Management of Diaphyseal Fractures of Femur in Children by Titanium Elastic Nails

Ashwinikumar Mannur[1], Sarang Padmawar[2]

ABSTRACT

Introduction: Fractures of the femoral shaft are common in children suffering with lower limb fractures. Management of pediatric femoral fractures has evolved gradually in the past decade toward operative approaches because of need for early recovery and rehabilitation of the patients, with the recognition that prolonged immobilization can have negative effects even in children.

Material and methods: 26 patients of diaphyseal fractures of femur in children were treated by titanium elastic nails in the department of orthopaedics, KIMS, Hubli during the period between 2014 to 2016.Patients were followed up till implant removal. The final results were evaluated using criteria which includes 4 deteminants limb length inequality, malalignment, pain and complication.

Results: Average time for union was 11.85 weeks in our study. Average time for union in age group 5-10 years(14 patients) was 8.86 weeks and in the age group 10-15 years (12 patients), it was 15.33 weeks. 2 patients in the age group 10- 15 years had delayed union. 3 patients (11.5%) had < 1cm shortening. One patient had 18 degree varus angulation. 5 patients (19.2 %) were having pain at the nail insertion site but in all the 5 patients pain got relieved after nail removal. 6 patients (23.1%) developed knee stiffness which resolved in 5 patients after nail removal but persisted in 1 patient. 17 patients (65.4%) had excellent outcome, 7 patients (26.9%) had satisfactory outcome and 2 patients (7.7%) had poor outcome.

Conclusion: Femur diaphyseal fracture in children between 5-15 years of age can be effectively managed with titanium elastic nails. It has a shorter operative time, few postoperative complications. Caution should be taken in the age group 11-15 years due to less remodeling potential. Knee stiffness and pain at nail entry site were common complications.

Keywords: children, femur, titanium elastic nailing.

INTRODUCTION

Fractures of the femoral shaft are common in children suffering with lower limb fractures. Fractures most commonly occurs in the middle third.[1] The annual rate of femoral shaft fractures in children is 20 per 100000. With regard to age, the distribution appears to be bimodal, with peaks at 2 and 17 years. Boys have higher rates of fracture than girls at all ages.[1]

Most pediatric femoral shaft fractures are treated conservatively, with Bryant's traction, in infants or by plaster hip spica (single/double) in early childhood. Management of pediatric femoral fractures has evolved gradually in the past decade toward operative approaches because of need for early recovery and rehabilitation of the patients, with the recognition that prolonged immobilization can have negative effects even in children.[1]

The purpose this study was to evaluate the results of treatment of diaphyseal fractures of femur in children by titanium elastic nails.

MATERIAL AND METHODS

It was a prospective study which was conducted after ethical clearance from IRB in the Department of Orthopaedics, Karnataka institute of medical sciences, Hubli between November 2014 to May 2016. In this study 26 children with diaphyseal fractures of femur were treated with titanium elastic nails. Study was

Children between age 5 to 15 years having closed or type 1 or type 2 open diaphyseal fractures were included. Closed comminuted fractures and segmental fractures were also included in the study. Pathological fractures, type III open fractures, metaphyseal fractures with / without involvement of epiphysis and children suffering from epilepsy, heart diseases, neuro muscular diseases and bleeding Diathesis were excluded in from the study.

A detailed history was taken from all patients and were examined clinically. All routine blood investigations and X-rays were done. All the children were immobilized with skin traction to affected lower limb or fixed traction or high groin slab and were operated with titanium elastic nails.

Operative Technique

Patient was induced with spinal or general anesthesia and patient was placed on fracture table, and then the fracture partially reduced by traction under C-arm guidance. Entry point was taken with awl around 2.5 cm above the femoral epiphysis at an angle 0f 45 degree. The nails of size 45 cm long with diameters of 3.0, 3.5, or 4.0 mm were used. Nails were then prepared by angling them at 45 degrees about 2 cm from one end to facilitate penetration of the medullary canal, and were bent into an uniform curve along their entire length. With the help of a T-handle, nail was introduced through a entry point and was advanced till the fracture site. Similarly medially entry point was taken and nail was introduced till fracture site. Then both the nails were advanced up the medullary canal to the already reduced fracture site. When they passed the fracture level, traction was released and the nails were pushed farther and their tips were fixed in the metaphysis, without passing through the physis. The nails were left slightly protruding for ease of removal.

Postoperatively, all children were immoblized with high groin

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slab. Static quadriceps exercise was advised. Patients were followed up at 4 weeks, 8 weeks, 12 weeks, 6 months and 1 year and were examined clinically for any evidence of wound infection, deformity, limb length discrepancy, knee stiffness, or any other complication and radiological assessment was done.
Results were evaluated with the help of criteria as follows (table-1). The case should meet all criteria to categorise it as a excellent result.

STATISTICAL ANALYSIS

Microsoft office 2007 was used for the statistical analysis. Descriptive statistics like mean and percentages were used for the statistical analysis.

RESULTS

The following observations were made from the data collected during this study.26 patients with femur diaphyseal fractures were treated with titanium elastic nails.
In our study, age distribution was 5 yrs to 15 yrs.14 patients were in 5-10 yrs group (53.8%). 12 patients were in 11 -15 yrs age group (46.2%).Mean age of the patients was 10.31 years. Majority of the patients were males (88.5%) compared to females (11.5%) The common mode of injury was road traffic accident in 61.5% patients and self fall in 38.5% cases. Right femur was involved in 15 patients (57.7%) and left side was involved in 11 patients (42.3%). Fracture site was in the proximal 1/3rd in 6 patients (23%), mid 1/3rd in 16 patients (61.5%) and distal 1/3rd in 4 patients (15.5 %).
In our study, closed reduction was achieved in 21 (80.8%) patients. Open reduction was done with lateral approach to femur in 5 patients (19.2%).The mean duration of surgery was 72.23 minutes.Average blood loss was 75.38 ml.
11 fractures (42%) united within 8 weeks, 13 fractures(50%) united between 9 -16weeks. Only in 2 (7.7%) fractures, union was delayed.In most of the patients (23 patients /88.5%), there was no limb length discrepancy. There was <1cm shortening only in 3 cases (11.5%).There was no malalignment in 23 patients (88.6%).<5 degree malalignment was seen in 1 patient(3.8 %),5-10 degree malalignment was seen in 1 patient (3.8 degree), >10 degree malalignment was seen in 1 patient. 21 patients (80.8%) were having no pain. Only 5 (19.2%) patients had pain at the nail insertion site. 20 patients (76.9%) were without any complication.6 patients (23.1%) developed complication. Most common complication observed in our study was knee stiffness.
TENS outcome score was excellent in 17 patients (65.4%), satisfactory in 7 patients (26.9%) and poor only in 2 patients (7.7%). Clinical and X-ray photographs of the patients are shown in figures 1-6.

DISCUSSION

The present study consists of 26 patients of diaphyseal fractures of femur in children treated in the Department of Orthopaedics, Karnataka institute of medical sciences, Hubli during the period between November 2014 to May 2016. The results obtained have been compared with the results obtained by the other works using same technique.
In our study there were 23 males (88.5%) and 3 females (11.5%). In the study conducted by Soni JF et al[2], 70.83% patients were male. In the study conducted by L. A. Moroz et al[3], there were 171 males (74.7%) and 58 females (25.3%). In the study conducted by Roop Singh et al[4], there were 28 males and7 females. In our study also males were predominant, may

Figure-1: Anteroposterior and lateral radiograph of right femur of 13 year old boy showing fracture shaft of right femur

Figure-2: Immediate postoperative radiograph

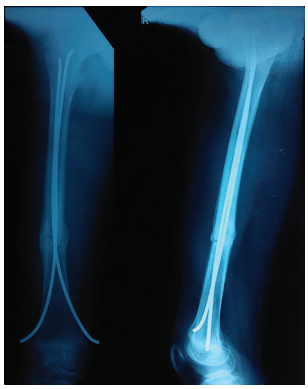

Figure-3: X-ray at 12 weeks

Figure-4: X-ray after implant removal

Figure-5: Clinical picture showing knee flexion

Figure-6: Clinical picture showing hip flexion

be because males are involved in more outdoor activities. In the study conducted by Saubhik Ray et al[5], there were 16 males and 4 females.

In our study, Road traffic accidents was responsible for 16 patients(61.5%) and self fall was responsible for 10 patients (38.5%). In the study conducted by Roop Singh et al[4], road traffic accidents was responsible for 40% cases. In the study conducted by L.A. Moroz et al[3], most common mechanism of injury was motor vehicle accident in 136 fractures (58.1%).

Right side was involved in 15 patients (57.7%) and left side in 11 patients (42.3%). Out of 26 patients, 3 patients were having associated fractures one patient was having fracture of base of 5th metatarsal of right foot. One patient was having fracture of distal end of left radius and one patient was having fracture of left tibia at mid 1/3rd. But functional outcome was not affected in any of the 3 patients. In the study conducted by Roop Singh et al[4], out of 35 patients, 15 patients were having associated injuries in which 5 had fracture of long bones. In the study conducted by L.A. Moroz et al[3], multiple injuries were present in 66 patients (28.8%) in which 51 patients had associated fractures.

In our study, 6 patients (23%) were having fracture in proximal 1/3 rd region, 16 patients (61.5%) were having in mid 1/3rd region and 4 patients (15.5%) were having fracture in the distal third region. In the study conducted by Roop Singh et al.[4], out of 35 patients, 28 fractures were in the middle third region followed by proximal third region. In the study conducted by L.A. Moroz et al[3], fracture occurred in proximal third 33 cases (14.1%), middle third in 165 cases (70.5%) and lower third in 35 cases (15%).

All patients were operated within a week of admission. Average operating time in this study was 72.23 minutes in the study conducted by. Saubhik Ray et al[5], the average duration of surgery was 60 minutes. In the study conducted by Roop Singh et al[4], average duration of surgery was 63 minutes.

Out of 26 patients, closed reduction was done in 21 patients (80.8%) while in 5 patients (19.2%) open reduction was done. In these 5 cases, a incision was taken at the fracture site on lateral aspect of the thigh and reduction was achieved. In all 5 cases soft tissue interposition was observed as obstacle for close reduction. In the study conducted by Roop Singh et al.[4], out of 35 cases, in 3 cases intraoperative close reduction was difficult. Soft tissue interposition was the obstacle for closed reduction in 2 cases and in those 2 cases open reduction was done.

Average blood loss was 75.38 ml in our study. Blood loss was more in cases of open reduction.

Average duration of hospitalization was 12 days in our study. Herndon et al[6] showed that the hospital stay in the nonsurgical group averaged 28 days and in the surgical group averaged 17 days which was significant. Reeves et al[7] have shown that the mean hospital stay in the non-operative group was 29 days while in the operative group it was 15 days.

No patient had postoperative infection in our study. In the study conducted by L.A Moroz et al[3], superficial infection at the site of nail insertion was seen in 4 cases (1.7%) and deep infection was observed in 2 cases (0.9%). In the study by Roop Singh et al[4], no cases of infection were seen. In the study by Saubhik Ray et al[5], out of 20 patients, 1 patient developed superficial cellulitis.

Average time for union was 11.85 weeks in our study. Average time for union in age group 5-10 years(14 patients) was 8.86 weeks and in the age group 10-15 years (12 patients), it was 15.33 weeks. 2 patients in the age group 10- 15 years had delayed union. In the study conducted by Saubhik Ray et al[5], average time for union was 7.7 weeks (6 – 12 weeks). In the study conducted by Roop Singh et al[4], all the fractures united within 4 months of fixation with titanium elastic nails without any nonunion or delayed union case. The patients belonging to the age group <10 years and those who had a transverse fracture pattern had a shorter union time. Oh et al[8] observed that all 31 fractures in his series healed within 12 weeks (mean 10.5 weeks) without delayed union. Buechsenschuetz et al[9] reported that in 42 patients treated, all fractures healed at a mean of 88 days from injury.

Out of 26 patients, 23 patients (88.5%) were without any limb length discrepancies in our study while 3 patients (11.5%) had < 1cm shortening. In the study conducted by Roop Singh et al[4], out of 35 patients, leg length discrepancy was seen only in cases who had angulation at the fracture sites. In the study conducted by Ajit saigal et al[10], 1 patient (5.5%) developed >2 cm limb length discrepancy. In the study conducted by Saubhik Ray et al[5], no patient had limb length discrepancy in titanium group but 2 patients had <2 cm shortening.In the study by L.A Moroz et al[3], minor limb length discrepancy was seen in 10 cases (4.3%).

Out of 26 patients, 23 patients (88.6%) were without any malalignment, one patient had < 5 degree angulation, one patient had < 10 degree varus angulation and one patient had 18 degree varus angulation. In the study conducted by Roop Singh et al[4],out of 35 patients, angulation in both anteroposterior

and varus/valgus planes was seen in two cases.[4] In the study conducted by Ajit Saigal et al[10], they observed rotational deformity in one patient (5.5%), varus malunion in one patient (5.5%).

In our study, 5 patients (19.2 %) were having pain at the nail insertion site but in all the 5 patients pain got relieved after nail removal. In the study conducted by M. Barry and J.M.H Paterson[11], complications were limited to discomfort or skin tenting at the sites of insertion of nail. These can be reduced by allowing the end of the nail to lie along the flare of the metaphysis and it should not be bent away from the bone. In the study conducted by Roop Singh et al[4], skin irritation due to nail ends was observed in 5 out of 35 patients. In the study conducted by Ajit Saigal et al[10], soft tissue and skin problems in relation to nails at the entry point was observed in 3 patients (16.6 %).

In our study, out of 26 patients, 6 patients (23.1%) developed complication. All 6 patients had knee stiffness which resolved in 5 patients after nail removal but persisted in 1 patient. In the study conducted by L.A.Moroz et al[3], loss of knee movement 2 months after nail removal was observed in 2 patients (0.9%). In the study conducted by Roop Singh et al[4], 5 cases (14.4%) had limitation of last 20 degree of knee flexion because of discomfort near the knee due to nail ends.

In our study 17 patients (65.4%) had excellent outcome, 7 patients (26.9%) had satisfactory outcome and 2 patients (7.7%) had poor outcome. The case should meet all criteria by Flynn[12] to categorise it as a excellent result. In the study conducted by Roop Singh et al[4], they observed excellent outcome in 25 patients, satisfactory outcome in 8 patients and poor outcome in 2 cases. In the study conducted by L.A.Moroz et al[3], the outcome was excellent in 150 fractures (65%), satisfactory in 57 cases (25%) and poor in 23 (10%). They found age was the strong predictor of outcome and odds ratio for poor outcome was 3.86 for children aged 11 years and older compared with those below this age. In the study conducted by Saubhik Ray et al.[5], results were excellent in 14 patients (70 %), satisfactory in 6 patients (30%) and poor in none in the titanium group. In the study by Flynn et al.[12], results were excellent in 38 cases (65.5%), satisfactory in 18 cases (31.03%) and poor in 1 cases (1.7%).

CONCLUSION

From our study we conclude that femur diaphyseal fracture in children between 5-15 years of age can be effectively managed with titanium elastic nails. Femur diaphyseal fractures are more common in middle third region and are common in males. It has a shorter operative time, lesser blood loss, and few postoperative complications. It leads to rapid bone healing due to undisturbed fracture hematoma and preservation of periosteal blood supply. It also allows early mobilization and early rehabilitation.

We also conclude, caution should be taken in the age group 11-15 years due to less remodeling potential. Knee stiffness and pain at the entry site were common complications.

So titanium elastic nailing is effective method for management of diaphyseal fractures of femur in children.

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