

Treatment of brachymetatarsia using a semicircular lengthener

1–3 years results in 6 patients

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6 women with brachymetatarsia involving 9 bones were treated by the use of the Ilizarov semicircular lengthener. The affected bones were the second, third and fourth metatarsals. Ilizarov half-rings were applied on the foot with 5 or 6 half-pins (3 mm in diameter) and a percutaneous osteotomy was done. The short metatarsals were lengthened 0.25 mm twice a day by the patient. The lengthened dis-

tance was 15 (10–22) mm and the overall treatment time was 15 (12–25) weeks. The postoperative course was uneventful, with smooth bone regeneration. No bone-grafting was needed. During treatment, the patients could bear full weight and tolerated the fixators well. We conclude that this technique is useful in the treatment of brachymetatarsia.

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Congenital brachymetatarsia can be a serious cosmetic handicap in young women, especially in Japan, where it is less common to wear shoes than in the West. Although various treatments have been proposed, no authors have reported the use of a semicircular external fixator (Urano and Kobayashi 1978, Mah et al. 1983, Yonenobu et al. 1986, Wakisaka et al. 1988). We have recently devised a novel semicircular type of fixator which consists of 2 Ilizarov half-rings and describe our first experience with this.

Patients and methods

6 women, mean age 31 (15–49) years, were operated on between 1991 and 1993. They had no pain or loss of function preoperatively but had a cosmetic handicap. They had a total of 9 affected bones: 1 third, 2 second and 6 fourth metatarsals (Table 1).

The proximal and distal ends of the affected bone were, with the help of fluoroscopy, fixed with 2 half-pins which were 3 mm in diameter. The angle between the pins was 30° to the sagittal plane or 60° to each other. The bone was then divided percutaneously with an osteotome at the proximal diaphysis through a 1 cm skin incision. To increase stability, 2 more pins were inserted, 1 into the navicular and the other into the cuboid bone. Distracton was started 1–2 weeks after the operation. Distracton at the rate

Table 1. Clinical data of 6 patients with brachymetatarsia

Case	Age	Affected metatarsal	Lengthened distance, mm	Treatment time, weeks
1	15	3	10	12
2	23	2	12	18
3	25	4 (R)	10	18
		4 (L)	10	15
4	27	2	10	13
5	34	4 (R)	22	26
		4 (L)	20	17
6	49	4 (R)	10	14
		4 (L)	21	19

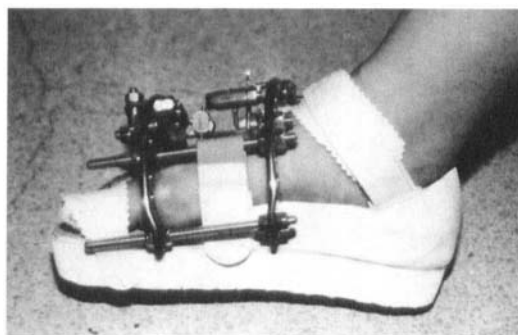
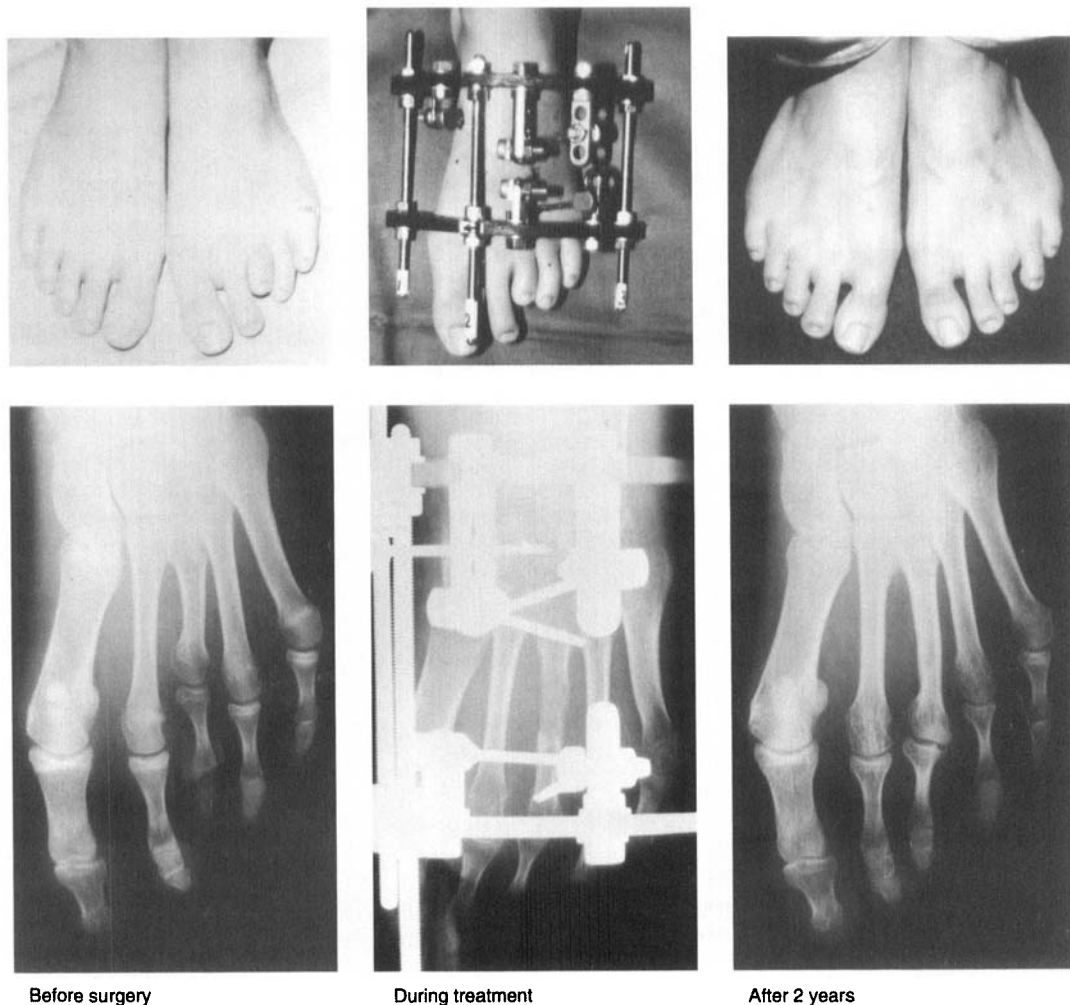


Figure 1. A special sandal for walking.

of 0.25 mm twice a day was performed by the patient. Full weight bearing in special sandals was permitted immediately after the operation (Figure 1).

Figure 2. Case 1. A 15-year-old girl. Clinical appearance and radiographic findings of the lengthening of the short third metatarsal. Note good callus regeneration and consolidation.



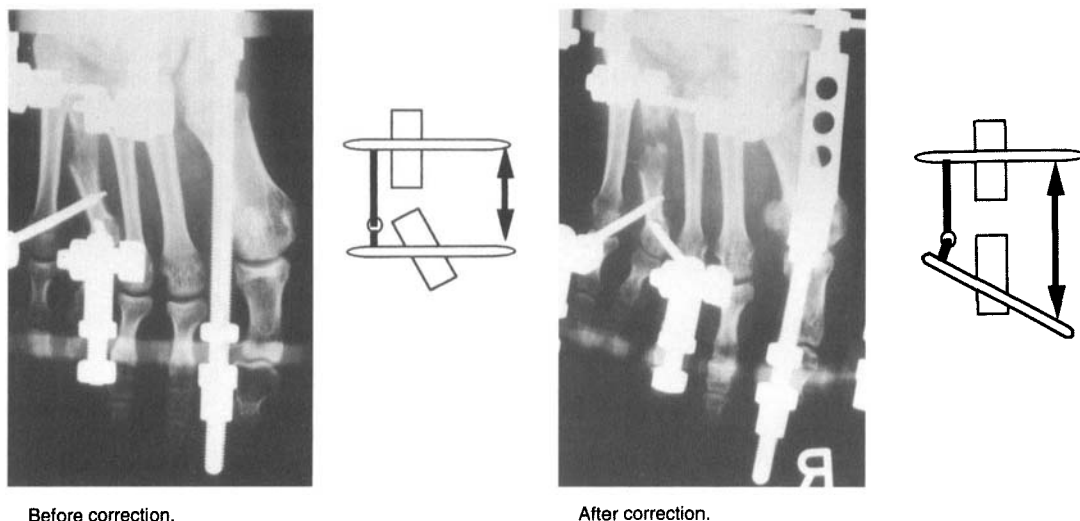
When the bone was lengthened to the anatomical length, the distraction was discontinued. All the pins were removed without anesthesia after the callus maturation was confirmed radiographically. In cases 3, 5 and 6, the metatarsals of both feet were lengthened at the same time.

Results

All patients could bear full weight on the day following surgery. Callus could be seen on the radiographs 3 weeks after the osteotomy and it consolidated in all cases (Figure 2). The bones were lengthened by 1.5 (1.0-2.2) cm. The patients were discharged from the hospital about 10 days after the

operation. The time-span between surgery and removal of the fixator was 15 (12-25) weeks. 7 of 52 pins had a superficial infection, which subsided with oral antibiotics. No limitation of daily life was found during the use of the fixator. The patients could walk without any aids but used crutches outside the house as a precaution against falls. Some patients complained of moderate pain during the distraction. 2 pins in the distal epiphysis in 2 cases became loose during the lengthening process. One of them required reinsertion under local anesthesia when it slipped out of the bone. Axial deviation of distracted bone developed during treatment in 2 cases; one was a 15° adduction in the frontal plane and the other was 5° in the same plane. The latter did not require correction. The former was corrected to the anatomical position

Figure 3. Case 5. Bloodless correction of axial deviation of the distracted bone with distraction hinge method.



by the distraction hinge method. This method made it possible to correct the deviated axis and lengthen the bone simultaneously and without loss of blood (Figure 3). No musculotendinous problems were encountered, nor was tendon-lengthening or bone-grafting necessary.

The follow-up period was 2 (1–3) years. At the latest follow-up, only 1 patient complained of occasional pain in the sole of the metatarsal bone head, which may have been caused by the malalignment of the transverse arch, but the pain improved when an insole was used. All the patients were satisfied with their cosmetically normalized feet. They had no limitations on daily life or on their hobbies.

Discussion

Some authors have reported various methods for the treatment of brachymetatarsia involving either immediate or gradual correction. Kaplan and Kaplan (1978) described metatarsal lengthening with the use of an autogenous bone graft. A study by Urano and Kobayashi (1978) using an interposing bone graft in the MP joint concerned 102 patients. They recommended a short immobilization period of 2 weeks after the operation, but two thirds of the cases had non-unions. Mah et al. (1983) and Yonenobu et al. (1986) used an artificial implant, however. No long-term results have been reported.

The gradual correction method is based on callus distraction (Ilizarov 1992). Upton et al. (1989) and Steedman and Peterson (1992) employed a two-stage operation with a bone graft after rapid distraction. To

our knowledge, gradual correction by callus distraction has been carried out only with a monolateral fixator (Nogarin et al. 1988, Wakisaka et al. 1988). We have found no previous reports on the use of a semi-circular lengthener. Treatment with a rigid monolateral fixator is certainly simple, but it precludes weight bearing for a considerable time. Moreover, because of the short distance between the pins, one may have to insert the 2 end-pins into the tarsal bone and proximal phalanx when using the Orthofix lengthener (Steedman and Peterson 1992). In contrast, our device with Ilizarov half-rings makes it possible to bear full weight soon after surgery and to insert pins even over a short distance. The risk of pin-tract infection is minimal, because of the good stability obtained by also fixing the cuboid and navicular bones.

When lengthening tubular bones, there is a risk of axial deviation due to the imbalance between muscle forces on different sides of the bone (Paley 1990). This occurred in 2 of our cases with pin loosening but was easily corrected with our device.

References

- Ilizarov G A. Transosseous osteosynthesis. Springer-Verlag, Berlin Heidelberg New York 1992.
- Kaplan E G, Kaplan G S. Metatarsal lengthening by use of autogenous bone graft and internal wire compression fixation: a preliminary report. *J Foot Surg* 1978;17 (2): 60–6.
- Mah K K, Beegle T R, Falknor D W. A correction for short fourth metatarsal. *J Am Podiatry Med Assoc* 1983; 73 (4): 196–200.

- Nogarin L, Magnan B, Bragantini A, Molinaroli F. The surgical correction of metatarsal dysmetria. *Ital J Orthop Traumatol* 1988; 14 (1): 77-80.
- Paley D. Problems, obstacles, and complications of limb lengthening by the Ilizarov technique. *Clin Orthop* 1990; 250: 81-104.
- Steedman J T, Peterson H A. Brachymetatarsia of the first metatarsal treated by surgical lengthening. *J Pediatr Orthop* 1992; 12: 780-5.
- Upton J, Khouri R, Ramos D, Micheli L. Distraction lengthening for the congenitally short metatarsal: A case report. *Foot Ankle* 1989; 10 (3): 184-7.
- Urano Y, Kobayashi A. Bone lengthening for shortness of the fourth toe. *J Bone Joint Surg (Am)* 1978; 60 (1): 91-3.
- Wakisaka T, Yasui N, Kojimoto H, Takasu M, Shimomura Y. A case of short metatarsal bones lengthened by callus distraction. *Acta Orthop Scand* 1988; 59 (2): 194-6.
- Yonenobu K, Takaoka K, Tsuyuguchi Y, Ono K, Tada K. Elongation of brachymetatarsy with ceramic implant: a roentgenographic evaluation of its utility. *J Biomed Mater Res* 1986; 20 (8): 1249-56.