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ORIGINAL STUDY

Flexible intramedullary nailing in the treatment of diaphyseal fractures of the femur in preschool children

Dieter MORTIER, Koen DE RIDDER

From Sint Augustinus & Sint Jozef Hospitals, Wilrijk / Malle, Belgium

Femur fractures in preschool children are mostly treated in a conservative way, by means of spica cast immobilisation or skin traction. In school age children the use of flexible intramedullary nails (FIN) is widely used and promoted.

We performed intramedullary nailing in 9 preschool children aged 1.5-6 years.

The mean length of postoperative hospital stay was 4 days (range : 3 to 6). The mean time to solid callus formation was 2.5 months (range : 2 to 3). Follow-up was available in all 9 children for a mean period of 18.9 months (range : 3 to 38). No complications were noted.

Flexible intramedullary nailing of femur fractures is a valuable technique in this particular age group. However, further study and long-term follow-up are needed.

Keywords : femur fracture ; preschool children ; flexible intramedullary nailing.

INTRODUCTION

Femur fractures are among the most common major paediatric fractures encountered. In children aged beyond six years, operative treatment is now well accepted (*10-12,15-18,21,24-26,28*). Techniques of intramedullary nailing, in particular, have been thoroughly studied and described (*3,10-13,15,17-21,24-26*). The advantages of operative fixation are early mobilisation, short hospital stay, and early weight bearing (*2,10-13,18,24,26*). On the other hand, operative fixation techniques are rarely described in preschool children (*2*). For these children, conservative treatment such as traction and/or spica cast immobilisation are considered state of the art treatment modalities (*1,4,7-9,12-14,20-22,26*). Despite the good to excellent results in this age group, complications such as skin breakdown, skin infection, compartment syndrome, refracture, Volkmann contracture, secondary displacement with repeated reductions, femur shortening and malrotation have been described (*1,2,4,5,8,9,11,12,23,14,24,26,27*). Before making the decision to perform an operative procedure, there are many factors that have to be taken into account, such as the experience of the surgeon, the child's age and body status, the fracture type and the child's social situation. Our first case of intramedullary nailing presented with skin blisters and necrosis with concomitant deep infection due to skin traction. Since spica cast immobilisation was not feasible due to the skin problems, we used titanium elastic nails (TEN) with excellent results.

■ Dieter Mortier, MD, SHO Orthopaedics.

■ Koen De Ridder, MD, Orthopaedic Surgeon.

Department of Orthopaedic Surgery, Sint Augustinus and Sint Jozef Hospitals, Wilrijk / Malle, Belgium.

Correspondence : Dieter Mortier, Hertogstraat 159 bus 204, 3001 Heverlee, Belgium.

E-mail : dieter.dwh.mortier@skynet.be

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Table I. — Patient population

Boy/Girl	AaT	L/R	Ø TEN	Cons	VOS	FU	LOS	POS	CL
B	53	L	2.5	3	3	36	9	6	No
B	70	R	3.5	3	3	24	6	6	§
B	37	L	2.5	2	2.5	3	6	3	No
G	34	L	3	3	3	3	4	4	No
B	38	L	3	3	3	4	6	3	No
B	63	R	3	2,5	3	32	5	4	No
B	33	R	2.5	2	2.5	4	7	3	No
B	19	L	2.5	2	2.5	38	3	3	No
G	69	R	3	2,5	3	26	5	4	No

AaT : age at trauma (months)
L/R : Left, Right
Ø TEN : diameter titanium elastic nail (mm)
Cons : time to solid callus formation (months)
VOS : removal of nails (months)
FU : follow-up (months)
LOS : total length of hospital stay (days)
POS : postoperative hospital stay (days)
CL : concomitant lesions
§ : ipsilateral pubic fracture, lung contusion

The aim of this small study is to illustrate that in this particular age group, intramedullary nailing is a safe and valuable alternative compared to conservative treatment.

PATIENTS AND METHODS

A retrospective analysis of all femur fractures treated in our orthopaedic department during a 3-year period was performed. Nine preschool children were included in our analysis (table I). The mean age of the patients was 46.2 months (range : 19 to 70). There were 7 boys and 2 girls (ratio : 3.5:1). All patients had closed femur fractures. One patient had associated injuries which included an ipsilateral pubic fracture and a lung contusion.

The surgical procedure was performed with the patient in the supine position. Smaller children were placed on a radiolucent table, whereas for bigger children (5-6 years of age) a fracture table was used. We used the technique described by Métaizeau *(20)*. The reduction was performed under fluoroscopic guidance.

A medial and lateral drill hole was made in the distal femur, proximal to the physis. Both drill holes were made at the same height. The diameter of the flexible nails depended on the size of the femur and the weight of the patient. Nail sizes 2.5, 3 and 3.5 mm were used in respectively four, four, and one patients. Prior to the introduction, both nails were slightly bent. The two titanium elastic nails (Synthes®) with equal diameter were then carefully introduced under fluoroscopic control using the ascending technique. The tip of the lateral nail was positioned just distal to the greater trochanter, the medial nail was positioned at the lesser trochanter. We made sure that the maximum curvature of the nail was situated at the fracture site. Both nails were cut off as close as possible to the femoral cortex to prevent skin irritation. No cast or splint was used. Immediate postoperative passive mobilisation was allowed. Weight bearing was allowed as tolerated.

RESULTS

Overall, the mean hospital stay was 5.6 days (range : 3 to 9). When considering only the postoperative days, the mean hospital stay was 4 days (range : 3 to 6). All patients were evaluated clinically and radiographically 6 weeks postoperatively. Solid callus formation was noted after a mean period of 2.5 months (range : 2 to 3) (figs 1-4). Nail removal was performed at a mean of 2.8 months (range : 2.5 to 3). Follow-up was available in all nine children. All patients showed irritation due to the subcutaneous position of the nails. None of our patients showed exteriorisation of the nails or skin infection, nor was there any malrotation or significant limb shortening (defined as greater than 1 cm) after a mean follow-up of 18.9 months (range : 3 to 38).

Fig. 1. — Middiaphyseal femur fracture (A/P)

Fig. 2. — Immediate postoperative radiographs showing 2 titanium flexible nails with reduction of the fracture (A/P and lateral).

Fig. 3. — Postoperative radiographs at 6 weeks (A/P and lateral).

Fig. 4. — Postoperative radiographs at 10 weeks showing solid callus formation (A/P and lateral).

DISCUSSION

Even when treated in a conservative way, fractures of the femoral diaphysis in young children are known to have a high remodelling potential and do heal at a faster rate than in adults. Owing to the high remodelling potential, a non-anatomical immobilisation is usually acceptable for the frac-

ture to heal without long-term complications (*4-6,26,27*). However, conservative treatment does have some drawbacks, e.g. skin problems, insufficient reduction which leads to sequential cast changes under general anaesthesia and serial radiographs, a great social and economic impact since longer hospital stay or daycare is needed. The initial decision to perform this operation was due to complications of the conservative treatment. Our first patient, a 19-month-old boy, sustained traction blisters on both lower legs. After one week, we noted progression of the blisters with development to skin necrosis. Since spica cast immobilisation was not feasible with the major skin problems, we decided to perform intra-medullary nailing. Postoperatively the toddler showed no major problems and the blisters and necrosis healed uneventfully.

Intramedullary nailing is already an internationally approved technique for school age children. Since it is a safe and easy to perform technique, we see no reason why this technique should not be used in preschool children.

In our patient population, we noted no serious peri-operative or postoperative complications. All patients showed a stable callus formation after a mean period of 2.5 months. Nail removal was performed after a mean time interval of 2.8 months. We would advise to make the entry portal as close as possible to the metaphysis, to avoid irritation by the nails. The patients benefited from early mobilisation and weight bearing. We also noted a short hospital stay postoperatively, i.e. a mean of 4 days whereas with conservative treatment the mean length of stay is 16.4 days (range : 1 to 29.7) (*4,8,9,11,14,18*). Absence of traction or spica cast immobilisation made regular hygiene and skin care at home possible. This also reduced the economic loss due to parents having to stay at home. We noted no secondary fracture displacement or nail migration. Femur overgrowth has been described in all age groups (*5,18*). At a mean follow-up of 18.9 months (range : 3 to 38), there was no significant leg length discrepancy and all children were able to perform regular activities. This study, however, lacks statistical power owing to the small number of patients. Bopst *et al* (*2*) performed a study including 72 preschool children. The study yielded similar results. The patients benefited from early mobilisation and weight bearing, short hospital stay, few complications and low morbidity. Twenty-seven children were noted to have a leg length discrepancy but it was significant in only 6. However, more studies and longer follow-up are needed.

CONCLUSION

Flexible intramedullary nailing of femoral shaft fractures appears as an excellent technique for walking pre-school as well as school-age children. The surgical procedure is minimally invasive with low peri- and postoperative risks. Although conservative treatment produces good to excellent results in pre-school children, we noted that, due to the short hospital stay and the fast and excellent recovery with intramedullary nailing, the overall morbidity and the social and economic impact appear to be considerably lower when compared to conservative treatment. This does not mean, however, that conservative treatment has to be abandoned. It still remains the first choice of treatment, even for complex fractures. The decision to perform intramedullary nailing should not be taken lightly, and the indication has to be well defined for every single case and always in consensus with the parents. Therefore we conclude that longer follow-up and larger studies are warranted.

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