Theron CP, Ramguthy Y, Nkosi CS. Direct medical costs of paediatric diaphyseal femoral fracture treatment in a public academic hospital in South Africa. *Orthopedic Reviews*. 2025;17. doi:10.52965/001c.141409. PMID:40688453

General

Direct medical costs of paediatric diaphyseal femoral fracture treatment in a public academic hospital in South Africa

Charles Petrus Theron, BSc Human Physiology (UP), MBChB (UFS)[1],
Yammesh Ramguthy, MBChB (Medunsa), FC Ortho(SA)[1],
Collen Sandile Nkosi, MBChB(UL), MMed(Wits), FC Ortho(SA)[1]

[1] Department of Orthopaedic Surgery, Chris Hani Baragwanath Academic Hospital, University of the Witwatersrand, Johannesburg, South Africa

Keywords: costs, orthoapedics, paediatrics, South Africa, femur fractures

https://doi.org/10.52965/001c.141409

Orthopedic Reviews

Vol. 17, 2025

Background

There is relatively little literature into the cost of treating diaphyseal femur fractures in paediatric population. This study aims to determine the cost of managing paediatric diaphyseal femur fractures in a South African Academic Hospital.

Objective and Methods

We conducted a retrospective study using prospectively collected data on paediatric diaphyseal femoral fracture treatment at our public academic hospital over a four-month duration. The study included patients who were between 2 years and 14 years of age and excluded those with femur fractures caused by pathological or atypical factors. The following costs were reviewed: emergency department, inpatient admission, anaesthesia and theatre, allied department, and radiology department.

Results

Data from 31 patients (80.6% males) with diaphyseal femoral fractures were included in the study; falls accounted for 64.5% of the injuries. The patients who underwent surgery had a mean hospital stay of 7.4 days (range:3 to 22 days), while the group that did not have surgery had a mean hospital stay of 24.1 days (range:17 to 34 days). The factors that had a greater impact on cost were the duration of the hospital stay, the cost of the implant, and the cost of the theatre. There was no statistically significant variation in the cost of emergency unit services among this group.

Conclusion

The data showed that orthopaedic surgeons need to be cognizant of the cost of treating paediatric diaphyseal femoral fractures in the current state of the economy.

INTRODUCTION

Femoral diaphyseal fractures are one of the most common lower extremity fractures in the paediatric population.[1] In international literature the incidence of femur fractures is described as 0.2 per 1000 per year, with a male predominance in a ratio of 2:1.[2] These fractures occur in a bimodal age distribution of 2-3 years and older than 6 years.[2] The most common mechanism of injury includes falls, sports activities and motor vehicle accidents, but non-accidental injury should be considered in children that are not walking yet.[1]

The treatment of paediatric diaphyseal femur fractures is influenced by intrinsic and extrinsic factors.[3] The intrinsic factors mentioned in the literature include age, fracture pattern, associated injuries and comorbidities whereas the extrinsic factors that play a role include, socioeconomic status, physician training and equipment availability.[3] The age of the patient is the main determining factor guiding the management of paediatric shaft fractures.[1]

Age based treatment of femoral shaft fractures can be broken down in the following: Infants to 6 months, 6 months to 5 years, 5 years to 11 years and older than 11 years.[4] Below the age of 5-6 years treatment is mostly non-operative and option in the infant to 6 month group include Pavlik harness or spica casting and between 6 months and 5 years spica casting or traction is preferred.[1,4] In children of school going age the treatment becomes increasingly more operative with flexible intramedullary nails and plate fixation the two most commonly used techniques depending on the nature of the fracture and the weight of the child.[1,4]

Submuscular bridge plating has shown good clinical outcomes in the treatment of length unstable femoral shaft

fractures when flexible elastic nails are not indicated.[5] Diaphyseal femur fractures in older children (> 11 years) is primarily treated with surgical stabilisation using either plate fixation or lateral trochanteric intramedullary nails.[1,4]

According to our knowledge there is no local literature specifically investigating the cost of treatment of diaphyseal femur fractures. This study aims to determine the cost of managing paediatric diaphyseal femur fractures in a South African Academic Hospital.

OBJECTIVES

The objectives of the study were to determine the cost of treating paediatric diaphyseal femur fractures, to compare the cost of non-operative treatment with operative treatment, and to describe the demographics of paediatric patients that present with diaphyseal femur fracture.

METHODS

ETHIC STATEMENT

This study was approved by the University of the Witwatersrand Human Research Ethics Committee (No. M240849). The requirement for informed consent was waived due to the retrospective nature of the study.

STUDY DESIGN AND SETTING

We conducted a retrospective review of all children that were admitted to our Academic Hospital with diaphyseal femur fractures between 1 January 2024 and 30 April 2024.

PARTICIPANTS

All patients between the age of 2 and 14 years that present to our unit with diaphyseal femur fractures, treated non-operatively and operatively were included in our study. We excluded patients with pathological femur fractures as well as polytrauma patients with femur fractures.

DATA COLLECTION

The relevant data was collected from the hospital admission register, in-patient files, picture archiving and communication system (PACS), and theatre register.

The Uniform Patient Fee Schedule (UPFS) for full-paying patients (private patients) was used to calculate the management costs.[6] For non-operatively managed patients costs from admission to discharge and two follow up visits were included. Patients managed operatively additional costs of theatre, implants, cost of readmission and hardware removal were also included. Ethical clearance was obtained from institution .

STATISTICAL ANALYSIS

The data were collected, entered in Microsoft Excel (Microsoft,Redmond, WA, USA), and analysed using the STATA software, version 18 (Stata Corp, College Station, TX, USA). Descriptive statistics were used to summarise the results. Categorical variables were presented as frequencies and percentages.

RESULTS

A total of 31 patients met the inclusion criteria (**Table 1**). There were 25 males (80.6%) and 6 females (19.4%) with an age range of 2-12 years (mean age 5 years). The mechanism of injury in the majority of cases was falls (n= 20; 64.5%) followed by gate injury (n =4;12.9%), passenger vehicle accident (PVA) (n= 3; 9.7%), Motor Vehicle Accident (MVA) (n =2; 6.5%) and non-accidental injuries (NAI) (n =2; 6.5%). The most common fracture pattern identified was spiral fractures making up 48.4 % (n=15) of all fractures. Most of the factures in our study population occurred in the middle 1/3 (n=27) of the femoral shaft.

Table 1. Demographic Characteristics for paediatric femur fractures

	n (%)
Gender	
• Male	25 (80.6)
• Female	6 (19.4)
Mechanism of injury	
• Fall	20 (64.5)
• PVA	3 (9.7)
• MVA	2 (6.5)
• NAI	2 (6.5)
• Gate injury	4 (12.9)
Side of injury	
• Left	20 (64.5)
• Right	11 (35.5)
• Bilateral	0 (0)
Fracture pattern	
• Oblique	6 (19.4)
• Spiral	15 (48.4)
• Comminuted	1 (3.2)
• Transverse	9 (29.0)
Fracture type	
• Open	0 (0)
• Close	31 (100)
Location on the femur	
• Proximal 1/3	2 (6.5)
• Middle 1/3	27 (87.0)
• Distal 1/3	2 (6.5)

PVA: passenger vehicle accident ,MVA: Motor Vehicle Accident, NAI:non-accidental injuries

More than two-thirds (n=21; 67. 7%) of the patients that presented to our unit were treated non-operatively. Of the 10 patients that were managed operatively, five were treated with Titanium Elastic Nails (TENS) and five with submuscular plating. The mean hospital stay for patients managed non-operatively was 24.1 days compared to 7.4 days in the operatively managed group. The cost of conservative treatment (**Table 2**) for a mean ward stay totalled

Table 2. Conservative Management Costs for femur fractures in paediatrics

VARIABLES	COSTS IN RANDS (R)
Emergency consultation – Facility fee	R 301
Emergency consultation – Specialist medical practitioner	R 778
In-patient General ward – Facility fee	R 2427 (x24) [R 58248]
In-patient General ward – Specialist medical practitioner	R 2792 (x24) [R 67008]
Follow up Outpatient consultation – Facility fee	R 149 (x2) [R 298]
Follow up Outpatient consultation – Specialist medical practitioner	R 468 (x2) [R 936]
Radiology – Facility fee	R727 (x4) [R 2908]
Radiology – Specialist medical practitioner	R1982 (x4) [R 7928]
Medication fee – Facility fee	R 56 (x24) [R 1344]
Supplementary health treatment – Facility fee	R 97 (x3) [R 291]
Supplementary health treatment – Allied health practitioner	R 167 (x3) [R 501]
TOTAL COST	**R 140541**

Table 3. Operative Management Costs for femur fractures in paediatrics

VARIABLES	**COSTS IN RANDS (R)**
Emergency consultation – Facility fee	R 301
Emergency consultation – Specialist medical practitioner	R 778
In-patient General ward – Facility fee	R 2427 (x7) [R 16989]
In-patient General ward – Specialist medical practitioner	R 2792 (x7) [R 19544]
Follow up Outpatient consultation – Facility fee	R 149 (x3) [R 447]
Follow up Outpatient consultation – Specialist medical practitioner	R 468 (x3) [R1404]
Radiology – Facility fee	R727
Radiology – Specialist medical practitioner	R1982
Medication fee – Facility fee	R 56 (x7) [R 392]
Supplementary health treatment – Facility fee	R 97 (x3) [R 291]
Supplementary health treatment – Allied health practitioner	R 167 (x3) [R 501]
Anaesthetics – Specialist medical practitioner	R2663
Major Theatre procedures – Facility fee	R8408
Major Theatre procedures – Specialist medical practitioner	R9479
Implants – (Submuscular plating Vertice company)	R 20000
Implants – (TENS Vertice company)	R 5000
TOTAL COST TENS	**R 68906**
TOTAL COST PLATE	**R 83906**

R 140,541 per patient, and this included a total of four x-rays, two follow-up visits, and three physiotherapist sessions. When broken down, it works out to R 42,739 per week.

Operative management costs (**Table 3**) were not only impacted by the fact that the patients had to go to theater for the initial surgery as well as a subsequent admission for removal of hardware but also by the implants used. For patients treated with TENS, the costs came to R 68906 per patient whereas plating costs R 83906 per patient.

The cost for readmission and removal of hardware (ROH) (**Table 4**) was calculated to be R 36992. Thus, the total cost for submuscular plating was R 120898, and for TENS R 105898.

When comparing the cost of treatment per week, submuscular plating was the most expensive at R 83906 per patient, followed by TENS and non-operative treatment at R 68906 and R 42739, respectively. Taking everything into account and comparing these three treatment options, the cost of conservative treatment exceeded that of both surgical treatment options even when the cost of a second admission is included in the calculation (**Figure 1**).

Table 4. Cost For Re-admission For Removal Of Hardware on femur fractures

VARIABLES	COSTS IN RANDS (R)
In-patient General ward – Facility fee	R 2427 (x3) [R 7281]
In-patient General ward – Specialist medical practitioner	R 2792 (x3) [R 8376]
Medication fee – Facility fee	R 56 (x3) [R 168]
Anaesthetics – Specialist medical practitioner	R2663
Major Theatre procedures – Facility fee	R8408
Major Theatre procedures – Specialist medical practitioner	R9479
Follow up Outpatient consultation – Facility fee	R 149
Follow up Outpatient consultation – Specialist medical practitioner	R 468
TOTAL COST	**R 36 992**

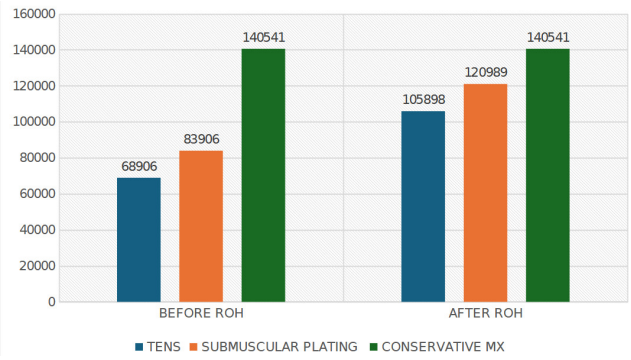

Figure 1. Costs comparison in paediatric femur fractures

ROH: Removal of hardware, TENS: Titanium Elastic Nails, MX: management

DISCUSSION

Similar to the study done by Albert et al.[7] in Tanzania, we also found a male predominance, albeit at a higher percentage; in our study, males made up 80.6% of patients compared to 68.5% of patients in the Tanzanian study. In both studies, falls were the most common mechanism of injury (64.5% vs. 57.4%), and the majority of patients, approximately two-thirds, were managed nonoperatively. In contrast to their study, we found a higher incidence of spiral fractures in our population where they had a higher incidence of transverse fractures.

Comparing our findings with a local study done by Mughal MA et al.[2] in Cape Town, we had a higher M:F ratio at 4:1 compared to 2.2:1 and a significantly higher incidence of falls as the mechanism of injury in our patients. Our study was consistent with the Cape Town study in that we managed the majority of patients non-operatively.

In contrast to the UK study by Wijesekera MP et al.,[8] who used spica casting as their method of conservative treatment, where we use inline skin traction, we found that the overall cost of conservative treatment was more than that of the surgical group. In the aforementioned study, the total cost of conservative treatment (hip spica casting) totaled £3,419.00 pp (R 79 544), and the costs of the surgical options were £7,739.62 pp (R 180 064) for flexible intramedullary nailing and £6,953.45 pp (R 161 774) for submuscular plating. Our study showed that in our setting, conservative treatment with in-line skin traction cost more than both surgical options: R 140,541 compared to R 105,898 for TENS and R 120,989 for submuscular plating.

Costs from the Finnish study by Laitakari et al.[9] more closely resemble the findings from our study. They found that treating patients surgically with flexible intramedullary nailing: 6302€ (R 119 897) was less expensive than treating them with hip spica casting: Hip spica casting: 7825€ (R 148 929).

The data from our study shows that the demographics of patients with diaphyseal femoral fractures differ between different treating institutions, both locally and internationally. Our study also highlights the costs of managing these fractures, which is an ever-growing concern, as cost management plays a big role in choosing the best treatment option for our patients. We found that after taking everything into account, the costs of conservative treatment exceeded that of surgical management independent of the implants used.

LIMITATIONS

Limitations of this study were short duration of it nature and being a retrospective study.

CONCLUSION

The data showed that orthopaedic surgeons need to be cognisant of the cost of treating paediatric diaphyseal femoral fractures in the current state of the economy. Furthermore, the patients who did not undergo surgery experienced a longer duration of hospitalisation. On the contrary, the patients who underwent surgery required a second-stage procedure for implant removal. After taking everything into account the cost of conservative management exceeds that of operative management.

Submitted: March 10, 2025 EST. Accepted: May 15, 2025 EST.
Published: July 18, 2025 EST.

REFERENCES

1. Liau GZQ, Lin HY, Wang Y, Nistala KRY, Cheong CK, Hui JHP. Pediatric Femoral Shaft Fracture: An Age-Based Treatment Algorithm. *Indian J Orthop*. 2020;55(1):55-67. doi:10.1007/s43465-020-00281-6

2. Mughal M, Dix-Peek SI, Hoffman E. The epidemiology of femur shaft fractures in children. *SA Orthopaedic Journal*. 2013;12(4):23-27.

3. Curran PF, Albright P, Ibrahim JM, Ali SH, Shearer DW, Sabatini CS. Practice Patterns for Management of Pediatric Femur Fractures in Low- and Middle-Income Countries. *J Pediatr Orthop*. 2020;40(5):251-258. doi:10.1097/BPO.0000000000001435

4. Weinstein SL, Flynn JM. Chapter 34. Lovell and Winter's Pediatric Orthopaedics. In: *Thoracolumbar Spine And Lower Extremity Fractures*. Wolters Kluwer Health; 2015.

5. Du Toit J, Salkinder R, Burger M, Du Preez G, Lamberts R. Short-term outcomes of submuscular bridge plating of length-unstable paediatric femoral shaft fractures in children - Insights from a South African tertiary hospital setting. *SA Orthopaedic Journal*. 2020;19(3). doi:10.17159/2309-8309/2020/v19n3a3

6. Gauteng (South Africa). Department of health. Provincial Gazette Extraordinary. *Gauteng provincial gazette*. 2024;30(154):1-44. https://gpwonline.sharepoint.com/sites/gpw-web/Shared%20Documents/Forms/AllItems.aspx?id=%2Fsites%2Fgpw%2Dweb%2FShared%20Documents%2FProvincial%2F2021%2D2025%2F154%2029%2D4%2D2024%20GautSeparate%2Epdf&viewid=7a8fe278%2D931f%2D49d0%2D9374%2Dc8d511d7c610&parent=%2Fsites%2Fgpw%2Dweb%2FShared%20Documents%2FProvincial%2F2021%2D2025

7. Macha AP, Temu R, Olotu F, Seth NP, Massawe HL. Epidemiology and associated injuries in paediatric diaphyseal femur fractures treated at a limited resource zonal referral hospital in northern Tanzania. *BMC Musculoskelet Disord*. 2022;23(1):360. doi:10.1186/s12891-022-05320-x

8. Laitakari E, Koukkula T, Huttunen TT, Mattila VM, Salonen A. The incidence, trends, and costs of treatment of femoral shaft fractures among Finnish children aged 2-12 years between 1998 and 2016. *J Child Orthop*. 2024;18(1):49-53. doi:10.1177/18632521231217267

9. Wijesekera MP, Martin E, Tang C, Chowdhury J, Sabouni MY, Foster P. Resource implications of managing paediatric femoral fractures in a major trauma centre: Analysis of 98 cases. *Injury*. 2023;54(8):110918. doi:10.1016/j.injury.2023.110918