

The Ludloff Osteotomy

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ABSTRACT

The Ludloff osteotomy originally presented in 1918 was abandoned for many years because of its instability. A modification by Mark Myerson led to a reappearance of this technique. Most recent clinical studies as well as biomechanical studies have shown that this technique is a reliable solution for moderate to severe hallux valgus deformities. In this article we describe our experience with and technical tips for this technique.

Keywords: hallux valgus, proximal metatarsal osteotomy, Ludloff, forefoot reconstruction

HISTORICAL PERSPECTIVE

More than 130 surgical procedures for the correction of hallux valgus have been described.¹ From a mechanical standpoint, a proximal metatarsal osteotomy^{2,3} can achieve a greater degree of correction and is therefore recommended for more severe hallux valgus deformities. Various techniques have been described over the last century. In 1918, Ludloff⁴ described an oblique osteotomy of the first metatarsal from dorsoproximal to distal-plantar. He originally shortened the metatarsal without internal fixation. Because of its unpredictable results without internal fixation, this technique has not been used for many years. But using the same plane of osteotomy, with internal fixation and rotation of the dorsal fragment, this procedure has gained a new dimension for its use in the treatment of metatarsus primus varus. Myerson modified the original technique and presented his first preliminary results in 1997.⁵

The technique has been biomechanically and mathematically investigated by Nyska, Trnka, Parks, and Myerson.^{6–9} The conclusion of the authors was that the Ludloff osteotomy is not the most stable, nor does it achieve the best correction of proximal metatarsal osteotomies. It is the authors' opinion, however, that with all parameters

taken into account, it offers on average the best correction with a satisfactory correction.

INDICATIONS AND CONTRAINDICATIONS

The indication for the Ludloff osteotomy is a hallux valgus deformity with an intermetatarsal 1–2 angle of more than 15 degrees. Contraindications are a narrow metatarsal so that adequate rotation of the dorsal fragment is not possible, first metatarsophalangeal (MTP) arthritis with intraarticular pain, major first tarsometatarsal instability, and severe osteoporosis. A relative contraindication is patient age 60 years and older, depending on the bone quality. In these patients the bone quality is in general too poor for this type of osteotomy.

PREOPERATIVE PLANNING

Standard weight-bearing anteroposterior and lateral radiographs are mandatory. The hallux valgus (HV) and intermetatarsal (IM) angles, tibial sesamoid position, and the length of first and second metatarsals are measured according to the guidelines of the American Orthopaedic Foot and Ankle Society.¹⁰ Clinical examination includes measurement of active and passive range of motion of the first MTP joint as well as inspection of the foot for plantar callus formation indicative of transfer metatarsalgia and stability of the first TMT joint.

TECHNIQUE

The procedure is generally performed under peripheral nerve blockade with tourniquet hemostasis control. In general we perform the procedure without an Esmarch tourniquet, which we think may reduce the postoperative swelling.

A dorsal incision over the first web space is made for the lateral soft tissue release, and a medial incision is made in the medial midline over the first metatarsophalangeal joint from midshaft of the proximal phalanx to the base of the first metatarsal.

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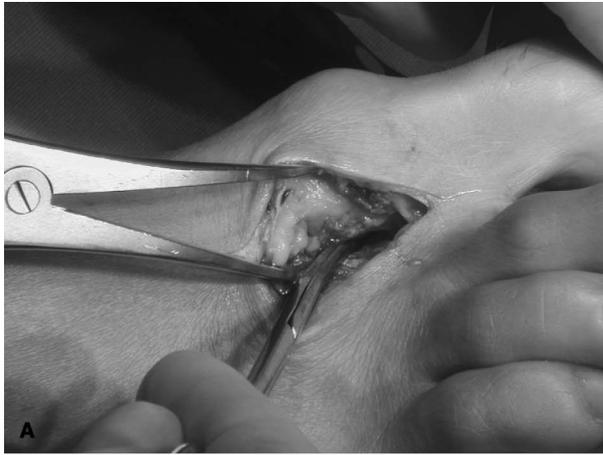


FIGURE 1. Release of the metatarso-sesamoid ligament.

Lateral Capsular Release

Then the lateral joint capsule (metatarso-sesamoid ligament) is incised horizontally just superior to the lateral sesamoid (Fig. 1). The lateral capsule is perforated at the first MTP joint line, and the great toe is forced



FIGURE 2. The great toe is brought into 20 degrees varus to demonstrate the release of the lateral structures.



FIGURE 3. Medial skin incision for the osteotomy.

manually into about a 20-degree varus position (Fig. 2). Usually it is not necessary to release the adductor tendon or the intermetatarsal ligament. One suture is placed through the lateral aspect of the first metatarsal and the medial periosteum of the second metatarsal. This suture is tied after the osteotomy is completed.

Medial Approach

The leg is now externally rotated. A second skin incision is made at the medial aspect of the first MTP joint

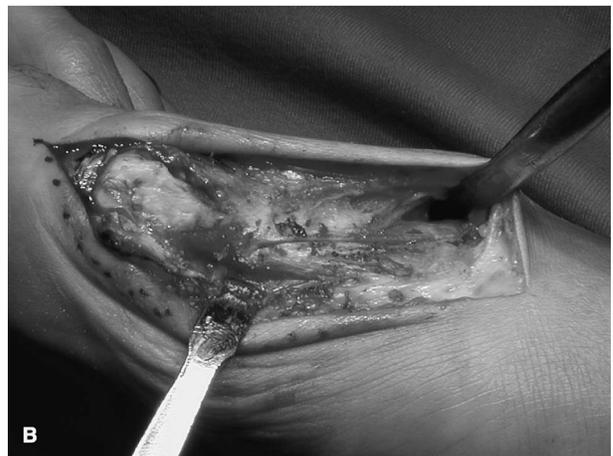
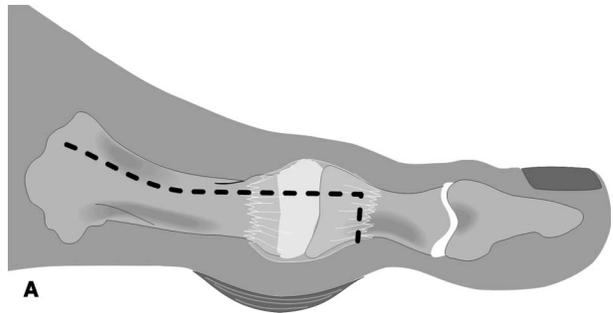


FIGURE 4. Exposure of the metatarsal.

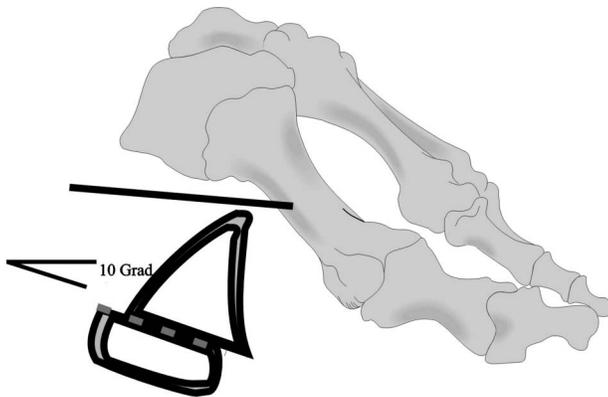


FIGURE 5. The osteotomy should be inclined 10 degrees from medial to lateral.

(Fig. 3). This incision is extended proximally in a slightly curved manner to the first metatarsocuneiform joint. The medial MTP joint capsule is opened with an inverted L-type incision. The joint is inspected for degenerative changes.

The metatarsal shaft is now exposed, and a Hohmann retractor is placed dorsoproximal and distal-plantar (Fig. 4). The distal plantar Hohmann retractor protects

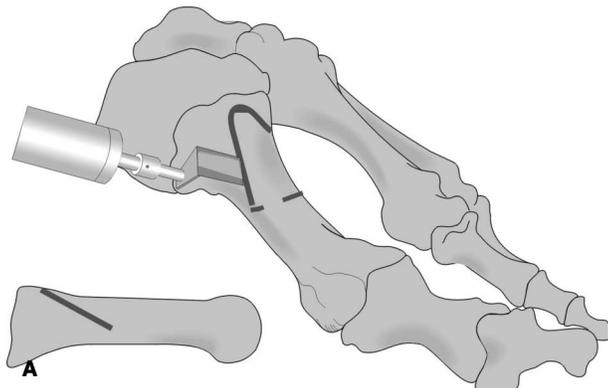


FIGURE 6. Dorsal two-thirds of the osteotomy is carried out.

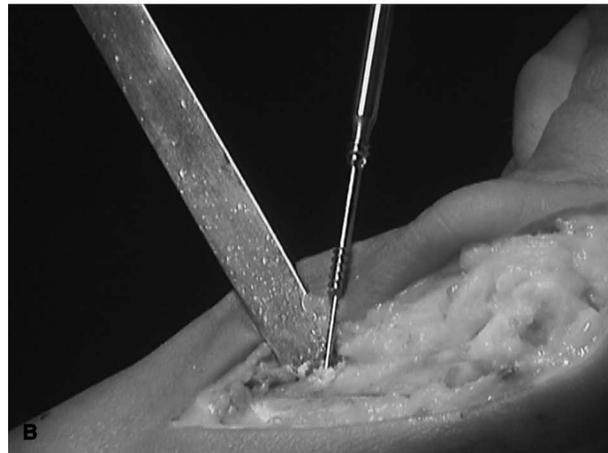
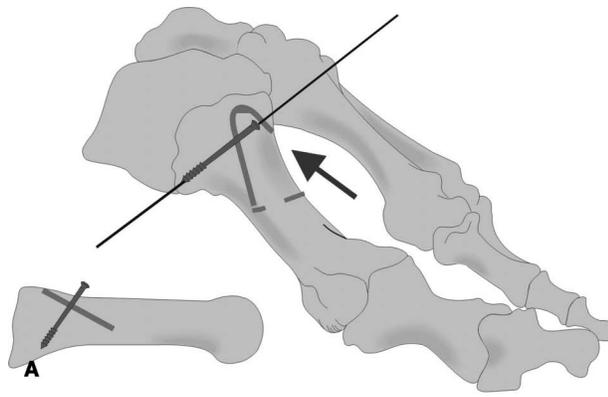


FIGURE 7. Insertion of the proximal screw.

the plantar artery to the metatarsal head, and the dorso-proximal retractor protects the extensor hallucis longus tendon and the interosseus branch of the dorsal pedis artery.

An oblique osteotomy is then made at the first metatarsal from dorsal at the level of the metatarsocuneiform joint, aiming distal, ending proximal to the sesamoid apparatus. The osteotomy is inclined 10 degrees from medially to laterally (Fig. 5). The dorsal two-thirds of the osteotomy is carried out first (Fig. 6).

A guide wire for a cannulated screw (3.0 Synthes or BOLD [New Deal]) is then inserted at the proximal end of the dorsal fragment perpendicular to the osteotomy. A 3.0-mm cortical screw (Synthes) is then inserted without total closing of the osteotomy (Fig. 7). The osteotomy is then finished distally (Fig. 8). With a towel clip, the plantar fragment is pulled medially, and the dorsal fragment is rotated laterally with the push of the thumb (Fig. 9). After the desired correction is achieved, the dorsal screw is tightened, and a BOLD (New Deal) screw is inserted from plantar to dorsal at the distal aspect of the osteotomy (Fig. 10). If instability is noted macroscopically, a third screw with bicortical fit should be placed from dorsal to plantar. Then the medial eminence is excised in line with

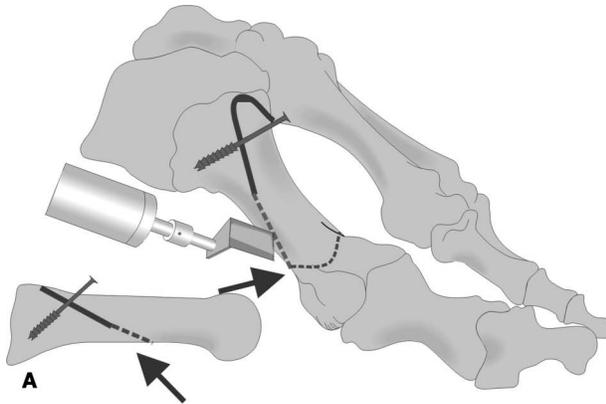


FIGURE 8. Osteotomy of the plantar one-third.

the metatarsal shaft, with care taken not to excise too much bone from the metatarsal head.

Attention is now directed toward the medial capsule, and a wedge of about 5 mm is removed from the short arm of the L-type capsular incision. As an assistant holds the great toe in a slightly overcorrected position, the medial joint capsule is repaired with U-type sutures, and the first web space sutures are tightened.

■ COMPLICATIONS

Complications seen with the Ludloff osteotomy include delayed bone healing (mainly seen in elderly patients) and hallux varus deformity fracture.

■ POSTOPERATIVE MANAGEMENT

Starting immediately postoperatively, ice application to the foot is helpful to reduce swelling. Provided that the bone quality was intraoperatively sufficient, patients are allowed to walk with a postsurgical orthowedge-type shoe on the same day, limited for 6 weeks. If the bone quality was not sufficient, the patients are put in an

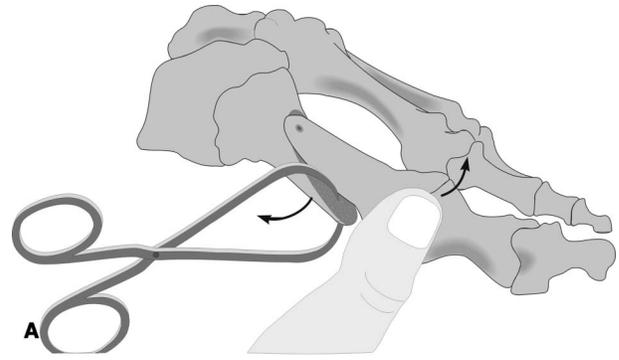


FIGURE 9. Rotation of the dorsal fragment around the proximal screw.

Aircast Walker or a short leg cast. Weekly changes of the tape dressing are necessary. Radiographs are taken intraoperatively and at 6-week follow-up. After radiographic union is achieved, normal dress shoes with a more rigid sole are allowed.



FIGURE 10. Insertion of the plantar screw.



FIGURE 11. (A) A 49-year-old man before surgery. (B) The same patient 2 years after surgery.

■ RESULTS

Trnka et al¹¹ reported in 2003 a series of 76 Ludloff osteotomies operated between September 1998 and October 1999. Patients were followed up clinically and radiographically for 36 (24 to 56) months. The mean hallux valgus angle was reduced from 37 degrees to 14 degrees, and the mean intermetatarsal angle I–II from 18 degrees to 9 degrees. On a 4-point scale, 81% of the patients were satisfied or very satisfied with the result of the operation, and 95% of them felt no or very mild pain (Fig. 11).

Chiodo and Myerson¹² presented their results on 82 consecutive Ludloff cases. Follow-up was possible in 70 cases (85%) at an average of 30 months (range 18 to 42 months). Preoperatively, the mean hallux valgus and first intermetatarsal angles were 31 degrees and 16 degrees, respectively. Postoperatively, these values improved to an average of 11 degrees and 7 degrees. In the sagittal plane, the first metatarsal was plantarflexed by an average of 1 mm, and there were no symptomatic transfer lesions of the second metatarsal. The mean AOFAS hallux score improved from 54 to 91 points. They noted an average first metatarsal shortening of 2.3 mm. Complications included prominent hardware requiring removal,⁵ hallux varus,⁴ delayed union,³ superficial infection,³ and neuralgia.³

Saxena¹³ presented in 1997 a series of Ludloff osteotomies with a reduction of the intermetatarsal angle of 6.5 degrees, the hallux valgus angle of 16.7 degrees, and an average shortening of 1.4 cm.

■ CONCLUSION

The Ludloff osteotomy⁴ was abandoned for many years because of its lack of stable fixation. Cisar¹⁴ in 1983

presented the Ludloff osteotomy with internal fixation. He still performed the osteotomy first and then fixed it by 2 AO screws. Because of the unstable situation during the correction, shortening of the first metatarsal was quite likely. Mark Myerson, unaware of Cisar's German publication, was also fascinated by the geometry and the rotational correction of the osteotomy. He modified the old technique with a modern osteosynthesis⁵ and presented his first experience in 1997. In his modification the proximal screw is inserted before the osteotomy is finished at the plantar cortex. The rotation of the dorsal fragment is performed around the proximal screw. Extensive shortening, besides the geometric shortening from the rotation, is therefore not possible.

It is a reproducible technique for moderate to severe hallux valgus deformities.

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