Percutaneous Distal Metatarsal Osteotomy for Correction of Hallux Valgus

Surgical Technique

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ABSTRACT

BACKGROUND:

Distal osteotomy of the first metatarsal is indicated for the surgical treatment of mild-to-moderate hallux valgus deformity. The aim of this study was to evaluate the results of a subcapital distal osteotomy of the first metatarsal with use of a percutaneous technique.

METHODS:

From 1996 to 2001, 118 consecutive percutaneous distal osteotomies of the first metatarsal were performed for the treatment of painful mild-to-moderate hallux valgus in eighty-two patients. The patients were assessed with a clinical and radiographic protocol at a mean of 35.9 months

continued

INTRODUCTION

The indication for surgical correction of hallux valgus is pain associated with deformity.

A distal osteotomy of the first metatarsal[1-10] can be used to achieve correction in mild-to-moderate hallux valgus with a first intermetatarsal angle[10] of 10° to 20°[3,5-7].

A linear osteotomy can be performed with use of a minimally invasive percutaneous approach[2,11-16], provided that technically correct execution is ensured and secure stabilization of the osteotomy site is achieved.

The potential advantages of a minimally invasive percutaneous approach are a reduction in operating time and surgical dissection, the possibility of performing the procedure bilaterally with fewer complications, the use of distal ankle-block anesthetic techniques, and early weight-bearing.

SURGICAL TECHNIQUE

The patient is placed in the supine position, with a below-the-knee wedge bracket allowing 90° of knee flexion and a plantigrade position of the foot on the operating table (Fig. 1). The operation is performed with ankle block anesthesia. The fluoroscopic image intensifier must be positioned to the side of the patient while the surgeon stands in front of the patient at the end of the table.

ABSTRACT | continued

postoperatively. The American Orthopaedic Foot and Ankle Society (AOFAS) hallux-metatarsophalangeal-interphalangeal scale was used for the clinical assessment.

RESULTS:

The patients were satisfied following 107 (91%) of the 118 procedures. The mean score on the AOFAS scale was 88.2 ± 12.9 points. The postoperative radiographic assessments showed a significant change ($p < 0.05$), compared with the preoperative values, in the mean hallux valgus angle, first intermetatarsal angle, distal metatarsal articular angle, and sesamoid position. The valgus deformity recurred after three procedures (2.5%), the first metatarsophalangeal joint was stiff but not painful after eight (6.8%), and a deep infection developed after one (0.8%). The infection resolved with antibiotic therapy.

CONCLUSIONS:

The percutaneous technique proved to be reliable for the correct execution of a distal linear osteotomy of the first metatarsal for the correction of a painful mild-to-moderate hallux valgus deformity. The clinical results appear to be comparable with those obtainable with traditional open techniques, with the additional advantages of a minimally invasive procedure, a substantially shorter operating time, and a reduced risk of complications related to surgical exposure.

FIG. 1

The position of the patient during the operation.

Step 1: Wire insertion. A 2-mm-diameter Kirschner wire is inserted, starting from the medial corner of the nail of the great toe (Figs. 2-A and 2-B). It is mandatory to place the wire in an extraperiosteal position in order to allow the lateral displacement of the capital fragment at the osteotomy site, and the wire must be midway between the dorsal and plantar aspects of the great toe in order to engage the metatarsal head correctly (Fig. 3). In this way, the hallux "guides the correction." This represents one of the most important biomechanical aspects of the technique.

The metatarsal head should be engaged more dorsally, if it is to be translated plantarly, or plantarly, if it is to be translated dorsally. Plantar translation is done more often.

Step 2: Skin incision. Almost 1 cm proximal to the end of the wire (which must not penetrate the skin), a 3 to 5-mm skin incision is made (Fig. 4). The incision is carried directly to the bone, cutting the periosteum, with care being taken to remain in the midline equally between the dorsal and plantar aspects of the metatarsal neck in order to avoid the neurovascular bundle.

Step 3: Periosteal detachment. Next, the periosteum around the osteotomy site is detached dorsally and then plantarly, with use of small scissors inserted through the skin incision (Figs. 5-A and 5-B). In this way, the soft tissues surrounding the metatarsal shaft can be kept away from the bone-cutter.

FIG. 2-A

Kirschner wire insertion starts from the medial corner of the nail of the great toe.

CRITICAL CONCEPTS

INDICATIONS:

- Painful primary mild-to-moderate hallux valgus deformity with a first intermetatarsal angle of 10° to 20° and a hallux valgus angle of ≤40° (Figs. 16-A, 16-B, and 16-C)
- Juvenile hallux valgus deformity with an increased distal metatarsal articular angle

CONTRAINDICATIONS:

- Severe degenerative changes of the first metatarsophalangeal joint (hallux rigidus)
- A previous Keller procedure

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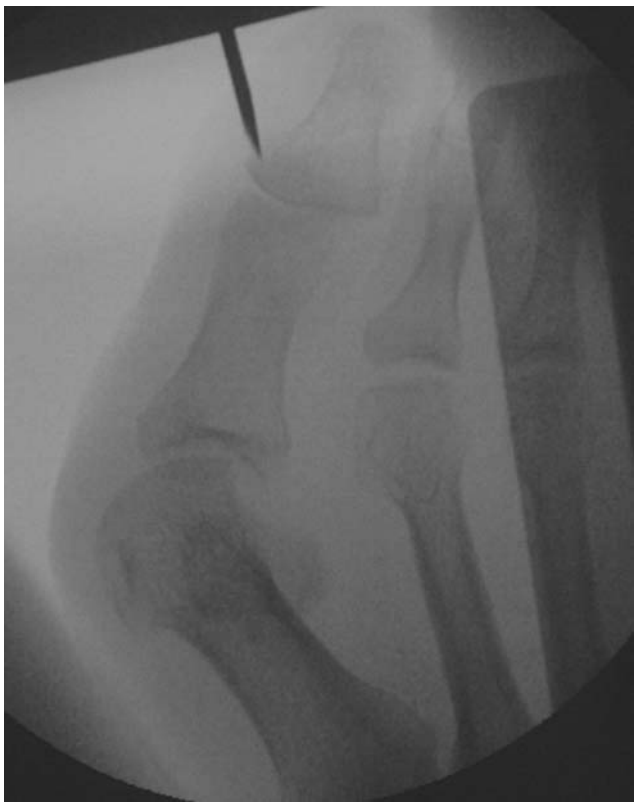

FIG. 2-B

This position is confirmed under fluoroscopy.

CRITICAL CONCEPTS | continued

PITFALLS:

The percutaneous procedure must be strictly followed step by step, avoiding any modifications, at least during the learning curve, in order to prevent complications. This rule includes both the surgical steps as well as the postoperative care.

Step 1: Wire insertion. Insertion at the distal corner of the nail must be avoided in order to prevent skin slough while the Kirschner wire is in position. The medial aspect of the metatarsal head must be firmly engaged to avoid losing contact, which can result in uncontrolled displacement of the capital fragment.

Step 5: Correction. Because of the quite effective action of the grooved instrument, care must be taken to displace the capital fragment gradually in order to avoid having the capital fragment fall off laterally into the intermetatarsal space. If this occurs, it can be easily resolved by manually repositioning the metatarsal head on the top of the diaphyseal fragment.

Achieving slight overcorrection is advisable to allow early removal of the Kirschner wire. No varus deformity has been observed in our clinical experience, probably because of the fact that a lateral release is never performed. Moreover, maintaining the integrity of the soft tissues laterally may be of some utility, in order to avoid tilting the metatarsal head.

continued

FIG. 3

The extraperiosteal position of the Kirschner wire centered between the dorsal and plantar aspects of the metatarsal head.

FIG. 4

The skin incision.

Step 4: Osteotomy. The osteotomy is then performed through the subcapital region of the first metatarsal with a 2.33-mm-diameter micromotorized Lindemann bone-cutter (Aesculap, Tuttlingen, Germany). The level of the cut is first checked under fluoroscopy (Fig. 6-A). The osteotomy is made perpendicular to the long axis of the shaft of the first metatarsal in the sagittal plane. In the frontal plane, the osteotomy should be performed with slight mediolateral obliquity to facilitate lengthening or shortening as dictated by the preoperative plan. Taking into account the fact that the burr removes about 2 to 3 mm of bone, a slight inclination is recommended. Irrigation of the burr during the osteotomy is advisable in order

CRITICAL CONCEPTS | continued

Step 6: Stabilization. Inadequate fixation of the osteotomy is avoided by driving the Kirschner wire into the base of the first metatarsal. Violation of the metatarsocuneiform joint with the Kirschner wire can be accepted without the risk of adverse events.

continued

FIG. 5-A

Figs. 5-A and 5-B The periosteum is detached around the osteotomy site with use of small scissors.

FIG. 5-B

FIG. 6-A FIG. 6-B

Figs. 6-A and 6-B The osteotomy is performed with use of a micromotorized Lindemann bone-cutter. **Fig. 6-A** The level of the cut is checked under fluoroscopy. **Fig. 6-B** The osteotomy is performed with use of a corticotomy technique from within the medullary canal.

to avoid skin damage or wound breakdown.

In order to avoid damage by the bone-cutter to the surrounding structures, the osteotomy is performed by drilling the medial cortex first and then the lateral cortex (Fig. 6-B), keeping the bone-cutter in the same medial entry hole and its tip inside the medullary canal of the first metatarsal. Multiple holes are then drilled circumferentially to complete the cut with use of a corticotomy technique.

Following the osteotomy, it is advisable to check the osteotomy site manually and radiographically to confirm that it is complete and that the metatarsal head can be mobilized.

Step 5: Correction. The curved end of the specially designed grooved instrument (Tecres, Verona, Italy) is then introduced into the diaphysis of the first metatarsal (Figs. 7-A and 7-B), and the Kirschner wire is advanced manually until it is possible to observe the tip of the wire in the groove of the instrument (Fig. 8).

Correction of the alignment of the first metatarsopha-

FIG. 7-A

Figs. 7-A and 7-B The curved end of the grooved instrument is introduced into the diaphysis of the first metatarsal.

FIG. 7-B

FIG. 8

The Kirschner wire is pushed into the groove in the device.

FIG. 9-A **FIG. 9-B**

Fig. 9-A Correction is performed through lateral displacement of the metatarsal head. **Fig. 9-B** The realignment is stabilized by the insertion of the Kirschner wire from distal to proximal into the medullary canal of the first metatarsal.

FIG. 9-C

The correction achieved is confirmed radiographically.

langeal joint is then obtained by levering the grooved instrument distally (Fig. 9-A) in order to displace the metatarsal head segment laterally while the surgeon's hand with the wire (and the hallux) tilts the metatarsal head (Fig. 9-B). The correction achieved should be checked under fluoroscopic guidance (Fig. 9-C).

The correction is usually satisfactory when contact between the medial aspect of the metatarsal head and the lateral cortex of the metatarsal neck is achieved in the frontal plane. Slight overcorrection is advisable.

Step 6: Stabilization. The osteotomy is stabilized by driving the Kirschner wire with a hammer from distal to proximal into the medullary canal of the first metatarsal; the Kirschner wire must be driven as far as the base of the first metatarsal in order to secure stability (Fig. 10). No associated soft-tissue procedures are performed. In particular, lateral release with dissection of the soft tissues is never done.

Step 7: Final adjustments. After careful re-

FIG. 10

The Kirschner wire is driven firmly as far as the base of the first metatarsal in order to improve stabilization.

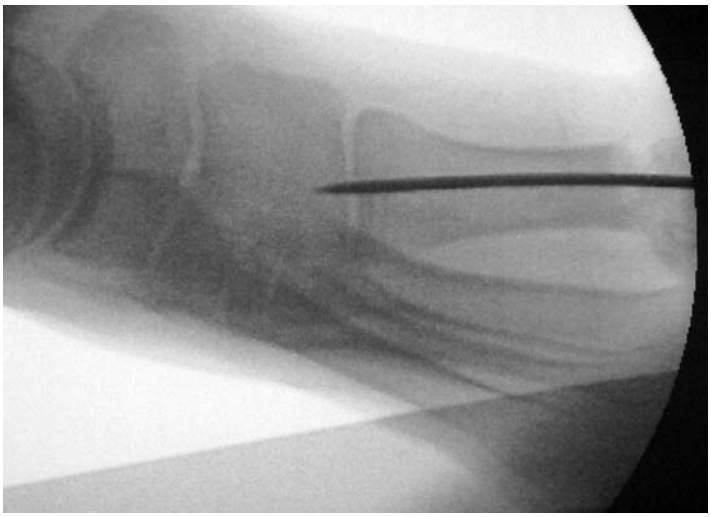

FIG. 11

Lateral fluoroscopic view showing the position of the Kirschner wire.

FIG. 12

Release of the soft tissue at the level of the skin incision.

FIG. 13

The tip of the Kirschner wire is bent before cutting.

FIG. 14

A single suture is used to close the wound.

FIG. 15-A

Figs. 15-A and 15-B Postoperative taping. **Fig. 15-A** The dressing is maintained for six weeks and is changed weekly.

CRITICAL CONCEPTS | continued

AUTHOR UPDATE:

The surgical technique has not been modified by the authors since it was published in the original article.

More recently, we have used the percutaneous technique in the treatment of recurrent hallux valgus deformities and in association with surgery for related deformities of the lesser toes. The results of these procedures are presently being evaluated.

moval of the grooved instrument, a lateral fluoroscopic image is used to check on the position of the Kirschner wire (Fig. 11). The soft tissue at the level of the skin incision is released (Fig. 12). The Kirschner wire is bent before cutting so that it can be used for postoperative anchorage of the tape

FIG. 15-B

The taping includes the use of a plantar kidney-shaped pad, in order to reduce the local weight-bearing pressure beneath the capital fragment, to prevent dorsiflexion of the capital fragment.

FIG. 16-A

Figs. 16-A, 16-B, and 16-C The left foot of a fifty-two-year-old patient who had a percutaneous distal osteotomy of the first metatarsal for a moderate hallux valgus deformity. **Fig. 16-A** Preoperative weight-bearing anteroposterior radiograph.

(Fig. 13). One suture is used to close the wound (Fig. 14).

Postoperative care: The great toe is taped in situ for six weeks, with the tape replaced every week (Fig. 15-A). It is used with a plantar kidney-shaped pad, with its concavity surrounding the plantar aspect of the head of the first metatarsal (Fig. 15-B) in order to reduce the local weight-bearing pressure beneath the capital fragment and prevent dorsiflexion of the capital fragment. The taping should maintain a slight hypercorrection of the hallux in order to counter recurrence of deformity.

Patients are allowed to walk on the day after surgery with the use of a postoperative shoe with a flat rigid sole. After the tape is removed at six weeks, patients are encouraged to exercise the first metatarsophalangeal joint, taking particular care to obtain full dorsiflexion within four to six weeks.

FIG. 16-B

Immediate postoperative anteroposterior radiograph.

FIG. 16-C

Anteroposterior weight-bearing radiograph, made six months after surgery, demonstrating complete healing of the osteotomy site and correction of the alignment of the hallux.

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