HALLUX VALGUS, INTRACTABLE PLANTAR KERATOSIS SUB SECOND METATARSAL, HAMMERTOE

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Introduction

The patient with hallux abducto valgus, hammertoe deformity, and plantar keratosis beneath the second metatarsal is commonly seen. Many surgical techniques have been described to treat these deformities. Failure of treatment or recurrence of deformity are all to common following surgical correction. With today's greater understanding of the mechanisms leading to deformity and improved surgical technique, an improved incidence of success can be anticipated. This review covers the clinical presentation, etiology, and treatment of these combined conditions.

Clinical Description

The patient presents with a mild to severely abducted hallux and metatarsal primus adductus. The second digit is contracted, possibly with a lesion over the proximal interphalangeal joint. Varying degrees of adaptive contracture may also be evident at the metatarsophalangeal joint. A tyloma with an intractable plantar keratosis may be present beneath the second metatarsal head. The patient's complaints of discomfort can be located in any or all of these areas depending on the amount of ambulation and shoe gear irritation that is attendant.

Etiology

The causes of these deformities can be biomechanical or iatrogenic. The biomechanical factors will usually include a moderate to severe amount of pronation of the rearfoot. Root and other authors have reported excessive subtalar joint pronation as leading to instability of the midtarsal joint at the oblique and longitudinal axes. This causes an increased hypermobility of the entire foot.

During the propulsive phase of gait the first ray needs to plantarflex and become stable to allow proper hallux dorsiflexion needed for propulsion. The peroneus longus requires a stable lateral column as a fulcrum to efficiently plantarflex the first ray. Inadequate or poor function of the peroneus longus (as in a hypermobile foot) results in a similar hypermobility of the first ray. The ground reactive forces cause dorsiflexion of the medial column resulting in transfer of weight to the second metatarsal (Fig. 1). Metatarsalgia, capsulitis, and stress fractures may occur as a result of the altered weight distribution.

Hypermobility of the first ray also leads to hallux valgus and metatarsus primus adductus. Other factors which have been identified leading to metatarsal primus adductus are heredity, a flexible foot, and the buckling forces of hallux abductus. The increased intermetatarsal angle and hallux position lead to poor weightbearing in midstance and propulsion resulting in the increase in pressure under the second metatarsal. Hallux abductus can cause the second digit to dorsally displace on the metatarsal leading to hammer digit deformity.

Flexor stabilization, extensor substitution and flexor substitution have been described by Green as the mechanisms leading to hammer digits. Flexor stabilization and extensor substitution are directly related to the same forces which cause hypermobility of the first metatarsal.

Hammertoe deformity usually consists of extension at the metatarsophalangeal joint, flexion at the proximal interphalangeal joint, and extension at the distal interphalangeal joint. The long flexor tendon may become displaced either medially or laterally to the metatarsophalangeal joint, adding an adduction or abduction component to the deformity. With the loss of the plantar stabilizing position of the flexor plate the unopposed extensors pull the proximal phalanx into a dorsiflexed position on the metatarsal head.

A retrograde force is thus placed against the dorsal aspect of the metatarsal head resulting in relative plantarflexion of the metatarsal (Fig 2).

Iatrogenic problems can also lead to this clinical presentation. The majority of those cases are related to recurrence of the deformity. An inadequate understanding of biomechanics can result in an improper choice of procedure.

Examples may include failure to recognize and adequately address the intermetatarsal angle or failure to control the original deforming forces postoperatively. Following any bunion procedure a metatarsophalangeal

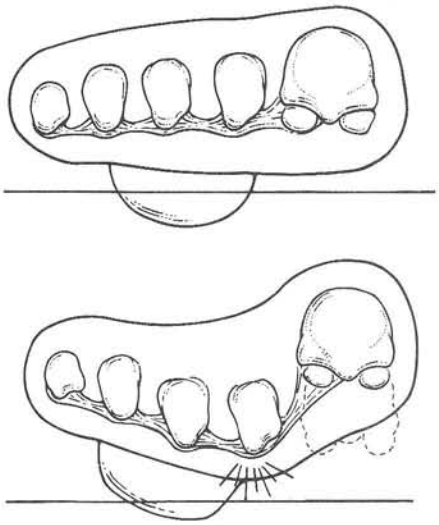

Fig. 1. A. Normal metatarsal weightbearing. B. Relative dorsiflexion of first metatarsal with excessive pronation.

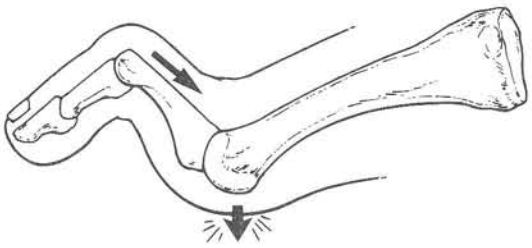

Fig. 2. Retrograde force of hammertoe against metatarsal.

joint limitus may develop that results in a lateral transfer of weight. This is usually associated a painful lesion submetatarsal five. Iatrogenic hallux limitus may be prevented by initiation of early range of motion exercises of the metatarsophalangeal joint postoperatively.

Complications which may be seen following base wedge osteotomy are nonunion and elevatus. These results can lead to recurrance of the original deformity or to the development of a painful transfer of weight to the second metatarsal head.

Postoperative care is important in preventing complications or recurrence. A patient who fractures an osteotomy secondary to weightbearing may develop a first metatarsal elevation as well as adduction deformity.

No matter what the initiating cause, hallux abductovalgus deformity with associated hammertoe second and associated tyloma sub second metatarsal is a frequent occurrance and must be carefully evalutated.

Treatment

Traditional treatment of these deformities begins with the correction of hallux abduction and first metatarsal adduction. A wide variety of procedures has been used depending on the extent of the deformity and the surgeon's preference. In the past the procedure was often not accompanied by adequate lateral release around the first metatarsophlangeal joint. Full elimination of lateral joint contracture is an important first step toward effective correction. The dorsiflexed position of first metatarsal was often not corrected by the procedures used to treat the metatarsal primus adductus.

The presence of a lesion beneath the second metatarsal head leads many to believe that the metatarsal is plantarflexed. This often results in the performance of some type of base or neck elevational osteotomy. Many such osteotomies were allowed to remain unfixed and permitted to "float" to "proper" position. This leads to instability of distal fragment. The distal fragment is relying on the deep transverse intermetatarsal ligament for stabilization. However, if this is sectioned in the first interspace then the second metatarsal capital fragment is tethered only laterally. This may lead to excessive dorsiflexion or even dislocation if the osteotomy was not fixated.

A common sequel of the excessively elevated metatarsal is "floating digit syndrome". As described by McGlamry and associates the metatarsal no longer bears weight when the balance of the metatarsals load under weightbearing. Non weightbearing of the metatarsal segment results in a lax or flabby flexor apparatus and a toe which is unstable.

The second metatarsal is thought by many to be the "backbone" of the foot. Due to its limited range of motion and its connection to the other metatarsals through soft tissue attachments, the second metatarsal can

stabilize the forefoot. A second metatarsal osteotomy does not directly address the deformity and also destroys this stability. Elevating the second metatarsal only allows for increased first metatarsal dorsiflexion and greater instability. The lesion may also be transfered from beneath the second to the third metatarsal.

The second hammertoe has often been treated by proximal interphalangeal joint arthroplasty which adds to the instability. Finally, an extensor tenotomy with metatarsophalangeal joint capsulotomy was usually performed. Such and approach often failed to adequately realign the metatarsophalangeal joint and stability was not restored to the toe.

Current Concepts of Treatment

The current concept in the treatment of these combined deformities begins by increasing the weight-bearing potential of the first metatarsal. This decreases pressure under the second metatarsal and encourages the first ray to become more functional. This may be accomplished by plantarflexing the distal aspect of the first metatarsal. The axis guide technique for the Austin and base wedge osteotomies has been demonstrated in films produced by Doctors Hospital Podiatry Institute (*Base Wedge Osteotomy in Hallux Valgus Surgery-Applied Principles of Rigid Fixation* and *Modifications of the Austin Bunionectomy*, produced by and available from Doctors Hospital Podiatry Institute, Tucker, GA.)

Plantarly Positioned Second Metatarsal

There are occasionally cases of true plantarflexed or relatively long second metatarsals. In these cases a second metatarsal osteotomy may be indicated. The amount of dorsiflexion should be carefully evaluated following completion of first metatarsal plantarflexion. The dorsiflexion of the second metatarsal which is subsequently achieved should be maintained with proper fixation and non weightbearing. This will allow for a proper weight-bearing pattern of the forefoot once boney healing is complete.

Hallux valgus surgery typically includes the utilization of adductor tendon transfer. Such transfer assists in realigning capsular structures around the first metatarsophalangeal joint. Improved function, increased stability, and proper alignment lead to increased long term success.

An arthroplasty of the second proximal interphalangeal joint may be all that is necessary to reduce the second toe deformity. However, greater stability may be gained with an arthrodesis of the proximal interphalangeal joint. The choice of an end-to-end or a peg-in-hole type arthrodesis can be debated. Although the peg-in-hole arthrodesis heals faster than the end to end arthrodesis, a greater shortening of the digit can be expected. The second digit should be maintained slightly longer than the hallux to provide a stable butress for the great toe. No matter which arthrodesis is chosen the objective is elimination of retrograde force at the metatarsophalangeal joint.

Additional soft tissue procedures such as extensor hood recession and metatarsophalangeal joint capsulotomy may be necessary depending on the severity of the deformity.

Postoperatively, the deforming forces which result in excessive pronation should be managed. Orthotic devices and other mechanical devices (i.e. heel lifts) may be utilized to control such forces.

Summary

The combined deformities of hallux abducto valgus, hammer digit second and intractable plantar keratosis subsecond metatarsal head are a common finding. Preoperative evaluation and surgical planning is important to any therapy. Specific surgical techniques may be mandated by certain clinical findings. Traditional therapy consisting of hallux abducto valgus correction, dorsiflexory osteotomy of the second metatarsal and arthroplasty of the second proximal interphalangeal joint frequently proved ineffective.

Current concepts which consider the mechanism by which the deformity occurred and surgical planning designed to deal with those mechanisms have increased the level of surgical success. Plantarflexory/abductory osteotomies increase the contact of the first metatarsal with the ground in gait. This results in better distribution of weight across the forefoot. Arthrodesis of the second digit provides greater digital stability and a decrease in the retrograde forces against the second metatarsal. The end result of these combined surgeries is a better weight distribution in the forefoot with increased stability.

Bibliography

Fielding MD (ed): *The Surgical Treatment of the Intractable Plantar Keratoma*. Futura Publishing Co, Mt. Kisco, NY, 1974.

Green DR, Ruch JA, McGlamry ED: Correction of equinus related forefoot deformities. *J Am Podiatry Assoc* 66:768, 1976.

Kelikian H: *Hallux Valgus, Allied Deformities of the Forefoot and Metatarsals*. W.B. Saunders Co, Philadelphia, PA, 1965.

McGlamry ED: Prominent lesser metatarsal head: some surgical considerations. *J Am Podiatry Assoc* 59:306, 1969.

McGlamry ED: Floating toe syndrome. *J Am Podiatry Assoc* 72:561, 1982.

Root ML, Orien WP, Weed JH: *Normal and Abnormal Function of the Foot: Clinical Biomechanics*, vol 2. Clinical Biomechanics Corp, Los Angeles, CA, 1976.

Sgarlato TE: *A Compendium of Podiatric Biomechanics*. California College Podiatric Medicine, San Francisco, CA, 1971.

Subotnick SI: Digital deformities: etiology and treatment. *J Am Podiatry Assoc* 65:542, 1975.

Young CS: An operation for correction of hammer toes and clan toes. *J Bone Joint Surg* 20:715, 1938.