EXTERNAL FIXATION OR FLEXIBLE INTRAMEDULLARY NAILING FOR FEMORAL SHAFT FRACTURES IN CHILDREN

A PROSPECTIVE, RANDOMISED STUDY

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We report the outcome of 19 children aged 5.2 to 13.2 years with 20 fractures of the femoral shaft requiring surgery, who were randomly assigned to have external fixation (EF) or flexible intramedullary nailing (FIN) (10 fractures each). The duration of the operation averaged 56 minutes for the EF group with 1.4 minutes of fluoroscopy, compared with 74 minutes and 2.6 minutes, respectively, for the FIN group.

The early postoperative course was similar, but the EF group showed much more callus formation. The time to full weight-bearing, full range of movement and return to school were all shorter in the FIN group. The FIN complications included one transient foot drop and two cases of bursitis at an insertion site. In the EF group there was one refracture, one rotatory malunion requiring remanipulation and two pin-track infections.

At an average follow-up of 14 months two patients in the EF group had mild pain, four had quadriceps wasting, one had leg-length discrepancy of over 1 cm, four had malalignment of over 5°, and one had limited hip rotation. In the FIN group, one patient had mild pain and one had quadriceps wasting; there were no length discrepancies, malalignment or limitation of movement. Parents of the FIN group were more satisfied.

We recommend the use of flexible intramedullary nailing for fractures of the femoral shaft which require surgery, and reserve external fixation for open or severely comminuted fractures.


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In children, fractures of the femoral shaft have been traditionally treated by immobilisation in a spica cast, either immediately or after a period in traction.1,2 Surgical treatment was limited to open fractures or for patients with head or multiple injuries.3,4 More recently, there has been a growing trend towards surgical treatment with widening of the indications to include isolated femoral fractures.1,5 The methods have included external fixation,7,10 compression plating11,12 and intramedullary nailing with either rigid13-20 or flexible nails.21-25

For several years we have used external fixation for femoral fractures in children which required surgery, but have recently introduced the use of flexible intramedullary nails. We compared the outcome of these two methods in a prospective, randomised study.

PATIENTS AND METHODS

Over a period of one year all children between the ages of 5 and 15 years treated at our hospital with fractures of the shaft of the femur at least 3 cm distal to the lesser trochanter and 3 cm proximal to the distal physis, comminution with less than 50% of the width in a butterfly fragment (Winquist I and II26) or open fractures of Gustilo grades I27 and II,28 were randomly allocated sequentially for management either by external fixation (EF) or by flexible intramedullary nailing (FIN). Within this group, the parents of children with isolated femoral fractures made a fully informed choice between surgical and non-surgical treatment.

There were 19 children with 20 fractures. Ten were treated by EF and ten by FIN.

Operations were performed or directly supervised by surgeons with subspecialty training in either trauma or paediatric orthopaedics. EF was performed with either an Orthofix (Orthofix SRL, Bussolengo (Vr), Italy) or an AO external fixator (Mathys Medical Ltd, Bettlach, Switzerland) (Figs 1a and 1b). Either stainless steel or titanium nails were used in the FIN group. The operations were performed on either a normal or a fracture table, and fluoroscopic control was used in all cases.

We recorded the patients’ details, the mechanism of fracture, associated injuries, the location of the fracture and...
its configuration, and the time from injury to operation. Records were also made of the duration of surgery and fluoroscopy, the surgical technique and the complications. After operation, note was made of the period in hospital, the course of rehabilitation, fracture healing, the removal of the device, the outcome and parent satisfaction.

RESULTS

The average age of the FIN group was 9.3 years (6.9 to 13.2) and of the EF group 8.3 years (5.2 to 11.1). The causes of the fracture were similar in both groups: in seven of the EF group and eight of the FIN group it was a motor-vehicle accident, and in the remainder either sport or a fall. There were two cases of multiple injury in the EF group and three in the FIN group. There was an even distribution as regards location and configuration, and no open fractures. The interval between injury and surgery varied from two hours to 16 days.

The average duration of the operation for EF was 56 minutes, with a mean 1.4 minutes of fluoroscopy. FIN averaged 74 minutes with a mean fluoroscopy time of 2.6 minutes.

For EF an AO fixator was used in three cases, a paediatric Orthofix fixator in two and an adult Orthofix fixator in five (Figs 1a and 1b). Stainless-steel nails were used in six intramedullary procedures and titanium implants in four. The first of the flexible nails was inserted from the lateral side, proximally in the three proximal-third fractures, and from the distal end in the seven mid- or distal-third fractures (Figs 1c and 1d). The second nail was inserted from the medial distal aspect. One fracture site had to be exposed to allow engagement of the distal fragment; the other nine nailings were performed closed. One of the FIN patients also had flexible nailing of an ipsilateral segmental tibial fracture.

Excluding the patients with multiple injuries, mobilisation to a chair took place in one or two days, with walking at three days after surgery in both groups. The EF group was allowed partial weight-bearing, but the FIN group was either partially or non-weight-bearing depending on the stability of the fracture. The EF group left hospital after an average of eight days, compared with six days for the FIN group.

Complications. In the EF group one patient had rotatory malunion caused by a technical error. This was treated by remanipulation and a spica cast. There were two deep pin-track infections which were initially treated with antibiotics. Both cases failed to settle and the fixators were removed. One patient subsequently refractured and was placed in a cast, as was the second patient after removal of the device. A fifth patient also had a supplementary cast, applied because of poor callus formation.

In the FIN group, one patient had a foot drop caused by operative traction; this resolved fully within weeks. Two patients had bursitis over the medial insertion site; one was mild, but the other required early removal of the nail. One lateral nail migrated proximally and required early removal.

Fracture healing and rehabilitation. The EF group had significantly less callus formation at a later date than the FIN group (Fig. 2), and achieved full weight-bearing in an
average of 10 weeks (5 to 17), a full range of movement in 16 weeks (7 to 32), with return to school within 13 weeks (3 to 32). By comparison, the FIN group was fully weight-bearing in 7 weeks (3 to 10), achieved full movement in 9 weeks (6 to 12), and returned to school at an average of 5 weeks (2 to 12).

The external fixators were removed in the clinic at an average of 2.4 months after surgery. The flexible nails were removed from nine of the femora at an average of 7 months from surgery as a day procedure under general anaesthesia.

Follow-up. The mean follow-up was 14 months (12 to 22), by which time all patients had full unrestricted activity. One FIN and two EF patients complained of mild pain, but none limped. There was a limb-length discrepancy of 1 cm in two EF patients, but in none of the FIN patients. There was quadriceps wasting of 1 cm or more in one FIN and in four EF patients. One EF patient had 20° loss of internal rotation at the hip; there was no loss of movement in the hip and knee in any other patient. All the fractures had healed fully, with no malalignment greater than 5° in the FIN group, but three malalignments in varus and one in recurvatum in the EF group.

Parent satisfaction. All the parents of children in the FIN group were satisfied with the treatment and would make the same choice again. The parents of two of the eight patients with isolated fractures in the EF group said that they would choose non-surgical treatment if faced with the same decision again.

DISCUSSION

Surgical treatment for femoral fractures in children used to be reserved for patients with head or multiple injuries or with severe soft-tissue damage,3,10,20 but indications have
REFERENCES