Simple Technique for Correction of Neglected Congenital Hallux Varus Deformity

*Sampat S. Dumbre Patil, DNB (Ortho), MNAMS,**
Hemant P. Parekh, MS, DNB (Ortho),†
*Ashraf I. Khan, DNB (Ortho), MNAMS,‡ Vaishali S. Dumbre Patil, MBBS, DMRE,**
*Shankar D. Wavre, MS, DNB (Ortho),**
*and Sachin S. Karkamkar, MBBS, MS (Ortho)**

Abstract: Hallux varus is an uncommon deformity in which the great toe is angled medially at the metatarsophalangeal joint. It exists in congenital as well as acquired forms. Congenital hallux varus is less common than the acquired type and is best addressed in infancy. If the deformity is not addressed early, or is undercorrected, the soft tissue imbalance will create osseous changes that maintain the deformity into adolescence or adulthood. Presentation of such neglected congenital hallux varus in adolescence or adulthood is rare. Its true incidence is not known. Several procedures have been described in the literature to correct congenital hallux varus presenting in infancy. To our knowledge, however, there is no recommended management strategy for correction of congenital hallux varus deformity presenting in adolescence or adulthood. In this article we describe an innovative technique to correct neglected congenital hallux varus by a simple, inexpensive, and reproducible method, which does not require plastic surgery.

Level of Evidence: Diagnostic Level 4. See Instructions for Authors for a complete description of levels of evidence.

Key Words: congenital hallux varus, adolescence and adulthood, gradual soft tissue distraction, external fixator

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HISTORICAL PERSPECTIVE

The alignment of the first toe has reflected human development from the time that prehistoric man began to walk upright.[1] Fossilized evidence reveals hallux varus in the footprints of man walking upright in Africa 3 million years ago.[2] In addition, other imprints discovered in northern Japan, dated to 2300 BC, also show varus alignment. The later development of shoe wear had a significant influence on alignment of the hallux.[3]

Flexible hallux varus is seen in newborns and is a reflection of intrauterine positioning.[4] This alignment gives way to the normal 0 to 20 degrees of hallux valgus that occurs after the child begins walking and after shoes have been introduced.[5,6]

Hallux varus deformity varies from only a few degrees to 90 degrees and has variable degrees of symptomatology and etiology. Causes range from the most common iatrogenic postoperative variety to idiopathic, rheumatic, congenital, and acquired or post-traumatic (due to tearing of the hallux lateral collateral ligament).

Acquired deformity can also occur because of surgical overcorrection of hallux valgus and may occur after distal soft tissue corrective procedures such as the McBride type of bunionectomy and after chevron, Mitchell, Keller, and Lapidus procedures.[7] The deformity may be recognized postoperatively or several months after the initial surgery.

Congenital hallux varus is less common than the acquired type and is best addressed in infancy. Congenital hallux varus is usually unilateral and is not considered hereditary. Historically, it has been classified into 3 types. The first, or primary type of congenital hallux varus, is not associated with any other deformity and involves a tight band of tissue, which extends from the medial aspect of base of the first metatarsal to insert into the base of the proximal phalanx. This tight band of tissue is, reportedly, the abductor hallucis, which acts as a taut bowstring, which gradually pulls the great toe into a varus position. The secondary type is associated with other congenital abnormalities, most commonly metatarsus adductus, equinovarus, clubfoot, or neuromuscular disorders such as polio and other teratogenic anomalies.[8–12] It can occur in combination with supernumerary phalangeal or metatarsal bones, syndactyly, congenital absence of the fibular sesamoid, and trapezoidal malformation of the proximal phalanx.[10,11,13–16] Longitudinal epiphyseal bracket syndrome or delta phalanx is also associated with hallux varus.[9,17] The tertiary type of congenital hallux varus is associated with severe skeletal abnormalities such as diastrophic dwarfism.

The factor most responsible for deformity in congenital hallux varus is the pull of the abductor hallucis into the base of the proximal phalanx. Thomson[12] demonstrated that primary dynamic infantile hallux varus was caused by medial insertion of the abductor tendon. Using cadaver dissections, he demonstrated that the abductor tendon actually inserts on the medial border of the phalanx in only 19% of the specimens. In the remainder, the tendon is either joined to the medial head of the flexor brevis at the sesamoid or inserts on the plantar aspect of the phalanx. In true hallux varus, the deformity occurs at the first metatarsophalangeal (MP) joint. In cases associated with metatarsus adductus and clubfoot, the apex of deformity is more proximal.[18]

Many different techniques have been described in the literature for correction of congenital hallux varus in infancy and acquired hallux varus. Treatment of acquired hallux varus depends on the severity and symptomatology of the deformity. Asymptomatic hallux varus is usually very flexible and less severe. No treatment is indicated in these cases, which are monitored for an extended period of time. Symptomatic hallux varus usually requires surgical intervention, which can involve

From the *Orthopaedic Department, Noble Hospital; †SKN Medical College; and ‡Ruby Hall Clinic, Wanowarie, Pune, Maharashtra, India.
The authors declare no conflict of interest.
Address correspondence and reprint requests to Sampat S. Dumbre Patil, DNB (Ortho), MNAMS, Orthopaedic Department, Noble Hospital, Magarpatta, Hadapsar, Pune 411013, Maharashtra, India. E-mail: sampatdumbre@gmail.com.

FIGURE 1. A–D, Clinical images of an adolescent's foot with hallux varus deformity. The great toe is deviated medially at almost a right angle causing poor cosmetic appearance and difficulty in wearing normal shoes. Note the medial fibrous band and a nodule at the metatarsophalangeal (MP) joint.

soft tissue release and tendon transfer, soft tissue procedures and osseous correction, or arthrodesis.

The proper treatment of congenital hallux varus depends upon the severity of the deformity and the rigidity of the contracted soft tissue structures. The deformity is usually treated in infancy with manipulation, casting, and splinting. Cases which are resistant to conservative treatment require surgical intervention. Various surgical techniques have been described in the literature for the deformity correction in infancy.[19]

The Farmer technique[19] is effective in correcting mild-to-moderate deformity, whereas the Kelikian procedure[19] is

FIGURE 2. A and B, Preoperative anteroposterior, oblique, and lateral weight-bearing radiographs of the same patient showing an intermetatarsal angle of 1 degree and an angle of 107 degrees at the metatarsophalangeal (MP) joint.

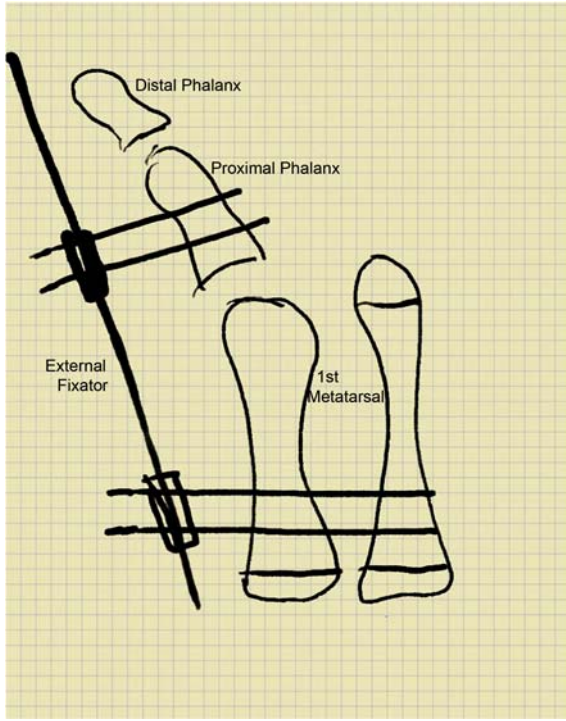

FIGURE 3. Diagrammatic representation of preoperative planning for application of external fixator.

satisfactory for severe cases with an excessively short first metatarsal. In Farmer technique, a broad Y-shaped flap of skin and subcutaneous tissue is developed from the dorsal surface of the web between the first and second toes. Great toe is moved laterally, and syndactyly is created between the hallux and the second toe. The dorsal flap is then rotated to cover the defect on dorsal and medial aspect of MP joint. Similarly, in Kelikian procedure, syndactyly is created between hallux and the second toe to maintain the deformity correction. Arthrodesis of the MP joint is considered in cases of associated traumatic arthritis at this joint. Amputation is rarely considered and is indicated only in very severe cases in which correction or arthrodesis could not be performed.[19]

If congenital hallux varus deformity is not identified in infancy, or is undercorrected, the soft tissue imbalance will create osseous changes that will maintain the deformity into adolescence or adulthood. If such cases are symptomatic, they will require soft tissue and osseous correction. To our knowledge, there is no recommended treatment strategy for correction of symptomatic, neglected congenital hallux varus deformity presenting in adolescence or adulthood.

We present a simple and inexpensive technique for correction of neglected congenital hallux varus deformity, which involves gradual distraction of the tight medial soft tissues with the help of an external fixator. The lateral soft tissues are allowed to contract on their own; thus, this technique does not require any plastic surgery for management of the soft tissues.

INDICATIONS AND CONTRAINDICATIONS

This technique is useful for correction of neglected congenital hallux varus deformity presenting with medially contracted soft tissues in either adolescence or adulthood.

PREOPERATIVE PLANNING

Proper preoperative planning necessitates careful clinical and radiographic evaluation of the deformity. A thorough clinical history should include the patient's age, activity level, duration of the deformity, and history of any previous surgery, trauma, or medical illness. The clinical examination should determine the degree of flexibility of the varus and the range of motion at the first MP joint (Fig. 1). Presence of a flexion contracture of the interphalangeal (IP) joint, signs of inflammation, and associated forefoot deformities (such as digital adductus) should also be observed. A thorough neuromuscular examination is also important to exclude any underlying neurological disorder.

Weight-bearing anteroposterior, oblique, and lateral radiographs should be performed to analyze the deformity. Radiographic evaluation helps to assess the intermetatarsal

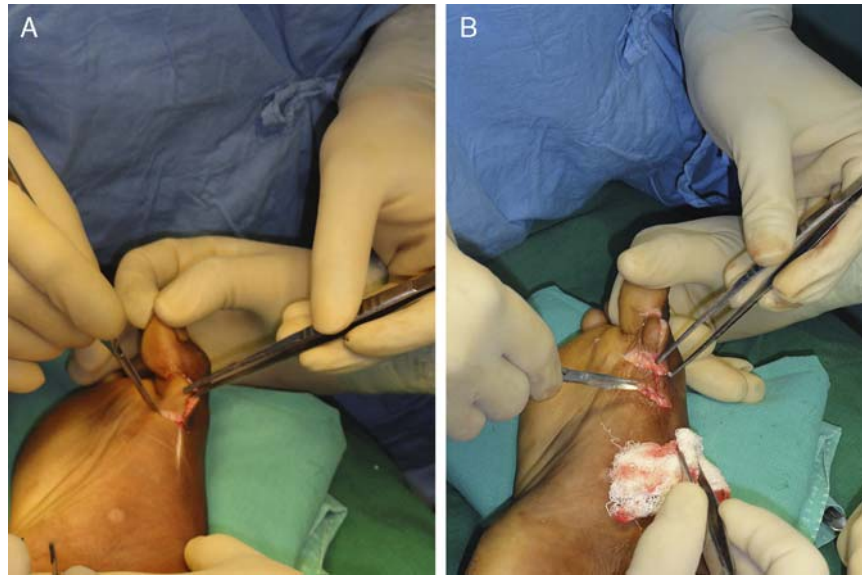

FIGURE 4. A and B, Medial zigzag incision centering at the first MP joint is taken for Z-plasty of the medially contracted soft tissue.

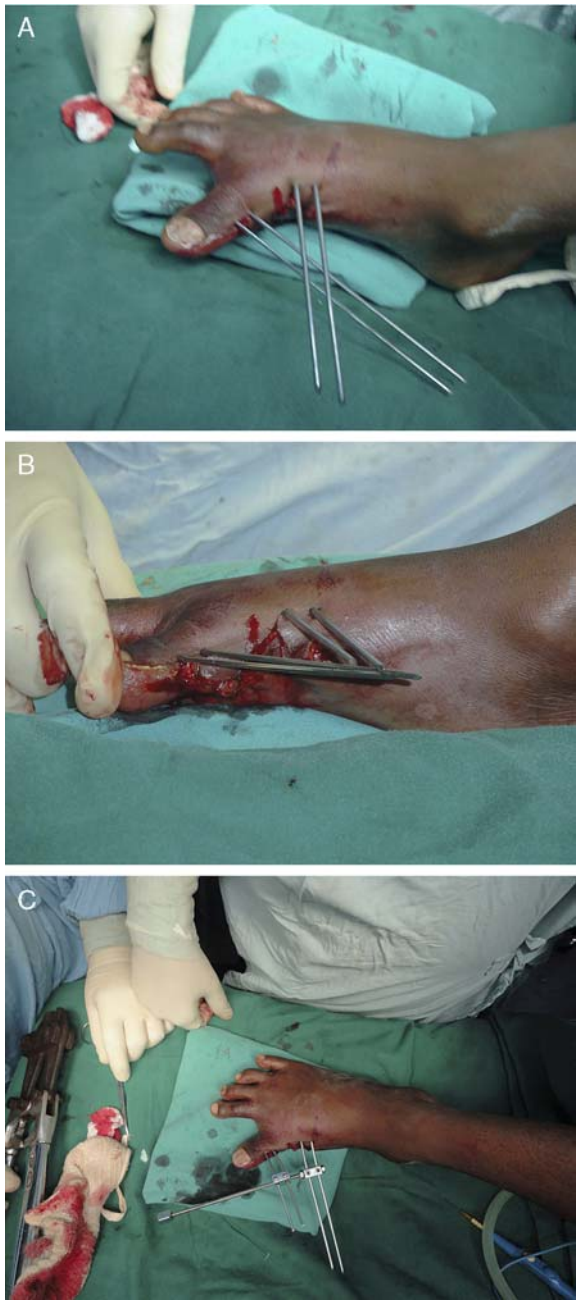

FIGURE 5. A to C, Insertion of K-wires and application of distractor on medial aspect of the MP joint.

angle, the angle at MP joint, MP joint congruency (Fig. 2), and the presence or absence of a fibular sesamoid. Distal metatarsal angle is also noted. In all our 3 cases it is abnormal because of developmental abnormality of the metatarsal head. Arthrosis involving the joint should be assessed to determine if a joint destructive procedure is required. After complete clinical and radiologic evaluation, operative planning is performed to determine the best approach for application of the fixator across the MP joint, as shown in Figure 3.

Foot is examined for the presence of a tough fibrous band on medial aspect of the MP joint. If it is present, Z plasty of this contracted tissue is planned to decrease stresses on external fixator during distraction. External fixator can be applied without Z plasty in absence of prominent medial fibrous band. We have done Z plasty in 2 cases out of 3.

TECHNIQUE

The goal of the procedure is to correct the deformity, maintain motion at the joint, and prevent recurrence. The patient is given spinal anesthesia. He is then placed in a supine position and a thigh tourniquet is applied. In cases with prominent medial fibrous band, Z plasty of contracted soft tissue is carried out. A central incision of about 4 cm is made medially on contracted soft tissue centering first MP joint. Z plasty flaps are created using an angle of 60 degrees on each side (Fig. 4A, B). This soft tissue release allows approximately 20 degrees of correction toward the lateral side. The incision is then closed without skin grafting. An external fixator, with uniplanar distractor, is applied. We used Joshi External Stabilization System (JESS)—6 inches double hole distractor (manufactured by Uma Surgicals, Mumbai, Maharashtra, India). The frame construct is made by inserting two 1.5 mm Kirschner wires (K-wires) into the proximal phalanx and two 1.8 mm K-wires into first metatarsal (Figs. 5A, B). These K-wires are connected to the uniplanar distractor (Fig. 5C). Distraction of 1 mm per day (one complete turn of 360 degrees of the distractor knob) is started from the third postoperative day.

The patient is usually discharged on the seventh postoperative day with a loose dressing over the surgical wound. No slab is applied. Before discharge, the patient is taught to distract the external fixator in increments of 1 mm per day at home. The patient is also supervised every week in the outpatient department. During the period of distraction, patient is kept non–weight-bearing and care is taken to avoid pin tract infection. The fixator is loosened each week and then reapplied to remove the tension on K-wires. At this time, great toe is manipulated to correct the deformity in sagittal plane, as the fixator is uniplanar. This will avoid dorsal or plantar subluxation of the first MP joint. Gradual distraction with external fixator aligned the proximal phalanx on the metatarsal head in an average of 6.33 weeks (range, 6 to 7 wk) (Figs. 6A, B). At this stage, the second step of procedure is performed to stabilize the MP joint.

The patient is again taken to the operating room. Under general anesthesia, an axial 1.8 mm K-wire is inserted from the tip of the great toe into the first metatarsal. This stabilizes first MP joint in the corrected position (Fig. 7A). The K-wire is maintained along with external fixator (Fig. 7B). The external fixator is removed in the outpatient department 10 days after this procedure (Figs. 8A, B). The axial K-wire is allowed to remain for an additional 4 weeks to maintain the correction and allow the lax lateral soft tissue to contract on its own. No surgical procedure is performed for lateral soft tissue plication. The axial K-wire is removed after 4 weeks in the outpatient department.

RESULTS

We treated 3 cases of such rare deformity using this novel technique. All patients were between 13 to 22 years of age and had >3 years of follow-up. In all cases, satisfactory cosmetic correction of the deformity was achieved (Figs. 9A, C) with excellent patient satisfaction. In all 3 patients, the great toe was plantigrade and was aligned with the metatarsal. At 3 years follow-up, movements at the MP joint are: (1) plantar flexion—average 30 degrees (range, 25 to 35 degrees); (2)

FIGURE 6. Follow-up radiographs (A) at 4 weeks and (B) at 6 weeks showing gradual distraction at the first metatarsophalangeal (MP) joint relocating the distal phalanx on the metatarsal head.

dorsiflexion (active)—average 10 degrees (range, 5 to 15 degrees); (3) dorsiflexion (passive)—60 degrees (range, 50 to 70 degrees). At IP joint there is 0-degree extension and 60-degree flexion. Functionally, toe-tip raising is possible (Fig. 9D). Patients are able to walk comfortably in regular shoes, and there is no evidence of recurrence of the original deformity. Postoperative radiographs at 3 years follow-up show short metatarsals in all 3 cases compared with the opposite normal side. Further, in 2 cases, there is earlier closure of the epiphysis. This may be due to congenital deformity and/or added by crossing of axial K-wire across the physis. The MP joint congruency and alignment are satisfactory (Figs. 10, 11A, B). The patients and their families are satisfied with the postoperative correction (Fig. 12).

COMPLICATIONS

Patients should be monitored for recurrence of the deformity. Particular attention is needed to prevent pin tract infection. We have not reported any superficial or deep pin tract infection, which required antibiotics or revision of K-wires.

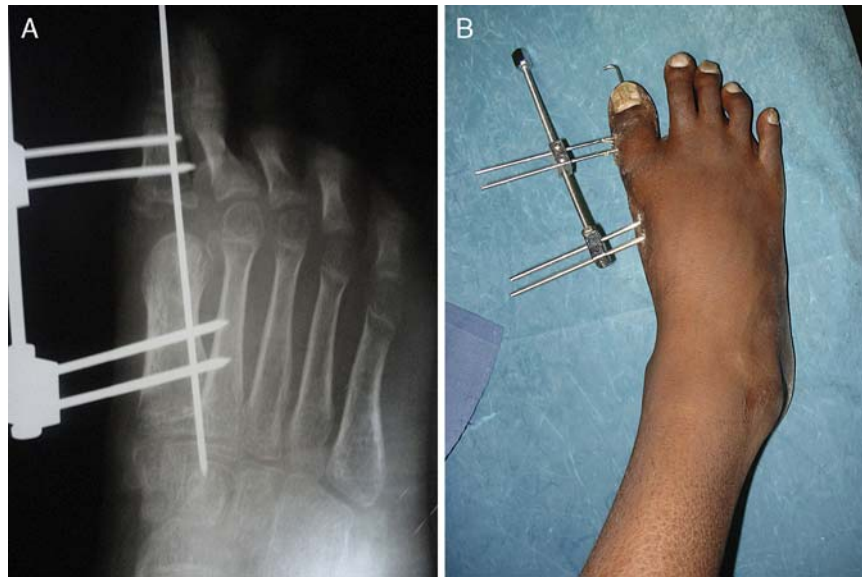

FIGURE 7. A, Follow-up radiograph and (B) clinical image showing insertion of K-wire across the metatarsophalangeal (MP) joint with fixator in situ after satisfactory alignment. This helps to maintain the correction and allows the lax lateral soft tissues to contract.

POSTOPERATIVE MANAGEMENT

After removal of the K-wire, patient is allowed to weight-bear and is advised to wear regular shoes. Shoes with a normal toe box help to maintain the correction. Active and passive physiotherapy is given in the outpatient department. Regular follow-up is advised to monitor the recurrence of the deformity.

POSSIBLE CONCERNS AND FUTURE OF THE TECHNIQUE

We have not addressed congenital deformity of the first metatarsal head in this technique. Movements achieved at MP and IP joints are less than normal but are sufficient for normal ambulation. We do expect arthritis of MP joint in future and patients are informed regarding the need of MP joint fusion.

The fixator used in this technique is uniplanar. To avoid deformity in sagittal plane, we have to manually adjust the fixator and manipulate the great toe. This has to be carried out every week by loosening the fixator.

This technique is particularly useful for correction of neglected, symptomatic congenital hallux varus deformity presenting in adolescence or adulthood. This method has not been attempted in other forms of hallux varus because of the difference in etiology. As this is a rare deformity, we feel that our 3 cases are sufficient to prove the usefulness of this technique.We also would like to encourage data sharing and debate regarding this method and subsequent outcomes to develop guidelines for future management of such deformities.

In conclusion, the key feature of this technique is gradual distraction of the tight medial soft tissue, with the help of an external fixator. Z plasty of the medial soft tissue helps to decrease the stresses on the external fixator. After achieving correction of the deformity, an axial K-wire kept for 4 to 6 weeks maintains the correction. This allows fibrosis of soft tissue and lateral capsule of the MP joint. Therefore, this technique does not require any complex plastic surgery procedures.

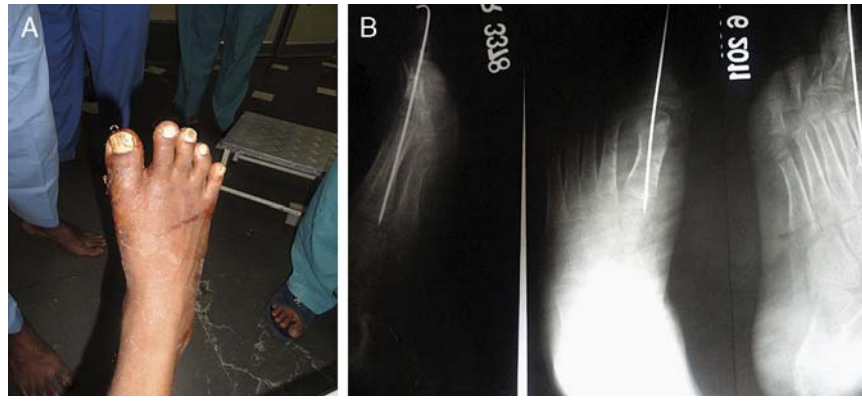

FIGURE 8. A, Clinical image and (B) radiograph showing axial K-wire kept for maintenance of correction after external fixator is removed.

FIGURE 9. A–D, Clinical image of the same foot shown in Figure 1 at 3 years follow-up showing satisfactory correction of the deformity. A, The great toe alignment is near normal, although the size of great toe is small because of hypoplasia. D, Satisfactory range of movement achieved at the metatarsophalangeal (MP) joint allowing the patient to perform toe-tip raising.

FIGURE 10. Weight-bearing anteroposterior radiograph at 3 years follow-up showing satisfactory alignment at the first metatarsophalangeal (MP) joint.

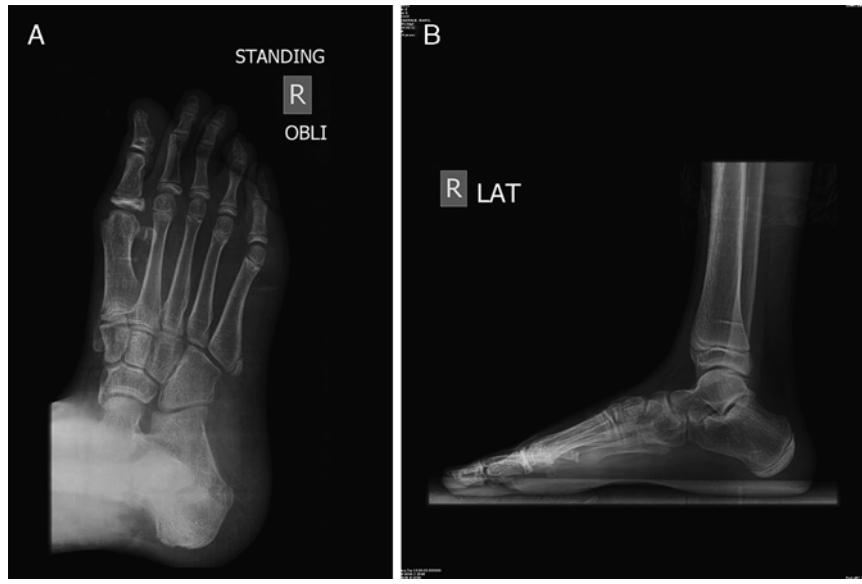

FIGURE 11. A and B, Weight-bearing oblique and lateral radiographs at 3 years follow-up showing satisfactory congruency at the first metatarsophalangeal (MP) joint.

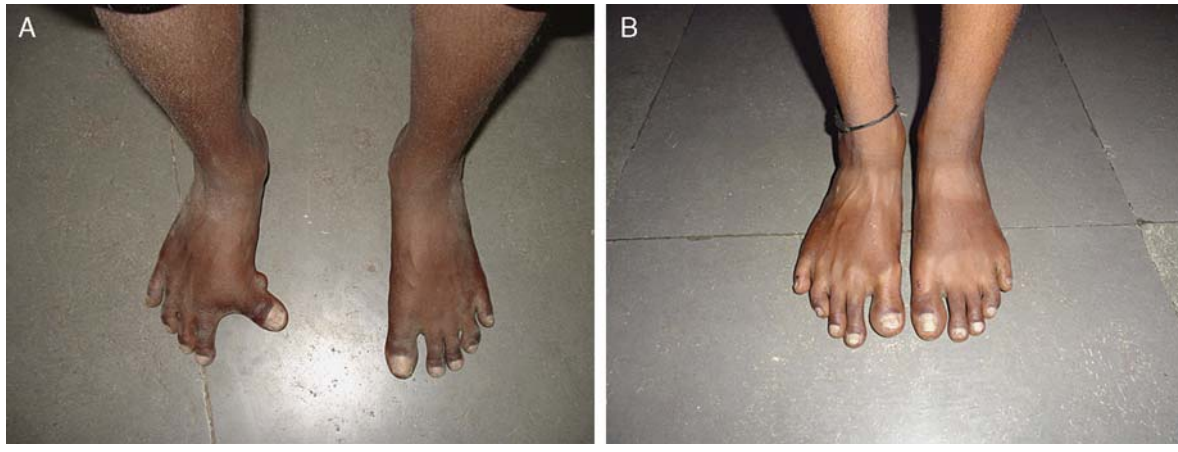

FIGURE 12. A, Preoperative hallux varus deformity with 90-degree medial deviation of the great toe. B, Correction of the deformity using our technique. The great toe shows normal alignment at 3 years follow-up, which allows the patient to wear normal shoes.

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