Deceptions in hallux valgus – what to look for to limit failures?

Erros no tratamento do hálux valgo – o que fazer para evitar falhas?

Kyung Tai Lee[1], Young Uk Park[2], Hyuk Jegal[3], Thomas H. Lee[4]

ABSTRACT

The treatment of hallux valgus is dependent on multiple factors, from clinical examination, patient considerations, clinical findings, radiographic assessment, and surgeon preference. Appropriate procedure selection and proper technique will usually result in good to excellent outcomes. As with any procedure however, there are complications following hallux valgus correction. These commonly include recurrence, transfer metatarsalgia, AVN, hallux varus, and nonunion and malunion of metatarsal osteotomies. In order to decrease the risks of complication, a precise and meticulous physical exam should be conducted preoperatively and should assess for the presence of planovalgus deformity, tight heel cord, rigid or correctable hallux valgus, great toe pronation, corns or calluses of the lesser toes, second metatarsophalangeal joint synovitis, interdigital neuromas, or first tarsometatarsal joint hypermobility. In addition, a surgeon should select appropriate osteotomies to correct complex hallux valgus deformities. As a general principle, the severity of deformity dictates treatment options. A distal Chevron osteotomy provides predictable outcomes for mild and select cases of moderate hallux valgus. For more severe deformities, multiple proximal first metatarsal procedures, combined with a distal soft-tissue procedure, appear to provide satisfactory treatment. These include proximal crescentic, proximal Chevron, proximal oblique (Ludloff), proximal closing wedge, Scarf osteotomies, and the Lapidus procedure. Finally, a surgeon should adhere to rigid bone principles to correct complex hallux valgus deformities.

Keywords: Hallux valgus/surgery; Hallux valgus/complications; Treatment failure; Prognosis

RESUMO

O tratamento do hálux valgo depende de múltiplos fatores, como quadro clínico, expectativas do paciente, achados clínicos, detalhes radiográficos e da experiência do cirurgião. A seleção apropriada do procedimento e da técnica adequada em geral produzirá resultados excelentes. Como em qualquer procedimento, há complicações na correção cirúrgica do hálux valgo. Entre elas, incluem-se recidiva, metatarsalgia de transferência, necrose avascular, *hallux varus*, e pseudoartrose ou retardo de consolidação das osteotomias metatarsais.

Correspondence
Thomas H. Lee
Research, Orthopedic Foot and Ankle Center
300 Polaris Parkway, Suite 2000 – Westerville, OH
43082
Phone: (614) 895-8747
E-mail: ofacresearch@orthofootankle.com

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1 Foot and Ankle Service of KT Lee's Orthopedic Hospital – Seoul, Korea.
2 Clinical Assistant Professor at Division of Foot and Ankle Surgery of the Department of Orthopaedic Surgery of Ajou University School of Medicine – Gyeonggi-do Republic of Korea.
3 Foot and Ankle Service, KT Lee's Orthopedic Hospital – Seoul, Korea.
4 Attending Physician of Orthopedic Foot and Ankle Center – Westerville, Ohio.

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No intuito de minimizar o risco de complicações, um exame físico completo e meticuloso deve ser feito no pré-operatório, atentando-se para a presença da deformidade em plano valgo, tendão calcâneo curto, deformidade fixa ou corrigível de hálux valgo, a pronação do hálux, calosidades nos dedos menores, sinovite da segunda articulação metatarsofalângica, neuromas interdigitais, ou hipermobilidade da articulação metatarsofalângica. Além disso, o cirurgião deve escolher a osteotomia adequada para a pretendida correção da deformidade complexa do hálux. Como princípio geral, a gravidade da deformidade dita as opções de tratamento. A osteotomia de Chevron distal fornece resultados previsíveis para os casos leves e selecionados de hálux valgo moderado. Para as deformidades mais complexas, múltiplos procedimentos no primeiro metatarso proximal, combinados com um procedimento para tecidos moles distais, parecem oferecer o tratamento satisfatório. Esses procedimentos incluem a osteotomia de base em crescente, Chevron proximal, oblíqua proximal (Ludloff), cunha de fechamento, osteotomia de Scarf e o procedimento de Lapidus. Finalmente, o cirurgião deve obedecer aos rígidos princípios de tática cirúrgica apropriadas à correção das deformidades complexas de hálux valgo. Finalmente, o cirurgião deverá obedecer aos rígidos princípios de tática cirúrgica apropriadas às deformidades complexas de hálux valgo.

Descritores: Hallux valgus/cirurgia; Hallux valgus/complicações; Falha de tratamento; Prognóstico

INTRODUCTION

The correction of hallux valgus (HV) deformities is one of the most commonly performed foot and ankle procedures. The surgical goal of HV management is to correct all pathological elements (HV, pronation of hallux, *metatarsus primus varus*, and protruded medial eminence) and yet maintain a biomechanically functional forefoot[1-3]. Successful treatment requires correcting bony alignment, restoring joint congruity, and balancing soft tissues.

Appropriate surgical selection and proper technique will usually result in good to excellent outcomes. As with any procedure however, complications arise following HV correction, and complications rates from HV surgery range from 10 to 55%[3]. Common complications include recurrence of deformities, transfer metatarsalgia, avascular necrosis, hallux varus, nonunion and malunion of metatarsal osteotomies. The treatment of HV is dependent on multiple factors from clinical examination, patient considerations, radiographic assessment, and surgeon preference. This article focused on common complications seen in HV correction and several points to be considered preoperatively and postoperatively in order to limit failures.

DIFFICULT HALLUX VALGUS

There are conflicting notions about the etiology of HV. Occupation, shoe wear, genetic predisposition, and *pes planus* have been implicated as causes of HV in adults[4-6]. Constricting footwear and high heel shoes are extrinsic factors considered important in the development of HV[7,8]. Heredity is likely to be a major predisposing factor in some patients, with up to 68% of patients having familial tendency[9].

The role of *pes planus* is complex. It is unlikely to be the initiating factor in HV, but progression of HV is more rapid in its presence. This is particularly the case in those patients with compromised medial joint capsule in rheumatoid arthritis, collagen deficiency, or a neuromuscular disorder. Scranton reported that 51% of his subjects had *pes planus* and suggested flatfoot deformity to be a predisposing factor for juvenile HV[10]. Kalen and Brecher reported that there were 8 to 24 times greater incidence of *pes planus* in adolescents with HV[11]. However, Mann and Coughlin found a very low incidence of advanced *pes planus* in adults with HV[12]. Some researchers stated that the presence of *pes planus* does not reduce the success rate of operations for HV[4,5].

Some investigators[13,14] believe that hypermobility of the first tarsometatarsal (TMT) joint is a causative component in certain cases of HV. In these patients, a fusion of the first TMT joint (the Lapidus procedure) should be considered for surgical correction, as opposed to an osteotomy. There is a correlation between hypermobility of the first ray and HV, and a higher incidence of hypermobility at this site causes a HV deformity that is painful[15,16]. Accurate clinical assessment of hypermobility of the first ray is difficult. However, a recent cadaver study has shown that correction of HV deformity by a distal soft-tissue procedure and a basal crescentic osteotomy significantly reduces hypermobility of the first ray[17], implying that hypermobility maybe a secondary phenomenon in a different set of cases.

However, primary hypermobility of the TMT joint does exist. It should be diagnosed based on clinical or radiographic evidence. Clinically, hypermobility is evaluated by determining sagittal motion (the grasping test). Because of its saddle shape, sagittal movement should be from dorsolateral to plantar medial. Others identifying signs such as the presence of a dorsal bunion, intractable plantar keratosis beneath the second metatarsal head, and arthritis of the first and second TMT joint. Radiographically, hypermobility is evaluated by measurements from the modified Coleman block test (for sagittal motion) and the radiographic squeeze test (for transverse motion) and by the identification of signs, such as cortical hypertrophy along the medial border of the second metatarsal shaft, a cuneiform split, a plantar gapping of the first TMT joint, the presence of os intermetatarseum, and the round shape and increased medial slope of the first TMT joint[14].

Metatarsus adductus (MA) has been cited as a cause of HV, particularly in the juvenile population, and it has been suggested that unrecognized MA deformity is a cause for recurrent HV deformity after surgery[18,19]. MA is described as a structural deformity occurring at the Lisfranc joint (TMT joints)[20] with the metatarsals being deviated medially in reference to the lesser tarsus.

The distal metatarsal articular angle (DMAA) describes the magnitude of the lateral slope of the distal metatarsal articular surface in relationship to the long axis of first metatarsal. The DMAA was measured between the perpendicular to the long axis of the metatarsal and a line uniting the extreme ends (medial and lateral) of the distal metatarsal articular surface. The measurement of this angle has significant inter- and intraobserver variation, and the valgus orientation of the joint should be confirmed intraoperatively[21]. The normal DMAA averages eight degrees, and higher DMAAs lead to severe deformity of the hallux. On physical exam, it can be suspected when a notable reduction of mobility occurs on the first metatarsophalangeal (MTP) joint when the valgus deformity of the toe is manually corrected. Surgical correction of this type of HV needs special attention. Basal osteotomies have the potential to worsen the valgus orientation of the joint. With distal osteotomies, the typical lateral displacement of the metatarsal head will result in the hallux leaning against the second toe. If we forcefully realign the hallux, when using one of the previous methods, an incongruent joint will be produced[5,22]. In contrast, a double or triple osteotomy can be performed, which is a demanding, extensive and aggressive procedure. Another option is the Chevron osteotomy with medial impaction but this technique is impossible with hard bone and has minimal potential for correction[23]. A Chevron osteotomy can also be used with an Akin operation, which aligns the toe but the joint surface maintains a valgus orientation[24]. A surgical method that can correct the articular angle malposition would be ideal. To correct this angle, medial rotation of the metatarsal head in the horizontal plane must be made.

Theoretically, there is no change in the DMAA in displacement osteotomies like Scarf and Chevron. These osteotomies can correct only intermediate deformities, however. The Scarf osteotomy can be rotated and displaced medially, leading to a limited correction of DMAA. While performing a Chevron distal osteotomy of a minor deformity, the distal segment may easily be rotated medially and address the high DMAA[25]. In the presence of an abnormally high DMAA, a soft tissue realignment procedure may place the foot at risk for recurrence. A Chevron osteotomy does not significantly realign the DMAA. Many such procedures are associated with significant postoperative recurrence in the presence of an increased DMAA. Correction of a congruous joint, with an increased DMAA, requires an extra-articular reconstruction. Thus, only an extra-articular correction, such as a double osteotomy, can effectively correct a HV angle with an increased DMAA[4].

High DMAA, MA, *pes planus*, and hypermobility of first metatarsal are also highly associated with juvenile HV, and surgical intervention for juvenile HV is noted to have a high failure rate[26-28]. Therefore, patients who have these factors are at an increased risk of surgical failure, and we consider these patients to have “difficult HV”. Treatment must also be individualized to address each of these factors, and careful preoperative planning is needed to ensure that the chosen procedure is appropriate for each specific patient.

COMPLICATIONS IN HALLUX VALGUS CORRECTION

Recurrence of deformity

The most apparent complication after a HV correction is the recurrence of deformity, which is reported to be as high as 16%[2,23,29,31]. Duan et al. reported that recurrence after certain procedures can be caused by factors related to the patient, to the operator, and to components of HV[32].

Operator-dependent factors that contribute to recurrent deformities are numerous[3,33,34]. (1) The characteristics of initial deformity must be considered, as well as whether the correct surgical procedure was selected. (2) Poor surgical technique should be avoided. (3) Certain underlying conditions should be evaluated because conditions associated with a HV deformity may preclude a satisfactory result. (4) Incomplete reduction of the sesamoids can be a risk factor for the recurrence of HV[35]. (5) Failure to discuss appropriate postoperative management with the patient may lead to malunion. Patient-dependent factors are poor patient compliance after surgery and poor choice of footwear[1,36,37]. Additionally, smoking is associated with increased rates of nonunion and wound infection in orthopedic surgery.

Certain procedures have specific shortcomings which makes recurrence more likely. A simple bunionectomy fails to release the lateral joint contracture and does not reposition the metatarsal head over the sesamoids. Consequently, recurrence is common[38]. For a distal soft-tissue procedure to succeed, the soft tissue must be adequately released. The main reason for recurrence after a distal soft-tissue procedure is the failure to recognize the presence of significant *metatarsus primus varus*. A distal soft-tissue procedure cannot be used to correct a fixed bone deformity. The Akin procedure consists of a bunionectomy and varus osteotomy of the proximal phalanx. This procedure does not address lateral joint contracture or realign the sesamoids, and has an increased recurrence rate when performed alone. A frequent cause of recurrence after a Chevron procedure is that the initial deformity was of greater magnitude than for which the procedure was designed. Failure to appreciate joint congruency and lateral slope of the distal metatarsal articular surface will prevent full correction in those cases[1,36]. The DMAA should be measured before a Chevron procedure, and if the angle is greater than 15°, a medial closing wedge Chevron or the addition of Akin procedure should be considered. Recurrent deformity after a crescentic, lateral closing wedge or Chevron-shaped proximal metatarsal osteotomy usually results from inadequate bone correction. In a study by Scranton et al., hypermobility was a cause of recurrence. Of the six patients with recurrence secondary to hypermobility from that study, a Lapidus procedure was successful in management of the HV recurrence[39].

If the recurrent deformity is asymptomatic, the patient is best advised to simply observe the foot as the likelihood of successful revision is reduced[37]. If the recurrence is symptomatic however, a revision surgery should be considered. Before the secondary operation, it is imperative to consider the factors which may have contributed to recurrence and to address them properly to minimize the chances of a second recurrence. The same guidelines for correction of a primary HV deformity apply to the treatment of recurrent HV. Successful treatment of a recurrence requires special knowledge of the HV pathomechanics regarding bony alignment, joint congruity, and soft-tissue balance. Additionally, bony alignment may require lateral capsule release to correct valgus.

Avascular necrosis

Avascular necrosis (AVN) of the first metatarsal head is a complication that primarily arises as a result of distal metatarsal osteotomies. Incidence of AVN is variable and ranges from zero to 76%[40-43].

A thorough understanding of vascular anatomy of the first metatarsal head is essential in HV corrective operations. Careful operative technique permits safe distal osteotomy and lateral soft tissue release. Because the intraosseous blood supply to the metatarsal head is completely disrupted with osteotomy, excessive capsular release and inadvertent injury to the lateral capsular vessels must be avoided. Several investigators have demonstrated a lower incidence of AVN with the use of a second lateral incision (2 to 40%)[42,44]. An alternative to the use of a second incision is the release of lateral capsule and adductor tendon through the joint[45].

Following a distal Chevron osteotomy, transient radiographic changes may be seen in the metatarsal head. However, the first metatarsal head has an excellent capacity to accommodate to changes in its blood supply. The radiographic changes following a Chevron osteotomy probably represent an adjustment period as the metatarsal head recovers from vascular compromise, and rarely progress to symptomatic AVN. Even with slight degree of vascular compromise, the patient may be asymptomatic, and many cases of subclinical radiographic changes probably occur but are most likely never identified. Management of AVN of the first metatarsal head has not been standardized because symptomatic AVN occurs so infrequently. Anecdotal experience suggests that simple activity and shoe modifications may suffice.

Various procedures have been described to alleviate more pronounced symptoms of metatarsal AVN. For less severe cases, a synovectomy of the first MTP joint is an option with subchondral drilling as a possible addition. More severe cases of AVN may require either a MTP fusion or a resection arthroplasty, such as a Keller procedure. If arthrodesis is undertaken, it may be necessary to use an interpositional bone graft to maintain the length of the first ray while adequately removing the avascular bone. In the event that a substantial amount of avascular bone must be removed, bone block distraction arthrodesis can be considered to avoid transfer metatarsalgia.

Hallux varus

Hallux varus is commonly seen as an iatrogenic complication after bunion surgery, resulting from overcorrection of HV. The incidence is relatively rare and is reported to range between 2 and 15.4% in literature[46,47].

Each case of hallux varus must be carefully evaluated to determine the exact etiology. Hallux varus develops due to an imbalance among the osseous, tendon, and capsuloligamentous structures at the first MTP joint, and this imbalance leads to a progressive medial deviation of the great toe. This typically involves a combination of medial contracture and overtightening with excessive laxity or soft tissue attenuation laterally. In those cases of iatrogenic hallux varus following bunion surgery, there may be loss of medial osseous support due to excessive bone resection or to overcorrected intermetatarsal angle (IMA). Combined with excessive lateral release, such imbalance leads to unopposed tension from the medial muscles, specifically from the abductor hallucis and the medial head of the flexor hallucis brevis. Most patients with hallux varus are asymptomatic. Pain associated with hallux varus can be caused either by subluxation of the MTP joint and subsequent alteration of joint mechanics or by the use of ill-fitting footwear.

Because of the different factors involved in pathophysiology, surgical decision making of hallux varus is a challenging endeavor. In addition to flexibility of varus deformity, it is important to consider interphalangeal (IP) joint contracture, rotational deformity, arthritis, and bony deformity. The first element to consider is the mobility and flexibility of the first MTP joint. In cases of severe stiffness or painful arthritis, an arthrodesis of this joint is the most appropriate solution. If the first MTP joint remains mobile and is painless in the reduced position, the choice of treatment will depend on the IP joint and neighboring rays. Other relevant osseous factors include excessive medial eminence resection, decreased IMA, and malunion of a proximal phalangeal osteotomy. Excessive bone resection at the medial aspect of metatarsal head removes the osseous support from the tibial sesamoid and the proximal phalanx. With good MTP motion in the absence of arthritis, autograft or allograft can be considered for restoration of the osseous buttress. Overcorrection of the IMA following bunion surgery must be recognized. This can either be due to a metatarsal osteotomy with overcorrection or be due to soft tissue release of the first web space causing a lateral force vector that obliterates the first interspace. If there is overcorrection of the IM angle caused by metatarsal osteotomy, the surgeon must consider revising the osteotomy with release of scar tissue and repair of the lateral ligaments. This soft tissue procedure alone may be sufficient if no metatarsal osteotomy malunion exists. The need for revision osteotomy can be determined by a simulated weight bearing fluoroscopic image to assess the IM angle after the release of scar tissue.

Varus malunion of a proximal phalangeal (Akin) osteotomy can be reversed by a lateral closing wedge osteotomy. For soft tissue deficits, such as attenuation or overly aggressive release of the lateral capsule and ligaments, dynamic or static transfers could reconstruct these lateral components of the MTP joint.

Transfer metatarsalgia due to malunion or shortening

A shortened first metatarsal is generally associated with transfer metatarsalgia. This is usually observed for the second metatarsal, although it has been reported to affect the lateral metatarsal head as well. If the first metatarsal shortening is confirmed radiographically, the possibility of a dorsal malunion must also be evaluated.

All metatarsal osteotomies are associated with some degree of shortening. The extent of shortening is dependent upon the type of osteotomy. The distal Chevron osteotomy is associated with minimal shortening, and some studies have reported metatarsal shortening of 2.0 to 2.5 mm[41,42,48]. Similarly, proximal metatarsal osteotomies are associated with relatively small amounts of shortening, which are also reported from 2.0 to 2.5 mm.[31,45] The Mitchell osteotomy is associated with the greatest amount of shortening with reports ranging from 3 to 7 mm[49,50].

Dorsal malunion of the first metatarsal may be seen with any type of metatarsal osteotomy, but it is most commonly reported with a crescentic osteotomy. This type of malunion arises from a variety of factors. One factor is an improper orientation of the osteotomy. More importantly, improper fixation or fracture at the fixation site may result in dorsal malunion. For this reason, careful protection of the osteotomy should be undertaken until the bone has completely healed. Initial treatment of the transfer lesion should be conservative. This is best addressed with a foot orthosis that includes a metatarsal pad to decrease the pressure being applied to the affected metatarsal heads. If the patient does not respond to conservative treatment, then surgical correction can be undertaken. In the presence of any significant shortening, a lengthening procedure is an option, which may be done either in one stage or by distraction osteogenesis using a miniexternal fixator. Lengthening is associated with increased stiffness of the first MTP joint, and also causes the dorsal skin to become taut on closure. Surgical treatment of dorsal malunion is similar to that used for a shortened metatarsal and includes a corrective osteotomy at the site of dorsal angulation.

SELECTION OF SURGICAL PROCEDURES

There are three main categories of surgical HV correction, which are based on the IMA. Mild valgus deformity has an IMA <15°; intermediate deformity has and IMA of 15 to 20°; and, severe deformity has and IMA >20°. Each category may be subdivided by DMAA. In a mild deformity with normal DMAA, a distal osteotomy can be performed. A mild deformity with high DMAA can be corrected by a distal rotated Chevron osteotomy. Intermediate deformities with normal DMAA can be corrected by displacement osteotomies, while an intermediate deformity with high DMAA can be corrected by rotated scarf or double osteotomy, which includes a base osteotomy to correct the IMA and a distal osteotomy to correct the DMAA. Severe deformity can only be corrected by angular osteotomies. These osteotomies inherently increase the DMAA, and can only be performed for deformities with a normal DMAA. Only a base angular osteotomy and distal rotation osteotomy can correct high levels of DMAA and severe deformity.

SURGICAL DECISION MAKING

The goal of operative treatment of HV is to correct all pathological elements and yet maintain a biomechanically functional forefoot. Successful treatment of a recurrence requires special knowledge of the HV pathomechanics. It requires correcting bony alignment, restoring joint congruity, and balancing soft tissues. Bony alignment also may require lateral capsule release to correct valgus. Surgical treatment of recurrence should be undertaken using the same guidelines for correction of a primary HV deformity. A thorough physical exam is critical. Physical examination of a HV deformity must be performed with the patient sitting and standing[36,51]. The involved foot is examined for *pes planus* and hindfoot valgus deformities and for contracture of the Achilles tendon, both of which may affect the choice and success of operation. The metatarsal-cuneiform joint should be checked for hypermobility, while keeping in mind that there is no absolute amount of motion considered to delineate hypermobility. A thorough interview with the patient is important not only to evaluate the major symptoms associated with HV deformity but also to educate the patient with regards to the problem, the alternatives for treatment, and the risks and complications of an indicated operation. The severity of HV deformity and the magnitude of first-second IMA should be determined with a standing X-ray view. Also, the degree of the DMAA, amount of lateral release and reduction of sesamoid complex should be assessed. Other deformities and complications of the first operation should be addressed such as limited range of motion in the MTP joint, pronation of hallux, callosities under lesser metatarsal heads, and lesser toe deformities like hammer/claw toes.

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