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Original Research Article

DOES TITANIUM ELASTIC NAIL (TEN) FOR FEMUR SHAFT FRACTURE IN CHILDREN HAVE SUPERIOR FUNCTIONAL OUTCOMES THAN SPICA CAST APPLICATION? AN EXPERIENCE FROM TERTIARY CARE HOSPITAL

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Abstract: *This study aimed to compare functional outcomes in children with femur shaft fractures treated with ether titanium elastic nail or spica cast application. This prospective cohort study was conducted at the Department of Orthopedic and Spine, Aziz Bhatti Shaheed Teaching Hospital, Gujrat, from 1st June 2020 to 31st December 2022. This study involved 60 children of both genders, aged 3-6 years, presenting with femoral shaft fractures (Winquist I & II), randomly allocated into two groups for treatment. Patients in Group E were treated with titanium elastic nails, while a hip spica cast was applied to patients in Group S. Functional outcome was measured with the meantime to walk independently, which was noted and compared between the two groups. Patients had a mean age of 4.42±1.12 years, while the mean weight was 18.23±2.09 Kg. There were 21 (35.0%) female and 39 (65.0%) male patients with a male-to-female ratio of 1.9:1. The mean time to walk independently was significantly shorter in children treated with titanium elastic nail as compared to hip spica cast (5.60±1.28 vs. 8.93±1.98 weeks; p<0.001). A similar significant difference was observed between groups across various subgroups of patients based on age, gender, and weight. We concluded that internal fixation of pediatric femoral shaft fractures utilizing titanium elastic nail had superior functional outcomes as compared to hip spice cast application in terms of significantly shorter mean time to walk independently along with the minimally invasive nature of the procedure and better patient hygiene and cosmesis advocate preferred use of titanium elastic nails for management of such fractures.*

Keywords: Femoral Shaft Fracture, Children, Titanium Elastic Nail, Hip Spica Cast.

Introduction

Childhood injuries are an important preventable cause of morbidity and mortality, which leads to approximately 2 million emergency department visits per year and 120 000 hospital admissions per year in pediatric and young adults aged between 1-14 years in the UK (Baker et al., 2015; Moon et al., 2016). Blunt trauma is a major cause of femoral shaft fractures, accounting for the most common pediatric injuries managed by an orthopedic surgeon. Femur shaft fracture involves about 70% of all femur fracture cases (Sela et al., 2013).

Different treatment options are available for femur shaft fracture, which depends on the type and mechanism of injury to personal experience and choice of surgeon. These methods include hip spica cast, skin traction, external fixator, plating, and intramedullary nailing (Khoriati et al., 2016). There is no consensus regarding the best treatment option for pediatric femoral shaft fracture as each carries its advantages and disadvantages, and no study can determine the long-term effects of operative vs. non-operative management (Madhuri et al., 2014).

Khan et al. in 2018 conducted a study and found that the mean time to bear weight in patients with femoral shaft fracture treated by elastic nailing vs. hip spica was 6.78 ±1.14 weeks vs. 9.87 ±1.56 weeks respectively; p<0.001 (Khan et al., 2018). Shah et al. conducted a similar study in 2015 and found that to be 8.77±1.88 weeks in the spica cast group vs. 11.99±2.30 weeks in the titanium elastic nail group; p 0.403 (Shah et al., 2015).

There is a conflict in the mean time to heal and weight bearing among the children with femoral shaft fracture treated by the two techniques (6.78±1.14 elastic nailing vs. 9.87±1.56 spica cast weeks respectively; p<0.001.6 8.77±1.88 weeks in

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spica cast group vs. 11.99±2.30 weeks in titanium elastic nail group; p= 0.403 (Shah et al., 2015). As both the studies are performed in Pakistan, and there is a conflict in the outcome of the studies, therefore more studies should be conducted in regional population so that the conflict can be resolved and a better treatment option could opt which can provide early healing and weight bearing to the children suffering from femur shaft fracture.

Methodology

Approval for this study was taken from the Ethical review committee of the hospital before commencement; 60 patients (30 patients in each group) who presented in the Emergency Department of Orthopedic Surgery and who fulfilled the above criteria were counseled and explained the details of the study. Written informed consent and detailed history were taken from each patient. These patients were then randomly divided into the following two groups using the lottery method. Group-S: (Spica Cast) and Group-E (Titanium Elastic Nailing). General anesthesia was given for all patients, surgeries were performed by the same team of the orthopedics department (involving the candidate), and according to weight dose of co-amoxiclav was given 30 minutes before incision after testing for sensitivity. Under an aseptic measure (patients in group E), a linear stab was given, the fascia was opened, and the muscle fibers were moved aside. A small hole was made in the distal femur using drill-bit and trocar, and a retrograde titanium elastic nail was placed (Figure 1). The size of the nail was 40% of the diameter of the narrowest part of the femoral canal-arm image intensifier used during the procedure.

All the patients were discharged after 48 hours of surgery and were called for regular follow-up. Patients in the S group received hip spica cast under general anesthesia as per operational definition (Figure 2). The cast lasted for the next 4 weeks. The mean time to walk was assessed as per the operational definition. Physically patients were called weekly after surgery for the next 12 weeks to assess the meantime to walk independently. The same surgical team performed all the surgeries. All the collected data was entered and analyzed through SPSS version 21.0. Numerical variables, age, body weight, and post-treatment duration taken to stand independently have been presented by mean ± SD. An Independent sample t-test was applied to compare the mean post-operative duration taken to walk independently between the two groups with p ≤0.05 as significant. Categorical variables such as gender were presented by percentages and frequencies. Data was stratified n terms of body weight, gender, and age. A post-stratification t-test was applied, having p ≤0.05 as significant.

Figure 1:
A: A female patient presented with closed fracture of femur
B: Stabilization with TEN was performed
C: Follow up x-rays showed callus formation

Figure 2:
A: A male patient presented with closed fracture of femur
B: Stabilization with spica cast was performed

Results

Patient's age varies between 3 and 6 years with a mean of 4.42±1.12 years, while the weight ranged from 14 Kg to 24 Kg with a mean of 18.23±2.09 Kg. There were 21 (35.0%) female and 39 (65.0%) male patients with a male-to-female ratio of 1.9:1, as shown in Table 1.

Table1: Demographic features of the study sample (n=60)

Characteristic	Study Cohort n=60
Age (years)	4.42±1.12
3-4 years	33 (55.0%)
5-6 years	27 (45.0%)
Gender	
Male	39 (65.0%)
Female	21 (35.0%)
Weight (kg)	18.23±2.09
14-18 Kg	29 (48.3%)
19-24 Kg	31 (51.7%)

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The mean time to walk independently was significantly shorter in children treated with titanium elastic nails compared to hip spica cast (5.60±1.28 vs. 8.93±1.98 weeks; p-value<0.001), as shown in Table 2. A statistically significant similar difference was found among each group across various subgroups of patients based on weight, age, and gender, represented by Table 3.

Table 2: Comparison of mean duration to walk independently (weeks) between the study groups

	Titanium Elastic Nail n=30	Hip Spica Cast n=30	P-Value
Mean duration to walk independently. (weeks)	5.60±1.28	8.93±1.98	<0.001*
*Independent sample t-test, * Observed difference was statistically significant.*			

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Table 3: Comparison of mean duration to walk independently (weeks) between the study groups across various subgroups

Subgroups	Mean Duration to Walk Independently (weeks)		P value
	Titanium Elastic Nail n=30	Hip Spica Cast n=30	
Weight			
14-18 Kg	5.60±1.30	8.86±2.21	<0.001*
19-24 Kg	5.60±1.30	9.00±1.83	<0.001*
Gender			
Male	5.58±1.12	8.90±2.08	<0.001*
Female	5.64±1.57	9.00±1.89	<0.001*
Age			
3-4 years	5.59±1.37	8.94±2.02	<0.001*
5-6 years	5.62±1.19	8.93±2.02	<0.001*
***Independent sample t-test, *Statistically significant difference was noted*.**			

Discussion

Blunt trauma is a major cause of femoral shaft fractures, accounting for the common major pediatric injuries managed by orthopedic surgeons. Femur shaft fracture involves about 70% of all cases of femur fracture. It significantly impacts families and hospitals as it requires hospitalization among the pediatric population. 8 Children have tremendous growth and remodeling potential; pediatric fractures heal quickly. This increases the acceptability of different deformities in the initial phase of the healed fracture. Many factors are involved in decision-making for either non-operative or operative management of femur shaft fracture. These may include the type of fracture, age and weight of the patient, socioeconomic status, and associated injuries (Kocher et al., 2010).

A hip spica cast is a conventional and most widely used treatment option among the various treatment options. However, prolonged immobilization, difficulty in nursing, poor hygiene, and social embarrassment are downsides of hip spica cast (Khoriati et al., 2016; Sela et al., 2013). Recent studies claimed that internal stabilization of fracture through minimally invasive titanium elastic nails was superior to this conventional practice in terms of significantly shorter mean time to walk independently. However, the available evidence was limited and contained controversy, necessitating this study 6, 7.

In this study, the mean age of the children was 4.42±1.12 years. Shah et al. observed mean age of 3.9±1.8 years among children presenting with femoral shaft fractures at Mardan Medical Complex Teaching Hospital Mardan (Shah et al., 2013), while Saeed et al. found 5.7±2.8 years at Allied and DHQ Hospital Faisalabad.21 Salam et al. and Kumar et al. reported comparable mean ages of 5.1±1.9 years and 5.4±1.8 years, respectively, in Indian children.11Amin et al. and Assaghir et al. reported similar mean age of 4.7±1.8 years and 4.5±1.5 years respectively among Egyptian children with femoral shaft fractures (Assaghir, 2012; Ramo et al., 2016). Ramo et al. observed it to be 4.7±1.3 years in the UK (Ramo et al., 2016), while Sel et al. reported it to be 3.5±1.1 years in Israel. (Sela et al., 2013)We observed a male predominance among such children with a male to female ratio of 1.9:1. Many regional studies observed the same male predominance in children with femur shaft fractures. Hayat et al 2:1, Naseem et al (2.1:1) and Shah et al (1.8:1) (Hayat et al., 2017; Naseem et al., 2015; Shah et al., 2013). Kumar et al. (2:1) and Sahu et al. (1.8:1) reported similar male

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predominance in India11,16while Wang et al. reported similar male predominance (m:f; 1.7:1) in Chinese such children (Wang et al., 2019).

Male predominance and younger mean age among patients with femoral shaft fractures are linked with the mechanism of injury behind these fractures, which is road traffic accidents and fall from height, frequently involving young boys. In the present study, the mean time to walk independently was significantly shorter in children treated with titanium elastic nails compared to hip spica cast (5.60±1.28 vs. 8.93±1.98 weeks; p<0.001). A similar significant difference was observed between the groups and across various subgroups of patients based on weight, gender, and age. Our results are similar to those found in regional studies where Khan t al. (2018) reported similar significantly shorter mean time to independent mobilization between children treated with titanium elastic nail versus hip spica cast presenting at Lady Reading Hospital, Peshawar (6.78±1.14 vs. 9.87±1.56; p<0.001) (Khan et al., 2018).

In a similar study in India, Kumar et al. also observed similar significantly lesser mean time to walk with titanium elastic nails when compared with hip spica cast in children with femoral shaft fractures (5.9±1.4 vs. 11.1±2.0 weeks; p<0.001) (Kumar et al., 2018). Saseendar et al., in another Indian study, also observed a similar significant difference in the meantime to walk independently with elastic nail versus spica cast (5.3±1.5 vs. 7.4±1.0 weeks; p<0.001) (Saseendar et al., 2010). Assaghir et al. also observed early recovery and independent weight bearing with nailing (5.0±1.5 vs. 7.7±1.5 weeks; p0.035) as compared to spica cast in Egyptian children with femoral shaft fractures (Assaghir, 2012). A similar difference has also been reported by Ramo et al. (6.1 vs. 6.8 weeks; p<0.001) in the UK (Ramo et al., 2016) in this study. We noted that internal fixation of pediatric femoral shaft fractures utilizing titanium elastic nail was better than hip spice cast application in terms of significantly shorter mean time to walk independently, which along with the minimally invasive nature of the procedure and better patient nursing, hygiene, and cosmesis advocate the preferred use of titanium elastic nails for the management of such fractures in future orthopedic practice. The limitation of our study is that we were unable to compare groups in terms of complications such as skin problems, infections, and implant failure. There is a need for such a study to elaborate further on the management of titanium elastic nails over hip spica cast. Such type of study is a need in the future.

Conclusion

In the present study, we observed that internal fixation of pediatric femoral shaft fractures utilizing titanium elastic nails was better regarding functional outcomes among children managed with hip spice cast application. It has further demonstrated that significantly shorter mean time to walk independently, along with the minimally invasive nature of the procedure and better patient hygiene and cosmesis, advocate the preferred use of titanium elastic nails to manage such fractures in future orthopedic practice.

Conflict of interest

The authors declared the absence of a conflict of interest.

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