Radiographic analysis of metatarsus primus varus

45 feet followed 15 months after distal metatarsal osteotomy and lateral soft-tissue release

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We analyzed standardized radiographs of 45 feet in 41 patients with symptomatic hallux valgus and an intermetatarsal angle of 17 (15–23) degrees 15 (9–24) months after distal metatarsal osteotomy and lateral soft-tissue releases. A mean reduction in the II-intermetatarsal angle of 12 degrees and hallux valgus angle of 24° was found. On average, the metatarsus primus varus angle improved by 4 degrees, the I-intermetatarsal angle by 3 degrees and the inclination angle of the first cuneiform by 4 degrees. We conclude that this operation corrects the metatarsus primus varus, without substantially altering the alignment of the long axis of the first metatarsal.

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Although still debated, the association of hallux valgus with medial (varus) angulation of the first metatarsal has generally been accepted (Ewald 1912, Truslow 1925, Haines and McDougall 1954, Piggott 1960, Houghton and Dickson 1979, Antrobus 1984, Scott et al. 1991, Yasuhito et al. 1995). Distal metatarsal osteotomy is commonly performed for correction of these deformities (Austin and Leventen 1981, Antrobus 1984, Harper 1989).

The correction is achieved by displacing the capital fragment laterally (Johnson et al. 1979, Lewis and Feffer 1981, Sarrafian 1985) and the operation is usually limited to cases with an intermetatarsal angle of less than 15°–20° (Corless 1976, Johnson et al. 1979).

However, the intermetatarsal angle as a measure of the extent of metatarsus primus varus (Lapidus 1934, Bonney and Macnab 1952, Haines and McDougall 1954, Pigott 1960, Carr and Boyd 1968) does not measure varus deviation of the first ray, but rather a valgus displacement of the second (Houghton and Dickson 1979).

Our purpose was to evaluate the correction of metatarsus primus varus by determining the varus angulation of the first metatarsal and inclination of the first cuneiform, following distal metatarsal osteotomy and lateral soft-tissue release.

Patients and methods

45 feet in 40 women and a man with painful unilateral or bilateral hallux valgus were operated on. The mean age of the patients was 59 (40–76) years and the right foot was involved in 29 cases. The indications for surgery were an intermetatarsal angle of 14° or more and a range of motion of at least 50° of the first metatarsophalangeal joint. In bilateral cases, operations were performed during the same session. Radiographs were taken preoperatively and at follow-up after 15 (9–24) months.

Radiographic technique

Dorsoplantar weight-bearing radiographs were made, with the roentgen beam inclined 15° from the vertical at a distance of 100 cm. In order to ensure precision, the beam was centered on the second tarsometatarsal joint.

The axis of the first proximal phalanx was a line connecting the most concave points of its proximal and distal articular surfaces (hallux valgus angle). The axis of each metatarsal was a line connecting the mid-points of the proximal and distal ends of its diaphysis (Piggott 1960, Scott et al. 1991) (I-intermetatarsal angle; I-IMT I/II, which measures lateral shifting of the first metatarsal) or a line measured from the mid-points of the metatarsal head and the base of the proximal metatarsal (II-intermetatarsal angle; II-

Radiographic data of 45 feet in 41 patients with symptomatic hallux valgus, mean SD (95% CI)

	Preoperatively	At follow-up	Mean individual reduction	p-value
Hallux valgus angle	40 2.6 (23–53)	16 1.4 (9–24)	28 2.9	
I-Intermetatarsal angle (I-IMT I/II)	18 0.7 (15–23)	14 0.8 (11–22)	16 0.6	0.004
II-Intermetatarsal angle (II-IMT I/II)	17 1.0 (14–27)	5 0.8 (3–11)	11 1.3	
Metatarsus primus varus angle	25 1.5 (16–39)	22 1.3 (13–31)	24 1.1	0.02
Inclination angle of os cuneiforme I	21 1.3 (13–28)	17 1.0 (14–27)	20 1.1	

IMT I/II which measures alignment of the first ray after lateral displacement of the capital fragment) (Harper 1989). The axis of the first cuneiform was a line connecting the mid-points of the medial and lateral ends of its proximal and distal articular surfaces. The valgus angulation of the first cuneiform was the angle between a perpendicular to the axis of the second metatarsal and the proximal articular surface of the first metatarsal (Yasuhito et al. 1995) (Figure 1).

Operative technique

The operations were performed through a medial approach to the first metatarsophalangeal joint, using a distally based L-type capsulotomy to expose the metatarsal head. The medial bunion deformity was excised with a saw 2 mm medial to the sagittal sulcus. The lateral soft-tissue releases were performed with a linear and horizontal capsulotomy and tenotomy of the adductor hallucis. With an apex localization in the center of the metatarsal head, a K-wire was installed in the anterior-posterior plane and directed an average of 5°–15° plantar. Subsequently, a 30°–45° chevron osteotomy was performed. After the osteotomy, the distal segment of the head and the proximal phalanx were distracted and displaced laterally, approximately 50% of the width of the head. The osteotomy was then impacted by manual pressure. The prominent medial shaft was excised flush with the metatarsal head and the medial capsular flap was sutured by tension to prevent a limitation of metatarsophalangeal joint extension.

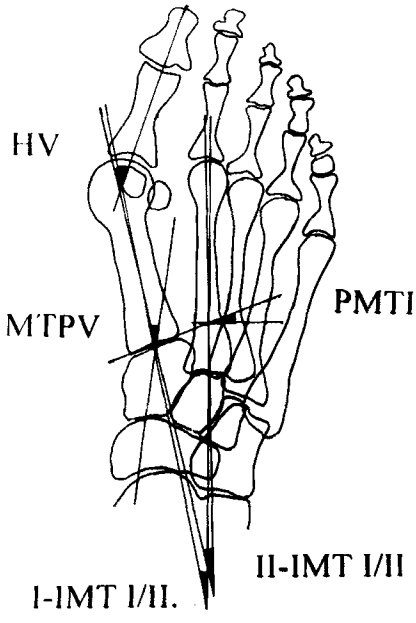

Figure 1. HV hallux valgus angle, I-IMT I/II I-intermetatarsal angle, II-IMT I/II II-intermetatarsal angle, MTPV angle of metatarsus primus varus and PMTI angle of inclination of the first cuneiform (PMTI proximal metatarsal inclination angle).

Statistics

The paired t-test was used to analyze reduction and the relationship between changes in the hallux valgus angle, the I- and II-intermetatarsal angle, the metatarsus primus varus angle and the angle of inclination of the first cuneiform.

Results

The average reduction in the hallux valgus angle was 19°. The average reduction in the inclination angle of the first cuneiform was 4° and 12° for the II-intermetatarsal angle. The mean individual reduction in the I-intermetatarsal angle was 16° ($p = 0.004$) and 24° in the metatarsus primus varus angle ($p = 0.02$) (Table). There was also a relationship between the preoperative metatarsus primus varus angle and hallux valgus angle at the time of follow-up ($r = 0.52$), and the inclination angle of the first cuneiform ($r = 0.55$) (Figure 2).

Discussion

Metatarsus primus varus has been described as the abnormal medial inclination of the first metatarsal relative to the medial cuneiform (Ewald 1912, Truslow 1925). Measurements reported by Bonney and Macnab (1952), Carr and Boyd (1968), Lapidus (1934),

Figure 2. Weight-bearing radiographs of a 55-year-old patient with painful hallux valgus.

Preoperative:
HV angle of 39°, MTPV of 23°,
I-IMT I/II of 19°, II-IMT I/II of 18°
and PMTI angle of 18°

9 months after operation:
HV angle of 11°, MTPV of 18°,
I-IMT I/II of 12°, II-IMT I/II of 9°
and PMTI angle of 13°

Piggott (1960), Harper (1989) assess a valgus displacement of the second ray rather than the varus deviation of the first (Houghton and Dickson 1979). Recent studies recommend that the relationships between the metatarsal and tarsal bones should be measured (Scott et al. 1991, Yasuhito et al. 1995).

Antrabus (1984), Austin and Leventen (1981) and Harper (1989) have reported correction of the varus by distal metatarsal osteotomy. In nonunion, delayed union and avascular necrosis of the metatarsal head the surgical procedures for distal metatarsal osteotomy should be different. Preserving (Jahss 1981, Mann and Coughlin 1981, Mann 1982, Horne et al. 1984) or performing lateral soft-tissue release (Resch et al. 1992, Peterson et al. 1994) results in different indications concerning more effective and acceptable limits of metatarsus primus varus (Corless 1976, Johnson et al. 1979).

However, in our patients, we clearly saw an improved alignment of the first ray after surgery. Considerable improvement in the II-intermetatarsal angle and correction of hallux valgus were achieved by displacing the capital fragment laterally and additionally with soft-tissue lateral release. This resulted in a moderate reduction in the metatarsus primus varus, the inclination angle of the first cuneiform and a lateral shift of the long axis of the first metatarsal.

A sufficient varus correction was achieved by distal metatarsal osteotomy and additional lateral soft-tissue releases. Our findings show that metatarsal division can be combined with an operation that does not appreciably alter the alignment of the long axis of the first metatarsal.

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