DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20243881

Original Research Article

Evaluation for results of the treatment with diversities of modality in comminuted sub trochanteric fracture of femur in children

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Received: 06 October 2024
Accepted: 18 November 2024

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ABSTRACT

Background: The diaphyseal femoral fractures account for around 2% of all pediatric fractures. Treatment includes conservative or surgical methods, but the choice of treatment differs depending on the child's age, fracture pattern, other concomitant fractures and the socioeconomic situation of the family. The study aimed to assess the result of the treatment with a diversity of modality in comminuted sub trochanteric fracture of the femur in paediatric patients.
Methods: This was a prospective randomized comparative study with a prospective follow-up that took place at the department of orthopedics at President Abdul Hamid medical college and hospital, Kishoreganj, Bangladesh from May 2022 to May 2024. The 110 patients with diaphyseal femur fracture and were 0-18 years old were included in the study and 48 participated in the outcome follow-up.
Results: Out of 110 patients 55 were males and 55 females. Conservative treatment was the most common treatment. The mean age of incurring this type of fracture was 7.45 years. Mainly, injury among all kids who fall from above standing level. The majority of the younger children received conservative treatment.
Conclusions: The treatment chosen and the outcomes after a fracture seem to be satisfactory. It is important for future studies to include a large number of patients and to examine not only the clinical outcomes, but also the social and economic aspects.

Keywords: Shaft of femur, Pediatric fracture, Surgical treatment, Conservative treatment

INTRODUCTION

Children are at high risk of injury, and approximately one in four children will suffer from an injury annually, where 25% of these injuries are related to fractures.[1,2] The definition of fracture is a break in the structural components of the bone and is usually caused by a direct injury. The fracture could have different patterns such as spiral, transverse, oblique or triangular. The pattern usually indicates the type of trauma causing the fracture, where a transverse pattern is related to high-energy trauma and spiral pattern to low-energy trauma.[3] Fractures have a big impact on children's lives and daily activities and are mostly caused by an accident or an assault.[4,5] It could be the case of a simple fall, but for older children the force of trauma has to be more severe, for example a RTA.[6] The most common pediatric long-bone fracture is the femoral fracture.[7] The femur bone is located in the upper part of the lower extremity and divided into three parts, proximal, diaphyseal (shaft) and distal femur.[8] The skeletal bones in a child have special characteristics compared to an adult, since the bone structure is not mature. During the skeletal development the physes is open, the periostium is thicker and the bone has different biomechanical behavior when mechanical pressure is applied on the bone.[7] Among children and teenagers the diaphyseal femoral fracture is the most serious fracture in the lower extremity with an annual incidence of 19/100.000.[9,10] The fracture has a bimodal pattern peaking at 2-3 years of age and at adolescence.[11] It is common to classify this type of fracture

based on fracture pattern: "1) transverse, spiral or oblique, 2) comminuted (multiple fragments) or non-comminuted, 3) open or closed fractures". Diaphyseal femoral fractures are treated conservatively (non-surgical) or surgical but the choice of treatment differs between children.[8,13] These methods have different advantages and disadvantages and there is no consensus for which method that is most ideal.[10,12,14] Treatment has changed over time. In the past the majority were treated conservatively, but in modern time new techniques have been developed and often used in order to reduce hospital stay.[13] The variables that determine what treatment to choose are the child's age, fracture pattern other concomitant fractures but also the socio-economic situation of the child's family.[7,15] Other important factors are bone age, size of the child, local tradition at the hospital, the surgeons' experience, if the treatment is available, cost of treatment and configuration of the fracture.[7] For older children 12 years up to adolescent a surgical procedure is almost always necessary.[5] If a surgical approach is used it aims to reposition the bone with an open instead of closed procedure. The surgical techniques include intramedullary nailing, plate fixation and external fixation.[8] The technique of treating pediatric femur fractures with elastic stable intramedullary nailing (ESIN) was introduced at a French hospital in Nancy.[16] For children younger than 5 years of age the ESIN is not necessary, but can be used from 5 years of age up until the proximal growth plate closes.[13] In this age group, elastic nailing is used to stabilize the fracture. Plate fixation is a treatment modality suitable for comminute fractures in poly-traumatized patients, in adolescents or in cases when intramedullary nails cannot be used because the fracture is too proximal.[7] External fixation is a treatment often used in poly-traumatized patients with comminute but also long oblique fractures.[5,17] The risk of becoming infected during hospital stay is 5% and at least 8% when performing invasive procedures. In a study of nosocomial infection at Tribhuvan university teaching hospital (TUTH) 72.5% of the patients were infected with *S. aureus* and 42.6% with MRSA. The highest observed prevalence of *S. aureus* infections in this study was at the surgical and orthopaedic ward.[18] This study aims to evaluate and compare the effectiveness and outcomes of various treatment of comminuted sub-trochanteric fracture of the femur in children. Written consent and ethical clearance were obtained before the study.

Objectives

General objective

The general objective of study was to find the management of comminuted sub-trochanteric fracture of the femur in paediatric patients.

Specific objective

The specific objective of study was to the treatment with diversities of modality in comminuted sub trochanteric fracture of femur in children.

METHODS

This prospective randomised comparative study was conducted at the department of orthopaedics at President Abdul Hamid medical college and hospital, Kishoreganj, Bangladesh from May 2022 to May 2024. Among 230 patients, the study included 110 young patients aged 0-18 years who came to the hospital with comminuted sub trochanteric fracture of the femur.

Inclusion criteria

This study included when each patient was diagnosed with subtrochanteric femur fracture and was 0-18 years of age.

Exclusion criteria

Patients who came for re-operation or removal of material due to treatment of the femoral fracture were excluded of this study. Patients with pathological shaft of femur fractures were also excluded.

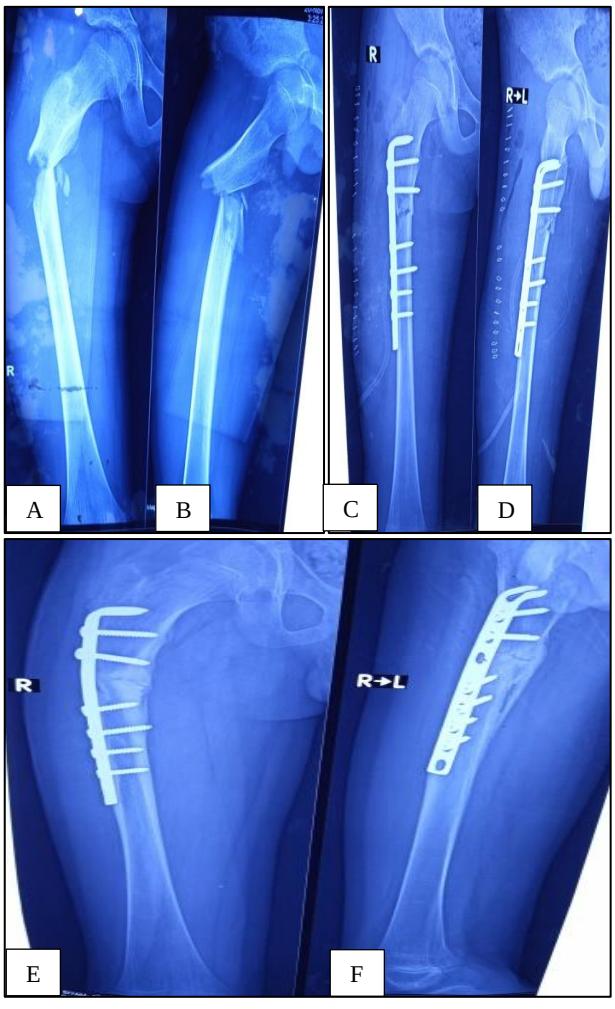

Figure 1 (A-F): Plate and screw fixation.

Figure 2 (A-D): TENS fixation.

Excel and STATA/SE version 13.0 programme were used to manage and analyse the study data. Mean values and standard deviations were calculated from the collected variables. Pearsons Chi square test was used to compare the variables of the conservative and surgical treatment and to find statistical significance. For cell value below 5, Fisher's exact test was used instead of Pearsons Chi square test. A significance level of $p<0.05$ was utilised. Ethical approval was received from the hospital's ethical committee. Furthermore, all study participants provided well-informed consent.

RESULTS

In this study, 110 patients (55 males, 55 females) were treated at the orthopaedic wards for subtrochanteric femur fracture. No deaths were reported. The patients' ages ranged from 0-18 years, with a mean age of 7.45±2.94 (Table 1). The 55 patients had a conservative treatment which included "Gallow's traction + hip spica" or "skin traction+hip spica". Patients younger than 18 months are usually treated with Gallow's traction + hip spica. 39 patients had a surgical treatment which included "skin traction+TENS", "skin traction+IMIL" or "skin traction+plate and screws" (Table 2). The conservative group was only given antibiotics in case of infection. 67.27% and 54.55% of the study population lacked information about fracture pattern and fracture site, respectively, in the medical records (p=0.103 resp 0.894) (Table 3). The conservative group had a higher number of days of traction application and duration of hospital stay (mean 14.67±3.17 resp 14.67±3.17) compared to the surgical group (mean 6.09±0.92 days resp 10.47 days±2.78). The variable differences in days of traction application were statistically significant (p=0.003) but not the duration of hospital stay (p=0.080) (Table 4). According to Table 5 and 6, the prevalence of the same fracture in children is higher in both groups. The need for assistance in the case of both treatments was significant.

Table 1: Age group of the study population (n=110).

Variables	Mean±SD	Min	Max
Age (in year)	7.45±2.94	0	18

Table 2: Distribution of treatment.

Treatments	N (%)	Cum.
Gallow's traction+hip spica	10	54.55
Skin traction+hip spica	50	
Conservative treatment	60 (54.55)	
Skin traction+TENS	22	89.09
Skin traction+ IMIL	8	
Skin traction+plate and screws	8	
Surgical treatment	39 (34.55)	
Missing obs	12 (10.91)	100.00
Total	110	100.00

Table 3: Comparison between conservative treatment and surgical treatment.

Injuries		Conservative treatment (%)	Surgical treatment (%)	Total (%)	P value
Associated injuries	None	52 (74)	18 (26)	70	0.009
	Poly-trauma	8 (31)	18 (69)	26	
	Missing obs	0 (0)	2 (100)	2	
Antibiotics	Yes	2 (5)	36 (95)	38	0.00
	Missing obs	0 (0)	2 (100)	1	
Fracture pattern	Transverse	10 (56)	8 (44)	9	0. 103
	Spiral	12 (100)	0 (0)	6	
	Comminute	0 (0)	0 (0)	0	
	Missing obs	38 (56)	30 (44)	34	

Continued.

Injuries		Conservative treatment	Surgical treatment	Total (100)	P value
Site	Proximal	6 (50)	6 (50)	6	0.894
	Mid shaft	16 (57)	12 (43)	14	
	Distal	2 (100)	0 (0)	1	
	More than one part	0 (0)	2 (100)	1	
	Missing obs	36 (67)	19 (33)	27	
Side	Right	28 (56)	22 (44)	25	0.566
	Left	30 (65)	16 (35)	23	
	Bilateral	0 (0)	0 (0)	0	
	Missing obs	2 (100)	0 (0)	1	

Table 4: Post-operative comparison between conservative and surgical treatment.

Variables	Conservative treatment				Surgical treatment				P value
	N	Missing OBS	Mean±SD	95% CI	N	Missing OBS	Mean±SD	95% CI	
Age (in years)	60	0	3.73± 0.27	2.78-4.29	38	0	11.76± 0.96	9.83-13.75	0.000
Days of traction application	48	12	14.67± 3.17	14.24-10.10	36	2	6.09± 0.92	4.20-8.02	0.003
Duration hospital stay	60	0	16.13± 3.01	16.06-20.20	38	0	10.47± 2.78	10.84-14.11	0.080

Table 5: Post-operative outcomes and feedback.

Outcomes and feedback	P value	Response	Conservative treatment, (%)	Surgical treatment, (%)
Choice of the same treatment for a similar fracture	0.493	No	4 (14)	0 (0)
		Yes	24 (86)	20 (100)
		Total	28	20
Pain during weight-bearing	1.00	No	14 (58)	12 (60)
		Yes	10 (42)	8 (40)
		Total	24	20
Pain medication due to femur fracture	-	No	28 (100)	20 (100)
		Yes	0 (0)	0 (0)
		Total	28	20
Normal movement	1.00	No	4 (15)	2 (10)
		Yes	22 (85)	18 (90)
		Total	26	20
Attending school	0.125	No	0 (0)	2 (10)
		Yes	16 (57)	16 (80)
		Not in school	12 (43)	2 (10)
		Total	28	20
Need of assistance	0.059	No	0 (0)	6 (30)
		Yes	28 (100)	14 (70)
		Total	28	20

Table 6: Post-operative outcome differences between conservative and surgical treatment (if "Yes" on question from Table 5).

Post-operative outcomes	Conservative treatment		Surgical treatment		P value
	N	Mean±SD	N	Mean±SD	
Attending school	16	116.88±44.05	16	91.75±59.12	0.127
Need of the assistance	28	92.18±8.66	14	77.57±84.04	0.087

DISCUSSION

In this study, a conservative treatment was the most common treatment received among children with a subtrochanteric femur fracture. The mean age for receiving this type of fracture was 7.45 years. The dominating cause of injury among all children was fall from above standing height. When comparing the conservative and surgical treatments, statistically significant differences were found regarding associated injuries, use of antibiotics, age, hospital cost and days of traction application. This study found that 55% of the injured were girls. In previous research, boys had a double incidence rate compared to girls. The current study population exhibited a similar age range as compared to a study on non-fatal injuries conducted in Makwanpur district, Nepal.[5] The primary cause of injury in this study was fall-related accidents, which is consistent with previous studies in Nepal.[2,8] The rate of lifetime injury in rural areas is large compared to urban areas.[2] It may be related to the fact that a larger proportion of the study population belonged to rural areas outside Kathmandu. The causes of diaphyseal subtrochanteric femur fractures differ between age groups. However, we found different results in our study compared to previous research in a worldwide perspective. The most common causes among infants are assault and RTA, but in this study fall-related accidents occurred most frequently, especially fall from standing height.[1] There were no cases of abuse in this study, but it is very difficult to diagnose according to research.[19,20] Cases of abuse could be present but not brought to light. Cases of low-energy falls were the most common cause of fracture, both in this study and previous research.[5] Among older children aged 4-12 years this fracture occurred during sport-activities, but in this study the main cause was fall from above standing height. Among children older than 12 years, RTAs is the most common cause, but in this study the main cause was fall from above standing height.[5] Of those who sustained a fracture due to falls above standing height, falling from a building was usually the cause. The reason for why is unclear, but it could be due to poor building constructions, that the parents are not supervising their children or that the children live in dangerous environments.

According to previous research, conservative treatment was frequently used in the past, but the trend points towards an increase in the use of surgical treatment.[13] It is found that patients often receive conservative treatment. The explanation could be that the trend is lagging in Bangladesh compared to the development in the western world. Another explanation could be that conservative treatment is more of a tradition in Bangladesh compared to surgical treatment. According to previous research, both local traditions at the hospital and fracture pattern determine the choice of treatment.[7] A conservative treatment is cheaper compared to a surgical treatment in this study. The reason why conservative treatment is more used could be due to low socioeconomic status and poverty among the study population. There is still no consensus about which treatment to recommend due to the lack of high-quality studies that compare the different treatments.[10,12,21] Many previous studies have focused on the evaluation of various treatment methods regarding clinical outcomes and risk of complications.[5,7,8,10] Initially, the idea of this study was to do a similar study compared to TUTH, Nepal. However, there were major deficiencies in the archive of medical records at TUTH that made it difficult to measure the complications and outcomes based on the medical records. The documentation lacked both x-ray files and follow-ups with physicians. PAHMCH also needs to improve their medical record system and would benefit from an electronic medical record system. With such a system, physicians spend more time on administration, but patients would benefit from a system with complete documentation. The following section will include a discussion between conservative and surgical treatment regarding the studied variables. We found statistically significant differences in the use of antibiotics between the studied treatment groups. Patients treated surgically had the highest use of antibiotics, but this is explained by the pre-operative routine at PAHMCH. It is expected that the use of antibiotics correlates to the presence of an infection. But in this study, the antibiotics were given prophylactically in the surgical group. We can therefore not make that assumption. Only one patient in the conservative group was given antibiotics. This may indicate the presence of an infection. All observations included patients treated at the hospital; no follow-up visits were included in the data. This means that infections could occur during healing after the hospital stay and the rate of antibiotics used or the presence of infections could be higher. The use of antibiotics is probably high in Bangladesh, because there is no need of a prescription from a physician. Previous studies have shown a high prevalence of infections, especially *MRSA* and *S. aureus* at both the surgical and orthopedic wards at TUTH, Nepal.[18] This means that the rate of infection could be large in this study. Instead of using antibiotics as a sign of infection, CRP or a bacterial tests would have been preferred.

We found no statistically significant differences between the groups regarding the variables fracture pattern, site of fracture or side of fracture. One explanation could be that fracture pattern and site of fracture exhibits large proportions of missed observations. A pediatric diaphyseal subtrochanteric femur fracture is usually classified according to fracture pattern, but in our study, this information was frequently missing.[8] This documentation in the case of a fracture is essential, especially when treated with a surgical intervention that is dependent on the anatomical information.[7] The proportion of missed observations was larger in the conservative group compared to the surgical group regarding the site of fracture. One explanation may be that this information is more frequently used when doing a surgical procedure. The distribution of the affected side was relatively evenly spread between the two groups. This can be explained by chance. It has been found that the surgical group had a mean traction application of 6.11±0.90 days. According to previous research repositioning of the bone is done during

a surgical treatment, and there is a question of if traction application is necessary.[8] Therefore, traction application may indicate a waiting time until surgery. The reason for waiting time could be due to that surgeries are performed only two or three days a week. It was also found that the conservative group had a longer period of traction application compared to the surgical group. According to previous research, a short hospital visit correlates with reduced hospital costs, but the cost of the conservative treatment was still lower compared to the surgical treatment even in all of the sub-groups, although the effect was not statistically significant.[22] The costs that were analyzed were direct costs. A surgical treatment is associated with early mobilization compared to conservative treatment, and if the indirect costs had been included in this study, the differences in total costs between the groups would have been even higher.[7] If the patients have a rapid recovery, there are economic and social benefits from surgical treatment.[23,24] Reducing the time of return to school means that parents need to take less time off from work and do not need to stay home and take care of the patients. Parents staying home from work results in loss of family income. This will have a negative effect on the already poor people in Bangladesh. A long recovery is associated with large opportunity costs for both the child and the parents.[25] The conservative treatment includes difficulties emptying both the bladder and the bowel, making it problematic to maintain good hygiene. These patients also have problems moving around, making them very dependent on their parents. There is still no consensus on how to treat pediatric diaphysis femur fractures. Previous studies present low evidence results.[21] Future studies should be prospective and assess more variables than clinical outcomes. The social and economic aspects must also be assessed. Evidence level in this study was too low to measure outcome. We found statistically significant differences when comparing conservative and surgical treatment regarding associated injuries, use of antibiotics, age, hospital cost and days of traction application. To increase degree of statistical significance in this study, number of observations had to be larger.

CONCLUSION

In this study, children with a subtrochanteric femur fracture received the majority of their treatment from conservative methods. Younger children typically receive conservative treatment, while older children and those with poly-trauma receive a surgical option. Moderate treatment was less expensive contrasted with careful treatment. No matter what the decision of treatment, the result after fracture appears off an impression of being agreeable. However, younger children may receive conservative treatment, while older children may receive surgical treatment.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Mustofa MG, Bhadra A, Saha S, Ahmed S. Evaluation for results of the treatment with diversities of modality in comminuted sub trochanteric fracture of femur in children. Int J Res Orthop 2025;11:6-12.