

Functional outcomes of femoral diaphyseal fractures using titanium elastic nail: A retrospective study

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Abstract

Background: Femoral Diaphyseal is common fracture in pediatrics. The Titanium Elastic Nail is designed to stabilize the long bone fracture in children where the implant flexibility is paramount and medullary canal is narrow. This study evaluates the functional outcome and complications of using elastic nail.

Materials and Methods: This was a single centric, retrospective and clinical investigation study. The study was consisting of thirty-eight children (29 boys, 9 girls) aged group of 9-15 years who underwent femoral diaphyseal fracture treatment in Gautemala between March 2018 to June 2019 were recruited. The patient outcome was analyzed by physical examination, radiographs, VAS and ASA score by one year follow up.

Results: The result showed better outcomes in all the patients with decline in the VAS score. All patients were available for the follow up of one year. The bone union was achieved in mean time of 7.1 weeks. The study reveal that no mechanical failure related to nail, bend or corrosion was seen in the patients. Finally, all the patient's bone healed with time without any adverse effect and severe complications.

Conclusion: The elastic nailing fixation is an efficient method for treating long bone fracture in children's.

Keywords: Elastic nailing; Titanium Alloy; Femoral diaphyseal fractures; Children; Femur; Complications

1. Introduction

Children's long bone shaft fractures are the leading cause of fractures worldwide, with the majority of the burden falling on low- and middle-income nations, particularly those in developing nations. Majority, of them are dealt with non-operatively with association paces of over 90% to 100% to full function recovery.¹ Different techniques exist for the management of fracture of the diaphysis of the femur in kids. Depending on the child's age, type of fracture, surgical facilities available, associated injuries, and socioeconomic status, a variety of treatment strategies can be used to treat them successfully.^{2,3} Various treatment option which includes surgical stabilisation with intramedullary devices, closed reduction with hip spica casting, bridging with plate and screws and external fixator.⁴⁻⁷ The spica casting is effective in <5-year old children, for skeletally mature teenagers intermedullary nail is the best option. However, the treatment option for school going children is still a controversy.^{8,9} Older children are more likely to experience complications after closed reduction with hip spica casts, including malunion, joint stiffness, angulation, shortening, and delays in functional recovery.

However, conservative treatment need long hospitalization, increasing workload on hospital administrators and financial loss to the patient family.^{10,11} From decade orthopaedic surgeons are in search of new treatment approaches

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that allow earlier mobilization with minimizing hospital stay and its consequences. Despite the fact that traction plus cast immobilisation yields better outcomes, these psychological factors, coupled with the growing focus on reducing hospital stays and their aftermath, have sparked interest in internal and external fixation of paediatric diaphyseal femoral fractures.^{12,13} Ideally, the implant that provide load sharing, helps in movement and maintains the length and alignment of the extremity until a bridging callus develops would be the implant for treating the majority of paediatric femur fractures. The implants would utilize dense bone, fast healing, and ability of remodelling without imperling the distal femur physis or blood supply to bone. Currently, the newly treatment that offers these features is titanium elastic nail. However, it's an effective treatment option with least complications.

Hence, the present retrospective study designed to evaluate the outcome of elastic nail with complications associated with the nail.

2. Material and Methods

This was a retrospective study conducted at Al Jadeed Hospital, Sudan from March 2018 to June 2019. A total of 38 patients with femoral diaphyseal fracture treated by Titanium Elastic Nail (Auxein Medical PVT LTD) was assessed. Data including demographics, details of fracture, surgical outcomes were collected from the hospital records of the patients.

The patient's outcomes determining fitness prior to surgery were classified according to the ASA (American Society of Anaesthesiologists) score. The ASA score is used to assessed and evaluate a patient's medical co-morbidity before anesthesia.¹⁴

The VAS is a pain grading scale that Hayes and Patterson initially used in 1921. It's often used to evaluate the frequency or severity of different symptoms in epidemiological and clinical investigations. Examples of the degree of pain levels that patients feel include none to severe pain. The VAS score was used to evaluate the clinical outcomes after elastic nail implantation.

2.1. Inclusion Criteria

Patients of age between 9-15 years having femoral diaphyseal fracture, physically fit except of the fracture site were included in this evaluation.

2.2. Exclusion Criteria

Subject suffering from chronic disease which would result in unsatisfactory. Addicted to any drug abuse, suffering from any genetic disorder and allergic to metal were excluded from the study.

2.3. Clinical data for statistical analysis

The mean, standard deviation, median, minimum, and maximum for the major outcomes were calculated using the 95% significance level. The Visual Analog Scale was calculated from the baseline to each visit of patient.

3. Results

All patient's incision was healed by first intention observed on first visit of follow up. A total of 38 patients who were treated by elastic nail in the Al Jadeed hospital in sudan were examined systematically between March 2018 to June 2019 with a follow up period of one year. The age range of the patients in this study was 9 to 15 years, with an average age of 11.6 years. Out of 38 patients, 29 (76.32%) were boys and 9 (23.68) were girls (Table 1). The cause of fracture reported highest in 17(44.7%) patients due to sports injury, 12 patients (31.5%) due to road vehicle accident and while remaining 9(23.6%) had fall from height (Table 2). 23 (60.5%) children had fracture on the left side and 15(39.4%) were had fracture on the right side. All the patients underwent surgery was physically fit. The average surgery time was 60 minutes. Patients were followed up for 1 year at different time interval of 1 month, 3 months, 6 months and 12 months after the surgery. The surgery was performed by expertise orthopaedic surgeon. For early mobilization of bone surgeon recommended post-surgical treatment therapy with precautions to be followed. In this retrospective study, ASA score was analysed prior to surgery. The 36(94.7%) patients were classified as grade 1 indicate healthy normal patients, 2(5.2%) patients were suspected to mild systemic disease classified into grade 2 (Table 1). The most complication was reported in 16 cases (42.10%) of mild pain at nail entry site and 2 cases (5.26%) of knee stiffness but patient healed out of complication of the second month of follow up (Table 3). The patients pain intensity was determining by the VAS Score that shows decline in the pain at every interval of follow up. According to the VAS score, the VAS percentage was 40 after one month, 22 after three, 10 after six, and 2 after twelve months (Table 4). At the

initial follow-up, three patients reported discomfort and five patients complained of pain. But following regular monitoring, it was noted that the bone had properly fused and that no health-related issues had emerged. Overall, the elastic nail showed positive outcomes for fracture stabilization.

4. Discussion

Over the past 20 years, there has been a significant shift in the management of paediatric femur fractures. Conservative treatment is progressively being replaced by internal fixation of paediatric shaft femur fractures using elastically stable intra-medullary nails (ESIN). A deeper understanding of the elastic nailing process, generally encouraging outcomes reported in several international publications, and patient demand have likely given us the confidence to start this apparently novel method of fixation.¹⁵

This study consisted of a retrospective data of 38 patients of diaphyseal femur fractures in the age group 6- 15 years treated by titanium elastic nail (Auxein Medical Pvt. Ltd.) and were assessed for functional outcomes using VAS score scale and complications reported after surgery. The patients were followed up for 1 year after post-surgery. The location of the nails, frontal and sagittal alignment, loss of reduction, callus development, disruption of trochanteric growth, osteonecrosis of the femoral head, and femoral length were all evaluated as part of the post-operative radiographic examination at each visit. No mechanical failure related to breakage, corrosion and back out was reported in this study.

Numerous research indicate that difficulties increase with body weight >50 kg. According to Ho et al., the risk of complications for patients over the age of ten was 34 percent, whereas the rate for those under ten was just nine percent. This highlights the idea that older and heavier kids have more complication.¹⁶ The several researchers used different material & different coating methods to combat corrosion, in the current investigation used titanium material due to light in weight, excellent biocompatible and better corrosion resistance characteristics¹⁷⁻¹⁹.

In this study could not cover any such results as many of the children were in the age group of 10-14 years weighing <50kgs. According to our findings, the majority of problems were mild and related to the surgical method, which is consistent with the findings of Narayanan et al.²⁰

In this study we could notice the most common complication was knee stiffness and pain at nail entry site that was revealed after nail get removed.

The overall results of retrospective study demonstrate that titanium elastic nailing for paediatric shaft femur fractures is a safe, economical treatment with a low incidence of short-term complications

Table 1 Demography data (N=38)

Demographics	Number of Patients (N)	Percentage (%)
Mean age in years	11.6	
Sex		
Male	29	76.32
Female	9	23.68
Leg Affected		
Left	23	60.5
Right	15	39.4
ASA		
Grade I	36	94.7
Grade II	2	5.2
Grade III	0	
Grade IV	0	
Grade V	0	

Table 2 Cause of fracture with corresponding number of patients (n=38)

Cause of Fracture	Number with %age
Road vehicle accident	12 (31.5)
Sports injuries	17 (44.7)
Fall from height	9 (23.6)

Table 3 Complications

Complications	Number	Percentage (Out of 38)
Pain at the site of nail insertion	16	42.10%
Deep infection	0	0
Knee stiffness	2	5.26%
Delayed union	0	0
Non union	0	0
Implant Failure	0	0

Table 4 Functional outcomes based on VAS Scoring

Follow up time	VAS score %
1	40
3	22
6	10
12	2

5. Conclusion

In conclusion, patients with femur diaphyseal fracture fixed with elastic nail recovered quickly and effectively with low rate of complication. The complication in this study was few but easily resolvable. Therefore, Titanium Elastic Nail is effective and safe method for treating long bone fractures in paediatrics.

Compliance with ethical standards

Disclosure of conflict of interest

The authors report no declarations of conflict of interest.

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