Triplanar distal osteotomy is a procedure for the correction of symptomatic mild-to-moderate hallux valgus deformity. It allows shortening and plantar displacement of the first metatarsal while correcting the intermetatarsal angle. However, complications such as dorsiflexion and excessive shortening of the first metatarsal have been associated with distal osteotomy. We describe a new device, designed by one of the authors (P.R.), that enables precise positioning of the Kirschner guide wire for the osteotomy cuts. (J Am Podiatr Med Assoc 99(6): 536-540, 2009)

**Technique**

A medial skin incision is made to expose the first metatarsophalangeal joint. A standard soft-tissue dissection, including a Y-shaped capsulotomy, is performed to gain adequate exposure. After a lateral release consisting of adductor tenotomy, lateral capsulotomy, and sesamoid detachment from the plantar part of the first metatarsal head, the medial prominence of the first metatarsal head is resected in line with the metatarsal shaft. A Kirschner guide wire is positioned in the distal-superior square of the metatarsal head with a new device composed of two elements (Fig. 1).

The main element consists of a dorsal component with a graduated scale that allows positioning of a secondary mobile element according to the planned shortening (Fig. 2). Therefore, the main element is composed of four medial components: two symmetrical scales to place the device in line with the first metatarsal declination angle, a handle, and an inferior slot that allows temporary fixation of the device to the metatarsal head.

The two elements are connected by a dorsal lock washer that controls the distal-proximal slide of the secondary element and by a dorsal central screw that from the study if the distal metatarsal articular angle was larger than 8°.
supplies provisional fixation of the device (Fig. 3). The amount of shortening of the first metatarsal is checked by the dorsal scale of the main element. The holes on the secondary mobile element are made at $5^\circ$ intervals (Fig. 4).

Before application of the device to the metatarsal head, the planned shortening must be set on the dorsal scale. The device is then attached parallel to the first metatarsal declination angle and is temporarily fixed with a Kirschner wire and by rotating the dorsal central screw counterclockwise (Figs. 5–7).

According to the amount of plantarflexion and shortening that had been planned, the Kirschner wire is positioned in the distal-superior square of the metatarsal head (Fig. 8). After device removal, a chevron osteotomy is performed by using an osteotomy guide inserted in the Kirschner guide wire. The capital fragment is displaced laterally, 5 to 6 mm. A Herbert screw, placed proximal-dorsal to distal-plantar, is used to provide internal fixation. Inclination of the Kirschner guide wire results in shortening and plantarflexion of the metatarsal (Fig. 9).

Beginning the day after surgery, partial weight-bearing walking is allowed with a postoperative shoe for 4 weeks. Range-of-motion exercises of the great toe are started on the first postoperative day and continue for 4 weeks. Four weeks after the operation, radiographs are obtained and walking with full weight-bearing is allowed if signs of bony consolidation are present.

Discussion

Triplanar distal bunionectomy allows plantarflexion of the capital fragment with lateral translation that also achieves shortening of the first metatarsal. The shortening improves the range of motion of the hallux, increasing the space of the first metatarsophalangeal joint. Complications have been associated with Austin-type chevron bunionectomy: hallux limitus, hallux rigidus, recurrent hallux valgus deformity, and excessive shortening of the first metatarsal with transfer metatarsalgia on the lesser metatarsals.4, 5
Dorsiflexion of the distal fragment may lead to transfer metatarsalgia. Conversely, first-ray metatarsalgia with cock-up deformity of the great toe and hallux limitus can occur with excessive plantar displacement of the first metatarsal head. Freehand osteotomy is more frequently subject to pitfalls such as avascular necrosis of the metatarsal head, dorsiflexion, and excessive shortening of the metatarsal, and it may not abide by preoperative planning. Surgeons beginning to master Austin-type bunionectomy and surgeons teaching surgical trainees should consider these complications.

A high degree of precision is clinically important in distal osteotomy for hallux valgus. Assistive devices are used in several techniques. The amount of lateral displacement of the first metatarsal head required for adequate correction of hallux valgus varies in individual patients. In most patients affected by mild hallux
valgus, lateral displacement of 3 to 5 mm is often considered sufficient for adequate correction. However, in patients affected by hallux valgus and hallux limitus, shortening and plantarflexing of the first metatarsal are necessary to increase the range of motion and restore hallux function to prevent transfer metatarsalgia. Displacement of 16 mm or greater causes excessive shortening of the first metatarsal relative to the second metatarsal, resulting in increased pressure beneath the second metatarsal head. Shortening must be coupled with plantarflexion of the capital fragment to avoid central metatarsalgia. Generally, with lateral displacement of 5 mm, shortening of 1 and 2.5 mm is obtained with positioning of the Kirschner wire at 10° and 30° of inclination, respectively. The inclination of the Kirschner wire, through the holes on the secondary mobile element, should be set at a minimum of 10° of plantarflexion to compensate for the shortening.

The device described herein may play an important role in reducing the learning curve for Austin-type osteotomies. We have performed triplanar distal osteotomy for hallux valgus with this device since 2006. In 26 patients affected by mild hallux valgus, the mean American Orthopaedic Foot and Ankle Society score improved from a preoperative value of 49.8 to 82.3 at 2-year follow-up. Radiologically, the hallux valgus angle improved from an average of 32° to 6.2°, and the first intermetatarsal angle improved from an average of 13.6° to 5.1°. No significant modifications were found in the distal metatarsal articular angle. Painful calluses under the second and third metatarsal heads were noted in two feet, and asymptomatic calluses were found in three feet. Two types of complications were observed: one case of hallux limitus and one case of recurrence. All of the complications were treated conservatively. Range of motion of the first metatarsophalangeal joint decreased from an average of 72° to 65°. There was no incidence of delayed healing or nonunion. Clinical and radiographic mid-term results are comparable with those of free-hand osteotomy performed by an expert surgeon and postoperative complications (Figs. 10 and 11). The device is not yet commercially available. We are conducting further studies to assess the reliability of the device.

Figure 8. After device removal, the Kirschner wire is placed in the distal-superior square.

Figure 9. A Herbert’s screw is placed proximal-dorsal to distal-plantar. Note the plantarflexion of the capital fragment (arrow).

Figure 10. Anteroposterior radiograph showing mild hallux valgus deformity.

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References

3. TOTH K, HUSZANYI I, KELLERMANN P, ET AL: The effect of

Figure 11. Immediate postoperative anteroposterior (A) and lateral (B) radiographs showing good correction of the deformity with plantar displacement of the metatarsal head. Two-year postoperative anteroposterior (C) and lateral (D) views showing good alignment of the first ray.