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*ORIGINAL STUDY*

# A new surgical procedure for iatrogenic hallux varus : Reverse transfer of the abductor hallucis tendon A report of 7 cases

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**Iatrogenic hallux varus is a possible complication of hallux valgus surgery following Mc Bride or Scarf osteotomy, with or without Akin osteotomy of the first phalanx. It may also occur following chevron osteotomy or Keller's procedure. One possibility for surgical revision of iatrogenic hallux varus is reconstruction of the lateral stabilising soft-tissue components of the first metatarsophalangeal joint. Until now, only dynamic tendon transfers, possibly combined with interphalangeal fusion, have been described. The aim of our study was to develop a static, anatomic reconstruction procedure.**

**A new surgical technique of ligamentoplasty using the abductor hallucis tendon is described. The new method was applied in 7 feet (5 patients) with a mean follow-up over two years. Hallux varus deformities were operated by transplantation of the abductor hallucis tendon. Subsequent radiographs showed correction of most of the factors considered to be responsible for the iatrogenic deformity. The American Orthopaedic Foot and Ankle Society (AOFAS) hallux metatarsophalangeal-interphalangeal (MTP-IP) score improved from 61 to 88.**

**This new technique is a reliable, anatomic reconstruction with use of the tendon involved in the pathogenesis of the hallux varus deformity. No other functional tendon is used.**

**Keywords** : iatrogenic hallux varus ; failed hallux valgus surgery ; transfer of abductor hallucis tendon.

## INTRODUCTION

Hallux varus deformity is a condition in which the great toe is medially oriented on the first metatarsal head. It is often a triplane deformity in which the medially deviated hallux is also hammered and supinated (*7*).

The condition can be congenital or acquired. Several subtypes of acquired hallux varus can be seen : iatrogenic, traumatic, following burn, in systemic disorders (rheumatoid arthritis, psoriatic arthritis), in Charcot-Marie-Tooth disease, in case of avascular necrosis of the metatarsal head and in poliomyelitis (*2,3,17,23*).

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Iatrogenic hallux varus deformity is not frequent, but is usually poorly tolerated. When the deformity is severe or is painful with difficulty wearing shoes, or when the cosmetic appearance is worse than the initial hallux valgus, patients will seek treatment (*20*).

The incidence of postoperative hallux varus has been reported to range between 2% and 15.4% (*4,5, 7,8*). The goal of surgical treatment is to produce a painless, cosmetically acceptable foot that can accommodate regular shoes, with a first metatarsophalangeal (MTP) joint that will remain stable and mobile, and will not develop early degenerative changes. The purpose of this article is to present a new surgical technique for reconstruction of the lateral components of the first MTP joint, and to show that it is more anatomical and physiological than other techniques currently used.

## MATERIALS AND METHODS

### Patients

From August 2003 to January 2007, seven patients with iatrogenic hallux varus were treated. Older patients with a long lasting deformity, degenerative changes in the MTP joint and claw toes with fixed interphalangeal (IP) joints were excluded from the study as our standard procedure for such cases is MTP arthrodesis. The reconstruction procedure was performed in seven feet, in five female patients (two had bilateral surgery) with an average age of 48 years (range, 32 to 58).

Primary treatment of the previous hallux valgus deformity had consisted in five cases in transfer of the adductor hallucis tendon using the McBride technique, resulting in sesamoidal and phalangeal instability ; the other two cases had a scarf osteotomy of the first metatarsal.

Initial clinical examination showed hallux varus, most marked when weight-bearing, with dorsiflexion and supination of P1.

All patients were operated with our personal technique by two senior surgeons (TL, PM).

### Surgical technique (fig 1)

The technique is based on a physiologic and anatomic (static and non dynamic) correction of the hallux varus deformity through reconstruction of the lateral collateral ligament with the help of a “reverse” transfer of the abductor hallucis tendon.

The first step is a wide capsular release essentially on the medial aspect of the first MTP joint, which is performed through a medial approach. One third of the width of the abductor hallucis tendon (ABH) is harvested from proximal to distal, keeping its distal bony attachment to the base of the first phalanx (P1) untouched. The fibers connecting the ABH tendon to the tibial sesamoid must be released. The tendon strap should be as long as possible.

Another incision in the first web space is then performed in order to free up and resect the fibrosis from a possible previous McBride procedure and to prepare the way for the tendon transplant. Two bone tunnels are then meticulously drilled, with a diameter depending on the size of the transplant (generally 3.5 mm diameter). The tunnels are slightly oblique : the tunnel in P1 starts a few millimeters distal to the insertion of the ABH tendon and is directed toward the lateral aspect of the proximal part of P1. The second tunnel should start just proximally and laterally to the articular cartilage of the first metatarsal head and should end just proximally and dorsally to the entry point of the plantar vascular pedicle of the metatarsal head.

Both tunnels must be perfectly centered on the neutral line (in the lateral view) in order to prevent any pronation or supination of the phalanx during tightening up of the transplant. The transplant is first passed through the tunnel in P1, recovered and tagged in the first web space, then pulled without twisting through the metatarsal tunnel. The purpose is to reconstruct the lateral collateral ligament of the first MTP joint.

The articular surfaces must remain congruent and mobile. The transplant is then sutured under slight tension and slight valgus of 10-15° using a transosseous nonabsorbable suture, secured to the remaining fibers of the ABH tendon.

Caution must be exercised not to close the medial capsule under tension, as it can be a cause of recurrence of the deformity. If so, only the skin should be closed.

Postoperatively the patient wears an orthopaedic shoe, without weightbearing on the forefoot for 6 weeks. Mobilisation of the first ray is started within the first few days after operation. A syndactyly with Elastoplast® between the first and second toe must be maintained for two months.

### Postoperative evaluation

Patients were retrospectively evaluated, both clinically and radiographically. Radiographic evaluation was done on preoperative and postoperative standing antero-

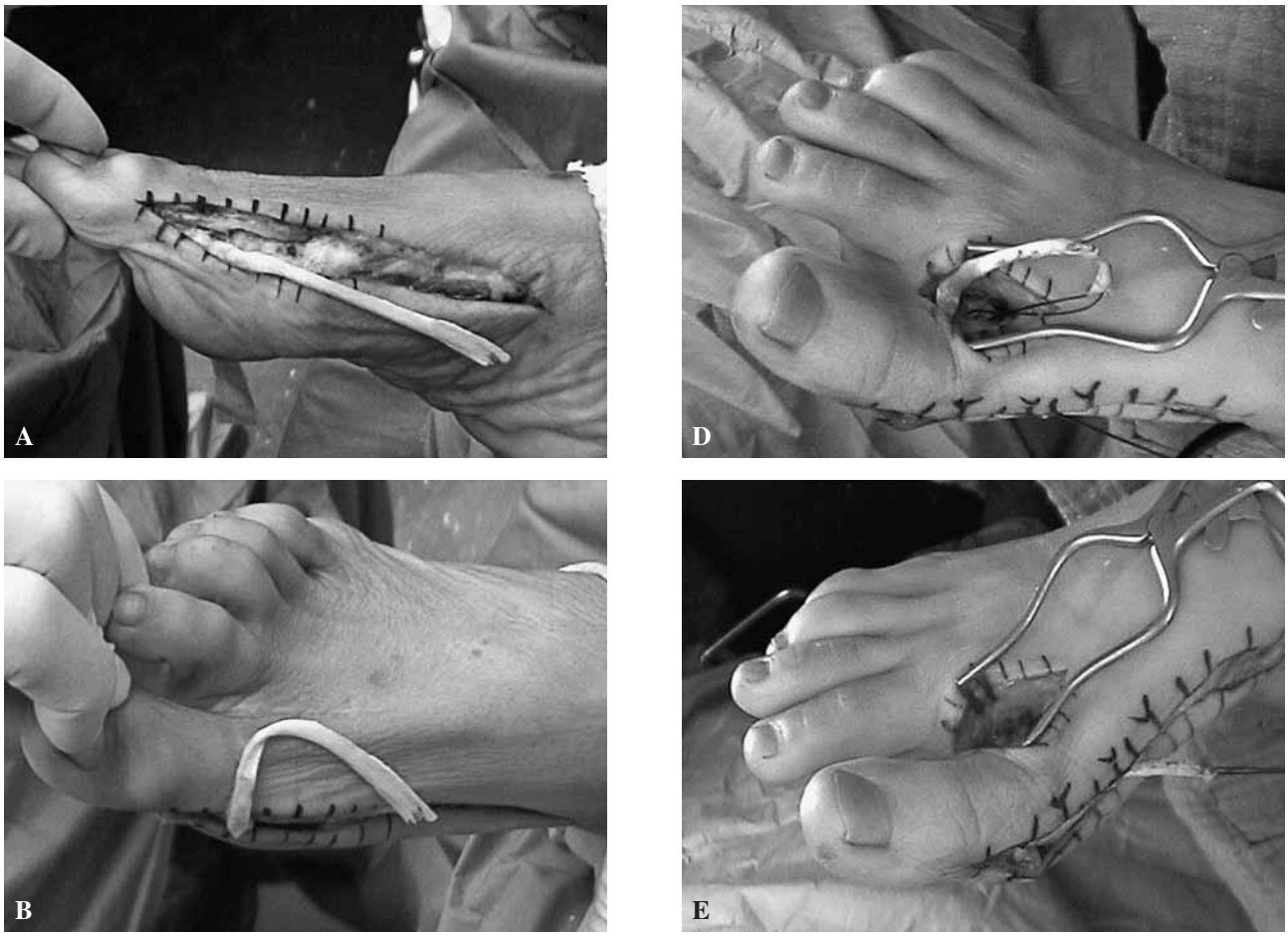


***Fig. 1.*** — A. medial release with harvesting of the middle third of the abductor hallucis tendon. B. Illustration of the transplant trajectory. C. passage of the transplant in the phalangeal tunnel after release of the first web space. D & E. passage of the transplant in the metatarsal tunnel from lateral to medial.

posterior and lateral radiographs of the foot (table I). On the standing anteroposterior (AP) radiographs, the intermetatarsal angle, the MTP angle, the position of the tibial sesamoid relative to the medial border of the first metatarsal, the distance between the center of the first and second metatarsal head were measured. The metatarsal protrusion angle was evaluated as positive when the first metatarsal was longer than the second metatarsal on the standing AP view, as negative when shorter and 0 when both were of similar length. The presence of cystic or arthritic changes in the articular surfaces of the sesamoids, the metatarsal head and phalangeal base was noted intraoperatively. On the standing lateral radiographs, we looked for the presence of dorsal subluxation of the first phalanx and exaggerated plantar flexion of the interphalangeal joint. The AOFAS score was measured pre and post operatively.

Table I. — Radiographic evaluation, patients pre- and post operative data

| | | Patient 1 | Patient 2 | Patient 2 | Patient 3 | Patient 4 | Patient 5 | Patient 5 |
|---|---|---|---|---|---|---|---|---|
| Initial surgery | | McBride | Scarf | Scarf | McBride | McBride | McBride | McBride |
| Follow-up period (months) | | 51 | 36 | 25 | 25 | 10 | 10 | 10 |
| IM angle | pre | 3° | 4° | 4° | 6° | 4° | 6° | 6° |
| | post | 7° | 7° | 8° | 7° | 6° | 10° | 9° |
| MTP angle | pre | 10° VR | 20° VR | 6° VR | 16,5° VR | 17° VR | 12° VR | 12° VR |
| | post | 10° VL | 12° VL | 18° VL | 18° VL | 10° VL | 14° VL | 13° VL |
| Tibial sesamoid position (mm) | pre | 9 med | 4 med | 1 med | 3 med | 5 med | 1 med | 2 med |
| | post | 3 med | 0 | 1 lat | 0 | 2 med | 0 | 2 lat |
| 1st to 2nd head distance (mm) | pre | 29 | 22 | 24 | 20 | 21 | 23 | 23 |
| | post | 31 | 27 | 26 | 21 | 23 | 24 | 23 |
| metatarsal protrusion angle | pre | positive | negative | negative | positive | negative | negative | negative |
| | post | 0 | negative | negative | 0 | negative | negative | negative |
| presence of fibular sesamoid | | yes | bipartita | yes | yes | yes | yes | yes |
| arthritic changes | | no | no | no | no | no | no | no |
| P1 dorsal (sub)luxation | | slight | no | slight | no | no | no | no |
| IP plantar flexion | | flexible | no | flexible | no | no | no | no |

(VR = varus ; VL = valgus ; IM = intermetatarsal ; P1 = first phalanx of great toe ; MTP = metatarsophalangeal ; med = medial ; lat = lateral ; IP = interphalangeal ; mm = millimeters).

## RESULTS

The mean follow-up was 25.2 months (range, 10 to 51 months). The mean mobility was 15° plantar flexion and 70° dorsal flexion in the MTP joint. There were no residual complaints of pain. All patients were able to wear commercial shoes without difficulty. All had resumed their sportive and professional levels of activity. The mean AOFAS score improved from 61 to 88.

The radiological results are presented in table I. During the follow-up period, there was no radiological evidence of tunnel site osteolysis or MTP joint degeneration (fig 2). No postoperative complications were noted. There were no signs of infection, reflex sympathetic dystrophy, transfer metatarsalgia or other disturbances of the foot.

## DISCUSSION

In order to approach the repair of iatrogenic hallux varus, thorough evaluation and understanding of its causes need to be undertaken. A combination of factors often leads to this postoperative deformity. The different factors leading to hallux varus are summarized in table II.

Different clinical presentations may be distinguished based on the patient's symptoms, the degree of deformity, the previous surgical technique used to correct the preexisting hallux valgus deformity, the time interval after initial surgery, the loss of osseous support for the first phalanx on the metatarsal head because of an excessive bunionectomy, the joint integrity, the flexibility of the hammertoe and the muscles and tendon imbalances (*15*). In case of a supple iatrogenic hallux varus in its initial stage in a young patient, without MTP and sesamoidal arthritis, surgical treatment is imperative and should consist in reconstruction of the lateral ligament. The essential common element in every correction is the release of the retracted medial soft-tissue component. Different combined procedures can then be proposed, they are summarized in table III.

If the hallux varus deformity has become chronic, if the MTP joint is stiff and presents a fixed

Table II. — Factors leading to hallux varus

| Factor | Surgical cause |
|---|---|
| loss of osseous support | the medial eminence resection is excessive and/or associated with the loss of part of the tibial sesamoid groove, the medial buttress stabilizing the first phalanx (P1) and tibial sesamoid is lost. This allows a medial drift *(3,4,7,23,24)* |
| excision of the fibular sesamoid | this removes the fulcrum on which the lateral head of the flexor hallucis brevis (FHB) relies to effectively plantar flex the lateral part of the the proximal phalanx *(4,7,8,10,21, 23,24)* |
| overcorrection of the intermetatarsal (IM) angle or the proximal articular set angle | as the IM angle decreases and becomes negative, the medial vector of pull of the soft tissues will increase, leading to varus position of the hallux *(3,4,5,7,23,24)* |
| excessive medial capsulorraphy | capsulorraphy *(3,4,5,7,23,24)* |
| muscle imbalance of the proximal phalangeal base | when there is concurrent release of the adductor hallucis (ADH) and the lateral head of the FHB tendons, compounded by a release of the lateral capsule, the muscles on the medial side are now unopposed, namely the abductor hallucis and the medial head of the FHB. These medial tendons will gradually migrate more medially, increasing the deforming forces. When the center of the base of P1 is medial to the midline of the metatarsal head, the extensor hallucis longus (EHL) will bowstring, pull the toe into a varus rotation, and extend P1. The flexor hallucis longus will then produce flexion at the interphalangeal (IP) joint, resulting in a hammertoe *(3,4,12,23,24)* |
| medially dislocated tibial sesamoid | excessive resection of the first metatarsal head *(4,5,23,24)* |
| excessive postoperative bandaging (4) | |

hammertoe deformity, or if one or both articular surfaces have been resected in an older patient, arthrodesis of the first MTP joint remains the treatment of choice *(3,4,7,15,19)*. Another valuable option would be a medial release combined with extensor hallucis longus (EHL) tendon transfer and IP arthrodesis. In our opinion, a Keller procedure, an osteotomy of the first metatarsal base or shaft or a total joint implant is not likely to provide satisfactory results on the long term *(4,24,25)*. Whenever there is an important loss of osseous support, reconstruction of the osseous buttress seems indicated and may be accomplished with an autograft or allograft *(7,16)*.

In the absence of MTP and capitosesamoidal arthritis in hallux varus, especially in a young subject, tendon transfers to reconstruct a lateral capsular ligament should be preferred to any other surgical technique. Even in the presence of a flexible IP claw toe, our new technique can provide excellent correction of the hallux varus deformity.

All other techniques described are based on a medial release as a first step in the correction of the hallux varus. For most authors however, this isolated action, even when it is extensive, is insufficient to entirely correct the deformation *(7,3,19)*.

Our technique seems to offer several advantages compared to others. Isolated tenotomy or tenectomy of the ABH tendon can, following postoperative fibrosis, lead to a recurrence of the initial deviation. For this reason, other authors propose the association of a reconstruction of the lateral collateral ligament *(4,6,10,18,24)*.

The dynamic transposition of the ABH on the lateral aspect of the base of P1 as described by Hawkins and Clark appears technically more demanding. We think that in some cases the lack of sufficient length of the transplant may cause technical difficulties. The dissection in the first web space is also very aggressive : the transplant must pass plantar to the deep intermetatarsal transverse ligament *(1,8,15)*. The insertion on the base of P1 as well as the whole path of the transfer will thus always be more plantar and may be responsible for a residual phalangeal supination.

Adductor tendon reattachment and reconstruction of the lateral conjoined tendon is often difficult because of the retraction of the muscular belly after a certain lapse of time *(4,10)*.

The advantage of the technique of Johnson using active transfer of the EHL into the proximal-lateral base of P1 is the neutralization of the medial

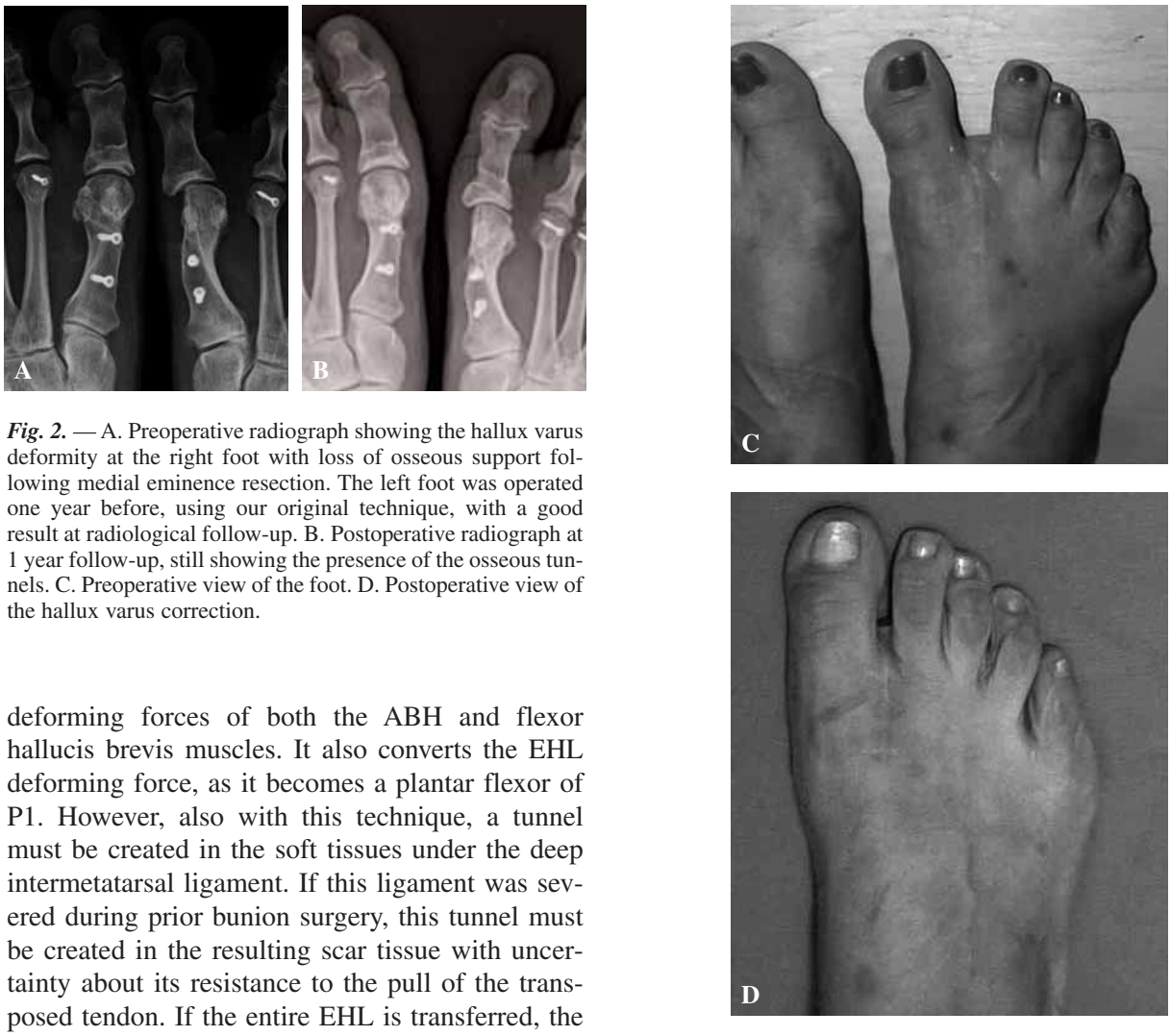


***Fig. 2.*** — A. Preoperative radiograph showing the hallux varus deformity at the right foot with loss of osseous support following medial eminence resection. The left foot was operated one year before, using our original technique, with a good result at radiological follow-up. B. Postoperative radiograph at 1 year follow-up, still showing the presence of the osseous tunnels. C. Preoperative view of the foot. D. Postoperative view of the hallux varus correction.

deforming forces of both the ABH and flexor hallucis brevis muscles. It also converts the EHL deforming force, as it becomes a plantar flexor of P1. However, also with this technique, a tunnel must be created in the soft tissues under the deep intermetatarsal ligament. If this ligament was severed during prior bunion surgery, this tunnel must be created in the resulting scar tissue with uncertainty about its resistance to the pull of the transposed tendon. If the entire EHL is transferred, the IP joint has to be fused. IP arthrodesis may become disabling if there is co-existing MTP stiffness and arthritis after several years (*3,5*). In order to address this necessity of IP arthrodesis, a modified split EHL tendon transfer has been proposed. In this technique, the lateral half of the EHL tendon is released proximally, which allows it to function as a static tenodesis (*3,13*).

Both procedures harvesting the EHL tendon may sometimes be impossible to perform because the transplant is too short. This may occur in cases with long-standing deformity of the MTP joint, hyperextension and contracture of the EHL tendon (*5*).

Valtin (*22*) has proposed to transfer the first dorsal interosseous muscle onto the proximal-medial part of P1, creating an efficient valgus force, but the long term effect on the second toe, deprived of its interosseous muscle, is not yet known. Furthermore, the transplant is often quite scrawny and reinsertion on P1 difficult.

The other techniques are all based on a dynamic transfer of tendons and propose in the postoperative period, a short-leg non-weightbearing cast with its inherent risks, for 4 to 6 weeks, generally followed by the use of an orthopaedic shoe.

As postulated by Granberry, we believe the initial deforming force to be excessive pull of the ABH tendon (*6,24*).

This imbalance, resulting in a larger moment arm of the abductor, leads to varus deformity and consequently to contracture of the medial capsule,

Table III. — Different associated procedures for correction of hallux varus

| | |
|---|---|
| 1. | medial release combined with abductor hallucis tenotomy, tenectomy or transfer on the lateral base of P1 (*1,4,6,8,10, 15,18,24*) |
| 2. | medial release combined with adductor tendon reattachment (*4,10*) |
| 3. | medial release combined with transfer of the EHL tendon under the deep transverse intermetatarsal ligament into the proximal-lateral base of P1, combined or not with an IP arthrodesis (*2,4,5,7,11,15,21*) |
| 4. | medial release combined with a modified split EHL tendon transfer (*7,13,14*) |
| 5. | medial release combined with the transfer of the first dorsal interosseous, detached from the base of P1 of the second toe and fixed through an osseous tunnel to the medial base of P1 of the great toe (*22*) |
| 6. | medial release combined with Saragaglia's technique of reconstruction of the lateral ligament using Ligapro suture (*19*) |
| 7. | medial release combined with reinforcement of the lateral capsular ligament by the use of fascia lata, or associated with capsular repair utilizing a soft-tissue anchor (*12,18*) |
| 8. | medial release combined with split extensor hallucis brevis tenodesis (*3,5,7,9*) |

decrease in the IM angle and leads to medial subluxation of the flexor and extensor mechanisms. It seems logical to address the cause of the deformation by weakening the abductor hallucis and using it for static rather than dynamic correction of the deformity. This is why we think our technique may be a more physiological approach. Moreover, some of the other techniques use extrinsic muscles with their origin and muscular belly at a larger distance from the transplant attachment, which makes it more difficult to control a rotational and dynamic force. If the tunnels in the phalanx and metatarsal bone are drilled on the neutral line, our ligamentoplasty using the ABH tendon is much closer to the center of rotation of the first MTP joint, which increases its stabilizing effect.

Major limitations of our study are the short follow-up time and the small sample size. We are as yet unable to state that the long term result will not be jeopardized by MTP degenerative disease. However, radiographs 4 years after operation do not show any osteoarthritic changes.

All of our patients demonstrated an excellent correction of the initial deformity. Anatomic reconstruction of the lateral capsular ligament using one third of the ABH tendon transferred in a reversed manner, is a new solution that appears reliable. It provides a good quality reconstruction by the use of a strong tendon autograft, which remains inserted on the proximal part of P1. The harvesting of this tendon is a mandatory step in the medial release of the first MTP joint, which is essential.

This new technique avoids using any functional tendon. We use and weaken the tendon that is, for a large part, responsible for the deformation, and this permits an anatomic reconstruction.

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