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Original Article

Use of Pavlik Harness in the Treatment of Infantile Femur Fracture: Clinical and Radiological Outcome

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Abstract

Background: Infantile femur fractures are a significant clinical challenge, with treatment modalities varying widely. The Pavlik Harness, traditionally used for developmental dysplasia of the hip, has been employed in the conservative management of femur fractures in infants with promising outcomes. This study aims to evaluate the clinical and radiological outcomes of using the Pavlik Harness in the treatment of femur fractures in infants aged less than 6 months.

Methods: This retrospective observational study was conducted at ChattogramMaa-O-Shishu Hospital Medical College in Bangladesh from January 2021 to December 2023, encompassing a review of 22 cases of isolated femur fractures in infants treated with the Pavlik Harness. Inclusion criteria were age under 6 months, isolated femur fracture, and fracture involving the proximal and middle third of the femur. Exclusion criteria included polytrauma, neuromuscular disease, and incomplete medical records or lack of parental consent.

Result: The majority of fractures were due to birth trauma (81.82%), with a higher incidence in males (63.64%) and right-sided fractures (63.64%). The mean age and weight at the time of injury were 11.00±20.07 days and 2.86±0.52 kg, respectively. Initial angulation was 17.91±2.67 degrees AP/Vulgus and 14.82±3.34 degrees Lateral/Procurvatum. At the 2-month follow-up, significant improvements were observed with mean angulations of 8.09±2.94 degrees AP/Vulgus and 5.91±1.80 degrees Lateral/Procurvatum. Limb length discrepancy was minimal, with a mean of 2.32±0.39 cm. The treatment was associated with a low complication rate, with only 9.09% of cases developing skin excoriation.

Conclusion: The Pavlik Harness is an effective conservative treatment for infantile femur fractures, ensuring satisfactory clinical and radiological outcomes. The harness facilitates proper fracture alignment and promotes favorable bone healing dynamics, with minimal limb length discrepancy and low complication rates. These findings support the continued use of the Pavlik Harness in appropriate cases and underscore the need for further prospective studies to validate these results.

Keywords: Pavlik Harness, Femur Fracture, Pediatric, Vulgus Angulation, Lateral Angulation, Limb Length Discrepancy.

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Introductio

Femur fractures in infants represent a significant concern within pediatric orthopedics, often resulting in hospital admissions and requiring meticulous care(1). The treatment of such fractures is complex, necessitating a nuanced understanding of the various modalities

available and their outcomes(2,3). Recent statistics indicate that diaphyseal femur fractures are commonplace in pediatric orthopedic settings, with a patient-specific treatment plan being crucial for optimal outcomes(4). Factors such as age, weight, fracture pattern, associated injuries, and social considerations play a pivotal role in determining the treatment approach. For children younger than 3 years, nonaccidental trauma is a critical consideration. Typically, young children are treated with noninvasive immobilization methods such as the Pavlik harness or early hip spica casting, while older children may require internal fixation (3).Femoral fractures are among the most common orthopedic-related reasons for hospital admissions in children. While the spica cast is recommended for most children younger than 5 years, recent decades have seen the Pavlik harness emerge as a safe alternative for young children(5,6). A retrospective study conducted over 7 years in a single tertiary hospital assessed the safety, outcomes, and complications of a hip abduction brace (HAB) for treating femoral fractures in children under 3 years of age. The study concluded that HAB is a safe and comfortable alternative for selected children aged 6–36 months with nondisplaced/mildly displaced proximal and diaphyseal femoral fractures(7). In infants, the treatment of femur fractures has traditionally involved the use of a spica cast. However, a study comparing the outcomes and complications of a soft spica cast, created with cotton padding and Ace wrap without a rigid component, with other treatments, found that soft spica casts are as effective as other treatment options for femoral shaft fractures in young children. These casts are advantageous as they are easier to apply, manage, and have a lower cost(8). Despite these advancements, the literature reveals a gap in the context of Bangladesh. The unique demographic factors, healthcare practices, and noted prevalence of such fractures necessitate a study tailored to the local setting. The current state of knowledge, primarily based on studies conducted in different healthcare environments, may not fully translate to the context of a tertiary hospital in Bangladesh. This underscores the need for a focused investigation into the clinical and radiological outcomes of using the Pavlik Harness for treating infantile femur fractures in this specific setting. The Pavlik Harness, a noninvasive treatment modality, has been traditionally used for managing developmental dysplasia of the hip in infants(9,10). Its mechanism involves allowing for controlled movement while maintaining the hip in flexion and abduction, promoting proper alignment and healing. Its application in the treatment of femur fractures in infants is based on similar principles, aiming to provide stable immobilization while minimizing discomfort and potential complications.The relevance and significance of exploring the Pavlik Harness as a treatment option in Bangladesh are multifaceted. Firstly, the demographic profile, including factors such as nutrition, healthcare access, and prevalent comorbidities, may influence both the incidence and healing of femur fractures. Secondly, the healthcare infrastructure, including the availability of resources and expertise, plays a crucial role in determining the feasibility and effectiveness of various treatment modalities. Lastly, cultural and social considerations, such as caregiver preferences and compliance, are pivotal in the successful implementation of any treatment plan. Given these considerations, the present study aims to bridge the knowledge gap by evaluating the clinical and radiological outcomes of using the Pavlik Harness in the treatment of infantile femur fractures in a tertiary hospital in Bangladesh.

Methods

This retrospective observational study was conducted at the Department of Orthopedics, Chattogram-Maa-O-Shishu Hospital Medical College, Chattogram, Bangladesh, spanning from January 2021 to December 2023. Within this period, hospital records of 22 infants diagnosed with femur fractures were scrutinized and included in the analysis. Selection was based on ICD-10 codes for femur fractures in patients under 6 months, with inclusion criteria focusing on isolated fractures of the proximal and middle third of the femur. Exclusion criteria ruled out cases with polytrauma, neuromuscular disease history, and incomplete records or lack of parental consent. Data were extracted on demographics, fracture specifics, and outcomes, both clinical and radiological. The duration of Pavlik Harness application was 45 days for all cases. Radiological outcomes were evaluated via follow-up X-rays for healing and alignment, while clinical outcomes were gauged through physical assessments and the necessity for further treatment.Ethical clearance was secured from the Institutional Review Board of the respective institute, in line with the Helsinki declaration. The retrospective design negated the need for informed consent. Patient anonymity was preserved throughout the data analysis process. Statistical analyses were conducted using SPSS version 25.0.

Results

Table 1: Baseline characteristics of the patients (n=22)

Variables	Frequency	Percentage
Age		
≤1 day	10	45.45%
2-7 days	8	36.36%
8-21 days	0	0.00%
22-45 days	2	9.09%
46-60 days	2	9.09%
Age Range	1-60 days	
Mean Age	11.00±20.07 days	
Sex		
Male	14	63.64%
Female	8	36.36%
Birth weight Distribution		
≤2.5 kg	8	36.36%
2.6-4 kg	14	63.64%
Weight Range	2-4 kg	
Mean Weight	2.86±0.52	

The majority of the infants (45.45%) were aged ≤1 day at the time of presentation, followed by 36.36% who were between 2-7 days old. No infants aged 8-21 days were included in the study. A smaller proportion of the cohort, each accounting for 9.09%, were aged between 22-45 days and 46-60 days, respectively. The age range of the cohort was 1-60 days, with a mean age of 11.00 days, albeit with a relatively large standard deviation of ±20.07 days, indicating a wide age distribution within the sample.The study group showed a higher prevalence of femur fractures in male infants, who constituted 63.64% of the cases, compared to female infants, who made up 36.36%.Regarding birth weight, 36.36% of the infants weighed ≤2.5 kg, while the majority, 63.64%, had a birth weight ranging from 2.6 to 4 kg. The overall weight range was 2-4 kg, with a mean weight of 2.86 kg and a standard deviation of ±0.52, suggesting a moderate variation in birth weight among the infants studied.

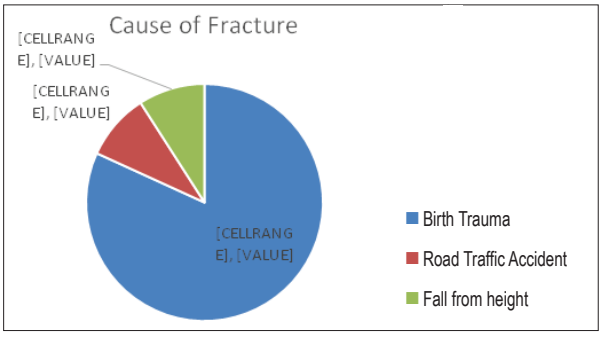

Figure 1: Distribution of the cause of fracture among participants (n=22)

In the study of 22 infants with femur fractures, the causes of injury were predominantly due to birth trauma, which accounted for 81.82% of the cases. Other causes included road traffic accidents and falls from height, each constituting 9.09% of the fractures.

Table 2: Distribution of the side of fracture among participants (n=22)

Side of fracture	Frequency	Percentage
Right	14	63.64%
Left	8	36.36%

The distribution of the side of femur fractures among the 22 infant participants was skewed towards the right side, with 63.64% of fractures occurring on the right femur. The remaining 36.36% of fractures were on the left side.

Table 3: Distribution of baseline fracture angulation among the participants (n=22)

Baseline Fracture Angulation	Frequency	Percentage
AP/Vulgus angulation		
≤15°	8	36.36%
16-20°	10	45.45%
21-25°	4	18.18%
Range	15°-22°	
Mean ± SD	17.91±2.67	
Lateral/Procurvatum		
≤10°	4	18.18%
11-15°	10	45.45%
16-20°	8	36.36%
Range	10°-20°	
Mean ± SD	14.82±3.34	

For AP/Vulgus angulation, the majority of fractures (45.45%) exhibited an angulation between 16-20°. A significant portion (36.36%) had an angulation of ≤15°, and a smaller group (18.18%) presented with an angulation between 21-25°. The range of AP/Vulgus angulation was between 15°-22°, with an average angulation of 17.91° and a standard deviation of ±2.67, indicating a relatively narrow spread around the mean.In terms of Lateral/Procurvatum angulation, the data showed that 45.45% of the fractures had an angulation between 11-15°, while 36.36% had a more pronounced angulation of 16-20°. A smaller fraction (18.18%) had an angulation of ≤10°. The range for Lateral/Procurvatum angulation was 10°-20°, with a mean of 14.82° and a standard deviation of ±3.34, suggesting a moderate variability in this type of angulation among the participants.

Table 4: Distribution of participants by operational outcome among participants (n=22)

Outcome	Frequency	Percentage
No Complications	20	90.91%
Skin Excoriation	2	9.09%

The vast majority of participants, 90.91%, experienced no complications following their treatment. However, a small subset, 9.09%, did encounter skin excoriation as a complication.

Table 5: Distribution of limb length discrepancy among participants (n=22)

Limb Length Discrepancy (in cm)	Frequency	Percentage
2	12	54.55%
2.5	6	27.27%
3	4	18.18%
Mean ± SD	2.32±0.390	

The most common limb length discrepancy recorded was 2 cm, occurring in 54.55% of the participants. A discrepancy of 2.5 cm was found in 27.27% of the cases, while a larger discrepancy of 3 cm was less common, present in 18.18% of the infants. The mean limb length discrepancy across the cohort was 2.32 cm with a standard deviation of ±0.390

Table 6: Distribution of fracture angulation during operation among the participants (n=22)

Fracture Angulation during Treatment	Frequency	Percentage
AP/Vulgus angulation (º)		
≤15°	12	54.55%
16-20°	8	36.36%
21-25°	2	9.09%
Range	12°-21°	
Mean ± SD	15.82±2.82	
Lateral/Procurvatum		
≤10°	6	27.27%
11-15°	12	54.55%
16-20°	4	18.18%
Range	10°-18°	
Mean ± SD	13.45±2.67	

For AP/Vulgus angulation, more than half of the cases (54.55%) had an angulation of ≤15° at the time of treatment. A significant proportion (36.36%) had an angulation between 16-20°, and a minority (9.09%) presented with an angulation between 21-25°. The range of AP/Vulgus angulation during treatment was from 12° to 21°, with an average angulation of 15.82° and a standard deviation of ±2.82, reflecting a modest spread of angulation degrees.In the case of Lateral/Procurvatum angulation, the majority (54.55%) had an angulation between 11-15° during treatment. A smaller group (27.27%) had an angulation of ≤10°, and 18.18% had an angulation between 16-20°. The range for Lateral/Procurvatum angulation during treatment was 10° to 18°, with a mean of 13.45° and a standard deviation of ±2.67, indicating a moderate variation in this type of angulation among the infants treated.

Table 7: Distribution of fracture angulation at 2-month follow-up among the participants (n=22)

Fracture angulation at 2-month follow-up	Frequency	Percentage
AP/Vulgus angulation (º)		
≤5°	10	45.45%
6-10°	8	36.36%
11-15°	4	18.18%
Range	5°-12°	
Mean ± SD	8.09±2.94	
Lateral/Procurvatum		
≤5°	16	72.73%
6-10°	6	27.27%
11-15°	0	0.00%
Range	4°-10°	
Mean ± SD	5.91±1.80	

For AP/Vulgus angulation, nearly half of the infants (45.45%) had an angulation of ≤5° at the 2-month follow-up. A substantial number (36.36%) had an angulation between 6-10°, and a smaller fraction (18.18%) had an angulation between 11-15°. The range of AP/Vulgus angulation at follow-up was between 5° and 12°, with a mean angulation of 8.09° and a standard deviation of ±2.94, suggesting a relatively low degree of residual angulation post-treatment.In terms of Lateral/Procurvatum angulation, a significant majority (72.73%) had an angulation of ≤5° at the 2-month follow-up, indicating a favorable outcome with minimal angulation. The remaining 27.27% had an angulation between 6-10°, and notably, there were no cases with an angulation between 11-15°. The range for Lateral/Procurvatum angulation at follow-up was 4° to 10°, with a mean of 5.91° and a standard deviation of ±1.80, demonstrating a generally successful realignment of the fractures in the lateral plane.

Discussion

In the observational study conducted at a tertiary hospital in Bangladesh, we meticulously documented the clinical and radiological outcomes of using the Pavlik Harness in the treatment of infantile femur fractures. Our findings revealed a strikingly high incidence of birth trauma as the cause of femur fractures, accounting for 81.82% of cases, which is consistent with the literature indicating a significant association between birth trauma and neonatal fractures, particularly in the context of Cesarean sections for breech presentations (11,12). The predominance of right-sided fractures, observed in 63.64% of cases, echoes the findings of other studies, although the underlying reasons for this laterality remain to be fully elucidated (13). The age distribution of the infants at the time of fracture was notably young, with 45.45% being ≤1 day old and a mean age of 11.00±20.07 days, suggesting that the majority of fractures occurred perinatally. This is in line with other reports in the literature, where the perinatal period is recognized as a vulnerable time for such injuries (14–16). The gender distribution skewed towards males, who comprised 63.64% of the cases, aligning with broader epidemiological data that suggest a slightly higher predisposition for males in pediatric fractures (3,17). The baseline fracture characteristics in our cohort showed a mean AP/Vulgus angulation of 17.91±2.67 degrees and a mean Lateral/Procurvatum angulation of 14.82±3.34 degrees. These initial angulations are critical for understanding the natural history of femur fractures in infants and the potential for remodeling, which is a unique aspect of pediatric orthopedics. The treatment outcomes were favorable, with a low incidence of complications, as 90.91% of patients experienced no complications, and only 9.09% had skin excoriation, underscoring the safety and efficacy of the Pavlik Harness in this context, which is supported by the findings from other similar studies (18,19).The limb length discrepancy (LLD) observed in our study, with a mean discrepancy of 2.32±0.39, is a critical indicator of the long-term orthopedic health of pediatric patients following femur fractures. Notably, this discrepancy falls within the range that is typically amenable to spontaneous correction as the child matures, a phenomenon well-documented in pediatric orthopedics (20). The minimal LLD observed underscores the efficacy of the Pavlik Harness in mitigating one of the most common complications associated with pediatric femur fractures. This finding is particularly impactful, considering that LLD can result in significant functional and developmental issues if left unaddressed (21). Moreover, the improvement in fracture angulation during treatment, with a mean AP/Vulgus angulation of 15.82±2.82 degrees and a mean Lateral/Procurvatum angulation of 13.45±2.67 degrees, further attests to the Pavlik Harness's ability to maintain proper alignment. This is crucial, as proper alignment is a determinant of effective healing and can prevent future complications such as malunion or the need for surgical intervention (22).At the 2-month follow-up, the continued decrease in mean AP/Vulgus angulation to 8.09±2.94 degrees and mean Lateral/Procurvatum angulation to 5.91±1.80 degrees is indicative of ongoing bone remodeling. This natural correction process is a unique advantage in pediatric patients, where the potential for bone growth and remodeling is high (23). The favorable angulation outcomes in our study not only highlight the Pavlik Harness's role in immediate fracture stabilization but also its contribution to the natural healing process, leading to improved long-term bone structure and function.In summary, the low incidence of LLD and the significant improvement in fracture angulation are key benefits of using the Pavlik Harness in the treatment of infantile femur fractures. These benefits have a profound impact on the prognosis of pediatric patients, offering a non-invasive treatment option that aligns with the body's natural healing mechanisms.

Limitations of The Study

The study was conducted in a single hospital with a very small sample size. So, the results may not represent the whole community. The rarity of the ailment, the short study duration and the retrospective nature of the study further limited the sample size.

Conclusion

In conclusion, our study contributes valuable data to the existing body of literature on the management of infantile femur fractures, particularly in the context of developing countries where resources may be limited. The high incidence of birth trauma as a cause of fractures highlights the need for improved perinatal care and possibly the development of protocols to reduce the risk of such injuries. The successful outcomes associated with the Pavlik Harness, including low complication rates and acceptable limb length discrepancies, support its continued use in similar clinical settings. Future research should aim to further elucidate the reasons behind the laterality of fractures and explore the long-term functional outcomes of infants treated with the Pavlik Harness.

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