Acta Orthop. Belg., 2006, **72**, 154-158

ORIGINAL STUDY

Limb length discrepancy following titanium elastic nailing in paediatric femoral shaft fractures

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The authors performed a prospective study to evaluate limb length discrepancy in children following titanium elastic nailing for femoral shaft fractures. Thirty-seven children (28 boys and 9 girls) were included in the study. The average time to radiological union in our study was 7.8 weeks (range : 5 to 14). Results after 3 years were evaluated for 29 children. Limb lengthening was noted in the first year in 15 children : at the time of nail removal, an average of 10.6 mm and at the end of one year 8.7 mm. After three years only nine were lengthened an average of 2.7 mm. An average of 12.6 mm shortening was seen in four patients at the time of nail removal, reduced to 12.1 mm at the end of one year. After three years three remained short, an average of 11.7 mm. No limb length discrepancy was seen in 10 patients. We conclude that limb length discrepancy is common following elastic nailing in paediatric femoral fractures, with lengthening being more frequent than shortening. Lengthening tends to decline with time at an average rate of around 1.5mm per year.

Keywords : femoral shaft fractures ; children ; intramedullary elastic nailing ; limb length discrepancy.

INTRODUCTION

For some 20 years, titanium elastic intramedullary nailing has been used in the treatment of femoral shaft fractures in children. The procedure is considered a safe surgical option in the growing child. We present a prospective analysis of 37 cases of titanium elastic nailing in paediatric femoral shaft fractures. The study aims to evaluate the results of nailing in terms of union and limb length discrepancy at 1 year and 3 years after the nail removal.

MATERIALS AND METHODS

This was a prospective observational study carried out between May 2001 and April 2005. A total of 37 children (28 boys and 9 girls) with femoral shaft fractures were included in the study. Overall results were analysed for 29 children. Children with bilateral fractures were not included. The average age of the patients was 8.6 years (range : 5 to 13). All patients were received at the accident and emergency section and preliminary management followed the Advanced Trauma Life Support protocol at our tertiary referral hospital. Children were admitted after ruling out all major visceral injuries. Initial management included a below knee

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No benefits or funds were received in support of this study

Fig. 1a. — Radiograph showing a fracture of the proximal third of the femur.

Fig. 1b. — Radiograph 11 weeks after nailing, showing stability and union at the fracture site.

skin traction with a weight of five pounds on a Thomas splint. The average time to theatre following admission was 2.8 days. There were 13 proximal, 18 middle and 6 distal femoral shaft fractures.

Closed reduction on a fracture table was achieved in 32 fractures. Open reduction had to be done in 5 cases. Soft tissue interposition was noted in all 5 cases. Two elastic titanium nails were inserted in an ascending manner from the distal metaphyseal area of the femur to gain a three point fixation in the diaphysis of the femur, stability being maintained by the opposition of the curves (fig 1a and 1b). Three nails were used in two patients (fig 2a and 2b). Post-op immobilisation was only done in children with distal femoral fractures. Partial weight bearing was allowed at an average of 9.2 weeks and full weight bearing at an average of 11.3 weeks. The average hospital stay was 9.6 days (range : 3 to 12). All patients were followed up on a regular basis. Results were analysed for clinical and radiological union. Limb length measurement was done using the block method.

Fig. 2a. — Radiograph showing fracture of the distal third of the femur fixed with three nails.

Fig. 2b. — Radiograph after 12 weeks showing good union

RESULTS

The average time to radiological union was 7.8 weeks (range : 5 to 14) (fig 3).

Three children were lost to follow-up. Titanium nails were removed in 29 patients after an average of 11.7 months. Results were analysed in these 29 children. Limb length was measured compared to the normal side at the time of nail removal, 12 months and finally 3 years after nail removal. Limb lengthening was noted in the first year in 15 children. Shortening was seen in four patients, while no limb length discrepancy was seen in 10 patients. The mean lengthening at time of nail removal was 10.6 mm (range : 7 to 13). The average shortening at time of nail removal was 12.6 mm (range : 9 to 14). At the end of one year the average limb lengthening was 8.7 mm while shortening was 12.1 mm.

Results analysed at the end of three years after nail removal showed that the average lengthening was 2.7 mm in nine of the 15 children who had limb lengthening. Six children in this group had equal limb lengths at the end of three years after

Fig. 3. — Radiograph showing good union of a proximal diaphyseal fracture at 10 weeks

nail removal. Shortening at the end of three years was present in three of the four patients who originally had limb shortening. The average shortening was now 11.7 mm. Since the shortening was less than 2 cm, no active intervention was planned for these patients. There was no child who had gradual progression of his or her limb length discrepancy.

We were not able to find any association between the fracture level and the amount of limb length discrepancy.

DISCUSSION

Elastic intramedullary nailing is a biological, minimally invasive treatment to achieve a high level of reduction and stabilisation of fractures in children (*7*). The complications in the procedure are usually minimal and are easily managed. Limb length discrepancy is a recognised complication in elastic intramedullary nailing of paediatric femoral shaft fractures. Although well reported, specific studies aiming at evaluating long-term limb length discrepancy are lacking. Our study aims to evaluate limb length discrepancy over a period, in children with femoral fractures. According to Parsch (*6*), overgrowth in late controls after intramedullary nailing of shaft fractures is about the same as the other types of treatment with an average overgrowth of 7 mm. In a series of 123 fractures of the femoral shaft in children, Ligier *et al* (*4*) have noted a low incidence of growth changes, with a mean lengthening of only 1.2 mm after an average follow-up of 22 months. They did not see any shortening in their study (*4*). These results are in accordance with our study but a dynamic change of limb length discrepancy over a period is not evaluated.

In a series of 31 patients who were followed up for a median of 2 years, Hoshian *et al* (*2*) found a leg-length discrepancy of up to 1 cm in 6 children and 10° of internal rotational deformity in one child. No angular deformity had occurred (*2*). In a series of 112 children with 118 diaphyseal fractures, Jubel *et al* (*3*) noted a mean lengthening of the injured leg of 2.4 mm. In this study too, lengthening was only noted at the time of nail removal and its dynamism with time was not noted. We conclude that lengthening following elastic nailing in children is a fairly common phenomenon. It gradually decreases and returns to normal in the majority of the children.

Limb shortening on the other hand is a surgical complication and by large occurs either due to wrong technique or due to the wrong indication for using the procedure (*5*). It can occur due to physeal damage or post-op fracture collapse due to poor stabilisation (*1*). Our early results highlight the same fact. Quantitatively shortening is much more important than lengthening and corrects very slowly with time.

REFERENCES

1. **Flynn JM, Hresko T, Reynolds RA *et al.*** Titanium elastic nails for pediatric femur fractures : a multicenter study of early results with analysis of complications. *J Pediatr Orthop* 2001 ; 21 : 4-8.
2. **Houshian S, Gothgen CB, Pedersen NW, Harving S.** Femoral shaft fractures in children : elastic stable intramedullary nailing in 31 cases. *Acta Orthop Scand* 2004 ; 75 : 249-251.
3. **Jubel A, Andermahr J, Isenberg J *et al.*** Experience with elastic stable intramedullary nailing (ESIN) of shaft fractures in children. *Orthopäde* 2004 ; 33 : 928-935.
4. **Ligier JN, Metaizeau JP, Prevot J, Lascombes P.** Elastic stable intramedullary nailing of femoral shaft fractures in children. *J Bone Joint Surg* 1988 ; 70-B : 74-77.
5. **Mazda K, Khairouni A, Penneçot GF, Bensahel H.** Closed flexible intramedullary nailing of the femoral shaft fractures in children. *J Pediatr Orthop* 1997 ; 6-B : 198-202.
6. **Parsch KD.** Modern trends in internal fixation of femoral shaft fractures in children. A critical review. *J Pediatr Orthop* 1997 ; 6-B : 117-125.
7. **Schlickewei W, Salm R.** Indications for intramedullary stabilization of shaft fractures in childhood. What is reliable, what is assumption ? *Kongressbd Dtsch Ges Chir* 2001 ; 118 : 431-434.