Hallux Valgus Surgery: The Minimally Invasive Bunion Correction (SERI)

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ABSTRACT

The main goal of hallux valgus surgery is the morphologic and functional rebalance of the first ray. Many techniques are reported to reach these goals, each with different indications depending on the pathoanatomy of the deformity requiring treatment. Many authors have reported their experience using various types of distal metatarsal osteotomies characterized by different indications, approaches, designs, and fixation. The authors present a minimally invasive technique, the characteristics of which can be summarized with the abbreviation SERI (simple, effective, rapid, inexpensive). The SERI technique is minimally invasive and has the same advantages of the percutaneous operation, but without the same disadvantages: no particular instrumentation is needed, and the operation is performed under direct vision and without fluoroscopy. Step-by-step surgical technique, perioperative management of the patient, and results of the first consecutive 54 feet are reported. Keywords: forefoot deformity, hallux valgus, bunion correction, minimally invasive surgery, metatarsal osteotomy

HISTORICAL PERSPECTIVE

The main goal of surgical correction of hallux valgus is the morphologic and functional rebalance of the first ray, correcting all other characteristics of the deformity.1 Historically, distal metatarsal osteotomies have been indicated in cases of mild or moderate deformity with an intermetatarsal angle as large as 15°. Using certain osteotomies, it is possible to correct intermetatarsal angles as large as 20°. Distal osteotomies may also be used to correct deformities characterized by deviation of the distal metatarsal articular angle (DMAA) or to address concomitant stiffness.2 Since the first operation published by Reverdin3 in 1881, many authors have reported their experience using different operations, each of them characterized by different indications, approaches, designs, and fixation.4-12 Several comparative studies have been reported comparing radiographic and clinical results among many different techniques, and a review of the literature reveals the satisfaction with all operations to be in the upper 80% level and higher.13,14 In 1983, New (personal communication) reported a percutaneous technique for hallux valgus correction. This technique was then reported by Bösch et al.,14 who perform a Hoffmann-type osteotomy fixed by only one K-wire, as described by Lamprecht and Kramer15 in 1982. These percutaneous operations reduce the surgical trauma because they are performed without large incisions and soft-tissue procedures. They need, on the other hand, the use of particular instrumentation, such as Lindemann's osteotrite, manipulators, or dislocators. Furthermore, with these percutaneous techniques, the correction is performed blindly, then the intraoperative use of fluoroscopy is needed. The minimally invasive bunion correction used by us, is not a new technique16 because it uses an osteotomy and a stabilization method already reported by others, making the surgical technique usable in accordance with current concepts in hallux valgus surgery. Our technique, in fact, consists of a linear distal osteotomy at the metatarsal neck level, as described by Hoffmann,4 Wilson,6 and Magek,9 which is performed through a small medial incision and is stabilized using only one
FIG. 1. Surgical technique. (A) The skin incision is approximately 1 cm in length. (B) The soft tissues are separated and diverged by two retractors that are 5 mm in width. (C) The metatarsal osteotomy is performed using a standard saw. (D) The insertion of the 2-mm K-wire in the soft tissue of the great toe along the long axis in a proximal to distal direction is shown. (E, F) The K-wire is retracted (E) up to the proximal end, reaching the osteotomy line (F).
FIG. 2. Surgical technique. (A) The grooved, small lever. (B, C) Correction of the deformity prizing the osteotomy and moving the metatarsal head as necessary. (D) The osteotomy is stabilized by inserting the K-wire into the diaphyseal channel in a distal to proximal direction. (E) The skin is sutured using one 3-0 reabsorbable stitch.

K-wire, as reported by Lamprecht and Kramer and Bösch et al., the characteristics of this technique can be summarized with the abbreviation SERI (simple, effective, rapid, inexpensive). This technique is simple and repeated easily, without removal of the eminence and without lateral release. It is minimally invasive and is performed under direct vision and without radiations. The technique is effective because, using different inclinations of the bone cut and different displacements of the head (lateral, dorsal, plantar, medial, tilt, or rotation), it is possible to correct the pathoanatomy of each deformity. The surgical time spent is approximately 5 minutes.
nally, the technique is inexpensive because no particular instrumentation is needed, the hardware is only one K-wire for stabilization, a short surgical time is spent, and less complications are reported.

- **INDICATIONS/CONTRAINDICATIONS**

The SERI technique is indicated to correct mild to moderate reducible deformity when the Hallux valgus angle is as large as 40° and the intermetatarsal angle is as large as 20°. The operation is indicated if the metatarsophalangeal joint is either incongruent or congruent, or with modification of the DMAA, and if mild degenerative arthritis is present. The technique is indicated even in cases of recurred deformity. Specific contraindications of the SERI technique are patients older than 75 years, severe deformity with the intermetatarsal angle more than 20°, severe degenerative arthritis or stiffness of the metatarsophalangeal joint, and severe instability of the cuneometatarsal or metatarsophalangeal joint.

- **PREOPERATIVE PLANNING**

The preoperative plan includes acquiring a complete history of the patient, and a physical and radiographic ex-
amination. The patient's complaints of pain, limitation in the use of footwear, and cosmetic concerns should be considered. Moreover, the severity of the prominent medial eminence and the hallux valgus deformity, as well as the great toe mobility at the metatarsophalangeal joint and the reducibility of the deformity should be evaluated. The latter is tested by pushing laterally the metatarsal head with one hand, and simultaneously the great toe medially with the other hand. Stability of the metatarsophalangeal and cuneometatarsal joints must be assessed. Combined rotational deformity of the great toe or calllosities under the first or second and third metatarsal heads must be considered, as well as any associated deformities of the lesser toes.

A standard radiographic examination, including anteroposterior and lateral weight-bearing views of the forefoot, allows the assessment of the arthritis and congruency of the joint; measurement of the hallux valgus angle, intermetatarsal angle, DMAA, and metatarsal- and the digital formula. Therefore, planning of the operation is performed in terms of the obliquity of the bone cut, the extent of the medial-lateral or dorsal-planter dislocation of the metatarsal head, and the correction of the DMAA.

■ TECHNIQUE

Before surgery the patient's foot or feet are scrubbed using disinfectant soap. The operation is usually performed using local or block anesthesia and ropivacaine hydrochloride monohydrate 7.5 mg. An Esmarch bandage is used at the ankle level. The patient is placed in the supine position. The foot is kept externally rotated and the lateral edge is placed on the operating table. Normally with this technique, soft-tissue release is not needed because attenuation is achieved with the lateral offset of the metatarsal head itself. If a slight stiffness of the metatarsophalangeal joint is present, manual stretching of the adductor hallucis is performed, forcing the big toe into a varus position.

A 1-cm medial incision is made just proximal to the medial eminence through the skin, subcutaneous tissue, and down to the bone (Fig. 1A). The soft tissues are separated dorsally and plantarly, and they are disarticulated using two retractors that are 5 mm in width (Fig. 1B). The medial wall of the metatarsal neck is now evident, and a complete osteotomy is performed using a standard pneumatic saw with a 9.5 x 25 x 0.4-mm blade (Hall Surgical Linvatec Corporation, Largo, FL, U.S.A.; Fig. 1C). With a small osteotome, the head is mobilized. A 2-mm K-wire is inserted, using a normal drill passing through the incision, into the soft tissue adjacent to the bone in a proximal to distal direction along the longitudinal axis of the great toe (Fig. 1D). The K-wire exits at

FIG. 4. (A–C) Outline showing the different inclination of the bone cut and dislocation of the metatarsal head allowed by this technique in a medial-lateral direction perpendicular (A) to the long axis of the second metatarsal bone (foot longitudinal axis), inclined proximally (B), and inclined distally (C).
the medial area of the tip of the toe close to the nail, is retaken by the drill (Fig. 1E), and is retracted up to the proximal end, reaching the osteotomy line (Fig. 1F). Using a small, grooved lever (Fig. 2A) to prize the osteotomy, the correction is obtained by moving the metatarsal head depending on the pathoanatomy of the deformity (Figs. 2B, C). Stabilization of the correction is obtained by inserting the K-wire into the diaphyseal channel in a distal to proximal direction until its proximal end reaches the metatarsal base (Fig. 2D). A slight varus position

FIG. 6. Illustrative case. (A, B) Hallux valgus deformity combined with first metatarsal overloading. (C, D) The postoperative radiographs in which the combined dorsal and lateral dislocation of the metatarsal head is evident.
FIG. 7. Outline showing the derotation of the metatarsal head to assess the pronation of the metatarsal bone if present.

(approximately 10°) of the toe is necessary and is obtained by forcing the toe after K-wire stabilization. If the proximal stump of the osteotomy is prominent medially, a small wedge of bone is removed. The skin is sutured with one 3-0 reabsorbable stitch (Fig. 2E). The distal extremity of the K-wire is curved and cut out of the tip of the toe (Fig. 3). This technique can be performed bilaterally or combined with the correction of any other associated deformity of the forefoot or hindfoot during the same surgical session. The key points of the technique are the inclinations of the osteotomy in the medial-lateral and dorsal-planter direction, the displacement of the head in the medial-lateral and dorsal-planter directions, and the rotation of the metatarsal head and its medial tilt according to the correction of the DMAA. The inclination of the osteotomy in the medial-lateral direction is perpendicular to the foot axis (i.e., to the long axis of the second metatarsal bone) if the length of the first metatarsal bone must be maintained (Fig. 4A). The osteotomy is inclined in a distal to proximal direction up to 25° if shortening of the metatarsal bone or decompression of the metatarsophalangeal joint is necessary in case of mild arthritis (Fig. 4B). More rarely, if a lengthening of the first metatarsal bone is necessary (i.e., if the first metatarsal bone is shorter than the second or if laxity of the metatarsophalangeal joint is present), the osteotomy is inclined in a proximal to distal direction as much as 15° (Fig. 4C). In a dorsal-planter direction, the osteotomy is normally inclined approximately 15° in a distal to proximal direction to control the dorsal dislocation of the metatarsal head under weight bearing (Fig. 5). The adjustment of the medial-lateral dislocation of the metatarsal head is performed by introducing the K-wire more or less superficially with regard to the medial eminence. The adjustment of the plantar dislocation of the metatarsal head, more rarely of the dorsal dislocation, is obtained introducing the K-wire in the upper (Fig. 5A) or more rarely in the lower (Fig. 5B) site, with regard to the long axis of the metatarsal head (Fig. 6). If shortening of the metatarsal bone is needed, normally it is necessary to dislocate the metatarsal head in the plantar direction by several millimeters according to the extent of the shortening performed.

If pronation of the first metatarsal bone is present, the correction is obtained with a derotation of the big toe up to the neutral position (Fig. 7). To correct the DMAA, the K-wire is introduced into the soft tissue obliquely in a medial to lateral direction by as many degrees as necessary to obtain the correction (Fig. 8).

■ RESULTS

Results regarding our first consecutive 54 feet in 37 patients (17 bilateral; 34 female patients, 3 male patients; mean age, 48 years; range, 10–70 years) are reported with a mean follow-up of 36 months (range, 22–52 months). The clinical evaluation was carried out postoperatively using the American Orthopaedic Foot and Ankle Society score. The radiographic evaluation preoperatively and postoperatively was carried out considering the hallux valgus angle, intermetatarsal angle, and DMAA measurements. All patients except four (7.4%)
declared their satisfaction with the result. Postoperatively the mean score obtained was 81 points: 35 feet (64.8%) were considered excellent, 10 (18.5%) were good, 5 (9.2%) were fair, and 4 (7.4%) were considered poor. All the osteotomies healed well, with callus evidence after an average of 3 months. All the metatarsal bones remodeled themselves over time (Fig. 9), even in cases with marked offset at the osteotomy (several millimeters of bony contact). In our experience, the healing of the osteotomy and remodeling capability of the metatarsal bone are not related to the offset at the osteotomy, but it is preferable to obtain a bony contact not less than one-third of the metatarsal section.

### COMPLICATIONS

No severe complications, such as avascular necrosis of the metatarsal head or nonunion of the osteotomy, have been reported. In 5 feet (9.2%) the radiographic healing of the osteotomy occurred more than 4 months after surgery. Three feet (5.5%) underwent a skin inflammatory reaction around the K-wire outlet at the tip of the great toe and one patient sustained a deep vein thrombosis. All fair and poor results are the result of an incorrect indication, such as severe arthritis, or incorrect surgical technique with an incomplete correction. Transfer metatarsalgia with plantar callosities under the second and third
metatarsal heads are reported in the 4 feet (7.4%) considered poor.

- POSTOPERATIVE MANAGEMENT

After the operation a gauze compression dressing is applied and a control radiograph (anteroposterior and oblique views) is acquired to confirm the placement of the osteotomy and the correction of any characteristic of the deformity. Ambulation is allowed immediately using "talus" shoes, and foot elevation is advised when the patient is at rest. K-wire fixation resulting from wire bending on insertion produces a very stable and elastic stabilization, maintaining the same position obtained during surgery, and favoring early healing of the osteotomy combined with early weight bearing (Fig. 10). After 1 month the dressing, the suture, and the K-wire are removed. Passive and active exercises such as cycling and swimming are advised, and the same is mandated wearing comfortable, normal shoes, and gradually returning to former footwear. As a general rule, postoperative swelling does not linger for more than 1 month.

- POSSIBLE CONCERNS, FUTURE OF THE TECHNIQUE

This minimally invasive technique enables surgeons to treat approximately 80 to 90% of all hallux valgus deformities without removal of the eminence and without open lateral release, performing only a manipulation of the big toe, with more than 90% excellent and good results after the learning curve. As with any other technique, during bunion correction the main concern is the ability to perform precisely and surgically what has been planned preoperatively. To facilitate this we developed software that, beginning with a scanned, standard weight-bearing anteroposterior view, we are able to simulate the correction needed, considering any anatomic variables of each patient. The software is able to state the precise amount of the bone cut inclination and the dislocation of the metatarsal head (Fig. 11).

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- REFERENCES


