European Journal of Orthopaedic Surgery & Traumatology (2018) 28:1633–1639
https://doi.org/10.1007/s00590-018-2235-6

ORIGINAL ARTICLE • FOOT - HALLUX

History of surgical treatments for hallux valgus

Laurent Galois[1]

Received: 16 April 2018 / Accepted: 22 May 2018 / Published online: 31 May 2018

Abstract
In the nineteenth century, the prevalent understanding of the hallux valgus was that it was purely an enlargement of the soft tissue, first metatarsal head, or both, most commonly caused by ill-fitting footwear. Thus, treatment had varying results, with controversy over whether to remove the overlying bursa alone or in combination with an exostectomy of the medial head. Since 1871, when the surgical technique was first described, many surgical treatments for the correction of hallux valgus have been proposed. A number of these techniques have come into fashion, and others have fallen into oblivion. Progress in biomechanical knowledge, and improvements in materials and supports have allowed new techniques to be developed over the years. We have developed techniques that sacrifice the metatarsophalangeal joint (arthrodesis, arthroplasties), as well as conservative procedures, and one can distinguish those which only involve the soft tissues from those that are linked with a first ray osteotomy.

Keywords Hallux valgus · Bunion · Techniques · History · Osteotomies

Introduction

Since 1871, when the surgical technique was first described, many surgical treatments for the correction of hallux valgus have been proposed. Thus, by 1965, Kelikian [1] had recorded over 100 different procedures, including some sixty variants. All of these techniques have to meet the same specifications: restoring the architecture of the forefoot to as close to normal as possible. Some gestures are common to all of these interventions for correcting sub-luxation of the metatarsophalangeal joint, whilst others allow for correction of congenital or acquired architectural disorders.

Firstly we will describe radical procedures that sacrifice the first metatarsophalangeal joint, and then conservative procedures that have been developed, separating those involving only the soft parts and those involving a first ray osteotomy.

✉ Laurent Galois
l.galois@chru-nancy.fr

[1] Orthopedic and Trauma Surgery Department, University Hospital of Nancy, Centre Chirurgical Emile Gallé, 49 rue Hermite, 54000 Nancy, France

Radical procedures

Arthroplasty resection

These procedures are all performed medially. Their objectives are to achieve metatarsophalangeal arthrolysis, releasing and refocusing the sesamoid ligament complex, and re-tensioning the medial structures. They differ in type and the site of resection—proximal in the Mayo technique [2] and distal in that of Keller [3].

The principle of the Keller technique (Fig. 1) relies on the associated lateral release of the sesamoid ligament complex with resection of the proximal half of the first phalanx of the big toe, followed by a medial capsular strengthening plasty.

These arthroplasty resections were failures, with a high rate of complications, due either to excessive shortening of the first metatarsal, exposing the patient to a syndrome of insufficiency of the first ray, or to a painful metatarsophalangeal stiffness. For some surgeons, they can still be useful in older patients who are not functionally demanding or who have advanced degenerative disease.

Metatarsophalangeal arthrodesis

This is mainly indicated for advanced hallux valgus with osteoarthritis. The goal of the procedure is to transform a

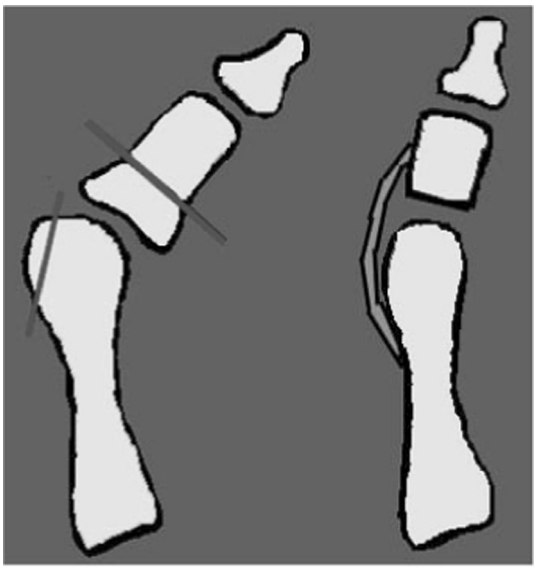

Fig. 1 Keller technique

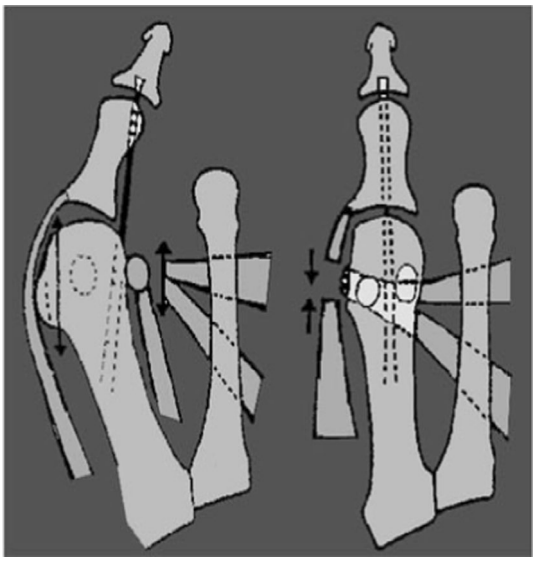

Fig. 2 McBride intervention

painful and often stiff joint into a fused, non-painful and stable joint. An effective arthrodesis procedure meets the following criteria: 10°–15° valgus and 15°–20° dorsal flexion for males, and 20°–25° for females. This metatarsophalangeal arthrodesis gives very good functional results. Arthrodesis can be performed alone or in combination with a metatarsus varus correction osteotomy. It is recommended in the literature as the treatment for numerous conditions including severe hallux valgus, osteoarthritis, rheumatoid arthritis and as a salvage procedure.

Metatarsophalangeal arthroplasty

Proposed by Swanson [4] in 1979 because of its success in hand surgery, the prosthesis is an interposition made of Silastic. The stabilisation entrusted to two axial rods has been developed with metallic structures and two or three components. These prostheses remain little used because of mechanical failures and the induction of bone destruction. Arthroplasty remains a field under research, with the development of resurfacing or interpositioned implants. A metatarsal correctional osteotomy is necessary when used for osteoarthritic hallux rigidus.

Conservative procedures

These involve two stages: the first stage is an external arthrolysis with a medial capsular plasty, and the second stage is to correct the metatarsophalangeal architectural anomaly. This second stage involves either tendinous plastics like those of Mac Bride or Petersen, or osteotomies whose varieties, which are very numerous, depend on the type and severity of the deformation to be corrected.

Soft tissue procedures

McBride intervention (1928) [5]

Inspired by the work of Silver [6], this has been modified several times with a suppression of lateral sesamoidectomy by Meary [7]. The originality of this operation lies in the transfer of the joint tendon on the medial side of M1 through an oblique transverse tunnel, which allows the reduction in the metatarsus varus and the lowering of the M1 head to be maintained (Fig. 2).

This technique, used alone, showed its limits in its indications (weak deformations on square feet or Greek or small Egyptian feet). The combination of a phalangeal osteotomy widened the indications to hallux valgus by hallomegaly on Egyptian feet, while reducing joint hyper-pressure, a factor in osteoarthritis.

The McBride technique was the technique of choice until the 1990s, but the adjustment was difficult, with either a residual risk of hallux valgus or iatrogenic hallux varus, often associated with deformation of the big toe where the tightening tension was excessive.

Smith Petersen (1888) intervention

Somewhat like the Mac Bride, this involves releasing the capsule laterally, but the reduction in metatarsus varus is this time entrusted to an inter-capsular point between the first two metatarsophalangeal joints.

It was modified by Lelievre [8], who preserved the lateral sesamoid. Stabilisation is ensured by a tenodesis of the adductor tendon, fixed to a point on the lateral face of the head of M1. Unfortunately the risk of hallux varus was quite common with this technique.

Metatarsal osteotomies

Conventional osteotomies are not used alone but in combination with lateral release, re-centring of the sesamoid strap and medial capsuloplasty. They allow a correction which is adapted to the various types of deformations and are stabilised by a metallic osteosynthesis, resorbable or an osteo-suture.

Proximal osteotomies

These are very effective at correcting metatarsus varus, but their main risk is that of orienting the distal articular surface of the first metatarsal (DMAA) outwards. One can distinguish: proximal opening (Fig. 3) or closing-wedge osteotomies [9], Kotzenberg chevron osteotomies [10], Mann's archiform osteotomies [11], and plane-oblique osteotomies [12]. Their disadvantages are related to the method of fixation, the risk of metatarsus elevatus and the risk of DMAA aggravation.

Fig. 3 Osteotomy of subtraction of the base

Diaphyseal osteotomies

Historically, the first diaphyseal osteotomy was that of Ludloff (1918) [13], which consisted of a long oblique plane osteotomy, and was modified by Mau [14] in 1926. These osteotomies experienced a real boom with the Scarf osteotomy (Fig. 4) [15, 16] which was popularised in the 1990s by Weil, and later Barouk. It combines a long longitudinal osteotomy with two short frontal osteotomies. The Scarf, the term is the English translation of "le trait de Jupiter des charpentiers", is a technique used by carpenters to increase the size of an entrance by longitudinally joining beams of timber. The shape and length of the osteotomy offer good stability and requires fixation with two screws. It allows lateralisation of the head shaft fragment to reduce intermetatarsal angle, maintains joint congruence and thus motion of the first MTP joint, and permits elevation or plantarisation of the metatarsal head, lengthening or shortening, and transverse plane rotation for correcting an increased distal metatarsal articular angle (DMAA).

Its success appeared to lie in the possibilities for correcting this osteotomy. Indeed, by varying the orientation of the lines, it is possible to obtain a lowering, a shortening or an elongation, and depending on the displacement applied to the distal fragment, a translation with or without rotation in the horizontal plane. In addition, the length of the longitudinal osteotomy promotes consolidation, and the immediate stability of the assembly makes it possible to resume support early.

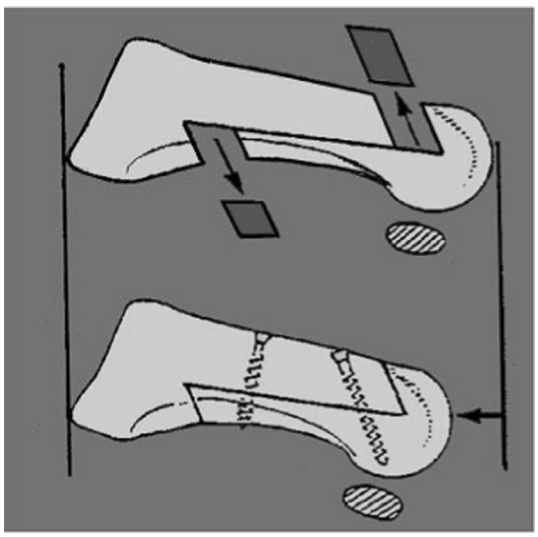

Fig. 4 Scarf osteotomy

Fig. 5 Chevron osteotomy

Distal osteotomies

These are numerous, and all aim to correct the DMAA by reorienting the distal articular surface of the first metatarsal. One could cite Baker's osteotomy, which consists of an extra-articular internal closure osteotomy, Reverdin's osteotomy [17] which copies that of Baker [18], but at the cephalic level in an exostosectomy.

Among the modifications, one may note that of Hohmann [19] with a osteotomy procedure in extra-articular position. In 1945, Mitchell [20] added an angulation, allowing a lateral closure of the lateral displacement.

Austin [21] in 1962 proposed a chevron osteotomy (Fig. 5) which also comprised arthrolysis and phalangeal shortening. To narrow the forefoot, the metatarsal head is shifted laterally and even though the chevron osteotomy is inherently stable, internal fixation with a screw helps to prevent malunion or nonunion. An abnormal DMAA can be addressed with an additionally medial closing-wedge osteotomy.

In 2007, chevron osteotomy was considered the gold standard for surgical treatment of hallux valgus by the American Academy of Orthopaedic Surgeons (AAOS).

Bifocal osteotomies

These combine a Baker type medial closure osteotomy with a basal osteotomy of internal opening by embedding a graft taken from a distal osteotomy. These are known in France under the name of Schnepp's osteotomy [22]. There has been a renewed interest in these osteotomies since the advent of percutaneous techniques.

Phalangeal osteotomy

It was first described in 1925 as a proximal phalanx medial closing-wedge osteotomy with minimal fixation.

Today, multiple fixation techniques including suture, wire, screw and staple fixation have been reported.

This is the Akin varisation osteotomy (Fig. 6) [23] which has been modified many times, resulting in diverse osteotomies, combining in varying degrees variation, shortening, and supination. Quite rapidly, it was considered inappropriate for correcting hallux valgus and was updated, in combination with the intervention of Mac Bride or metatarsal osteotomies.

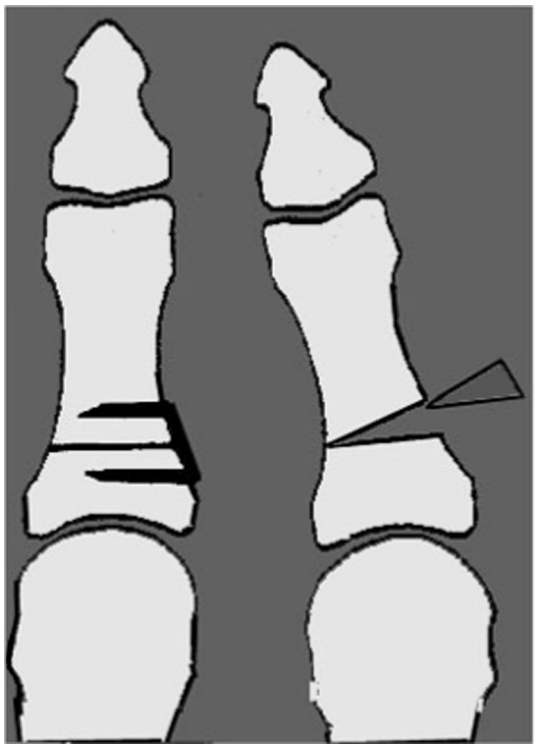

Fig. 6 AKIN osteotomy

Cuneo-metatarsal arthrodesis (Fig. 7)

Described by Lapidus [24], this is widely used in the USA and in Germany too. Promoted by Myerson in the USA, it has a more limited use in France. It is used in metatarsus varus featuring significant osteoarthritis of the cuneo-metatarsal joint (CMJ) or basal articular hyper-mobility. Lapidus originally described a fusion between the base of the first and second metatarsal and the first CMJ to correct metatarsus primus varus in patients with hallux valgus deformity. The modified Lapidus procedure typically consists of an isolated fusion of the first CMJ with a lateral and plantar closing-wedge osteotomy of the medial cuneiform.

Percutaneous surgery

Percutaneous foot surgery has interested a large number of surgeons and foot specialists since the 1950s. So, the first surgeon to develop the idea of a sub-dermal surgery for the forefoot was Morton Meyer Polokoff [25]. He developed numerous miniaturised instruments, before developing miniaturised graters, quite similar to those used in plastic

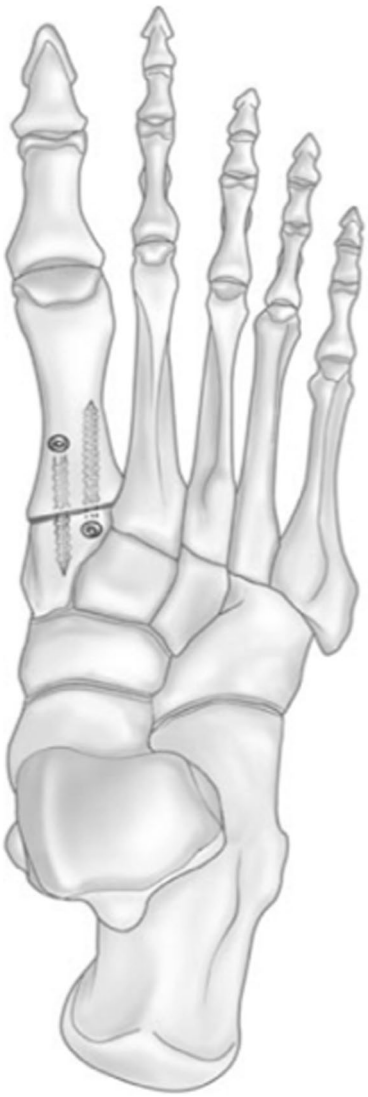

Fig. 7 Cuneo-metatarsal arthrodesis

surgery for performing rhinoplasty, to achieve a reduction in range of exostoses encountered in foot pathologies.

Simultaneously in Europe, and particularly in Spain, many surgeons were beginning to use percutaneous techniques for fore foot surgery because of the theoretical advantages of faster recovery and less soft tissue trauma. In Spain in the 2000s, De Prado [26] introduced the osteotomy of Isham-Reverdin [27] and extended its indications. In France, the diffusion of these techniques was accelerated by the foundation of GRECMIP (Groupe de Recherche et d'Etude en Chirurgie Mini-Invasive du Pied) in 2002, and the organisation of annual theoretical and practical courses and the publication of numerous works [28–30]. In practice, percutaneous techniques are performed through millimetric incisions (1–3 mm long) using the surgeon's tactile senses and a mini-blade for soft tissue dissection and power rotary burr for osseous procedures, most commonly under intraoperative fluoroscopic guidance (Fig. 8). Scientific validation of the safety and efficacy of these techniques remains inconclusive, and more long-term studies are needed.

Conclusion

There are many operative techniques for hallux valgus correction: modified McBride procedure, distal metatarsal osteotomies, metatarsal shaft osteotomies, the Akin osteotomy, proximal metatarsal osteotomies, the hallux joint fusion and recently minimally invasive procedures.

The decision on which surgical technique is used depends on the degree of deformity, the extent of degenerative changes of the first metatarsophalangeal joint and the shape and size of the metatarsal bone and phalangeal deviation.

The development of surgical techniques for correcting hallux valgus has been continuous over the last century. This is probably one of the orthopaedic pathologies for which the surgeons' imagination has been the most prolific. Currently, the surgical management of hallux valgus is dominated by Scarf osteotomies and chevron osteotomies for open surgery and percutaneous techniques. For further evaluation, more comparative long-term studies are needed.

Fig. 8 Percutaneous metatarsal and phalangeal osteotomies. **a** Preoperative X-rays, **b** Postoperative X-rays, **c** 6-month postoperative X-rays

Compliance with ethical standards

Conflict of interest The author (LG) has no interest, any financial gains, or relationship to any party relating to this study.

Ethical standards This study complies with the current laws of the country in which it was conducted.

References

1. Kelikian H (1965) Hallux valgus, allied deformities of the forefoot and metatarsalgia. WB Sanders company, Philadelphia
2. Mayo CHXVIII (1908) The surgical treatment of bunion. Ann Surg 48(2):300–302
3. Keller WL (1904) The surgical treatment of bunions and hallux valgus. NY Med J 80:741–742
4. Swanson AB (1995) Silastic single-stem implants in the treatment of hallux rigidus. Foot Ankle Int 16(12):809
5. McBride ED (1928) A conservative operation for bunions. J Bone Joint Surg Am 84(11):2101
6. Silver D (1923) The operative treatment of hallux valgus. J Bone Joint Surg Am 5(2):225–232
7. Meary R (1970) Traitement de l'hallux valgus. In: Conférence d'enseignement de la SOFCOT. Paris. Expansion Scientifique Française, pp 227–272
8. Roy-Camille R, Lelievre JF (1974) Cure of hallux valgus by Petersen's technic. Nouv Presse Med 3(6):299–300
9. Galois L, Mainard D, Valentin S (2007) La double ostéotomie métatarsienne et phalangienne du premier rayon dans le traitement de l'hallux valgus. Med Chir Pied 23:104–106
10. Sammarco GJ, Brainard BJ, Sammarco VJ (1993) Bunion correction using proximal Chevron osteotomy. Foot Ankle 14(1):8–14
11. Mann RA, Rudicel S, Graves SC (1992) Repair of hallux valgus with a distal soft-tissue procedure and proximal metatarsal osteotomy. A long-term follow-up. J Bone Joint Surg Am 74(1):124–129
12. Lelievre JF (1994) Correction du metatarsus important de l'adulte par une ostéotomie plane-oblique proximale du premier métatarsien. Med Chir Pied 10:99–101
13. Weinfeld AB (2000) The Ludloff's osteotomy for correction of hallux valgus: a historic procedure re-invented. In: Osteotomies of the hindfoot and forefoot. 2nd International spring meeting (AFCP) Bordeaux, May 4–5–6 2000
14. Schnepp J (1996) Chirurgie de l'hallux valgus. Techniques. Indications. Encycl Med Chir (Éditions Scientifiques et Médicales Elsevier SAS, Paris), Techniques Chirurgicales –Orthopédie-Traumatologie, 44–930, pp 1–16
15. Weil LS (2000) Scarf osteotomy for correction of hallux valgus. Historical perspective, surgical technique, and results. Foot Ankle Clin 5(3):559–580
16. Barouk LS (2000) Scarf osteotomy for hallux valgus correction. Local anatomy, surgical technique, and combination with other forefoot procedures. Foot Ankle Clin 5(3):525–558
17. Helal B (1981) Surgery for adolescent hallux valgus. Clin Orthop 157:50–63
18. Baker AE (1844) An operation for hallux valgus. Lancet 1:655
19. Hohmann G (1921) Symptomatische oder physiologische behandlung des Hallux valgus. Mund Med Xscher 68:1042–1045
20. Mitchell CL, Fleming JL, Allen R, Glenney C, Sanford GA (1958) Osteotomy-bunionectomy for hallux valgus. J Bone Joint Surg Am 40(1):41–60
21. Austin DW, Leventen EO (1981) A new osteotomy for hallux valgus: a horizontally directed "V" displacement osteotomy of the metatarsal head for hallux valgus and primus varus. Clin Orthop Relat Res 157:25–30
22. Schnepp J, Carret JP, Courcelles P, Revel JJ, Texier A, Vallat MP (1983) Treatment of hallux valgus with irreducible metatarsus varus of the 1st metatarsus. Bipolar metatarsal osteotomy. Rev Chir Orthop 69(Suppl 2):113–115
23. Akin DF (1925) The treatment of hallux valgus. A new operative procedure and its results. Med Sentin 33:678–679
24. Lapidus PW (1934) Operative correction of the metatarsus varus primus in hallux valgus. Surg Gynecol Obstet 58:183–191

25. Polokoff MM (1962) Raspostectomy. Reduction of exostoses and hypertrophied condyles with files and rasps. J Am Podiatry Assoc 52:599–602
26. De Prado M, Ripoll PL, Golano P (2003) Hallux valgus. Cirurgia percutanea del pie. Barcelone, Masson
27. Isham S (1991) The Reverdin-Isham procedure for the correction of hallux abducto valgus. A distal metatarsal osteotomy procedure. Clin Podiatr Med Surg 8(1):81–94
28. Bauer T (2014) Percutaneous forefoot surgery. Orthop Traumatol Surg Res 100(1 Suppl):S191–S204
29. Bauer T, de Lavigne C, Biau D, De Prado M, Isham S, Laffenêtre O (2009) Percutaneous hallux valgus surgery: a prospective multicenter study of 189 cases. Orthop Clin N Am 40(4):505–514
30. Lucas y Hernandez J, Golanó P, Roshan-Zamir S, Darcel V, Chauveaux D, Laffenêtre O (2016) Treatment of moderate hallux valgus by percutaneous, extra-articular reverse-L Chevron (PERC) osteotomy. Bone Joint J 98B(3):365–373