

Femoral shaft fractures in children

Elastic stable intramedullary nailing in 31 cases

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ABSTRACT We report our experience with elastic stable intramedullary titanium nailing (ESIN) of femoral shaft fractures in children. From 1998 to 2001, we treated 31 children (20 boys), median age 6 (4–11) years, with ESIN for 29 closed and 2 grade I open femoral shaft fractures. We reviewed 30 children clinically after median 1.5 (1–3) years. Their median hospital stay was 6 (2–20) days. All fractures were radiographically united at a median of 7 (5–9) weeks. The nails were removed in 29 children after a median of 22 (6–38) weeks postoperatively. At follow-up, we found a leg-length discrepancy up to 1 cm in 6 children and 10 degrees of internal rotational deformity in 1 child. No angular deformity had occurred. Elastic stable intramedullary nailing seems to be a safe method for the treatment of femoral shaft fractures in children between 4 and 11 years of age.

Patients and methods

From May 1998 to May 2001, we treated 31 children (20 boys), median age 6 (4–11) years, with ESIN (Nancy nail, Landos, France) for 29 closed and 2 grade I open femoral shaft fractures. The causes of injury were motor vehicle accidents in 10, a fall in 14, sports related in 3 and other reasons in 4 patients. The associated injuries included subarachnoidal bleeding in 2 patients, and abdominal injuries in 1. 5 fractures involved the proximal third, 22 the middle third and 4 the distal third of the femur. 8 fractures were oblique, 12 transverse, 10 spiral and 1 comminuted. All patients were followed radiographically until the fracture healed and were reviewed clinically for leg-length discrepancy, rotational and angular deformities after median 1.5 (1–3) years.

Surgical technique

The procedure was performed during general anesthesia with the patients in a supine position, without the use of a fracture table. All nails were inserted in a retrograde fashion. Two nails were used. The diameter of the nail should be 40% of the narrowest diameter of the diaphysis.

These nails are precurved to an angle of 30 degrees. The apex of the curvature of the nails should be at the level of the fracture site to ensure a good equilibrium of reduction and stabilization forces (Mazda et al. 1997). By using lateral and medial incisions above the knee, the nails penetrate the medullary space and avoid the distal femoral epiphyseal line. They are gently driven proximally

Traction or traction combined with a spica cast remains the gold standard in the treatment of femoral shaft fractures in children less than 4 years of age. Particularly in older children, malunion, joint stiffness and delay in functional recovery are well-known complications of this method (Reeves et al. 1990). The long hospital stay required by non-operative methods also increases the cost of treatment (Reeves et al. 1990). We report our experience with use of elastic stable intra-medullary nailing (ESIN) for the treatment of femoral shaft fractures in children.

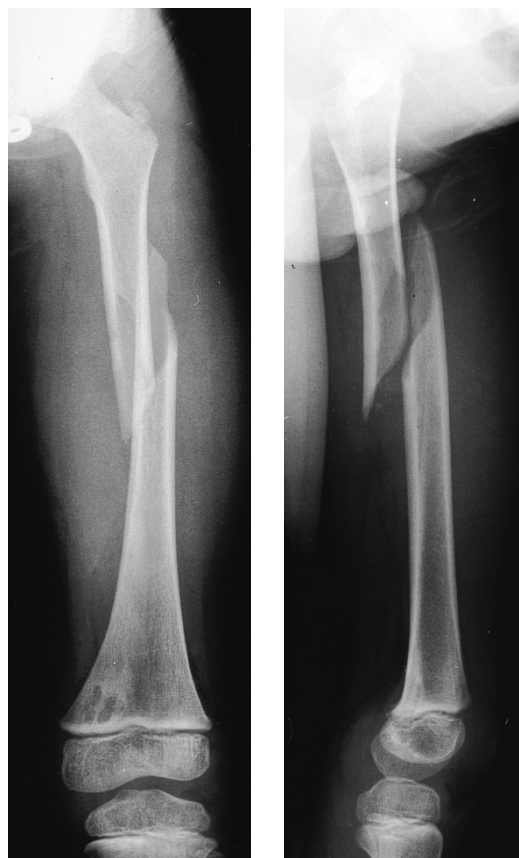


Figure 1. A 5-year-old boy with a spiral femoral shaft fracture on admission.



Figure 2. 6 weeks after flexible intramedullary titanium nailing, the fracture has united.

across the fracture site. The proximal point of the nails must be impacted in the area of the femoral neck distal to the femoral epiphysis and in the tip of the greater trochanter. After surgery, the patients were mobilized without weight-bearing immediately. Partial weight-bearing was then allowed for 3 weeks and full weight-bearing after 6–8 weeks.

Results

The median duration of surgery was 60 (40–100) minutes, and the median hospital stay 6 (2–20) days. All fractures were radiographically united after median of 7 (5–9) weeks (Figures 1 and 2). The nails were removed in 29 of 31 children after median of 22 (6–38) weeks. 1 patient had the nails removed at 6 weeks because they penetrated the skin.

At follow-up, all patients had unrestricted movement of the hip and knee joints. A leg-length discrepancy up to 1 cm was found in 6 patients, and a 10-degree internal rotational deformity in 1. No angular deformity was seen.

Discussion

Surgical treatment of femoral shaft fractures is seldom considered in patients less than 4 years of age, in whom early reduction and immobilization in a spica cast or traction are well-established methods. However, in older children, such treatment may be necessary to avert complications, such as delayed union, malunion, rotational deformity, refracture, knee stiffness, limb-length discrepancy and psychosocial problems (Reeves et al. 1990). In children from 4 to 10 years old, the

primary surgical options for femoral shaft fractures include external fixation (Krettek et al. 1991), plate and screw fixation (Hansen 1992), and intramedullary nailing (Heinrich et al. 1994). Hansen et al. (1992) recommended the use of plate osteosynthesis. It has the disadvantage of large soft-tissue dissection, an increase in the risk of infection and delayed union, nonunion, besides a need for secondary large soft-tissue dissection to remove the plate (Reeves et al. 1990, Ward et al. 1992).

Krettek et al. (1991) suggested the use of an external fixator, which provides good stability and early mobilization, but one fourth of his patients developed an infection at the site of the screws and one fifth of the patients were unhappy with the device. In a prospective study, Bar-on et al. (1997) compared flexible intramedullary nailing to external fixation and found the flexible intramedullary nail better as regards pain, leg-length discrepancy and time for healing of the fracture. The concept of flexible intramedullary nails was first proposed by Eriksson and Hovelius in 1979 for the treatment of femoral shaft fractures. Good results with flexible Ender nails have been reported in the 5–10-year age group by Heinrich et al. (1994) and Kissel and Miller (1989). Recent views in favor of flexible intramedullary nailing by Ligier et al. (1988) have been supported by Bar-on et al. (1997) and Flynn et al. (2001).

Ligier et al. (1988) reported good results with elastic stable intramedullary titanium nailing of 123 femoral shaft fractures in children. They reported no nonunions or delayed unions, only 1 infection and minimal limb-length discrepancy.

This method provides a combination of axial stability and elastic mobility that stimulates the development of bone callus. Partial rotational stability is achieved by the double crossing of the curved

nails, which provides three-point fixation (Ligier et al. 1988). Stability enables rapid return to function and partial weight-bearing.

No competing interests declared.

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