

Lengthening of the tibia over an intramedullary nail, using the Ilizarov external fixator

Major complications and slow consolidation in 9 lengthenings

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We lengthened 9 tibial segments over a nail to reduce the time in the external fixator in 5 patients with constitutional shortness. The median lengthening was 7 (5.5–7.3) cm and the external Ilizarov frame was removed after median 99 (63–125) days. In spite of a short time in the external fixator, consolidation was slow, with a median lengthening index of 4.4 (2.4–6.1)

months/cm. The procedure resulted in 3 fatigue fractures of the intramedullary nail or interlocking screws that needed revision and bone grafting. In 1 patient, a deep intramedullary infection occurred. After the experience of these major complications we have returned to the traditional callotasis lengthening method described by Ilizarov.

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We report our experience with tibial lengthening using an intramedullary nail which reduces the time in the external fixator during the period of consolidation.

Patients and methods

In 5 patients (4 girls) with a median age of 17 (16–21) years, we lengthened 9 tibial segments because of constitutional shortness (135–153 cm) during the years 1994–1995. After progressive reaming of the intramedullary cavity up to 9.5 mm, an 8 mm diameter intramedullary nail (Russel Taylor) was inserted. With the nail in situ, a simple Ilizarov frame (2 rings, 3 distraction rods) was mounted with 3 1.8 mm wires in each ring (Ilizarov, 1992). The nail was removed before a proximal Gigly saw osteotomy was performed and thereafter reinserted with proximal locking.

The lengthening with 1 mm per day (0.25 mm × 4) was started on day 14 postoperatively. 2 weeks after the end of distraction, the nail was distally locked and the external apparatus was removed. Full weight bearing was allowed 2 weeks later. The patients were given antibiotics prophylactically during the period of external fixation.

Results

8 tibial segments were lengthened by a median of 7.0 (5.5–7.3) cm. The median preoperative tibial length was 32 (28–33) cm and the relative gain in length 21 (18–24)%. The median time until frame removal was 99 (63–125) days. The time until consolidation (3 cortices found on the radiographs) was 30 (17–39) months, resulting in a median lengthening index of 4.4 (2.4–6.1) months/cm (Table). At consolidation, removal of the intramedullary nail was planned. 1 patient wanted this procedure performed immediately and both nails were removed, while the other patients wanted removal at a later time.

In 1 patient, a deep intramedullary infection occurred during the distraction period in the first operated tibia (Figure 1). The distraction procedure was stopped at 5.5 cm of lengthening and the nail was removed. All the other patients were satisfied with the procedure and wanted to have the other side operated on with the same method.

Complications

Many complications occurred (Table). Only 3 lengthening segments in 2 patients had no major complications and did not need additional surgery.

Patient data

A	B	C	D	E	F	G	H
1	M	Left	17.5	73	2.9	—	—
		Right	18.8	73	2.4	—	—
2	F	Right	20.0	66	4.9	1,4	1,2
		Left	21.0	70	4.6	2	3
3	F	Right	16.1	55	6.1	4	4
		Left	17.0	55	4.1	2	3
4	F	Left	17.2	72	5.4	—	—
		Right	18.2	72	3.8	2	3
5	F	Left	16.9	55	—	3	5

A Patient

B Gender

C Side

D Age at operation

E Lengthening, mm

F Lengthening index, months/cm

G Complications

1 Ankle joint contracture

2 Nail/locking screw fracture

3 Deep intramedullary infection

4 Local irritation of IM nail/screw

H Additional surgery

1 Achilles tendon lengthening
+ posterior capsulotomy

2 Revision of intramedullary nail

3 Revision of intramedullary nail
+ bone graft

4 Removal of interlocking screw

5 Removal of intramedullary nail
+ application of gentamicin beads

The most serious complication was a deep intramedullary osteomyelitis (*Corynebacterium diphtheriae*) in 1 patient 8 weeks after starting distraction. The infection was treated with nail removal and mechanical cleaning of the intramedullary cavity followed by rigorous irrigation with Ringer's solution. The 2-ring external frame was expanded with an extra ring, 2 Kirschner wires and a half-pin. Thereafter antibiotic beads with gentamicin were placed in the intramedullary cavity for 14 days. This patient later needed autologous bone grafting from the ipsilateral iliac crest because of insufficient bone regeneration. After this procedure, the lengthening zone healed. Oral antibiotics were administered until full consolidation and removal of the external fixation device. The patient's other leg was operated on without an intramedullary nail by using bifocal osteotomies.

In 5 more segments in 3 patients, the nail or screws had to be revised or removed because of

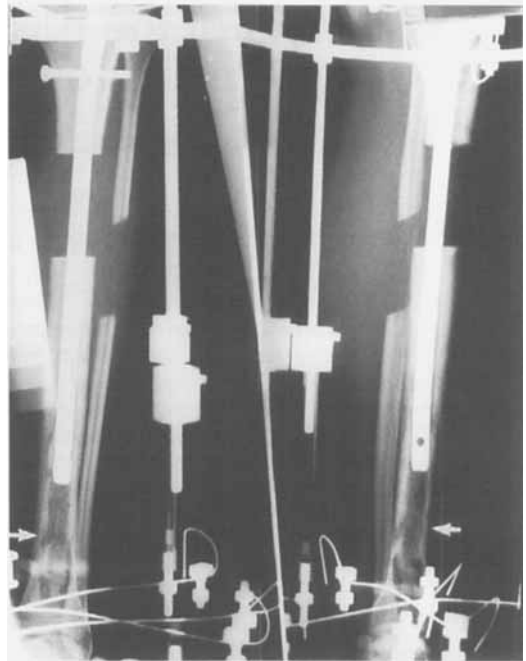


Figure 1. In patient 5, a deep intramedullary infection occurred during the distraction period in the first operated tibia. Radiographs showed intramedullary destruction in the distal region of the operated tibia.

breakage or skin irritation. Additional autologous bone grafting was needed in three of these segments.

In 1 patient, Achilles tendon lengthening and posterior capsulotomy were performed 8 months postoperatively because of persistent ankle joint equinus contracture which did not respond to closed treatment.

Discussion

To our knowledge, results of lengthening over a nail in the tibia in constitutional shortness have not been previously published. The surgical technique, postoperative management and complications in general have been described by Herzenberg and Paley (1997), but details of bone formation and complication rates were not presented. However, in poliomyelitis, unilateral lengthening over an intramedullary nail in the tibia in 12 patients has been reported by Huang (1997), with few complications. The main advantage of lengthening over a nail is to reduce the time in the exter-



Figure 2. Patient 4. Breakage of the intramedullary nail occurred during the consolidation period before bone bridging across the lengthening zone 12 months after end of distraction.

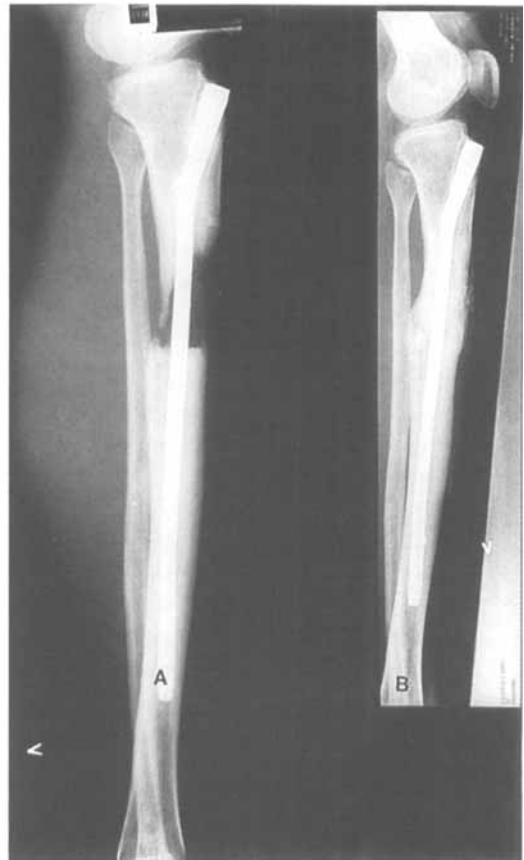


Figure 3. Patient 3 with 5.5 cm lengthening and minimal bone formation 17 months postoperatively (A) and after replacement of broken interlocking screw and simultaneous autologous bone grafting at full consolidation 23 months postoperatively (B) resulting in an increased lengthening index of 4.1 (months per cm lengthening).

nal fixation frame and thereby minimize the related problems (Paley 1990, Velazquez et al. 1993, Kristiansen et al. 1994). In bilateral lengthening, this is of special interest. Furthermore, the aim is to secure axial alignment and prevent fracture after frame removal. In the tibia, where the mechanical and the anatomical axes are identical, lengthening over an intramedullary nail method is indicated in particular, compared to the femur, where the two axes are different and would cause an additional translation (Baumgart et al. 1997, Paley et al. 1997).

Apart from the patient with a deep intramedullary infection in which the nail had to be removed early, the time in the fixator was effectively reduced to the distraction period, plus 2 weeks for

each leg. However, the lengthening index (months postoperatively until 3 cortices in the lengthening zone could be seen on radiographs per cm lengthening) was significantly increased (Figure 3), compared to 1.5–1.7 of traditional mono- or 1.0–1.1 of bifocal lengthening osteotomies (Paley 1990, Kristiansen and Steen 1998). This could be due to reduced endosteal blood supply after reaming of the intramedullary cavity (Grundnes et al. 1994), but Paley et al. (1997) did not find an increased lengthening index after reaming and lengthening over a nail in the femur. Even lengthening with an intramedullary nail in the femur (Guichet et al. 1992), which allows an axial rotational movement of more than 20°, results in spontaneous callus formation in the distraction

gap. The difference in lengthening index between the femur and tibia may be due to the lack of soft tissue on the anteromedial part of the tibia, or mechanical changes due to the internal fixation. The transformation of forces from weight bearing will not create a normal micromovement situation in the callotasis zone mediated through the Ilizarov frame (Steen et al. 1997).

The fatigue fractures of the osteosynthesis material (2 nails and 1 screw) were probably related to the delayed osteogenesis and resulted in additional surgery. Our patients were allowed full weight bearing 4 weeks after the end of distraction, and this may be too early since bone bridging was not seen on the radiographs.

Complications related to joint contracture are expected, due to the lengthening procedure per se and not to the method (Paley 1990, Velazquez et al. 1993, Kristiansen et al. 1994, Kristiansen and Steen 1996). Local skin irritation from interlocking screws or protrusion of the proximal part of the nail at the insertion site cannot be considered serious problems and are related to unsatisfactory operative technique.

In spite of the fact that 4 of the 5 patients were satisfied with the method used and wanted to have the same procedure performed on the second leg, we found that the method was associated with an unacceptably high lengthening index and too many serious complications for future use.

For these reasons we have returned to the traditional callotasis lengthening technique in our hospital (Kristiansen et al. 1996, Kristiansen and Steen 1998), even if the patient does not need axial correction.

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