THE COLE OSTEOTOMY – INDICATIONS & TECHNIQUE

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INTRODUCTION

Pes cavus is a sagittal plane equnius of the forefoot on the rearfoot. In pure terms, pes cavus is a sagittal plane deformity, however, in most instances pes cavus also exhibits a degree of frontal and transverse plane angular components. Cavovarus, cavo-adducus, or cavo-adducto-varus are used to describe the predominant features of most deformities.

Symptomatic pes cavus is a result of poor shock absorption due the rigidity that accompanies the deformity, and patients are more prone to developing stress injuries to either the soft tissues (plantar fasciitis) or bone structures (5th metatarsal base fracture). Compensation occurs within the plane of the deformity, such that most pes cavus deformities are fully-compensated with a plantigrade foot. This is due to the normally large available range of motion in the adjacent ankle joint, which can easily accommodate even severe sagittal plane contractures. Transverse plane adduction is generally well-tolerated with external rotation of the hip, however, severe pes valgus can result in the difficult to treat "Z" foot or skewfoot. Frontal plane valgus is poorly-tolerated regarding the ability to compensate within the foot. Therefore, it is not uncommon for a valgus foot contracture to cause ankle varus instability.

Conservative management of severe cavus deformities can be challenging at best. Above-ankle bracing is usually required and may not be able to accommodate the most severe of deformities, due to the rigidity that accompanies this foot type.

Surgical management of the pes cavus foot involves forefoot, midfoot, and rearfoot/ankle procedures, depending on the severity of the deformity and the dominant plane(s) of contracture. Digital IP joint fusions remain the pillar of treatment for extensor contracted hammertoes. Forefoot valgus can cause reducible heel varus, which is amenable to a dorsiflexing osteotomy of the first metatarsal (DFWO). Fixed heel varus is addressed through a lateral wedge osteotomy of the calcaneus (Dwyer). Midfoot sagittal plane contractures are adequately addressed with a midfoot osteotomy/arthrodesis (Cole), while complex tri-plane deformities of the hindfoot usually require a triple arthrodesis in addition to other forefoot balancing procedures. Ankle instability can be addressed with ligament repair if arthrosis is not severe, and as an adjunct to other corrective procedures. End-stage ankle arthritis in the pes cavus foot usually requires an ankle or pantalar arthrodesis.

COLE OSTEOTOMY

The Cole osteotomy is actually a combination osteotomy and arthrodesis procedure. The procedure is intended to address a pes cavus foot type that has its apex of deformity within the midfoot, and is most powerful to correct deformities within the sagittal plane. To a lesser extent, the Cole osteotomy/arthrodesis can address transverse and frontal components of the deformity. The basis for correcting sagittal plane pes cavus within the midfoot lies in the removal of a wedge of bone across the dorsum of the foot, thereby allowing a plantar hinge to support a controlled collapse of the arch.

Technique

Patient position is supine on the operating table, and a below knee tourniquet is utilized for hemostasis. A 2-incision approach proves well-suited for the procedure, both longitudinal over the apex of the deformity, slightly curving in the direction of the deformity, medial and lateral. The medial incision extends from the talonavicular joint to the metatarsal-cuneiform joint, at the dorsomedial aspect of the foot, one-fourth way down the medial bisection of the bony structure of the medial arch. The lateral incision is high on the cuboid, one-fourth way down its lateral bisector, from the calcaneocuboid joint to the cuboid-metatarsal joints.

On the medial side of the foot, one will encounter the medial marginal vein and its tributaries, the tibialis anterior tendon, periosteum and joint capsule, and bone. The tibialis anterior tendon is usually able to be retracted inferiorly and need not be sectioned in the majority of instances. Laterally, one must take care to retract the superficial peroneal nerve and its branches. Next one encounters the deep fascia over the extensor digitorum brevis muscle, which is longitudinally divided. Regarding the muscle, individual preference is to either longitudinally split the muscle, retract it superiorly, or divide and later repair it, all of which have been done by the author with equal success.

Access to the bone is critical for both adequate visualization and ease of bone wedge removal. On the medial side of the foot, one should target the naviculo-cuneiform joint line, and use the joint space as a pocket from which to dissect both proximally and distally, directly on the bone. It is important to completely dissect the dorsal ligaments off all three cuneiform bones and its adjoining navicular surfaces. The author utilizes a Freer elevator to achieve the necessary suspension of the ligaments that are subsequently released with the scalpel. On the lateral side of the foot, one can make a vertical incision through the periosteum after retracting the extensor brevis muscle. It is also common to encounter the Venous Plexus of Ruch in this dissection and attention to its hemostasis is recommended. Periosteum needs to be reflected from the bone both proximally and distally, enough to be able to identify the dorsal calcaneocuboid joint proximally, as well as the cuboid-metatarsal joints, without causing joint instability due to over-dissection of the supporting ligaments.

On both sides of the foot, the dissection needs to focus on the dorsal aspect of the bone/joints, and little attention should be spent on the plantar ligaments. Dissection of the plantar ligaments should be discouraged as this is the structure that is relied upon to support the bone wedge and aid in providing dorsal compression. A clear ability to see a dorsal-wedge point of access is imperative to being able to make an accurate osteotomy.

The author inserts a K-wire in the cuboid, from dorsal to plantar, in the exact center of the bone. Then attention is shifted medially where the first cuts are made. With adequate retraction, a transverse cut is made through the navicular from medial to lateral, wider dorsally, aiming just proximal to the K-wire. A long blade is necessary to achieve these long cuts (38+ or 40). Next, a second cut is made through the cuneiforms, again from medial to lateral, wider dorsally, aiming laterally and just distal to the K-wire in the cuboid. The initial goal for the total dorsal wedge removal is 1.0 - 1.5 cm. Osteotomes are used to release the bones, and a curette and curved osteotome are used to pry the bone wedges out the medial incision. It can be difficult to remove the lateral cuneiform wedge from the medial incision, in which case it can be removed later from the lateral side of the foot.

With retraction now directed to the lateral incision, 2 cuts are then made in the cuboid, from lateral to medial, wider dorsally and converging plantarly, on either side of the K-wire. Again, the goal of the dorsal wedge resection should approximate that of the medial side, unless the frontal or transverse planes need to be corrected as well. In the case of metatarsus adductus, a smaller medial wedge will allow for abduction of the forefoot on the rearfoot. In the case of forefoot valgus, rotation motion will be available through the arthrodesis site since the osteotomy is through-and-through the entire mid-foot. Additional reciprocal planning is utilized to achieve the desired final position and degree of correction.

A strong dorsiflexion force can be placed on the osteotomy/arthrodesis site with little concern of plantar displacement. It is due to the inherent stability of this osteotomy/arthrodesis that little fixation is necessary to maintain good bone-to-bone contact and stable alignment. The author fashions thin wire staples from 1.1mm K-wires, inserting one laterally and one or two medially. Care should be taken to avoid placement of fixation into the calcaneocuboid or cuboid-metatarsal joints, as the remaining section of bone on either side of the osteotomy is thin and narrow.

The tourniquet is released prior to closure and hemostasis is aided with an injectable local anesthetic containing epinephrine. Layered wound closure is performed using absorbable suture, the suture lines reinforced with steri-strips, and the foot is dressed with a layered gauze/kling wrapping. A short-leg, well-molded, fiberglass cast is then applied.

Postoperative Care

In most cases, this type of surgery is done as an out-patient and pain management includes a combination use of long- and short-acting oxycodone preparations. Ice and elevation aids in edema control and pain management. The patient is maintained nonweight bearing for a 6-week course. The cast is checked 1 week following surgery, and removed at the 6-week mark following. Radiographs are utilized to assess bone consolidation, however, routinely this osteotomy/arthrodesis procedure heals timely such that most patients are ready to begin progressive ambulation at this time. The patient is placed in a cam walker and seen again in 3 weeks. At 9 weeks following surgery, if the patient is comfortable bearing full weight in the cam walker, and if radiographs confirm solid consolidation and bone remodeling, they are permitted to advance to unprotected ambulation in regular shoes. A compressive sleeve from the forefoot to above the ankle will aid in edema control. Repeat visits at 6 and 12 months following surgery allow for full assessment of the surgical result and confirm patient progress to full activities.

SURGICAL TECHNIQUE

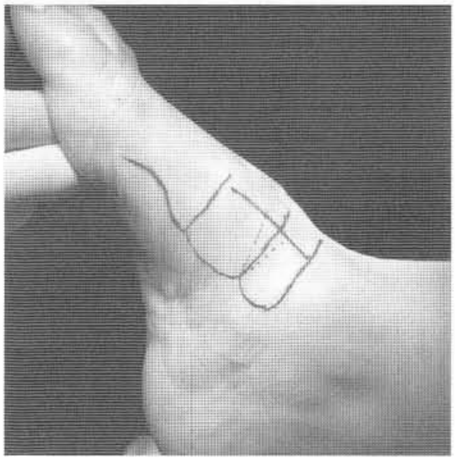

Figure 1. Dorsal-medial incision, from the talo-navicular joint to the cuneiform-metatarsal joint.

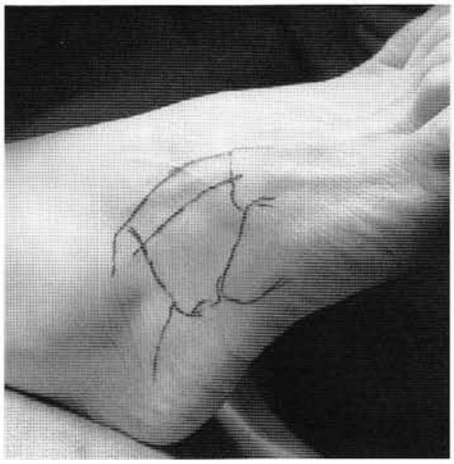

Figure 2. Dorsal-lateral incision, from the calcaneo-cuboid joint to the cuboid-metatarsal joint.

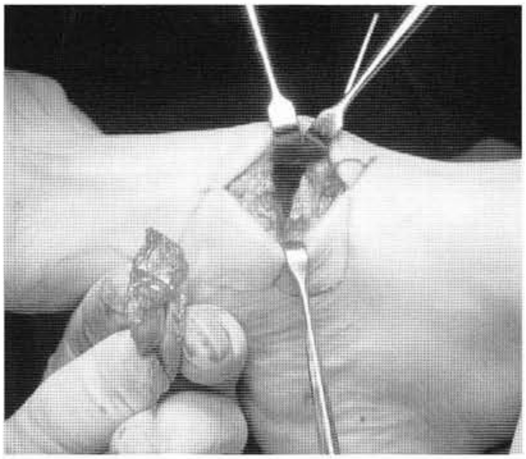

Figure 3. Medial bone cuts at arthrodesis site.

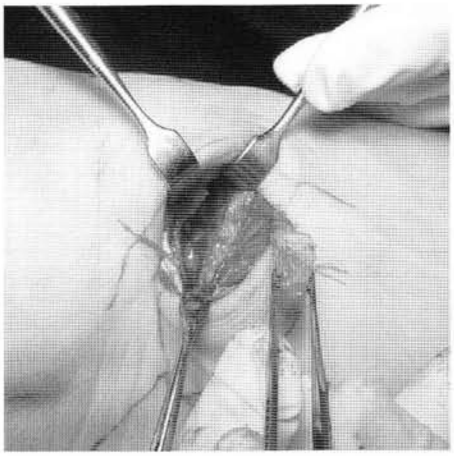

Figure 4. Lateral cuboid osteotomy.

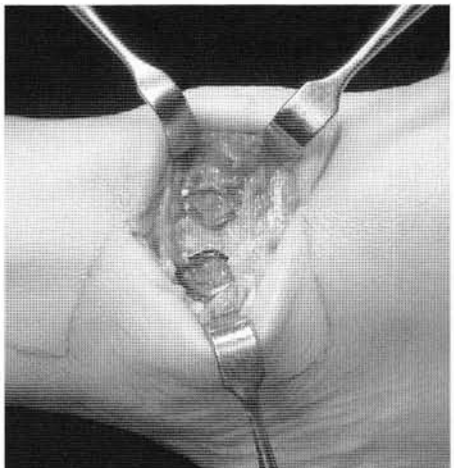

Figure 5. Medial bone fixation.

Figure 6. Before lateral weightbearing radiograph.

Figure 7. After lateral weightbearing radiographs.

Figures 8. Preoperative clinical appearance.

Figure 9. Appearance after arch reduction.