CHAPTER **40**

STEPWISE APPROACH TO HALLUX LIMITUS

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Hallux Limitus/Rigidus is a well-known entity to physicians treating the foot and ankle. The surgical approaches to hallux limitus are varied, and all attempt to increase the first metatarsophalangeal joint range of motion. Attention is often directed towards the osseus deformity to affect the overall alignment of the joint. However, it is important to remember that the soft tissues will also play a substantial role in limitation of joint motion. The purpose of this paper is to establish a sequential surgical approach which can effectively address this often puzzling deformity.

Proper clinical and radiographic evaluation of the hallux limitus deformity is vital in the preoperative period. Although the first metatarsal is often elevated above the second metatarsal on the lateral radiograph, it is the change in the elevatus from the base to the metatarsal head that is truly significant. Camasta described the variability in superimposition of the first and the second metatarsals on the lateral radiograph with positional changes in the tube head. Green described a reproducible method of evaluating radiographic elevatus by picking standard reference points. He measured the difference between the two cortices at one centimeter distal to the metatarsocuneiform joint, and then compared the difference one centimeter proximal to the first metatarsal head. A dorsoplantar radiograph is helpful in assessing the first metatarsal length with respect to the second metatarsal. Both a long and short first metatarsal can predispose to a hallux limitus condition, as compensation takes place along the medial column. At times, a plantar axial radiograph will show a clear elevation of the first metatarsal segment.

The joint space of the first metatarsophalangeal joint should also be evaluated. Dorsal spurring and hypertrophic bone indicates anatomical adaptation to increased stress at this level. Severe joint arthrosis and narrowing may direct the surgeon to consider a joint destructive versus a joint salvage procedure. A step-wise approach to the surgical correction of hallux limitus is presented to assist in the preoperative and intra-operative decision-making process.

CHEILECTOMY

This is the important first step in allowing increased range of motion. Initial radiographic examination is performed to carefully evaluate the metatarsal head. There will routinely be hypertrophic bone on the metatarsal head. At times, this will be best visualized intra-operatively. When the normal anatomy is altered, the dorsal spurring at the first metatarsal head should be remodeled. If moderate to severe changes also exist at the proximal phalangeal base, then these should also be addressed. It is recommended to minimize aggressive resection from adjacent sides of the joint, as postoperative bleeding from both bones may predispose to increased scarring. Rarely, a hallux limitus will present which does not show any adaptive changes on the first metatarsal head. In these situations, the cheilectomy should be bypassed, and attention directed towards structural correction of the metatarsal. During the cheilectomy procedure, careful inspection of the articular surface should be performed. This will determine the need for an abrasion arthroplasty or subchondral drilling, to encourage cartilage repair.

Banks and McGlamry described the importance of the plantar plate in hallux limitus. Mobility of the flexor plate and the sesamoid apparatus should be assessed with the initial joint release. If plantar adhesions are noted, then they can be effectively released with either sharp dissection or a McGlamry metatarsal elevator.

The range of motion should be evaluated after capsular release and cheilectomy. If the metatarsal is determined to be elevated, and the range of motion after the initial cheilectomy is not sufficient, than an osteotomy should be performed.

OSTEOTOMY

Depending on the degree of metatarsus primus elevatus, an assessment should be made as to the exact level of the osteotomy. For situations where there is greater than 5 mm of metatarsal elevatus, a more aggressive proximal osteotomy should be considered.

Proximal Osteotomy

The proximal osteotomy can be one of several forms. Three good options include the oblique plantarflexory wedge osteotomy (PFWO), the oblique Juvara with breaking of the medial hinge, and the sagittal scarf. The plantarflexory moment of all the above osteotomies occurs around an axis of rotation. The final position of the articular cartilage will result in a more plantar-declinated position. Although the hallux may be at a better mechanical advantage to dorsiflex on the metatarsal head, the actual range of motion with respect to the ground is not much improved. Therefore, a rotational proximal osteotomy should be performed in conjunction with a distal osteotomy. This "double osteotomy" approach will realign the articular surface in a more rectus position. A Waterman-type of procedure will adequately achieve this goal.

The oblique plantarflexory wedge osteotomy and the Juvara designs are best suited to achieve a proximal level of correction. The oblique nature of the osteotomy will prevent extension into the metatarsal head region. A sagittal scarf procedure can be utilized if the distal arm does not extend into the metatarsal head.

In certain situations, structural correction from a proximal osteotomy can be achieved by strict plantar displacement of the metatarsal, rather than rotation around a proximal axis. This will not effect the final position of the articular cartilage as significantly, and a distal osteotomy may be avoided. As a trade-off, there will be a higher chance of troughing into the medullary canal, since there is decreased medial to lateral cortical overlap. The oblique Juvara and sagittal scarf are two techniques which allow for plantar displacement.

Distal Osteotomy

In situations where there appears to be 5 mm or less of metatarsus primus elevatus, a more distal osteotomy can be considered. Plantarflexing in conjunction with shortening of the capital fragment will produce a better mechanical environment for hallux range of motion. This will also effectively reduce tension on the plantar structures, and allow for increased range of motion. In planning the osteotomy, an attempt is made to shorten the metatarsal head and secondarily plantarflex the metatarsal. There are several designs which will adequately achieve this. Bernbach and McGlamry reported success with the Green-Watermann modification. This design will allow predictable shortening and inherent mechanical stability. Fixation can be provided with screws, wires, or absorbable pins. Youngswick also described a modification to the Austin procedure which also attempts to shorten and plantarflex the capital fragment. In situations of hallux limitus with a concomitant hallux valgus, an aggressive plantarflexory-shortening Austin is a suitable option. An axis guide wire is directed from dorsal-distal-medial to plantar-proximal-lateral. An isolated Watermann osteotomy will not alter the structural elevatus of the metatarsal, yet this is ideal in a double osteotomy approach. The hallux range of motion is now re-evaluated to assess the contribution of the osteotomy.

JOINT DESTRUCTION

In situations where the joint is deemed non-salvageable, the decision to preserve first metatarsophalangeal joint range of motion, versus an arthrodesis, should be made. A modified Keller arthroplasty and implant arthroplasty techniques are viable options to maintain joint motion.

Modified Keller

Modifications to the Keller arthroplasty have decreased the previous complications of loss of toe purchase and flail toe. The modification attempts to maintain plantarflexory power to the first metatarsophalangeal joint, and in turn, increase weight bearing along the first metatarsal. For the long flexor tendon to plantarflex the metatarsophalangeal joint, the tendon is sutured to the plantar aspect of the remaining base of the proximal phalanx. There may be situations where the short flexor tendon can be re-attached, however, this usually results in a very tight joint. Care should also be taken to avoid overzealous osseus resection from the base of the proximal phalanx. Banks recommended resection of less than one-third of the bone, to minimize the occurrence of a flail toe postoperatively.

Implant Arthroplasty

Implant arthroplasty is also a good option in joint destructive procedures. Along with the popular use of Silastic joint implants, there has been a tremendous evolution of two-component implants within

the past several years. Their non-constrained design allows the two components to essentially function independent of one another. Currently, there are five designs which are being marketed. Several of the implant designs have now recommended a more aggressive resection of bone from the base of the proximal phalanx. This will decrease tightness and jamming of the implant during postoperative range of motion. Therefore, re-attachment of the long flexor tendon is again recommended to maintain hallux purchase.

During the joint destructive procedures, first metatarsal position should again be evaluated. If a structural metatarsal elevatus is present, then it should also be addressed during both arthroplasty techniques. In a moderate to severe metatarsus elevatus, this may require a proximal osteotomy to realign the joint. When this is not addressed, there is considerably more stress on the implant, which in turn will limit joint motion and decrease the life expectancy of the implant itself. The range of motion should again be assessed after placement of the implant.

ARTHRODESIS

First metatarsophalangeal joint arthrodesis is an option in cases of severe hallux limitus. The procedure provides predictable functional stability to the first metatarsal and hallux complex. First metatarsal weight-bearing is shown to be significantly better after arthrodesis techniques versus arthroplasty.

SOFT TISSUE RELEASE

After the steps mentioned previously have been performed, the joint's motion should again be evaluated. In certain situations, there is recognizable soft tissue tightness of the medial band of the plantar fascia. The distal insertion of the plantar fascia sends vertical slips into the flexor plates of the metatarsophalangeal joints. These slips may also play a role in limitation of sesamoid gliding motion at the joint level. Release of this medial band has provided considerable increase in range of motion. This is performed effectively through a medial stab incision at the level of the metatarsal shaft. The tight fascial band is easily isolated at this location which is safely away from the joint capsule. One must be careful to avoid the long and short flexor tendons in this region. Although this release can also be carried out at a more proximal location, this will affect the rearfoot structure much more, similar to a heel spur resection. The final range of motion should again be assessed.

POSTOPERATIVE MANAGEMENT

Proximal osteotomies need to be protected (non-weight bearing) for 6-8 weeks to insure osseus healing without displacement. The distal osteotomies can be treated with protected weight bearing in a postoperative Darco shoe. Regardless, early joint mobilization is paramount to the overall success of the procedure. The range of motion achieved intra-operatively is never maintained during the healing period. Due to capsular adhesions and fibrosis, the patient will usually lose 5-10 degrees of final motion. Modalities such as Continuous Passive Motion (CPM) or the Dynasplint should be employed early in the postoperative period to ensure maintenance of joint motion.

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