HALLUX LIMITUS

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Introduction

Degenerative joint disease of the first metatarsophalangeal joint was first described by Davies-Colley in 1887 (1). Cotterill in 1888 (2) termed the condition hallux rigidus. Various designations have been used to describe this condition including hallux limitus, hallux flexus, and dorsal bunion (1,3).

Hallux limitus is now considered to be a limitation of first metatarsophalangeal range of motion with hallux rigidus being a complete absence of motion (4).

Etiology

Numerous etiologies have been discussed by various authors. Bingold and Collins (5) concluded osteoarthritis of the first metatarsophalangeal occurs secondary to an abnormal gait developed for either protection of an inflamed joint from weight-bearing pressure or stabilization of a hypermobile first ray. Nilsone (6) suggested a long first metatarsal as the primary factor. Goodfellow (7) implicated osteochondritis dissecans as the most common etiology.

Metatarsus primus elevatus has been demonstrated by several authors to result in first metatarsophalangeal joint limitation.

McMaster (8), after reviewing seven patients, implicated characteristic chondral and subchondral lesions of the first metatarsal head as resulting in limited dorsiflexion. He suggested a traumatic etiology, acute or chronic, producing these characteristic lesions.

Root (9) discusses a number of factors including: elongated first metatarsal, hypermobile first ray, immobilization, metatarsus primus elevatus, gout, rheumatoid arthritis, and osteochondritis dissecans.

After the performance of standard hallux limitus operative procedures, such as cheilectomy or Watermann type repairs, Cochrane (10) observed an elastic resistance to dorsiflexion still existed. He reasoned this to be caused by shortened and contracted structures on the plantar aspect of the first metatarsophalangeal joint, especially the plantar fibers of the lateral ligaments. Concomitant spasm of the intrinsic muscles inserting into the base of the proximal phalanx also was a consideration. Cochrane (10) suggested these factors when combined with "blood clots and the development of painful adhesions" were responsible for unsatisfactory surgical results. First metatarsophalangeal joint capsule and flexor apparatus contracture secondary to trauma, previous surgical intervention, or prolonged dorsiflexed position should be appreciated as etiologic factors of hallux limitus.

Anatomical and Biomechanical Considerations

According to Joseph (11) total passive dorsiflexion ranges from 40 to 100 degrees of dorsiflexion with an average of 75 degrees. Passive dorsiflexion was assessed with the subject bending the foot at the first metatarsophalangal joint on a stool while leaning as far forward as possible (Fig. 1). Joseph performed lateral radiography of subjects in the above position. He measured the long axis of the first metatarsal by drawing a line along its dorsal shaft edge. The long axis of the proximal phalanx was established by a line which bisected at right angles the perpendicular to its most narrow width. The angle formed between these lines determined the range of motion at the first metatarsophalangeal joint.

Root (9) indicates normal first metatarsophalangeal joint dorsiflexory range of motion to be 65 degrees to 75 degrees. However, only 25 to 30 degrees of dorsiflexion is possible without first ray plantarflexion. Accordingly, when considering a hypermobile first ray secondary to pronation, there is inadequate plantarflexion to allow the necessary 65 to 75 degrees of dorsiflexion. Dorsal jamming and degenerative changes are the end result.

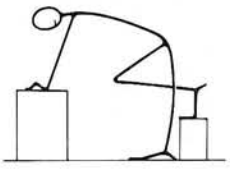

Fig. 1. Passive dorsiflexion measured at the first metatarsophalangeal joint as performed by Joseph.

Clinical Characteristics

The classic presentation includes a gradual onset of pain, limitation of first metatarsophalangeal joint range of motion, and pain aggravated by walking and relieved by rest.

Hyperextension of the hallux interphalangeal joint is noted as well as plantar callous formation beneath the joint itself. In gait the patient tends to compensate by adducting the foot and rolling the weight laterally from a supinated position.

Radiographic findings are consistent with degenerative changes. The most common signs are uneven joint space narrowing, flattening of the first metatarsal head, and osteophytic lipping at the margins of the joint space on both the metatarsal head and proximal phalangeal base. Metatarsus primus elevatus may also be observed (Fig. 2).

Surgical Goals

Correction of hallux limitus requires several specific changes. The following objectives should be appreciated: 1) removal of osteophytic spurring, 2) creation of slack in the flexor apparatus, 3) shortening the first metatarsal if excessively long, 4) reorientation of the first metatarsal head articular surface, and 5) stabilization/plantarflexion of the first ray. Although all objectives will not apply to every situation, all must be considered in a comprehensive surgical plan. For example, where excessive degeneration of the articular surface exists, implantation may be the only alternative. For implantation to be successful, contractures of the flexor apparatus as well as the presence of metatarsus primus elevatus, should be addressed. Each goal will be described as it applies to a systematic, decision making process of hallux limitus surgery.

Stepwise Surgical Approach

Cheilectomy

Removal of osteophytic proliferation should be the first step in hallux limitus repair (Fig. 3). Without the excision of the "osseous block" little increase of range of motion may be expected. Attention should be directed to the proximal phalangeal base as well as the first metatarsal head.

Watermann/Modified Watermann

If a satisfactory increase of motion is not obtained following cheilectomy (65 to 75 degrees dorsiflexion), reorientation of the first metatarsal head articular surface is considered (Fig. 4). Dorsiflexory position may be structurally obtained by either a through and through trapazoidal osteotomy (Watermann) or by maintaining an intact planter cortical hinge (modified Watermann). The procedure of choice usually being the modified Watermann because of its increased stability and lower complication rate.

Other surgical goals achieved by this procedure are

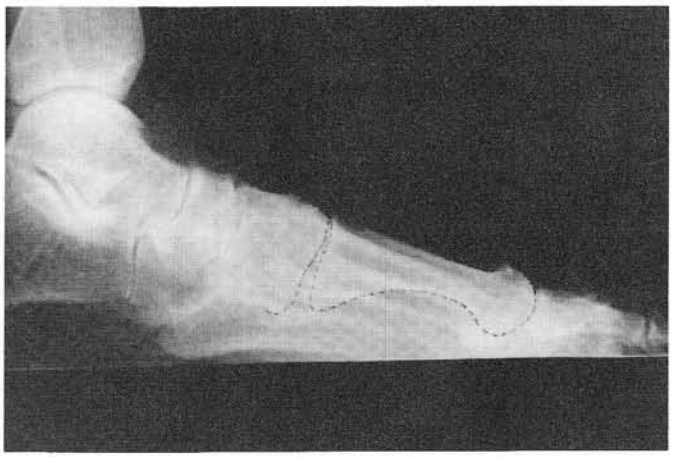

Fig. 2. A. Dorsoplantar radiograph demonstrating uneven joint space narrowing, flattening of the first metatarsal head and osteophytic development. B. Lateral radiograph indicating metatarsus primus elevatus.

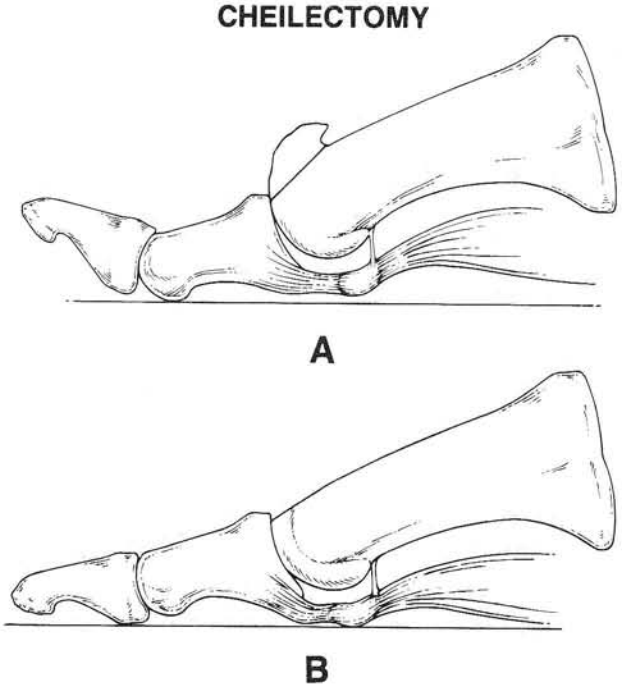

Fig. 3. Cheilectomy. A. Preoperative. B. Postoperative.

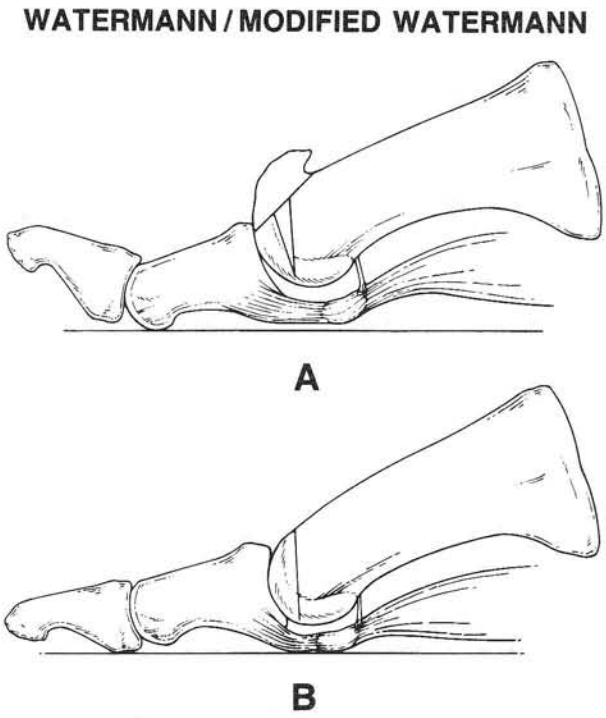

Fig. 4. Watermann/Modified Watermann. A. Preoperative. B. Postoperative.

shortening of the first metatarsal and relaxation of tight plantar structures producing slack in the flexor apparatus.

Plantarflexory Wedge Osteotomy

If inadequate dorsiflexion is obtained after cheilectomy and Watermann type procedures, elevated first metatarsal position must be considered. Dorsiflexory movement of the proximal phalanx on the first metatarsal is substantially decreased in the presence of metatarsus primus elevatus. The primary objective then becomes plantarflexion and stabilization of the first ray. This is accomplished by an oblique plantarflexory wedge osteotomy at the base of the first metatarsal (Fig. 5). In some instances a plantarly displacing Austin osteotomy may achieve adequate plantarflexion.

Austin Procedure

As an alternative to the Watermann procedure where mild to moderate metatarsus primus elevatus exists, a plantarflexory Austin osteotomy may be considered (Fig. 6). The surgical goals of first metatarsal shortening, slack in the flexor apparatus, as well as plantarflexion of the first metatarsal head may all be achieved. Given the proper indications, the Austin will yield satisfactory results.

Implant Arthroplasty

After the previously mentioned procedures have been performed and limitation of first metatarsophalangeal joint motion still remains, implantation of the first metatarsophalangeal joint should be considered. In the presence of adequate articular surfaces, the above procedures in various combinations are effective. However, if degeneration is severe, implantation in lieu of the above procedures may be the preferred option. The importance of the surgical goals applies to implants as well, since an implant will not function well in the presence of an elevated or long first metatarsal and contracture of the flexor structures (Fig. 7).

Postoperative Care

Maintaining good dorsiflexory range of motion is the primary postoperative goal. Early passive motion of the first metatarsophalangeal joint should be encouraged. Early ambulation with a flexible surgical shoe (Darby Type) will assist in early motion. A rigid post operative shoe should be discouraged (Fig. 8).

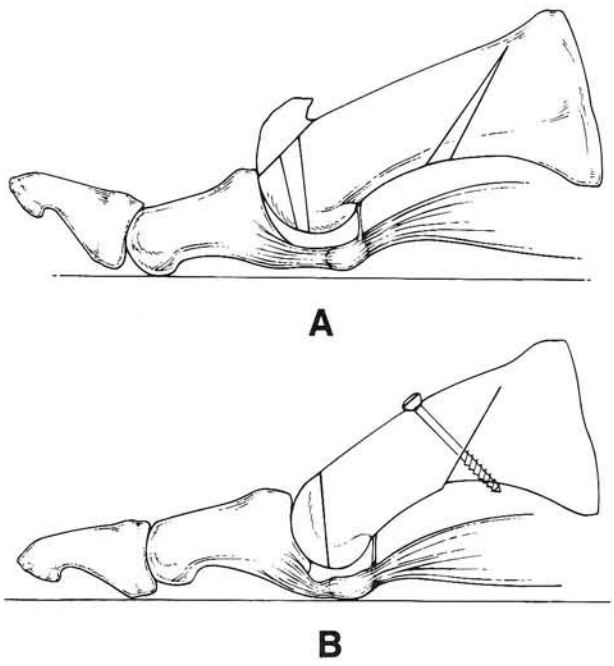

Fig. 5. Plantarflexory wedge osteotomy. A. Preoperative. B. Postoperative

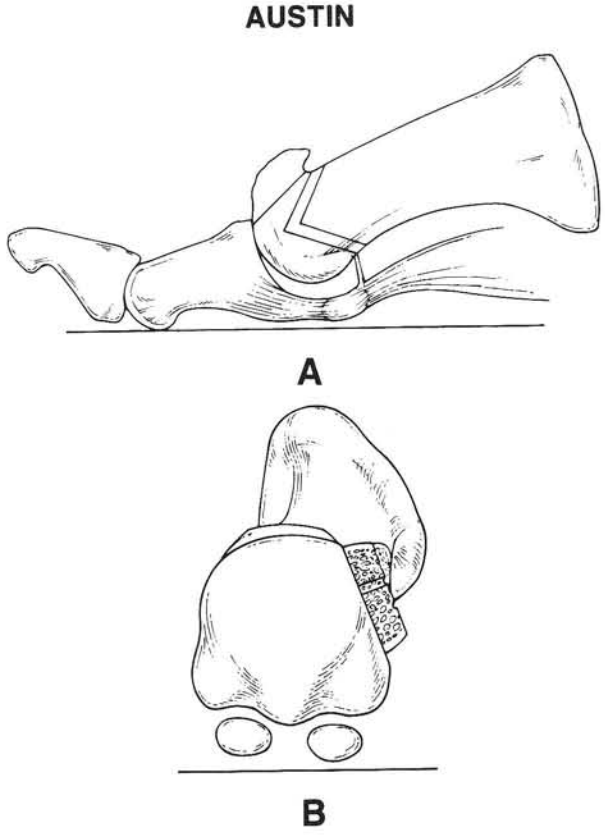

Fig. 6. Austin procedure. A. Preoperative. B. Postoperative (note plantar position of metatarsal head).

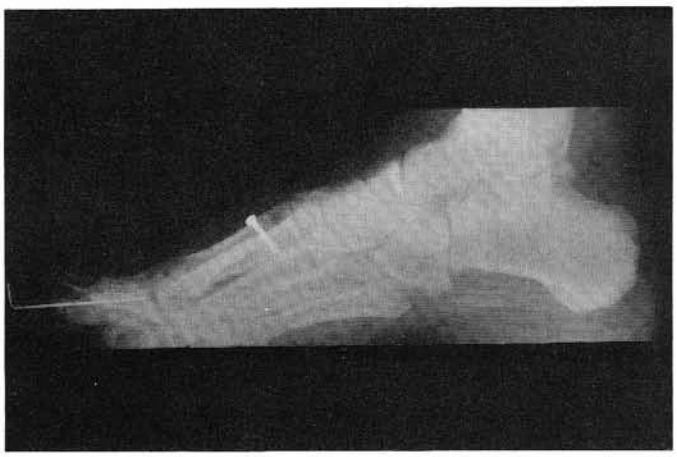

Fig. 7. Lateral radiograph with implant and concurrent metatarsus primus elevatus.

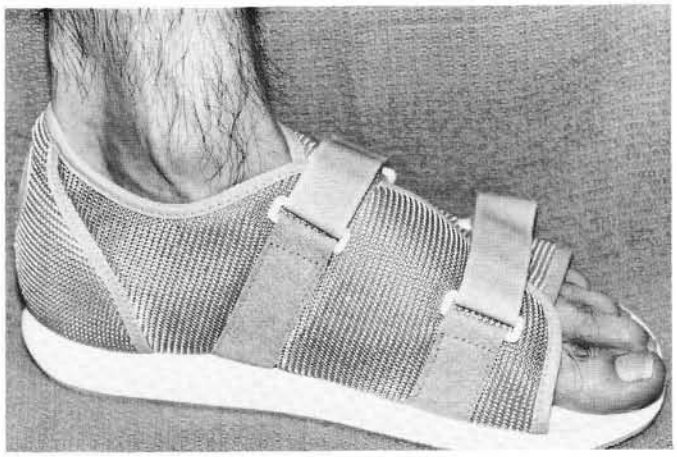

Fig. 8. Darby shoe.

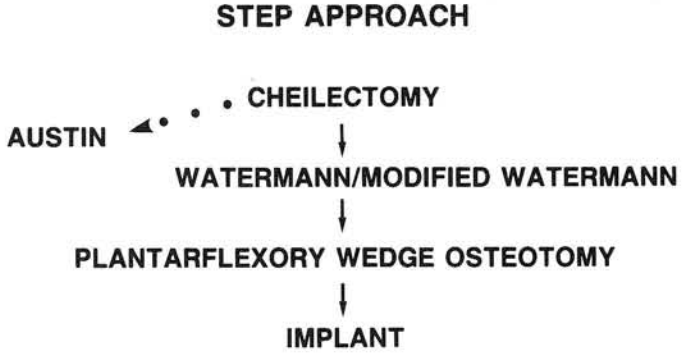

Table 1. Stepwise Surgical Approach.

Summary

A stepwise approach to hallux limitus repair has been presented. Attention to the surgical goals with the above mentioned operative procedures is an effective approach to this deformity.

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