COLE OSTEOTOMY

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INTRODUCTION

The deformity of pes cavus was first specifically identified by Little in 1853.[1] Since that time, numerous classification schemes and surgical procedures have been devised for its assessment and treatment.

Anterior tarsal resection was initially described by Saunders[2] in 1935. He described a dorsally-based wedge resection through the naviculocuneiform joints, extending laterally through the central portion of the cuboid. The procedure was subsequently reported and popularized by Cole[3] in 1940, and the procedure now bears his name.

Although its indications are limited, the Cole osteotomy has a definite place in the surgical management of the pes cavus deformity. This paper will review the indications, associated procedures, surgical technique, postoperative course, and results of the Cole osteotomy.

INDICATIONS

Prior to surgical intervention, a thorough history and physical examination must be performed on any patient with a pes cavus deformity. This assessment should include a family history review, and a neurological examination including muscle testing. Brewerton et al.[4] reported that 62 of 77 (81%) of the patients presenting at their pes cavus clinic showed evidence of neuromuscular disease, or a family history of pes cavus. If necessary, neurologic consultation should be considered.

Since the Cole osteotomy preserves the midtarsal and subtalar joints, these joints may undergo further deformation in a patient with a dynamic or progressive cavus foot deformity. Therefore, the Cole osteotomy is primarily indicated for patients with a static or non-progressive pes cavus deformity, that is preferably idiopathic in origin.

Japas[5] described 3 types of cavus deformities: (1) anterior pes cavus, characterized by plantarflexion of the forefoot on the rearfoot; (2) posterior pes cavus, constituting a dorsiflexed attitude of the calcaneus; and (3) combined pes cavus, which is a combination of anterior and posterior pes cavus. He further divided anterior pes cavus into 2 types, global anterior cavus (i.e., plantarflexion of the entire forefoot), and local anterior cavus (i.e., plantarflexion of the first ray only).

McGlamry and Kitting[6] further divided anterior pes cavus into 4 types: (a) metatarsus cavus, or excessive plantarflexion occurring at Lisfranc's joint; (b) lesser tarsus cavus, or plantarflexion occurring over the lesser tarsal bones; (c) forefoot cavus, or excessive plantarflexion occurring at Chopart's joint; and, (d) combined anterior cavus, or plantarflexion occurring at two or more of the aforementioned areas. Thus, anterior pes cavus is primarily a sagittal plane deformity. The Cole osteotomy corrects mainly in the sagittal plane, and is primarily indicated for an anterior cavus deformity. In the strictest terms, it is indicated for a global anterior cavus or lesser tarsus cavus.

The apex of an anterior pes cavus deformity can be assessed both clinically and radiographically.[7] Clinically, a patient with lesser tarsus cavus has a generalized prominence over the dorsum of the lesser tarsus. (Figure 1) Often the patient complains of irritation to this part of the foot in closed shoes, and has difficulty fitting shoes. Radiographically, the apex of the cavus deformity is in the lesser tarsus. Meary's angle, or the angle formed by lines drawn through the centers of the longitudinal axes of the talus and first metatarsal on a lateral weight-bearing radiograph, can be used. The intersection of these lines occurs roughly at the apex of the cavus deformity. (Figure 2) Simi-

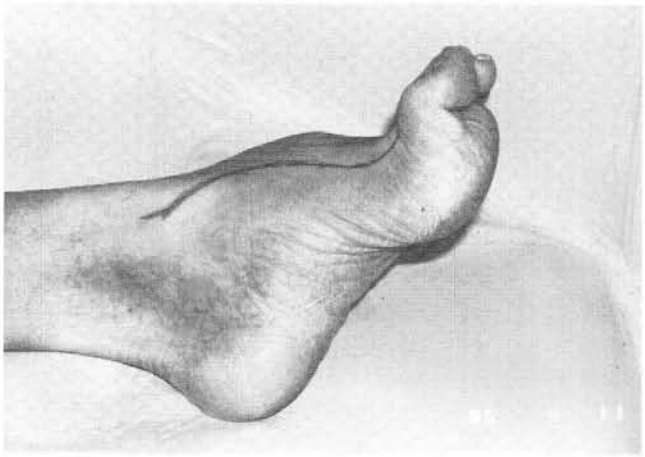

Figure 1. Clinical example of a patient with anterior global cavus with the apex at the lesser tarsus (i.e., a lesser tarsus cavus deformity).

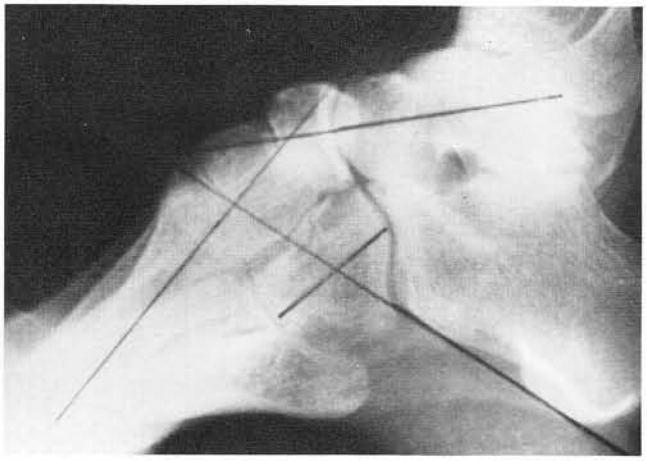

Figure 2. Demonstration of Meary's and Hibb's angles. Note that for both angles, the lines forming each angle intersect in the lesser tarsus. This patient has an anterior global cavus with the apex at the lesser tarsus (i.e., a lesser tarsus cavus deformity).

larly, Hibb's angle, or the angle formed by lines representing the longitudinal axes of the calcaneus and first metatarsal on a lateral weightbearing radiograph, can be used. Again, the intersection of these lines is thought to occur at the apex of a pes cavus deformity.[8] (Figure 2) When the apex of the deformity occurs near the naviculocuneiform joints, or over the lesser tarsus, the Cole osteotomy may be considered.

The Cole osteotomy is primarily indicated for a non-progressive, global anterior or lesser tarsus pes cavus deformity. It may also be combined with other procedures for a patient with a pes cavovarus deformity or combined anterior cavus deformity.

ASSOCIATED PROCEDURES

Some authors have condemned the Cole osteotomy in the past due to its ability to achieve only sagittal plane correction. However, the osteotomy may be combined with other procedures to achieve multiplanar correction. For example, the Cole osteotomy is often combined with a Dwyer calcaneal osteotomy (i.e., a lateral closing wedge osteotomy of the calcaneus) to correct a rigid cavovarus deformity. If a metatarsus primus equinus deformity is seen in combination with a lesser tarsus cavus deformity, the Cole osteotomy may be combined with a dorsiflexory base wedge osteotomy of the first metatarsal or similar elevating procedure for the first ray.

In some instances, multiplanar correction can be achieved by modifying the Cole osteotomy. Alvik[9] suggested broadening the medial cuneiform-navicular wedge to correct a concomitant metatarsus primus equinus deformity. Saunders,[2] in his initial description of the osteotomy, described correction of a cavoadductus deformity by widening the resection laterally.

Finally, when performing the Cole osteotomy, a plantar fascia release or Steindler stripping (i.e., release of the plantar fascia and intrinsic plantar musculature) may occasionally be necessary to allow complete correction and closure of the osteotomy. Saunders[2] found a plantar fasciotomy to be necessary in only 9 of 102 (8.8%) cases. Leal and associates[8] routinely combined a Steindler stripping and peroneus longus tendon lengthening in their 8 reported cases. The author has not found plantar release to be routinely necessary when performing the Cole osteotomy.

SURGICAL TECHNIQUE

Anterior tarsal resection is performed under spinal or general anesthesia with the use of a mid-thigh pneumatic tourniquet. (Figure 3A) Two incisions are typically used, one medial and one lateral. Alternatively, a single dorsal incision may be used, if desired. The medial incision is 4 to 8 centimeters in length, and is placed just medial to the tibialis anterior's insertion to the first metatarsocuneiform joint area, and centered over the medial cuneiform-navicular articulation. The incision is deepened in blunt fashion and punctilious hemostasis obtained. The saphenous nerve, if

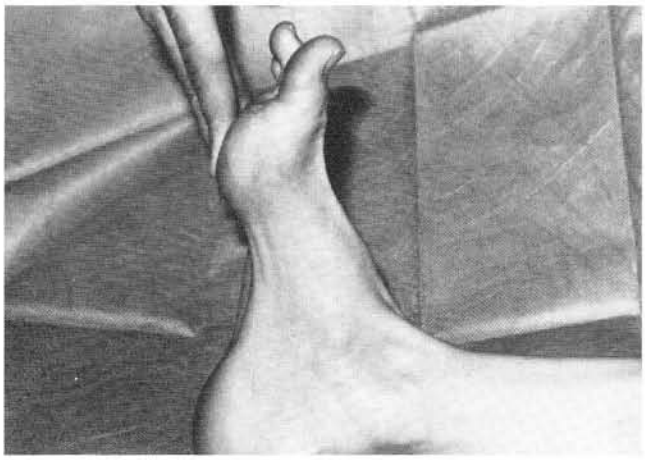

Figure 3A. Preoperative appearance of a patient with cavovarus deformity.

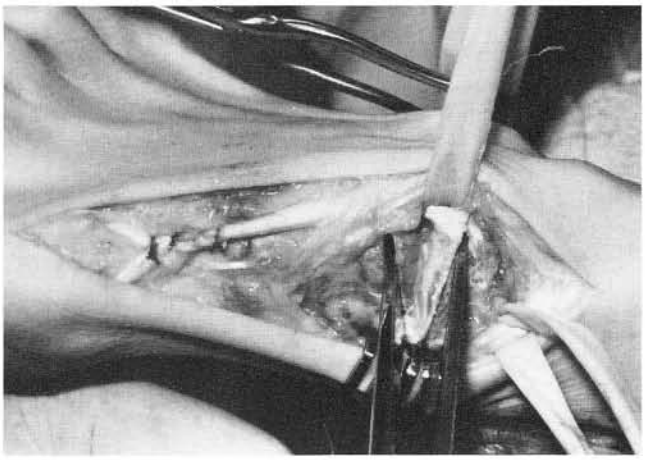

Figure 3B. Anterior wedge resection through the naviculocuneiform joints. Note that a Jones' tenosuspension is being performed simultaneously.

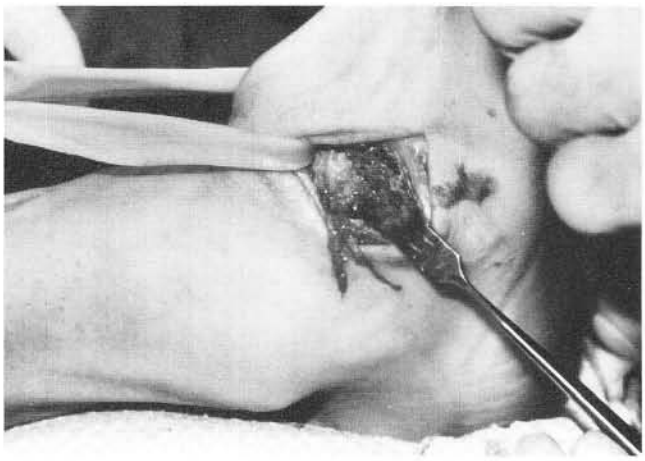

Figure 3C. Lateral incision for wedge resection from the cuboid.

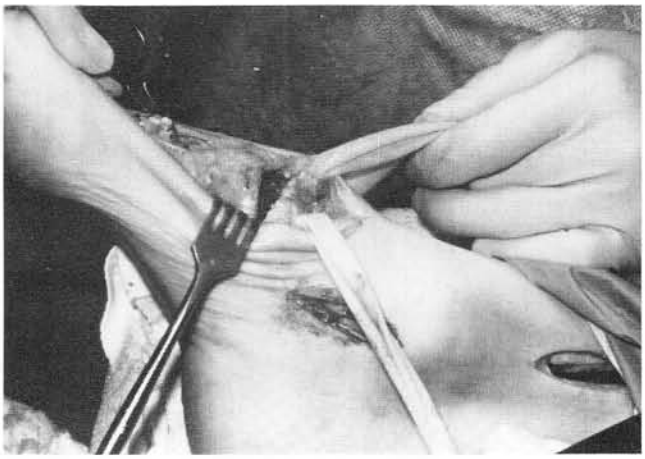

Figure 3D, 3E. Appearance after the wedge resection is complete.

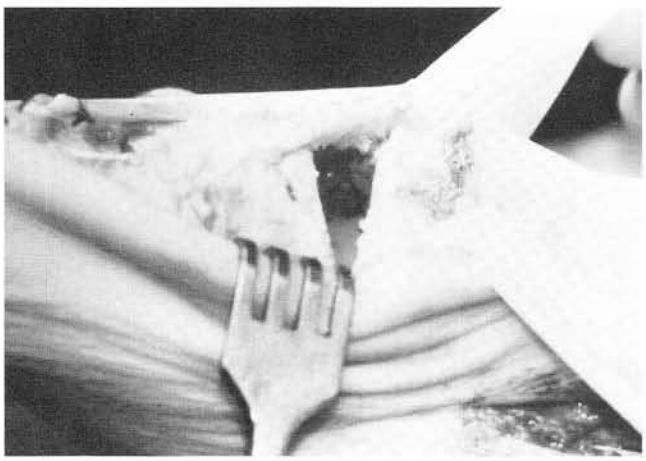

Figure 3E.

encountered, is retracted with a small vessel loop. The deep fascia, periosteum, and joint capsule of the medial cuneiform-navicular joint are then sharply incised, and the joint exposed. The tibialis anterior may occasionally need to be partially detached from its insertion, and is retracted dorsolaterally. Attention is then directed laterally where a 4 to 6 centimeter, slightly curvilinear, incision is made dorsal to the peroneal tendons, over the body of the cuboid. Dissection is carried deep, again in blunt fashion, and hemostasis obtained. If exposed, the lateral dorsal cutaneous nerve is gently retracted. The deep fascia and periosteum are then incised, exposing the lateral cortical wall of the cuboid. If desired, Crego elevators may then be utilized to create a sub-periosteal channel from medial to lateral, connecting the 2 incisions.

With appropriate retraction, a dorsally-based wedge osteotomy is then performed through the naviculocuneiform joints via the medial incision. (Figure 3B) The proximal cut through the navicular is made perpendicular to the longitudinal axis of the talus. The distal cut through the cuneiforms is made perpendicular to the longitudinal axis of the first metatarsal. In this fashion, the cuneiform cut is usually oriented from dorsal-distal to plantar-proximal. Both cuts are made through-and-through without maintaining a plantar hinge. Care is taken to avoid inadvertent cuts through the cuboid or calcaneus laterally. The wedge of bone created is then removed in toto.

Attention is then directed laterally, and a dorsally-based wedge osteotomy is made through the central portion of the cuboid. (Figure 3C) Once this wedge has been removed, the osteotomy is assessed. (Figure 3D, 3E) The osteotomy usually requires some "feathering" or reciprocal planing to reduce uneven surfaces and completely close the osteotomy. Intraoperative radiographs may be taken, if desired. Once adequate correction has been achieved, and the osteotomy is closed, it is fixated with two 1/8" Steinmann pins. The first pin is typically oriented to stabilize the cuneiformnavicular arthrodesis site by driving it from distal to proximal from the first intermetatarsal space. The second pin is then oriented to stabilize the cuboid osteotomy. A closed suction drain may be inserted if desired, but is usually not necessary if the Cole osteotomy has been performed alone. If it was reflected, the tibialis anterior tendon is repaired.

The deep fascia, subcutaneous tissue, and skin are then closed in layer fashion. Adhesive surgical strips, saline moistened sponges, a dry sterile dressing, and a below-knee Jones' compression cast are then applied.

POSTOPERATIVE CARE

The Jones' compression dressing is maintained until the first dressing change at 3 to 5 days postoperative. The patient is then placed in a below-knee synthetic cast. The patient is maintained non-weight bearing for 6 to 8 weeks in the cast, followed by another 4 to 6 weeks in a weight-bearing cast. The pins are usually removed at 8 to 12 weeks, when evidence of osseous consolidation is observed on radiographs. (Figures 4A - 4C)

Figure 4A. Preoperative lateral radiograph of the patient depicted in Figure 3.

Figure 4B. Postoperative AP radiograph, 1 year following Cole osteotomy combined with a Dwyer calcaneal osteotomy, Jones' tenosuspension, and tibialis posterior tendon transfer with screw/washer fixation.

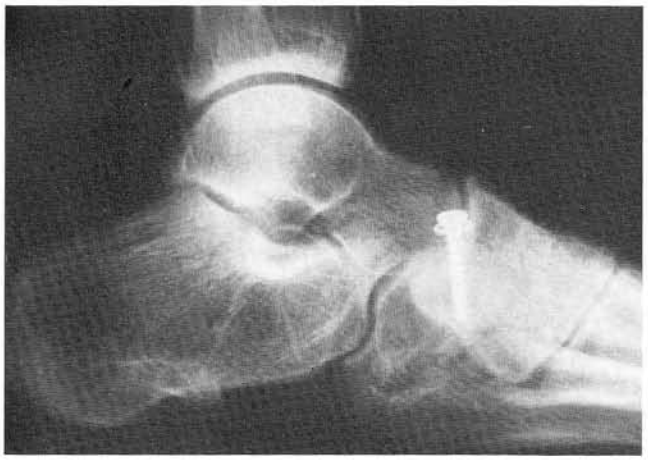

Figure 4C. Lateral radiograph, 1 year postoperative.

The cast is removed after 3 months, and physical therapy is instituted. Compression stockings are maintained until the patient is walking without pain or edema. Long-term, the patient is fitted for functional orthoses and is instructed to wear appropriate shoes.

RESULTS

When performed for the proper indications, the Cole osteotomy is a very successful procedure. Reports of the procedure's technical difficulty, poor cosmetic appearance, high incidence of delayed union or nonunion, and poor postoperative function are empirical and inconsistent with the good results reported in long-term follow-up studies.[1,10] Saunders[2] reported his results in 102 operations in 86 patients. With a minimum follow-up of 2 years, he found 59 (58%) excellent and good results (no residual cavus deformity, flexible foot with good ankle joint dorsiflexion, and no pain or limp), 41 (40%) fair results (slight stiffness or nonelastic gait, limited ankle joint dorsiflexion, or residual cavus deformity), and 2 (2%) poor results (unstable laterally). Radiographic evaluation of his cases revealed complete boney union in all but 2 cases.

More recently, Leal et al.[8] reported good results in 8 cases performed on 6 patients. The author has utilized the Cole osteotomy for the past 5 years with consistently good results as well. No long-term problems with midtarsal joint function, widening or shortening of the foot, or cosmesis have been reported.

SUMMARY

Anterior tarsal resection, better known as the Cole osteotomy, is a surgical procedure with strict indications. However, when performed for the patient with non-progressive, anterior global cavus with the apex in the lesser tarsus, the procedure has very gratifying subjective and objective long-term results. Further, the procedure may be modified or combined with other procedures to achieve multiplanar correction in the pes cavus foot.

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ADDITIONAL REFERENCES

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