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First Tarsometatarsal Joint Derotational Arthrodesis—A New Operative Technique for Flexible Hallux Valgus without Touching the First Metatarsophalangeal Joint

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ABSTRACT

No operative technique for hallux valgus has been introduced in which the first metatarsophalangeal joint is not touched. We report the first tarsometatarsal joint derotational arthrodesis in which we mimic the function of the peroneus longus tendon without involving the first metatarsophalangeal joint, allowing function of the windlass mechanism without interference. We treated 66 patients (62 women and 4 men) with 84 flexible hallux valgus feet using our new operative technique. Preoperative and postoperative follow-up weight-bearing radiographs were evaluated. Most patients had a pronation type foot (78%) preoperatively, and mean correction in hallux valgus and intermetatarsal angle was 20° and 9°, respectively ($p < .001$). The LaPorta classification showed a median change of 2.5 U ($p < .001$). We have described a new operative technique for flexible hallux valgus. The first tarsometatarsal joint derotational arthrodesis showed notable correction angles in hallux valgus, although the first metatarsophalangeal joint was left intact.

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Hallux valgus is a common foot deformity in adults leading to more than 200,000 surgeries in the United States every year (1). Consistently, the annual incidence of surgery in Finland has been 78 operations per 100,000 persons (2).

The etiology of hallux valgus remains unclear. Shoe wear, excessive loading, genetic factors, female gender, ligamentous laxity, age, metatarsal anatomy, first ray hypermobility, pes planus, ankle equinus, and malfunction of the first metatarsophalangeal joint have been suggested as predisposing factors for the development of hallux valgus (3). We have found that, regardless of the etiologic factors, the same clinical findings will be present. According to the theory of Root et al (4), in hallux valgus the first metatarsal dorsiflexes and rotates to an inverted position relative to the proximal phalanx, the first metatarsal turns to varus, the sesamoids dislocate laterally, the first toe turns to valgus, and hallux valgus will be noted (4).

More than 100 different hallux valgus operation techniques have been reported within the past century. Routinely, hallux valgus operations have included some type of intervention to the first metatarsophalangeal joint (e.g., capsulotomy, bunionectomy, lateral soft tissue release, and/or medial capsulorrhaphy with or without osteotomy of the first metatarsal).

Lapidus (5) described the first tarsometatarsal arthrodesis procedure in 1934. In this well-known operation, arthrodesis of the first tarsometatarsal joint is accompanied by fusion of the bases of the first and second metatarsus, bony exostectomy, soft tissue release, and repair of the distal metatarsophalangeal joint (5). However, Lapidus (5–7) noted that correction of metatarsus primus varus occurred rather than first metatarsal rotational correction. Metatarsus primus varus is still an indication for a Lapidus operation (8).

In hallux valgus, the first metatarsal rotates to an inverted position relative to the hallux (4), and the peroneus longus tendon is the only evertor of it (9). Thus, malfunction of the peroneus longus tendon might play a crucial role in the development of hallux valgus (9,10). To our knowledge, no such operation has been introduced in which surgery is directed to correct first metatarsal malrotation, mimicking peroneus longus function during the late midstance and propulsion phase of the gait and leaving the first metatarsophalangeal joint intact to avoid any restriction of joint motion.

Our goal was to develop a hallux valgus correction technique that imitated or restored the peroneus longus tendon function. We introduce our technique of first tarsometatarsal joint derotational

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Table 1
Demographic data of 66 patients with 84 operated hallux valgus feet

Variable	Value
Age (y)	48 ± 10
Gender	
Female	62
Male	4
Women	62/66 (94)
Smoker	11 (13)
Diabetes	0 (0)
Ankle equinus	
Initially	65/84 (77)
Preoperatively	58/84 (69)
Hallux valgus angle, preoperatively	30° ± 7°
Intermetatarsal angle 1-2	13° ± 3°
Osteoarthrosis, preoperatively (Kellgren-Lawrence 0–3)	74/83 (89)
Meary's angle <0.0° (pronation type)	60/77 (78)
Meary's angle >0.0° (supination type)	17/77 (22)

Data presented as mean ± standard deviation or n (%).

arthrodesis and report our initial postoperative radiologic follow-up results.

Patients and Methods

From January 1, 2003 to December 31, 2009, 90 consecutive first tarsometatarsal joint derotational arthrodesis procedures were performed for flexible hallux valgus deformity at the University Hospital. Six feet could not be followed up radiologically; thus, 84 operated feet were included in the present retrospective analysis. Of the 66 patients, 62 were female and 4 were male, with a mean age of 48 ± 10 years (Table 1). Five of the feet had previously undergone surgery for hallux valgus: 2 chevron osteotomies and 3 bunionectomies had been performed in 4 patients as primary surgery. All patients underwent examination preoperatively and 6 weeks postoperatively. Clinical signs and symptoms were collected using weightbearing dorsoplantar and lateral radiographs of the foot. The complication data (Table 2) were collected retrospectively from the patient records up to 1 year postoperatively. The study was conducted according to the Declaration of Helsinki, and the local ethical review board approved the study protocol.

First tarsometatarsal joint derotational arthrodesis is effective only if the hallux valgus deformity is still flexible and the first metatarsophalangeal joint has good sagittal motion once the deformity has been reduced. The severity degree of the hallux valgus deformity did not seem to affect the result. A previous hallux valgus operation, such as chevron osteotomy or bunionectomy, was not a contraindication in our patient cohort. This correction technique is not recommended for fixed hallux valgus or if the range of motion of the first metatarsophalangeal joint is limited with or without crepitance, which indicates degenerative changes (11).

We used the midline of the body as a reference frame for the frontal plane in rotational directions (inversion–eversion). Spontaneous correction of the hallux valgus deformity was tested when the patient was standing on both feet, lifted the toes off the floor, and increased the floor contact under the first metatarsal head at the same time (Fig. 1). Thus, the peroneus longus activity was increased and the long toe flexor activity decreased. If hallux valgus was reduced both axially and rotationally with this test, the deformity was considered a good candidate for our new correction technique. Both feet were examined to note any possible degenerative deformity of the opposite hallux. The use of different operative methods for the correction of hallux valgus between the 2 feet could have long-term effects on gait kinematics; thus, the correction method should be carefully considered.

Table 2
General information about first tarsometatarsal joint derotational arthrodesis

	n (%)
Headless cannulated screw fixation	84 (100)
Adjunct procedures, all	63 (75)
Gastrocnemius/Achilles elongation	57 (68)
Weil osteotomy	9 (11)
Flexor digitorum longus transposition	16 (19)
Complications	
Nonunion	2 (2)
Suspected infection	4 (5)
Verified infection	2 (2)
Reoperation	3 (4)

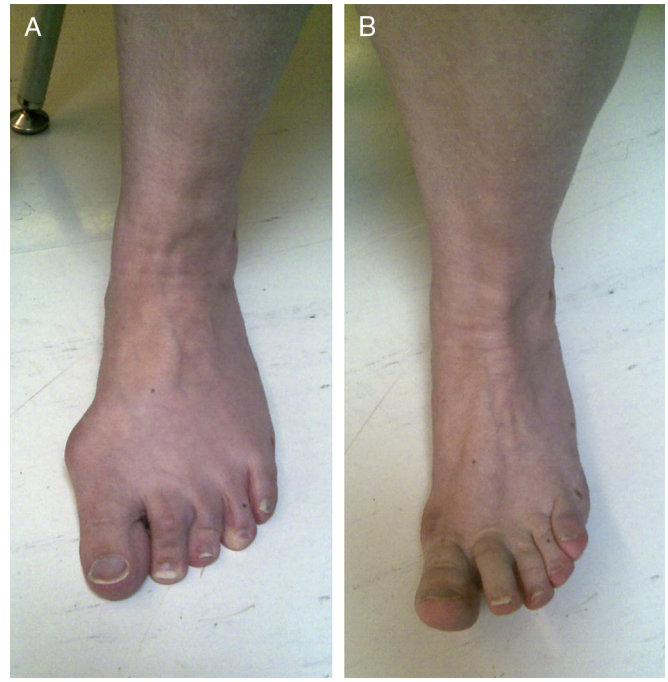

Fig. 1. Peroneus longus activation test. (*A*) Hallux valgus reduced by the peroneus longus when flexor hallucis longus eliminated with toe extensors (*B*).

Dorsoplantar and lateral weightbearing radiographs of the foot were taken preoperatively and 6 weeks postoperatively. The long flexor tendon activity of the toes (flexor hallucis longus and flexor digitorum longus) was registered when the patient was standing and walking. Thickening of the skin or local callosities were also registered to evaluate for long-term signs of increased foot pronation or supination during gait. Callus under the second metatarsal head and the medial margin of the interphalangeal joint of the hallux indicated a pronation problem of the foot and possible ankle equinus. Thickening of the skin under the fifth metatarsal head, combined with the first toe plantar keratosis, indicated a supination problem. These gait abnormalities altered the pre- and postoperative rehabilitation plan. Passive ankle dorsiflexion was examined according to the principles described by Silvferskiold et al (12). Achilles equinus contracture was treated operatively if residual ankle equinus remained after a preoperative stretching program.

Surgical Procedure

The patient was placed in the supine position, and a tourniquet was applied above knee level. Tourniquet positioning allowed adjunctive gastrocnemius elongation, if needed. The toes were left visible. The initial incision was made dorsomedially, starting proximal to the first tarsometatarsal joint, above the dorsal margin of the tendon tibialis anterior, and ending at the edge of the first metatarsophalangeal joint capsule. The distal branch of the medial dorsal cutaneous nerve was protected. The first tarsometatarsal joint was exposed, avoiding unnecessary stripping of the distal insertion of the tendon tibialis anterior. A self-retaining retractor was used. A straight chisel was placed into the first tarsometatarsal joint for orientation to the joint surface contour. Joint line orientation was maintained (without the need for extra plantarization), and an oscillating saw was used with a 10-mm blade to cut the cuneiform joint surface. Sawing began from the cartilage surface to avoid shortening of the first ray. The saw cut was directed perpendicular or in a slightly proximal direction to the second metatarsal to achieve enough axial correction of the intermetatarsal angle (1–2 intermetatarsal angle). The bean-shaped, convex cuneiform cartilage was removed. The first metatarsal base was placed firmly against the cuneiform medialis, and maximal eversion of the first metatarsal was applied around its imaginary rotational axis to imitate the peroneus longus tendon pull. The intermetatarsal angle was corrected by compressing the "bunion" with a squeeze test grip at the same time. A parallel cut to the cuneiform joint line was made as proximally to the base of the first metatarsal as possible (proximal to the ridge at the base of the first metatarsal). A small joint distractor was placed into the first tarsometatarsal joint, and the resected joint cartilage was removed. The distal insertion of the peroneus longus tendon could be seen attached to the base of the first metatarsal at the bottom of the first tarsometatarsal joint. The resected joint surfaces were perforated with multiple cannulated screw guidewire drills. The first metatarsal was positioned and held manually, as previously described, and the first tarsometatarsal joint was fixed axially with a guidewire, starting dorsally and approximately 2 to

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