CHAPTER **32**

COTTON OSTEOTOMY: Technique and Complications

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INTRODUCTION

The Cotton osteotomy is a medial cuneiform opening wedge osteotomy with the wedge based dorsally to plantarflex the medial column (1). It has been traditionally used in conjunction with other procedures to correct a pes planovalgus foot with forefoot varus deformity. The author most commonly uses the procedure as an adjunct to an Evans calcaneal osteotomy and gastrocnemius recession for correction of a flexible pediatric pes planovalgus deformity. The Cotton osteotomy has additionally been used for hallux limitus, metatarsus primus elevatus, as an additional procedure in adult flatfoot correction, and forefoot supinatus. Alternatives to this procedure include any variety of medial column fusions such as a naviculocuneiform joint arthrodesis or first metatarsocuneiform joint arthrodesis, a plantarflexory first metatarsal osteotomy, or soft tissue medial arch reconstruction.

Advantages to the Cotton osteotomy compared to the latter list of procedures is its simplicity, reliable results, ease of intraoperative adjustability, and preservation of the medial column joints (2, 3). In addition, the Cotton osteotomy lengthens the medial column as opposed to the shortening that occurs typically with arthrodesis procedures. There are few documented complications with the Cotton osteotomy, and the author's own experience corresponds to this. However, the author has experienced a few instances of complications in the use of this procedure. These instances as well as previously documented complications will be reviewed in this update.

PROCEDURE

The procedure is performed with the patient in a supine position. Typically, a posterior lengthening (gastrocnemius recession or tendo-Achilles lengthening) and the primary corrective procedure (Evans calcaneal osteotomy, subtalar joint fusion, etc.) are performed first. The surgeon will then place the subtalar joint in a neutral position and evaluate the medial column stability and position. Once the surgeon has decided to correct any residual forefoot varus with the Cotton osteotomy, the incision is planned. A variety of incision placements have been described including a medial, dorsomedial, or dorsal linear incision overlying the medial cuneiform. The author's preference is to make a linear dorsal to dorsomedial incision 3-4 cm in length overlying the medial cuneiform. Anatomic dissection is performed to avoid the medial dorsal cutaneous nerve and the saphenous (medial marginal) vein and nerve. Perforators of the medial marginal vein may be encountered and ligated as necessary and then the medial marginal vein is retracted laterally (4). A linear capsular-periosteal incision just medial to the extensor hallucis longus tendon is made with care not to disrupt the dorsal ligaments of the adjacent joints and the tibialis anterior tendon that will be just medial and plantar to the planned osteotomy (2).

A variety of methods can be utilized to identify the first metatarsocuneiform and naviculocuneiform joints to ensure that the osteotomy will be extra-articular. These include palpation of these joints and the second metatarsocuneiform joint, use of a 25 or 27 gauge needle inserted into the joints, and intraoperative C-arm fluoroscopy. The level of the osteotomy is best placed, in the author's opinion, just proximal to the level of the second metatarsocuneiform joint.

Although others have suggested that the second metatarsocuneiform joint level allows easier mobilization of the osteotomy, one of the complications the author has experienced is that of interposition of the graft into the second metatarsocuneiform joint requiring surgical re-intervention. The transverse osteotomy is than created using a sagittal saw from dorsal to plantar paralleling the first metatarsocuneiform joint (not parallel to the weightbearing surface) while taking care to preserve the medial cuneiform's plantar cortex (Figure 1).

Complete visualization of the medial and lateral edges of the medial cuneiform are necessary to ensure both the medial and lateral cortices are cut prior to attempted opening of the osteotomy (Figure 2). If one of these cortices fail to be cut, than the plantar hinge may fracture into the proximal or distal joint when the osteotomy is opened (4). Once the cut is performed, the osteotomy can then be opened a variety of ways including osteotomes, a Synthes mini-distractor, a Weinraub distractor (Innomed, Savannah, GA), or smooth lamina spreader (2). The author prefers using either the mini-distractor or Weinraub distractor, which allows pin placement distal and proximal to the osteotomy. This allows adjustability of distraction to intraoperatively determine the amount of desired

Figure 1. Dorsomedial skin and periosteal incisions have been performed exposing the dorsal surface of the medial cuneiform. The transverse lines on the skin were marked using intraoperative fluoroscopy at the proximal and distal adjacent joints to help orient the osteotomy.

Figure 2. The completed osteotomy with care taken to cut both the medial and lateral cortices while maintaining the plantar cortex.

plantarflexion for deformity correction and it offers an unobstructed view for measurement of the desired graft width/dimensions once that has been determined. It also allows an easier insertion of the graft by opening the osteotomy slightly greater than the planned graft upon insertion. The dimensions of the graft determine the amount of plantarflexion achieved.

The general idea is to re-establish weightbearing of the first metatarsal head equal to the fifth metatarsal head as dictated by Cotton's concept of the foot as a tripod (1). The graft is tamped into the osteotomy with care taken to not enter the second metatarsocuneiform joint or bury the dorsal cortex of the graft past the dorsal edge of the medial cuneiform (Figure 3). The author typically uses a freeze-dried iliac crest wedge allograft (usually left over from an Evans procedure) cut to the desired dimensions (typically 4-8 mm at the dorsal wedge base tapering plantarly in a trapezoidal manner) for correction with the cortex based dorsally, although autograft could certainly be used as the surgeon feels appropriate. It has been the experience of the author as well as others that graft incorporation is typically not a problem with freeze-dried allograft (5), although it has been observed that time to incorporation may be prolonged in adult patients (8-16 weeks, average 12) compared to pediatric patients (6-8 weeks)(6).

Figure 3. The osteotomy was opened with osteotomes and the graft impacted into place.

The graft may be remodeled after placement as needed. Typically, the graft is driven from a dorsal to plantar direction for plantarflexion, however, it may be driven dorsomedially as an attempt to provide some transverse intermetatarsal correction for a bunion as well as plantarflexion (4). Fixation is typically not necessary if the graft press fits well into the osteotomy site. Options for fixation, if desired by the surgeon, could include a Kirschner wire, staple, screw, or two- or three-hole plate. Only when the graft does not appear to tightly oppose the adjacent bone has the author used fixation (Figure 4). The author recommends intraoperative fluoroscopy to review graft placement prior to soft tissue closure, which is performed in layers. A non-weightbearing below-knee cast is applied postoperatively until time of graft incorporation, which as noted earlier, may be longer in adults.

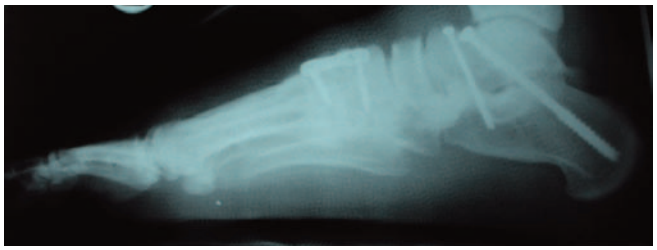

Figure 4. A 2-hole "peanut" plate was used to stabilize the Cotton allograft wedge in this adult patient. Intra-operatively, there appeared to be a slight gap at one of the bone to graft interfaces and therefore the area was compressed and stabilized with the plate as shown. Of note, this was a case with iatrogenic first ray shortening and elevation after a Lapidus procedure. The Cotton procedure both plantarflexed and lengthened the medial column.

COMPLICATIONS

Complications can result from surgeon error performing the procedure such as proper patient selection, joint violation, undercorrection with lateral foot pain, overcorrection with sesamoid pain or plantar fasciitis, and dissection-related such as saphenous vein or nerve disruption or tendon disruption. Delayed union is common with the adult population compared to the pediatric population, but nonunion has rarely been reported (4, 6). Other complications can include bone graft displacement either dorsally or into the second metatarsocuneiform joint and bone graft collapse with loss of correction, which are also rare.

Relatively few complications have been documented with the Cotton procedure or experienced by the author; however the author has experienced a few complications that serve to emphasize the importance of each surgical step in the above described procedure. The first case was a pediatric pes planovalgus correction in which the Cotton osteotomy was created more perpendicular to the foot than the orientation of the first metatarsocuneiform joint, therefore the osteotomy came close to entering the inferior aspect of the joint. The patient had some transient tenderness to this area postoperatively, but this eventually resolved with orthotics. The author now double checks the proposed orientation of the osteotomy and location of the adjacent joints with C-arm fluoroscopy prior to the performance of the osteotomy. The second case was also a pediatric pes planovalgus correction in which the graft on the initial postoperative films appeared to be well-placed. Two weeks postoperatively, the patient reported a fall in the bathroom and radiographs demonstrated interposition of the graft into the second metatarsocuneiform joint (Figure 5). This patient was taken back to surgery that day, the graft was repositioned with little difficulty, and the graft ultimately incorporated uneventfully. Lastly, a third patient for pediatric pes planovalgus correction was noted to have interposition of the graft into the second metatarsocuneiform joint on intra-operative fluoroscopy (Figure 6). The graft was repositioned intra-operatively with no complications postoperatively. Because of these latter two cases of graft interposition into the second metatarsocuneiform joint, the author now performs the osteotomy proximal to the second metatarsocuneiform joint to avoid this complication, which also provides some lateral stability to the graft wedge.

Figure 5. Postoperative radiograph demonstrating displacement of the graft wedge into the second metatarsocuneiform joint.

It should be emphasized that proper patient selection is key to the success of the procedure, particularly if the patient has arthritis or medial column instability at the

Figure 6. Intra-operative fluoroscopy showed interposition of the graft into the second metatarsocuneiform joint after graft impaction. The graft was then repositioned which was confirmed with fluoroscopy.

talonavicular, naviculocuneiform, and/or the first metatarsocuneiform joints. In this instance, a Cotton osteotomy may worsen any faulting or fail to provide adequate medial column stability (3, 4, 7). In these cases, it would be more appropriate to perform a medial arch tendosuspension or arthrodesis depending on the particular issue. A recent study in 2011 by Lutz and Myerson evaluated the results of 81 Cotton osteotomies as an adjunct to a variety of procedures (8). They reported 10 "adverse" effects attributed to the Cotton osteotomy: three painful screws (resolved with screw removal or padding), two painful medial cuneiform exostoses (resolved with exostectomy or padding), one painful sesamoid (resolved with orthotics), one plantar fasciitis (resolved conservatively), two fifth metatarsal overloads (resolved with orthotics), and one developed a recurrent flatfoot (resolved after medial calcaneal displacement osteotomy). The high incidence of painful fixation led the authors to abandon the routine use of fixation. They reported no nonunions or malunions and no adjacent joint arthritis. They felt that the plantar fasciitis and sesamoid complications were secondary to over-plantarflexion of the medial column and the fifth metatarsal overload as essentially undercorrection of the Cotton osteotomy (8).

CONCLUSION

The Cotton osteotomy is a medial cuneiform opening wedge osteotomy used primarily to plantarflex the medial column. It is a powerful procedure that is simple, quick, reproducible, and with very few documented complications. A review of the author's personal instances of complications as well as previously documented complications have been presented.

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