Acta Orthop. Belg., 2011, **77**, 516-521

ORIGINAL STUDY

Percutaneous double metatarsal osteotomy for correction of severe hallux valgus deformity

Christophe De Lavigne, Quentin Rasmont, Bao Hoang

From the Centre de Chirurgie Orthopédique et Sportive, Bordeaux, France

Double osteotomy of the first metatarsal is an option in treatment of severe hallux valgus deformity. Good short-term results have been reported with percutaneous surgery in hallux valgus with moderate deformity. We report short-term results with percutaneous double osteotomy of the first metatarsal in severe deformities.

This is a prospective study of 6 patients with severe hallux valgus deformity who were treated with percutaneous double osteotomy of the first metatarsal (proximal closing wedge and distal chevron osteotomy) in 2008. They were assessed preoperatively and one year and two years after surgery, with clinical and radiological AOFAS MTP-IP score.

All patients were satisfied. The AOFAS score improved from 34 to 84. The postoperative radiological assessment showed significant improvement, compared with preoperative values of the intermetatarsal and hallux valgus angles. No complications were encountered. Post-operative stiffness of the first MT joint was observed but resolved after physiotherapy.

This preliminary study showed that correction of severe hallux valgus deformity by percutaneous double osteotomy can achieve good clinical and radiological results.

A larger number of cases with a longer follow-up is needed to firmly demonstrate the advantages of this technique compared with classical open surgical techniques in the treatment of severe hallux valgus deformities.

Keywords : severe hallux valgus ; percutaneous ; double osteotomy ; bipolar first metatarsal osteotomy.

INTRODUCTION

A number of bony and soft-tissue procedures have been used to treat symptomatic hallux valgus. Most hallux valgus deformities are currently treated by chevron and scarf osteotomies. For severe hallux valgus deformity (M1-P1 angle > 40°, intermetatarsal angle > 18°), an additional proximal osteotomy (lateral closing wedge) or Lapidus arthrodesis (CM1 hypermobility) is performed. Conventionally, these have been open procedures. Recent studies (*3,8,10*) have reported on minimal invasive approaches to correct hallux valgus deformities with moderate deviation (intermetatarsal angle < 18°) by percutaneous osteotomies of the first metatarsal.

■ Christophe de Lavigne, MD, Orthopaedic Surgeon.
Centre de Chirurgie Orthopédique et Sportive de Bordeaux-Mérignac, Bordeaux, France.

■ Bao Hoang, MD, Orthopaedic Surgeon.
Grand Hôpital de Charleroi - site Notre Dame, Charleroi, Belgium.

■ Quentin Rasmont, MD, Resident in orthopaedic surgery.
Grand Hôpital de Charleroi - site Notre Dame, Charleroi, Belgium.

Correspondence : Quentin Rasmont, Department of orthopaedic surgery, Grand Hôpital de Charleroi - site Notre Dame, Grand'Rue, 3, 6000 Charleroi, Belgium. E-mail : quentin.rasmont@gmail.com

No benefits or funds were received in support of this study

Table I. — AOFAS Score values of the patients

Patient	B.C.		B.A.		C. M-C.		B.D.		B.H.		M.H.	
Age (years)	57		72		60		58		44		70	
Side	Left		Right		Left		Left		Left		Right	
HV Score	Pre op	Post op	Pre op	Post op	Pre op	Post op	Pre op	Post op	Pre op	Post op	Pre op	Post op
Pain (0-40)	20	40	0	30	20	40	20	40	20	40	20	40
Function (0-45)												
Activities Limitation	4	7	0	7	4	7	4	7	4	10	4	7
Shoe wear	3	5	0	5	3	5	3	5	3	5	3	5
MP Mobility	5	5	5	5	5	5	10	5	10	5	5	5
IP Mobility	5	5	5	5	5	5	5	5	5	5	5	5
Calluses	0	5	0	5	0	5	0	5	0	5	0	5
MP Stability	0	5	0	5	0	5	0	5	0	5	0	5
Alignment (0-15)	0	8	0	15	0	8	0	15	0	15	0	15
Total	37	80	10	77	37	80	42	87	42	90	37	87
Total Difference	43		67		43		45		48		45	

We report the short-term clinical and radiological results achieved with a double percutaneous osteotomy of the first metatarsal in the surgical correction of severe hallus valgus deformity.

MATERIALS AND METHODS

From December 2007 to June 2008, 6 percutaneous double osteotomies of the first metatarsal were performed for severe hallux valgus deformities in 6 patients. The indications were pain and/or deformity. All patients were women with an average age of 60 years (range : 44-72), following failure of conservative treatment. Some patients had additional complaints (lateral metatarsal head pain) and hammer toes. No previous surgery had been performed. All patients were operated by the same surgeon (C.dL.). The hallux metatarsophalangeal-interphalangeal (MTP-IP) score from the American Orthopaedic Foot and Ankle Society (AOFAS) was used for clinical assessment (Table I). Anteroposterior and lateral weight-bearing radiographs of the foot were taken preoperatively (Fig. 1a) and three months after surgery (Fig. 1b) to check healing of the osteotomies. As recommended by the AOFAS, the hallux valgus (HV) angle and first intermetatarsal (IM) angle were measured. Shortening of the first metatarsal (M1) and tibial sesamoid position were also measured.

Surgical Procedure

The procedure was performed with a below-knee nerve block anaesthesia and a mid-calf tourniquet (at least 5 cm below the fibular head) inflated at 350 mm Hg. The patient was in supine position with the operated heel over the edge of the table and the contralateral hip and knee flexed by hip and foot supports. The image intensifier (FI) was on the side of the operated leg (Fig. 2).

A first 3-mm skin incision directly to the bone was made laterally to the chosen proximal osteotomy site, 1 cm distal to the first cuneo-metatarsal joint. A specially designed periosteal elevator protected the soft tissue and periosteum from the drill. Under fluoroscopy, the osteotomy was started from lateral to medial with preservation of the upper medial cortex. The burr was irrigated during the osteotomy to avoid tissue burn. The osteotomy was then closed manually and the position was maintained using a temporary Kirschner wire through M1 and M2 (Fig. 3). Fixation was performed with a percutaneous cannulated screw inserted overa K-wire introduced from distal to proximal and from medial to lateral.

A second dorsal 3-mm skin incision was made over the first MP joint, 3 mm lateral to the long extensor hallucis tendon in the axis of the first metatarsal. Through this incision, we released the transverse

Fig. 1. — (a) Anteroposterior and lateral radiographs of a foot with severe hallux valgus deformity (pre operative status) ; (b) Anteroposterior and lateral radiographs of severe hallux valgus (same patient) three months after surgery.

metatarsal ligament, adductor hallucis and performed a plantar capsulotomy.

A third 3-mm skin incision was made on the medial lower corner of the M1 head, straight to the bone. We used the periosteal elevator to create a working intracapsular space. Under fluoroscopy, the bunionectomy was performed using the bunion burr with a to and fro movement. Bone fragments were carefully extracted. The distal chevron osteotomy was made with the bone cutter under fluoroscopy, proximal to the head of M1. The specially designed burr enabled further medial rotation to correct the distal metatarsal articular angle (DMAA) (Fig. 5). The knife introduced in the osteotomy site allowed a complementary lateral arthrolysis through the same incision. Definitive positioning of the M1 head (translation, rotation) was performed manually using another specially designed instrument (Fig. 5).

The osteotomy was stabilized with a percutaneous self-tapping cannulated screw from proximal to distal, dorsal to plantar. An additional Akin osteotomy was performed, and other deformities such as hammer toes and too long lateral metatarsals, if present, were treated in the same procedure.

Hospital stay was usually limited to 2 days. The patient was allowed full weight bearing on a rigid flat

Fig. 2. — Typical installation for mini-invasive surgery. Operated foot over the edge of the table. Contralateral lower limb held by supports. Fluoroscopy ipsilateral side.

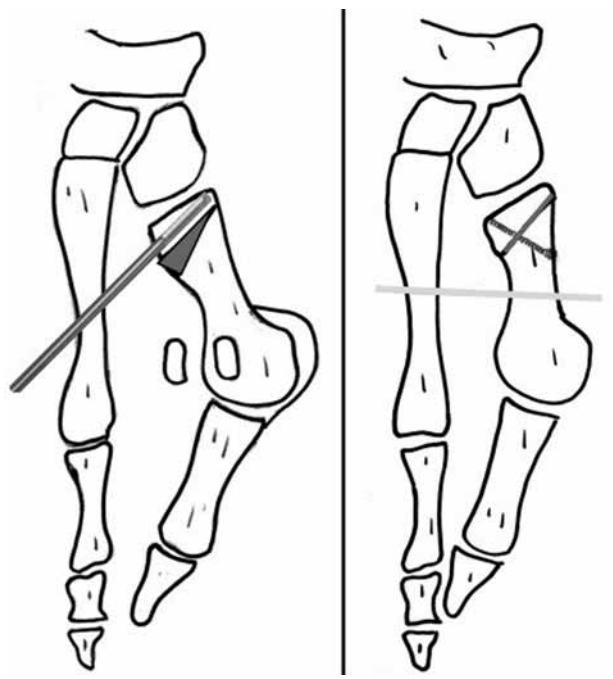

Fig. 3. — Representation of anteroposterior view of forefoot. Left : Wedge osteotomy with burr placed in lateral side of first metatarsal. Right : Temporary fixation with a Kirschner wire (grey line) transfixing M1 and M2, and final screw fixation of the osteotomy with a percutaneous cannulated screw.

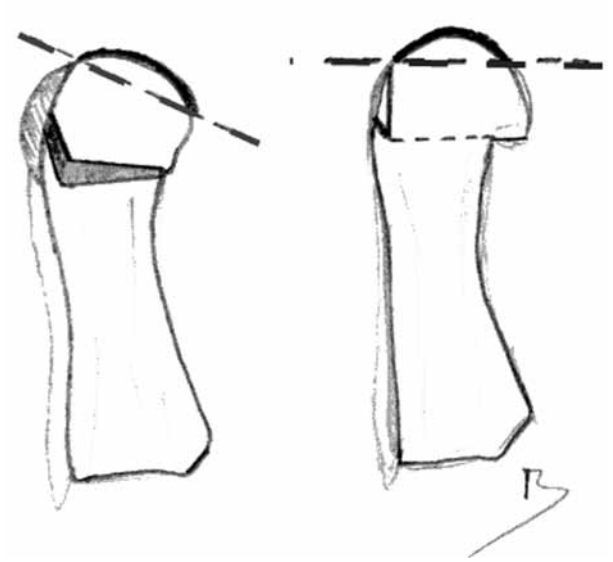

Fig. 4. — Anteroposterior view of schematic distal osteotomy of the first metatarsal. The axis of the distal joint was realigned towards the diaphyseal bone axis (correction of the DMAA).

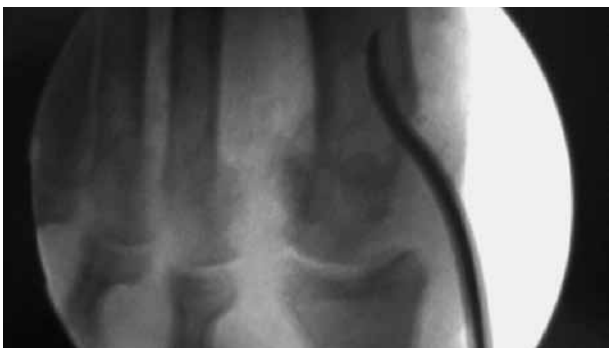

Fig. 5. — Anteroposterior fluoroscopic view of the first MTP joint during surgery, showing the specially designed instrument inserted through the distal osteotomy to help translation of the head of M1.

sole shoe during three weeks. Patients left the hospital with an adhesive elastic bandage maintaining the desired position of the toes, which was removed on the 8th post-operative day. Radio-clinical controls took place one month, three months and one year postoperatively.

RESULTS

No wound complications were noted. Pain was completely relieved in 5 patients ; one patient reported subtotal pain relief. The clinical aspect of the foot was satisfactory (Fig. 6). All functional criteria improved except for metatarso-phalangeal mobility. The mean total Hallux MTP-IP AOFAS score improved from 34 to 84 (Tables II & III). Healing of the osteotomies was confirmed radiologically in all patients within 4 months. Hallux valgus angle, IM angle, and sesamoid position were improved. The HV angle improved from 43° (40°-53°) to 16° (12°-20°), the IM angle improved from 22° (18°-29°) to 11° (9°-14°), and the tibial sesamoid position was reduced from 8 mm (11-4) to 6 mm (3-7) (Table III). M1 was shortened by 4 mm on average.

Fig. 6. — Comparative view of a foot with clinically severe hallux valgus deformity. Left : before surgery. Right : after Surgery (three months).

The DMAA improved in all patients but this could not be accurately quantified.

No major complications were noted. A relatively important postoperative stiffness of the first MTP joint resolved within a few weeks with physiotherapy.

DISCUSSION

Several studies have now shown comparable early esults with percutaneous and open techniques in the treatment of hallux valgus deformities (*4,14,15,16,22*).

Numerous open techniques have been described to correct severe deformities in adults and adolescents (*11,19*). To our knowledge, none of these techniques have yet been tried percutaneously. The

Table II. — AOFAS Score and angle values after surgery

	AOFAS (pts)	HV Angle (°)	IM Angle (°)	TSP (mm)
Pre op	34	43	22	8
Post op	84	16	11	6

Table III. — Hallux valgus improvement after surgery

X-Ray	Pre op	Post op	Pre op	Post op	Pre op	Post op	Pre op	Post op	Pre op	Post op	Pre op	Post op
HV Angle (°)	53	20	43	14	40	18	40	15	41	12	40	14
HV Difference (°)	33		29		22		25		29		22	
IM Angle (°)	29	14	20	9	25	14	18	10	22	10	20	10
IM Difference	15		11		11		8		12		10	
M1 shortening (mm)	3		4		4		4		4		4	
Tibial sesamoid (mm)	11	7	7	5	4	3	10	6	9	6	9	6

challenge was to find a proper technique allowing both correction of IM angle (translation) and correction of the DMAA (rotation) in a percutaneous procedure. Performing a scarf osteotomy appeared to be difficult with a percutaneous technique, while a chevron procedure required associated tissue release, necessarily in an open manner.

The percutaneous procedure offers a new technique for treating hallux valgus. Indications remain unchanged and contraindications still are osteoarthritis and hallux rigidus. Relative contraindications are hypermobility of the first tarsometatarsal joint and a short M1.

Our radiological results are satisfying, with correction of the IM angle and MTP angle toward normal values. Clinically, almost all patients were relieved. Kadakia *et al* (*13*) reported a high rate of complications with percutaneous procedures, including infection, nonunion and malunion, in contrast with other authors, who reported good results in moderate hallux valgus deformity (*16,22*).

The present study shows that even severe hallux valgus deformities can be treated percutaneously with clinical and radiological results similar to conventional open techniques after two years.

Shortening of the first ray is still a debated question, as multiple osteotomies result in theory in more shortening than isolated osteotomies. However, we only had an average shortening of 4 mm, clinically unremarkable and no more important than following classic open single osteotomy techniques. Several studies had comparable results and made identical conclusions with conventional open techniques (*2,17,25*). We combined (percutaneous) lateral metatarsal Weil type osteotomies (*2,3,4*) in all patients to prevent transfer metatarsalgia due to this shortening, and we suggest to do so on a systematic basis. Our proximal M1 osteotomy is incomplete and leaves a supero-medial hinge, to allow a downward translation of the head, further limiting transfer metatarsalgia.

We believe that replacing K-wires by self-tapping percutaneous screws improves fixation stability and prevents infection as seen with protruding wires. We take great care to prevent dorsal displacement of the capital fragment during osteosynthesis (*24*).

Bone dust and bone particles may cause delay in joint motion recovery ; we therefore advise a meticulous lavage.

Although our number of cases is small and our follow-up is short, this percutaneous technique appears as an interesting alternative to treat hallux valgus with severe deformity.

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