CHAPTER **44**

Reconstruction Of The Stage III Cavus Foot

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Reconstruction of the severe cavo-varus foot type is demanding not only in terms of the technical surgical skills, but also in terms of the preoperative assessment. With the severe cavo varus foot, there is an extremely high probability that there is a neurologic etiology for the deformity. This neurologic etiology must be precisely determined in order to evaluate whether the deformity is progressive or static. In addition, the primary deforming force must be identified. A complete muscle inventory must be taken to determine which muscles are strong and potentially transferable, and which muscles are weak.

The initial assessment of the severe cavo-varus foot therefore begins with the creation of a muscle inventory. Manual muscle testing is performed for each of the individual muscles of the anterior, lateral, and posterior compartments. If additional information is needed, electromyography can be performed to specifically determine the status of a particular muscle or group of muscles.

The next step in the evaluation is an assessment of the structural deformities. This not only involves assessing the areas of deformity, but also whether the deformities are flexible or rigid. The areas that are generally assessed include the degree of heel varus, first metatarsal declination, and the position of the midfoot, specifically with regards to the transverse and frontal planes. In terms of heel varus, this is assessed by means of the calcaneal axial X-ray (to look for curvature within the calcaneus itself), as well as the lateral block test. With the lateral block test, a wedge is placed under the lateral portion of the forefoot. If the heel comes back to a perpendicular position, then it is apparent that the perceived position of heel varus is a result of plantarflexion of the first ray, and not a true osseous heel varus. In the same way, a high calcaneal inclination angle is usually more of a reflection of retrograde forces exerted by plantarflexion of anterior segments of the foot, rather than true structural posterior cavus. Nonetheless, one must determine whether correction needs to be performed in the body of the calcaneus or through correction of the anterior cavus, in order to reduce the calcaneal inclination angle.

The first metatarsal is a key element of cavus foot reconstruction. Even in the very severe cavus foot, failure to address the first metatarsal can be a critical mistake, because it plays such an important role in the function of the subtalar and mid tarsal complexes. The first metatarsal must be assessed in terms of sagittal plane position, particularly its comparative relationship to the other metatarsals. Its position in the transverse plane must be assessed as well, because any excessive adduction of the medial column should be compensated for during the surgical reconstruction.

SURGICAL PROCEDURES

There are a number of different procedures that are used in combination when addressing the severe cavo varus foot type. Digital surgery, involving interphalangeal joint fusion with relocation of the metatarsophalangeal joint, is quite appropriate. In addition, less significant tendon transfers may also be indicated, including the split tibialis anterior tendon transfer and/or the Hibb's tendo suspension. However, the mainstay of surgical procedures for the Stage III cavus foot are triple arthrodesis, the Cole osteotomy, and major tendon transfers.

Triple Arthrodesis

Triple arthrodesis is definitive and allows correction in multiple planes. It is an extensive procedure that, even in the best of hands, requires a significant postoperative period of morbidity, and can be associated with a variety of complications. Tenuta et al., in evaluating twenty four patients at a mean 14.2 years following triple arthrodesis, had several observations. First, they identified that 43% of the feet had degenerative changes at the ankle joint. Likewise, patient satisfaction strongly correlated

with the amount of residual deformity. Persistent pain and distance limitations were also strongly correlated with residual pes plano valgus deformity. Mulier et al. also did a follow up study on triple arthrodesis. They reviewed twenty five cases of triple arthrodesis in neuromuscular deformities. Eight of the twenty five patients had Charcot-Marie-Tooth disease. The mean age at surgery was nineteen, and the follow-up time was 3.8 years. It concluded that there was a less than favorable result in 28% of the cases. Pseudo-arthrosis nonunion was present in 8% of the feet. The presence of a varus deformity always resulted in a fair or poor result.

There are several elements of the cavus foot triple arthrodesis which make the procedure less difficult than other deformities. The lateral exposure is much simpler than it is with a flatfoot, as the lateral side of the talonavicular, calcaneocuboid and subtalar joints are more vertically oriented. A two incision approach, however, is certainly recommended for both exposure and fixation purposes. In addition, poor results with triple arthrodesis are correlated with either residual deformity or the presence of pes plano valgus, as mentioned above. Since it is easier to reduce the deformity in a cavus foot than it is in a flatfoot, the chance of having a good result following a triple arthrodesis in a cavus foot should be better than they are for a triple arthrodesis for a flatfoot.

Correction with the triple arthrodesis depends upon the apex of deformity. If the deformity has a significant anterior equinus component that is global in nature, then correction can be achieved by wedging of the midtarsal joint during fusion. In this case, very little bone is removed plantarly and much more bone is removed dorsally. If there is indeed a structural varus heel deformity, then the subtalar joint can be wedged in order to bring the heel into valgus. Wedging of the midtarsal joint can be used to correct for transverse plane adductus, as well as to de-rotate any frontal plane component. The security of internal fixation in a cavo-varus foot triple arthrodesis is also important. Since many of these patients have neurologic etiologies, it is particularly important that the fixation be stable in order to allow muscle re-education, which begins approximately six weeks postoperative. This can best be performed with large screw fixation, using a 6.5 millimeter screw in each of the three major joints. There may be room for two 6.5 millimeter screws in the subtalar joint. If the large 6.5 millimeter screw is not used for the talonavicular joint, then 2 points of fixation should be considered; for example, two 4.5 millimeter screws, a 4.5 and a 4.0 millimeter screw, addition of a staple, etc. The calcaneocuboid joint can be stabilized very effectively with staples and/or a Steinmann pin.

When triple arthrodesis is used in the severe cavus foot, it is usually indicated not only due to the severity of the deformity, but more likely out of the fear of progression of the deformity. Providing a stable foot in the neurologically impaired limb is an important goal of the triple arthrodesis.

Tendon Transfers

Major muscle transfers are an important part of reconstruction of the severe cavo-varus foot. Although any number of muscles can be transferred, most commonly these involve the tibialis posterior or peroneus longus. These muscles are most often transferred because they are often the primary deforming force and also because in the most common neurologic diseases for which we perform cavus foot surgery, these muscles remain strong for a long period of time. The tibialis posterior transfer is a more common one to perform. It has been described a variety of different ways, but the objective is to release the tibialis posterior from the navicular, pass it from the posterior compartment through the interosseous membrane, into the anterior compartment, and then anchor it to dorsum of the foot.

If the transfer is being performed in conjunction with a triple arthrodesis, then the medial incision approach will already be present. In that case, a six-inch length of suture is affixed to the end of the tibialis posterior after it has been released. A 4-5 inch incision is then made on the anterior leg. This incision is then deepened and the anterior compartment muscles are retracted laterally. The surgeon is then able to view the interosseous membrane, which separates the anterior and posterior compartments. At this point, a uterine packing forceps is used to pass the suture tag attached to the tibialis posterior, from behind the medial malleolus to the back edge of the interosseous membrane. The point at which the packing forceps is making contact with the interosseous membrane will be visible on the anterior interosseous membrane. An incision is made over this spot, and lengthened for

about an inch in each direction, in order to allow unrestricted motion and prevent fibrosis around the tendon. The suture is then grabbed through the anterior leg incision, and the tibialis posterior muscle is pulled through the interosseous membrane.

In order for this transfer to be successful, the surgeon needs to insure that the tibialis posterior is not sectioned on the talar head side of the talonavicular joint. You will need all possible length in order to make the transfer successful. At this point the surgeon has the option to either transfer the muscle to one central bony location in the midfoot region, or to split the tendon and anchor it to the tibialis anterior and the peroneus tertius. If the transfer is being performed in conjunction with a triple arthrodesis, the author's preference is to anchor the tendon to a central location in the midfoot region. There are a variety of good bone anchor systems available now, which will readily affix the tendon to the middle cuneiform region. It is important to insure that the tendon is passed below the extensor retinaculum in order to avoid having the tibialis posterior bow string on the front of the ankle.

The peroneus longus tendon transfer is another powerful pes cavus procedure. The peroneus longus is not as strong a muscle as is the tibialis posterior, but it can be an important deforming force. In this procedure, the peroneus longus is sectioned distally as it passes by the cuboid, and then retrieved on the lateral side of the leg. An incision is then made between the lateral and anterior compartments, and the tendon is passed down the anterior compartment where it can either be anchored directly to the midfoot, or split for transfer to the tibialis anterior and peroneus tertius.

When these muscle transfers are performed, it is often not only to address the cavus foot, but also to provide relief for a drop foot deformity associated with anterior group weakness. Before a decision on muscle transfers is made, however, it is important to determine the effect of the loss of the muscle. For example, loss of tibialis posterior will make it much more difficult for the foot to resist abductory compensation. If this is performed in conjunction with a triple arthrodesis, however, this will not be an important factor. Loss of the peroneus longus can result in very significant instability of the first ray.

Cole Osteotomy

The last major component for the significant cavus reconstruction is the Cole Osteotomy. The Cole is a midfoot osteotomy-fusion procedure. The medial column osteotomy passes through the navicular-cuneiform articulation and creates a fusion. The lateral column osteotomy is through the cuboid. The osteotomy is performed with a "V" shaped resection of bone, with the base of the triangle located dorsally. The osteotomy can be varied in order to allow for correction of other planes of deformity. A small amount of rotation around the longitudinal axis can also be performed at the same time. The surgical approach is through two incisions. The medial incision exposes the navicular-cuneiform area. The lateral side exposes the cuboid. The osteotomy is performed with power instrumentation, and the wedges of bone are removed with osteotomes. Fixation is generally achieved with Steinmann pins. If the plantar fascia is left intact, then the patient is allowed to bear weight around 4-6 weeks. Total casting time is somewhere between 8-12 weeks.

ALTERNATE PROCEDURES

Posterior group lengthening is rarely necessary in cavus foot surgery. Maintaining the strength of the heel cord is an important method of allowing the subtalar joint to compensate through pronation. The apparent equinus in cavus foot deformity is usually a result of the forefoot being plantarflexed on the rearfoot. It is uncommon for there to be a true rearfoot equinus. Nonetheless, there are occasions when there is a co-existing equinus deformity or spasticity associated with a severe cavo-varus foot type. Regardless, these situations are limited and should be carefully evaluated before pursuing surgical treatment for an apparent equinus deformity.

Steindler stripping or plantar fascial release, can also be an important part of cavus foot correction. In particular, this can be a highly effective procedure when performing procedures other than a triple arthrodesis. Usually there is enough shortening that occurs with a triple arthrodesis that a plantar fascial release is not necessary. However, the plantar fascia release can be used in conjunction with the Stage II type procedures, or even in conjunction with the Cole-type osteotomy. There is

no question that these procedures have a very significant and dramatic effect on the forefoot equinus component of the cavus deformity.

SUMMARY

Major cavus foot reconstruction can be accomplished using a variety of techniques. Triple arthrodesis is most commonly used for correction of very severe deformities in neurologic patients. It is particularly useful when the deformity is expected to be progressive and/or there is a need for multi-planar correction.

Major tendon transfers are important procedures in that they can remove a major deforming force in an area and be transferred to a position of correction. Most commonly, this involves the tibialis posterior and/or peroneus longus tendons. These major tendon transfers are usually performed in neurologic cavus feet. The Cole osteotomy is a very useful procedure for correction of forefoot equinus. It involves significantly less morbidity than a triple arthrodesis. Other adjunctive procedures include the Steindler stripping and plantar fascia release which can be used in combination with a variety of procedures to reduce forefoot equinus.

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