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A COMPARATIVE STUDY OF TITANIUM ELASTIC NAILING VERSUS HIP SPICA IN TREATMENT OF FEMORAL SHAFT FRACTURES IN CHILDREN

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A B S T R A C T

Background: There is no consensus on treatment of closed femoral-shaft fractures in children. We compared hip spica cast with titanium elastic nailing (TEN) in the treatment of femoral shaft fractures in children.

***Materials and Methods*:** Study was conducted at Rajah Muthiah Medical College and Hospital, Chidambaram, Tamilnadu, India. Out of 30 paediatric patients of diaphyseal fracture femur in the age group of 4 -16 years, 12 were treated conservatively by spica cast and 18 were treated with TEN. Follow up done regularly up to twelve months of injury with taking into account, various parameters.

Results: All diaphyseal fractures of femur healed, whether treated conservatively by spica cast or treated operatively with TEN. The time of union and weight bearing was less in operative group as comparative to spica cast group. 2 patients (16.6 %) in spica group compared to none in operative group had malunion while 2 patients in the operative group had soft tissue irritation.

***Conclusions*:** Results of TEN turned out to be far superior to traction and spica cast treatment in paediatric femoral fractures. Rate of complications was far low with operative than conservative Treatment.

INTRODUCTION

Femoral shaft fractures are among the most common fractures of the lower extremity in children, with an annual incidence of up to 1 per 5,000[1,2] .There are several different options for treating femoral shaft fractures in children, including skeletal or skin traction, early or immediate application of a hip spica cast, closed reduction and minimally invasive plate osteosynthesis, external fixation, plate fixation and internal fixation with the insertion of intramedullary nails [3,4]. Selecting the management strategy is dependent on factors such as the presence of other associated injuries or multiple trauma, fracture properties, age and socioeconomic factors.

Because of its clinical effectiveness and low rate of complications, elastic stable intramedullary nailing for fractures of long bones in the skeletally immature patient (e.g. children) has gained widespread popularity. Titanium elastic nailing (TEN) is commonly used to stabilize femoral fractures in school aged children. We tried to compare the end results of both modalities of the treatment of diaphyseal fracture femur and found the operative treatment stands far superior to age old traditional cast treatment.

METHODS

Prospective study was conducted from July 2014 to July 2016. Children with closed femoral shaft fracture, age ranging between 4 to 16 year were included in this study. The selection of mode of treatment whether operative or conservative was using random allocation. Cases with comminuted fracture (Winquist type III and type IV), patients with neuromuscular dystrophy, cerebral palsy, metabolic bone disease, pathological fracture and open fractures were excluded from this study.

Every patient included in this study was managed initially with skin traction. For patients in TEN operation group the standard technique was applied according to the method described by Flynn and colleagues [5]. Surgery was done under general or spinal anaesthesia on a fracture table or by manual traction. Entry point for nail was made with bone awl at 2.5 cms above physis and each titanium elastic nail was retrogradely placed through the distal part of the femur. Each nail was estimated to be 40% of the

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canal diameter at the isthmus level of the femoral shaft. Reduction and fixation was done under C-arm image intensifier. All patients received first generation cephalosporin prophylaxis, which was initiated 12 h preoperatively and continued upto 5 days postoperatively [5]. Supportive plaster slab was given for 2 patients in operative group. Patients were discharged after 12 days following suture removal.

Spica cast group was also managed initially with skin traction. Once edema subsided, early one and half spica cast was applied under general anaesthesia. Limb was fixed in spica cast with hip joint at 20° to 30° flexion & knee joint at 10° to 15° flexion with 10° to 15° external rotation of lower limb. Spica cast was kept for 6 to 8 weeks depending upon the age of patient. After removal of spica cast, non-weight bearing hip, knee and ankle mobilizing exercises were advised for 3 to 4 weeks. After this period protected weight bearing was allowed.

All patients were followed up at 2 week for wound status or assessment of spica cast, then at 6 weeks for assessment of union, limb alignment, rotation, range of motion of lower limb joints, operative site. Patients were followed up later every month. Details of hospital stay duration, fracture union time, non-weight bearing time, partial weight bearing time and complications were recorded. Angular and rotational alignment was assessed postoperatively and in subsequent visits by AP and lateral radiographs. Final assessment in both groups was done at six months follow up with Flynn criteria.

Fracture union was defined clinically by ability of painless full weight bearing and radiologically by bridging callus visible at atleast 3 cortices.

Delayed union was defined by persistence of pain & tenderness, and no visible callus after 3 months of fracture treatment. Non-union was considered by painless movements in 2 planes and absence of visible callus on x-rays, angular malalignment was defined by more than 10° angulation in coronal plane and more than 15° angulation in sagittal plane. According to Wall EJ *et al* rotation greater than 10° was defined as rotational malalignament [3]. Limb length was measured with tape and compared with normal limb to decide limb length discrepancy. Final outcome was assessed using Flynn criteria [4].

RESULTS

30 patients were included in this study with informed consent. 12 patients were treated with early spica cast (within one week) and remaining 18 patients were treated with close reduction and internal fixation with TEN under C–arm control.

All the 30 patients were followed up properly up to 12 months after the application of spica or TEN nailing. In spica cast group 8 were male and 4 were female child. Mean age of this group was 7.2 years. In operative group 14 were male and 4 were female child with mean age of 10.1 years. Follow up period in both groups was 12 months. Average time of bridging callus and union in spica cast group was 4.5 weeks and 10 weeks respectively. In operative group average bridging callus and union time 4.4 weeks and 8.2 weeks respectively. Majority of patients (97%) in spica group achieved full range of knee movement in 12 weeks, while in TENS group it was 94 % cases in 12 weeks. 16 % cases in tens group had terminal restriction of knee flexion (20-30 degree) initially which resolved within weeks of starting physiotherapy.

Table 1 Comparison of outcomes between groups

Parameters	Spica cast (n=12)	TEN (n=18)
Age	Mean =9.6	Mean =10.17
Male/ Female	8(66.66) / 4(33.33%)	14(77.7%) / 4(22.22%)
Hospital stay (days)	12	10.4
Bridging callus (weeks)	Mean =4.5	Mean =4.4
Union time (weeks)	Mean =10	Mean =8.2
Weight bearing (weeks)	Mean =10.2	Mean =8.4
Restriction of knee ROM at 12 weeks	1 (8.3%)	1 (5.5%)

One patient developed infection and inflammation in operative group and none in spica cast group. Infection was superficial and was cured with oral antibiotics. Pressure sore was found in 1 patient (8.3%) of spica cast group at the time of cast removal.

In 1 patients (8.3 %) of spica cast group delayed union was noted where all patients in operative group got union within 3 months time. Two patients (16.6 %) in spica cast group got malunion whereas in operative group no malunion was not noticed. 5 cm lengthening was noted in 2 patients (16.6 %) of spica cast group while in operative group 1 patient (5.5 %) noticed lengthening of 0.7 cm. No neurovascular injury was noted in any group.

Table 2 Comparison of complications between groups.

Parameters	Spica cast (n=12)	TEN (n=18)
Infection and inflammation	Nil (0%)	1 (5.5 %)
Pressure sore	1(8.3%)	Nil (0%)
Delayed union	1(8.3%)	Nil (0%)
Malunion	2(16.6 %)	Nil (0%)
Limb length discrepancy	2(16.6 %)	1 (5.5 %)

Figure 1 Pre-operative

Figure 2 Post-operative at 3 months

Figure 3 Before spica

Figure 4 Post spica at 3 months and 6 months

DISCUSSION

Although spica casting with skeletal traction is traditionally used for femoral shaft fractures in children, recent studies have shown its possible effects on social, economic, educational, and emotional costs. In contrast, elastic intramedullary nailing of femoral shaft fractures has gained extensive popularity because of its better clinical and psycho-socioeconomic outcomes with lower risk of complications[5-7]. In our study, we showed the benefits of the TEN surgical method versus traction and spica casting with respect to time of union, time to start walking, limb length discrepancy and complications. Our findings were in agreement with the results of many studies that showed the efficacy and benefits of elastic nails for treating femoral shaft fractures.

Ligier *et al* used elastic intramedullary nail (anterograde or retrograde) with Kirschner wires or pins [8]. They reported more desirable outcomes in 120 femoral-shaft fractures treated with TEN. In Reeve *et al* study, 41 patients with femoral fractures were treated with traction and casting, and 49 cases underwent intramedullary nailing surgery. They showed complications were higher in the traction and casting group in comparison with the group undergoing surgery [9].

In our study, the duration of hospital stay was longer in operative than the traction and spica cast group. This is in contrary with other studies which reported shorter hospital stays with TEN, but is in conformity with Saseendar's study[5,9-12]. This difference was due to the fact that in our institute plaster room day was earlier than routine surgery day and the spica patients were usually discharged a day or two following spica casting after assessing for the presence of Plaster-of Paris related complications.

Our findings showed shorter time of union and weight bearing in the TEN group compared with the spica casting group. It is probably because of better contact of the fracture surfaces and anatomical reduction in patients who underwent TEN surgery. Such earlier recovery milestones have also been shown by Greisberg *et al*[10]. and Flynn *et al* [5].

In our study, a higher rate of malunion and limb length discrepancy was observed in the traction and spica group compared with the TEN group. This finding conforms to the results of a similar study conducted by Kirby *et al*., which compared traction and cast with intramedullary nailing and reported malunion only in the traction and casting group[13]. In other studies, the rate of malunion in the traction and cast group was higher than that in the TEN group [11,14].

Flynn score was better in operative group. Common causes of poor Flynn score in spica cast group were malunion and limb length discrepancy. Our study had certain limitations. Treatment cost, time to return school, parents satisfaction were not measured in either group. As with any other new procedure, we had a small sample size, and thus the results could show falsely high complication rates.

CONCLUSION

In modern era of fashion and comfort, titanium elastic nail treatment stands far better than spica cast for treatment of diaphyseal femoral fractures. TEN takes lesser time for union, has minimal limb length discrepancy and malalignment, allows earlier rehabilitation and return to activities of day to day life than spica cast treatment. Patient feels very much comfortable after TEN treatment as compare to spica treatment. Parents of children, treated with TEN returned to their work earlier than the other group. Convenience of micturition & defecation in TEN group, also make it better than spica treatment. Thus TEN treatment proved to be superior than spica cast treatment for diaphyseal femoral fractures.

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