Flexible intramedullary nails for treatment of femoral shaft fracture in children, Aden, Yemen

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Abstract

Background: Femoral shaft fractures in children constitute less than 2% of all fractures in children.
Objective: To describe the characteristics variables of children with femoral shaft fracture and to assess the results following treatment by flexible intramedullary nail.

Patients and method: It was a retrospective study conducted in the orthopedic section at Algamhoria Teaching Hospital and 2 private hospitals in Aden. We retrieved the patients' records of children with femoral shaft fracture and we found 37 cases (6 – 12 years old) who were treated with flexible intramedullary nails during a period of three years, from January 2014 to December 2016.

Results: Total patients were 37 and they were 22 [59.5%] males and 15 [40.5%] females.
The mean age was 8.51 years. The mean age of males was 9.09 years and the females 7.67 years ($p < 0.05$). In nineteen (51.4%) cases, the fracture occurred at the middle third. Types of fracture were oblique 19 (51.4%) and transverse fracture 18 (48.6%). Motor vehicle accidents were responsible for the majority of cases (56.8%).

Mean of fracture union was 12.14 weeks, the mean time of weight bearing was 4.65 weeks, also the mean duration of knee flexion was 2.46 weeks. The mean time of removal nails was 7.26 months. Twenty seven (73.0%) cases were closed and 10 (27.0%) cases were opened.

We found bursa over the site of nail entry in 6 (16.2%) cases, limb lengthening of 2 cm in 2 cases and 1.5 cm in another 2 cases. The rest 33 (89.2%) had no limb length discrepancy.

There were 3 (8.1%) cases of entrance pin infection and malalignment in 2 (5.4%) cases.

Conclusions: Flexible intramedullary nail is a great choice for the treatment of pediatric patients (6–12 years old) with closed and opened femoral shaft fracture. It can provide a rapid recovery.

Key words: Femoral shaft fracture, children, treatment, flexible intramedullary nail, Aden

Introduction

Femoral shaft fractures in children constitute less than 2% of all fractures in children [1]; yet they are a significant burden on healthcare systems and families as they are the most common fractures requiring hospitalization in children [2,3]. These injuries often require prolonged immobilisation or surgery [2].

The mechanism is typically high-energy trauma, such as a fall from a height or motor vehicle collision. The fractures are located in the diaphysis, and surgical intervention is typically necessary [3].

Fractures of femur in children occur most frequently in the middle third of the shaft. According to Hinton et al, the annual rate of femoral shaft fractures in children is 19.5 per 100,000 [4].

Femoral shaft fractures treatment goals in children are achieving bone union with length, alignment and limb's function restoration, without losing movements of adjacent joints. Femoral shaft fracture is an incapacitating pediatric injury [5]. Femoral shaft fractures, including subtrochanteric and supracondylar fractures, represent approximately 1.6% of all body injuries in children. The annual rate of femur shaft fractures in children was 1 per 5,000 [6]. However, incidence appears to show minor variations in its geographical distribution.

Orthopaedic surgeons have long maintained that all children who have sustained a diaphyseal fracture of femur recover with conservative treatment, given the excellent remodeling ability of immature bone in children. But time and experience of many surgeons have shown that diaphyseal femur fractures in children do not always recover completely with conservative treatment [7]. Angulations, shortenings and mal-rotations are not always corrected by conservative treatment [8].

A variety of methods have been introduced to treat pediatric femur fractures, including spica casting, traction followed by spica casting, internal fixation with plate, intramedullary nailing, and external fixation. Controversy exists regarding the most optimal surgical treatment for femoral shaft fractures in children [9]. The treatment should be decided based on age, fracture location and pattern, associated injuries, socioeconomic situation, as well as the preference of surgeons [10].

During the past two decades, flexible intramedullary nailing has become a popular choice for the fixation of femoral shaft fractures in children [11].

This study was intended to describe the characteristics variables of children with femoral shaft fracture and to assess the results following treatment of fracture by flexible intramedullary nail and the complications.

Patients and Method

This study was designed as a retrospective study. It was conducted in the orthopedic section at Algamhoria Teaching Hospital and 2 private hospitals in Aden.

We retrieved the patients' records of children with femoral shaft fracture and we found 37 cases between the age group 6 – 12 years who were seen and treated by the author with flexible intramedullary nails during a period of three years, from January 2014 to December 2016.

Data collected included patient demographics, fracture characteristics, treatment, complications and outcomes.

The collected data were tabulated and statistical analysis using SPSS 17 was done by estimating rates, frequency, percentage, and means with standard deviations. Statistical significance was set at a p-value < 0.05.

Results

During the period January 2014 to December 2016 we had operations on 37 cases of femoral shaft fractures with intramedullary flexible nails, and they were 22[59.5%] males and 15[40.5%] females.

The mean age of patients was 8.51 years with a minimum age of 6 years and maximum age of 12 years.

The mean age of male patients was 9.09 years and the female patients 7.67 years; the difference between means was statistically significant ($p < 0.05$).

We grouped the patients into 2 age groups 6 – 9 years and 10 – 12 years and we found the age group 6 - 9 years predominant (70.3%). Most of the patients were from Aden governorate 23(62.2%). All data were listed in Table 1.

Table 2 reveals that in 19 (51.4%) cases the fracture occurred at the middle third and at the proximal and distal third for each 9 (24.3%).

The types of fracture were oblique 19(51.4%) and transverse fracture 18(48.6%).

Fracture involved the right side in 19(51.4%) patients and the left side in 18 (48.6%). Motor vehicle accidents (either in cars, bicycles, or as a pedestrian) are responsible for the majority of femoral shaft fractures 21 (56.8%) followed by fall from a height 10 (27.0%) and other 6 (16.2%).

Fracture union ranged from 8 to 16 weeks (mean 12.14 weeks), and the time of weight bearing ranged between 3 to 6 weeks (mean 4.65 weeks), also, the duration of knee flexion ranged between 1 – 4 weeks (mean 2.46 weeks). The time of removal nails among our patients ranged between 6 to 10 months and the mean time was 7.26 months. All mentioned data were listed in Table 3.

In reduction of fracture 27 (73.0%) cases were closed and 10 (27.0%) cases were open.

There was formation of bursa over the site of nail entry in 6 (16.2%) cases. We found limb lengthening of 2 cm in 2 cases and 1.5 cm in another 2 cases. In those cases, fractures were in the middle third of femur in 2 cases and proximal third in 1 case, also distal third of femur in 1 case. The rest 33 (89.2%) had no limb length discrepancy.

There were 3 (8.1%) cases of entrance pin infection. We also found malalignment in 2 (5.4%) cases, as shown in Table 4.

Table 1: Characteristic variables of children with femoral shaft fracture (n =37)

Variables	Range	Mean ± SD	No	%
Sex:				
Males			22	59.5
Females			15	40.5
Age range (years):	6 – 12			
Mean Age (years):				
Age of all patients		8.51 ± 1.77		
Age of males		9.09 ± 1.87		
Age of females		7.67 ± 1.24		
P-value		P = 0.014		
Age groups (years):				
6 – 9			26	70.3
10 – 12			11	29.7
Residency:				
Aden			23	62.2
Other governorates			14	37.8

Table 2: Distribution of characteristics of femoral shaft fracture (n=37)

Variables	No	%
Fracture location:		
Middle third	19	51.4
Distal third	9	24.3
Proximal third	9	24.3
Fracture type:		
Oblique	19	51.4
Transverse	18	48.6
Side of fracture:		
Right side	19	51.4
Left side	18	48.6
Cause:		
Motor vehicle accidents	21	56.8
Fall from a height	10	27.0
Other	6	16.2

Table 3: Range and means of postoperative results

Variables	Range	Mean ± SD
Time of union (weeks)	8 – 16	12.14 ± 2.43
Weight bearing (weeks)	3 – 6	4.65 ± 1.11
Knee flexion (weeks)	1 – 4	2.46 ± 1.04
Time of removal nails (months)	6 - 10	7.26 ± 1.05

Table 4: Distribution of reductions and complications (n=37)

Variables	No	%
Reduction:		
Close	27	73.0
Open	10	27.0
Complication:		
Bursa at entrance	6	16.2
Lengthening	4	10.8
Entrance pin infection	3	8.1
Malalignment	2	5.4
None	22	59.5

Discussion

During the past two decades, flexible intramedullary nailing has become a popular choice for the fixation of femoral shaft fractures in children [11]. Flexible nailing offers many advantages, including minimal invasiveness, short hospital stays, early mobilization, and fewer complications [12].

The flexible intramedullary nails are load sharing devices which offer good fixation (relative stability and subsequent fracture union by indirect bone healing/callus formation), are relatively cheaper and have a short learning curve as it is relatively easy to insert and remove these nails [13]. Bone growth is affected minimally, as the need to cross physis can be avoided with these nails; the mean femur overgrowth is 1.2 mm. Operating time and blood loss is significantly reduced [13,14].

In our study there were 22 (59.5%) males and 15 (40.5%) females. The sex incidence is comparable to other studies in the literature. El-Adl et al [15] reported in their study that out of 66 patients, there were 48 (72.7%) males and 18 (27.3%) females. Also, Hwaizi et al [16] reported in their study that males were 31 (77.5%) and females were 9 (22.5%).

We found in the present study the mean age of patients was 8.51 years with a minimum age of 6 years and maximum age of 12 years.

The mean age of male patients was 9.09 years and the female patients 7.67 years; the difference between means was statistically significant ($p < 0.05$). Similar findings were reported by others [17-21].

We grouped the patients in-to 2 age groups 6 – 9 years and 10 – 12 years and we found the age group 6 - 9 years predominant (70.3%). Al-Azzawi [22] from Iraq reported in his study that the age of the patients range between four months and ten years; the age group (6-8) years is the most common.

In the current study we found that in 19 (51.4%) cases the fracture occurred at the middle third and at the proximal and distal third for each 9 (24.3%).

Hassan et al [19] reported in their study from Egypt that more than two-thirds of the fractures occurred in the middle third.

Also, Khanna et al [23] reported in their study from India that (77.78%) patients had fracture of middle third, 6 (13.34%) had fracture of proximal third and 4 (8.89%) had fracture of distal third of femoral shaft.

Vishwanath et al [24] reported that fractures involving the middle l/3rd accounted for 26 (52%) cases, proximal 1/3rd 17(34%) and distal l/3rd 07 (14%) of cases.

Govindasamy et al [25] found 36 (75%) fractures were in the middle third followed by, 7 (14.6%) proximal third and 5 (10.4%) distal-third fractures.

Tamrakar et al [21] reported in their published study in Nepal that 19 fractures (54.3%) occurred on the middle third, 9 (25.7%) on the proximal third and 7 (20%) on the distal third of the femur.

We found also in our study the types of fracture were oblique (51.4%) and transverse fracture (48.6%).

This finding is similar to findings by others [24] and differs from that reported by Khanna et al [23] in which (68.89%) patients had transverse fracture, (26.67%) had short oblique fracture and (4.45%) had minimally comminuted fracture.

In the present study we found fracture involved the right side in 19(51.4%) patients and the left side in 18 (48.6%). Similar to our finding it was found by Mohammad et al [26] from India in which 13 (61.9%) fractures were on right side and 8 (38.1%) fractures were on left side, and by Chitgopkar [27] from Saudi Arabia where there were 8 on the right side and 7 on the left side.

Khanna et al [23] mentioned that right side was more commonly affected (64.4%) than left.

Tamrakar et al [21] from Nepal found in their study that 20 (71.4%) femoral fractures occurred on the right side whereas ten (28.6%) were on the left side.

We found in our study that motor vehicle accidents (either in cars, bicycles, or as a pedestrian) are responsible for the majority of femoral shaft fractures 21 (56.8%) followed by fall from a height 10 (27.0%) and other, 6 (16.2%).

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Chitgopkar [27] reported in his study that 14 (87.5%) children had met with a road traffic accident and 2 (12.5%) had a fall from a height. Khanna et al [23] reported that the most common mode of injury was road traffic accidents (68.9%).

Govindasamy et al [25] found in their study from India that the most common mechanism of injury was road traffic accident (70%) followed by fall from height (30%).

In the current study fracture union ranged from 8 to 16 weeks (mean 12.14 weeks).

Our result is consistent with the result of Govindasamy et al [25] in which all fractures were united within 12 weeks of fixation with no non-union or delayed union.

Oh et al observed that all 31 fractures in his series healed within 12 weeks without delayed union [28].

Tamrakar et al [21] reported in their study from Nepal that all femoral fractures united radiologically with a mean duration of 8.17 weeks (range: 6 to 10 weeks) and clinically with a mean duration of 9.83 weeks (range: 8 to 12 weeks).

Also, in our study we found the time of weight bearing ranged between 3 to 6 weeks (mean 4.65 weeks). Khanna et al [23] reported that full weight bearing was possible in a mean time of 8.7 weeks (range; 7-12 weeks).

Also, the duration of knee flexion ranged between 1 – 4 weeks (mean 2.46 weeks).

Govindasamy et al [25] reported that functional range of movement of knee was achieved in an average of 8.6 weeks (6 – 14 weeks).

In our study the time of removal of nails among our patients ranged between 6 to 10 months and the mean time was 7.26 months.

Our finding is consistent with the finding reported by Luo et al [12] in which the average removal of implants time was 7.8 months (range, 3–20 months).

We found in our study 27 (73.0%) cases were closed reduction and 10 (27.0%) cases were open reduction.

A similar finding was reported by Tamrakar et al [21] from Nepal that 27 (77.1%) fractures were operated with closed reduction whereas eight (22.9%) fractures required mini-open at the fracture site.

We found in our study limb lengthening of 2 cm in 2 cases and 1.5 cm in another 2 cases. The rest 33 (89.2%) had no limb length discrepancy. In those cases, fractures were in the middle third.

Similar to this finding was reported by Singh et al [29] in which three patients had limb length discrepancy, 1 case had overgrowth of 0.5 cm and another up to 0.5 -2.0 cms. 1 case had shortening of 7 mm due to shortening in the tibial component because of segmental ipsilateral tibia fracture. The rest 17 (85%) had no limb length discrepancy.

Also, our study showed formation of bursa over the site of nail entry in 6 (16.2%) cases. Kapil et al [17] reported in their study, regarding the complications, there was formation of bursa over the site of nail entry in 6 (21.4%) cases because of friction between the tip of nail and skin. There were 3 (8.1%) cases of entrance pin infection in our study. Vishwanath et al [24] reported in their study that superficial infection was seen in 4 (8%) cases, which was controlled by antibiotics and regular dressings on alternate days within a week.

We also found in our present study malalignment in 2 (5.4%) cases.

Lohiya et al [30] mentioned in their study that angulation measured at final follow up in both coronal and saggital planes revealed significant malalignment in 3 (4.1%) cases however minor malalignment was observed in 29 (39.7%) cases.

Conclusion

We concluded that flexible intramedullary nail is a great choice for the treatment of pediatric patients (6–12 years old) with closed and opened femoral shaft fractures.

This technique can provide a rapid recovery and leads to decrease in the incidence of malunion, nonunion and functionally important limb length discrepancy. It also satisfies many of the parents of the patients who insisted on perfect alignment at initial treatment. In addition to those benefits it has little psychological impact on the children and is cost-effective.

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