Group 2 (n=33)
Age Range	3 months – 5 years	5 – 10 years
Average Age	2 years 9 months	7.2 years (approx.)
Weight Range (lb)	11 – 35	35 – 70
Mean Weight (lb)	25	45
Mean Shortening (Before Reduction)	1.6 cm (0–3 cm)	1.4 cm (0–3 cm)
Mean Shortening (After Reduction)	0.6 cm (0–2 cm)	1.0 cm (0–2 cm)
Cast Duration	6 weeks (3–8 weeks)	7 weeks (5–9 weeks)
Mean AP Angulation (Before)	10.3° (0–45°)	9.5° (0–55°)
Mean Varus/Valgus (Before)	8.5° (0–57°)	5.3° (0–26°)
Mean Final AP Angulation	7.5° (0–50°)	5.5° (0–20°)
Mean Final Varus/Valgus	4.2° (0–35°)	2.5° (0–18°)

- **Group 1 (younger children)** tolerated angulation and shortening better due to high remodeling capacity.
- **Group 2 (older children)** showed relatively higher residual deformities, with longer cast duration required.
- Despite these differences, final outcomes were acceptable in both groups.

Table 6: Union and Functional Outcomes

Outcome	Number of Patients (n=68)	Percentage (%)
Union Time		
Union ≤10 weeks	64	94.1
Union 10–16 weeks	4	5.9
Delayed Union	4 (all in Group 2)	5.9
Malunion (Significant)	2	2.9
Nonunion	0	0
Shortening <10 mm	9	13.2
Shortening >20 mm	2	2.9
Limb Lengthening <1.5 cm	3 (Group 1)	4.4
Result		
Excellent	64	94.1
Good	4	5.9
Poor	0	0

- Union was achieved in all cases, with 94.1% healing within 10 weeks.
- Delayed union occurred only in older children (Group 2).
- Malunion and significant shortening were rare (≤3%).
- Final outcomes were excellent in 94.1% and good in 5.9%, with no poor results reported.

DISCUSSION:

Fracture healing in children differs significantly from adults due to their remarkable capacity for remodelling and overgrowth. Malaligned fractures can correct themselves as the mechanical axis reorients during growth. Remodelling follows Wolff's law, with bone deposited in regions of high stress.

Overgrowth is particularly prominent between the ages of 2–10 years, as the affected femur often grows faster for approximately two years post-fracture, with an average overgrowth of 1.5 cm compared to the contralateral side [6].

There are different treatment options for isolated closed diaphyseal fractures of the femur in children including immediate spica cast, traction for 7-21 days followed by spica cast, internal fixation with plating, intramedullary nailing, and external fixation. However, the drawbacks of these methods were:

- **Skin traction** → blistering, ulceration, neurovascular ischemia
- **Skeletal traction** → pin tract infection, osteomyelitis, physeal injury
- **Hospital stay** of 7–21 days and higher costs
- **Family separation** during hospitalization

With accumulating evidence, **early spica casting** emerged as a safe and effective alternative.

Table 7: Traditional Vs. Early Spica Management

Parameter	Traction + Spica	Early Spica
Traction duration	7–21 days	Not required
Hospital stay	Prolonged (weeks)	~3–5 days
Cost	High	Reduced
Family separation	Significant	Minimal
Complications	Skin/Skeletal traction-related	Fewer

Evidence From Literature:

Multiple studies have compared early spica casting with traction-based protocols. Across these, **early spica was consistently associated with reduced hospitalization, lower costs, and equivalent union and alignment outcomes**.

Table 8: Key Comparative Studies

Author	Study Population	Intervention	Key Findings
Allen et al. [7]	Children with femoral fractures	Early spica vs. traction + spica	Similar union & alignment; shorter hospital stay with early spica
Staheli & Sheridan [8]	20 children (<9 yrs)	Early spica	Minor discrepancies (≤7 mm length, ≤20° rotation); all asymptomatic
Splain & Denno [9]	Review	Early spica vs. traction	No proven advantage of traction
Sugi & Cole [10]	191 children (<10 yrs)	Early spica	Leg length discrepancy rare; costs reduced
Martinez et al. [11]	51 children	Early spica	Shortening >20 mm most common; risk ↑ with older children
Rasool et al. [12]	170 children	Early spica vs. traction + spica	Spica sufficient; cost-effective; earlier family reunification
Newton & Mubarak [13]	Comparative	5 modalities	Early spica = lowest cost

Findings From The Present Study

In the current series of **68 cases**, our results align closely with international literature.

- Shortening was <10 mm in 9 children; one child developed a 32 mm shortening.
- Radiographic shortening was 0–10% of femoral length.
- Angular deformities: 6 cases varus (<12°), 2 cases valgus (<15°), 3 cases AP bowing.
- Overgrowth (<1.5 cm) occurred in 3 cases.
- Hospital stay averaged 3.7 days.
- Parent satisfaction was overwhelmingly positive due to early mobilization and discharge.

Table 9: Findings From Present Study

Parameter	Findings
Sample size	68 cases
Shortening <10 mm	9 children
Significant shortening (32 mm)	1 child
Radiographic shortening	0–10% of femoral length
Varus angulation	6 cases (<12°)
Valgus angulation	2 cases (<15°)
AP angulation	3 cases
Overgrowth	3 cases (<1.5 cm)
Avg. hospital stay	3.7 days
Parent satisfaction	High

Complications And Risk Factors:

The most frequent complication across studies remains shortening, often accentuated in older children and those with initial displacement >20 mm. Angular malunions were generally mild and remodelled over time. Overgrowth was common but seldom symptomatic. Compared with traction-based methods, complication rates were similar, yet psychosocial and economic outcomes favoured early spica casting.

Age-based Considerations:

- **Preschool children (<5 years):** Early spica casting is highly effective, with reliable remodeling and minimal complications.
- **Children 5–11 years:** Still suitable for spica, though risk of significant shortening and malunion increases.
- **>11 years:** Alternative fixation methods (e.g., elastic intramedullary nails, plating, external fixation) may be preferable due to reduced remodeling potential.

CONCLUSION:

Hip spica cast application is a simple, safe, and effective treatment method for femoral shaft fractures in children. It provides:

- Early mobilization and rehabilitation
- Shorter hospitalization
- High union rates with minimal complications
- Economical treatment without need for implants or secondary surgery

With proper selection (children <10 years, weight <70 lbs.) and careful follow-up, hip spica remains an excellent modality for pediatric femoral shaft fractures.

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