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Original Research

Cotton Osteotomy in Flatfoot Reconstruction: A Review of Consecutive Cases

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ABSTRACT

The Cotton osteotomy or opening wedge medial cuneiform osteotomy is a useful adjunctive flatfoot reconstructive procedure that is commonly performed; however, the outcomes are rarely reported owing to the adjunctive nature of the procedure. The Cotton procedure is relatively quick to perform and effectively corrects forefoot varus deformity after rearfoot fusion or osteotomy to achieve a rectus forefoot to rearfoot relationship. Proper patient selection is critical because the preoperative findings of medial column joint instability, concomitant hallux valgus deformity, or degenerative joint disease of the medial column might be better treated by arthrodesis of the naviculocuneiform or first tarsometatarsal joints. Procedure indications also include elevatus of the first ray, which can be a primary deformity in hallux limitus or an iatrogenic deformity after base wedge osteotomy for hallux valgus. We undertook an institutional review board-approved retrospective review of 32 consecutive patients (37 feet) who had undergone Cotton osteotomy as a part of flatfoot reconstruction. All but 1 case (2.7%) had radiographic evidence of graft incorporation at 10 weeks. No patient experienced graft shifting. Three complications (8.1%) were identified, including 2 cases with neuritis (5.4%) and 1 case of delayed union (2.7%) that healed with a bone stimulator at 6 months postoperatively. Meary's angle improved an average of 17.75°, from −17.24°± 8.00° to 0.51°± 3.81°, and this change was statistically significant ($p < .01$). The present retrospective series highlights our experience with the use of the Cotton osteotomy as an adjunctive procedure in flatfoot reconstructive surgery.

Pes valgus or flatfoot deformity is defined by pathologic pronation or a decreased longitudinal arch and can include varying degrees of ankle equinus, rearfoot valgus, midfoot abduction, and forefoot varus. Multiple combinations of both soft tissue and osseous procedures can be performed for the correction of pathologic flatfoot conditions. Ankle equinus is treated with Achilles lengthening or gastrocnemius recession. Rearfoot valgus is treated with medial displacement calcaneal osteotomy (1), talonavicular fusion, or subtalar joint fusion. The Evans opening wedge calcaneal osteotomy provides multiplanar correction of the rearfoot, midfoot, and forefoot (2). Adjunctive medial column procedures are typically necessary to restore a plantigrade position of the medial column. These procedures include arthrodesis of the first tarsometatarsal (TMT) joint, arthrodesis of the naviculocuneiform (NC) joint, or Cotton osteotomy or opening wedge osteotomy of the medial cuneiform. Posterior tibial tendon restoration options include primary or secondary repair, a Kidner procedure, and flexor digitorum longus transfer (3–5).

The Cotton osteotomy is a commonly performed adjunctive procedure primarily used in the treatment of pes valgus. Starting back in 1908, both Riedl and then Young used a closing wedge osteotomy of the medial cuneiform for hallux valgus correction. Cotton originally described the procedure in 1936 for pedal deformities of the first metatarsal head when the metatarsal head could not carry any weight. He described the function of the procedure as restoring the "triangle of support." Additionally, he believed that the procedure could be used to correct flatfoot deformity if it was reinforced with muscular training and exercise (5,6).

Contemporary indications for the Cotton osteotomy include forefoot supinatus without hallux valgus or medial column joint fault, rigid forefoot varus, and hallux limitus with elevatus of the medial column. The procedure is especially useful to realign the forefoot after correction of rearfoot deformity in the treatment of posterior tibial tendon dysfunction and acquired flatfoot deformity (7).

Patient selection is an important aspect of success with the Cotton osteotomy. Arthrodesis is preferred when gross instability or arthritis of

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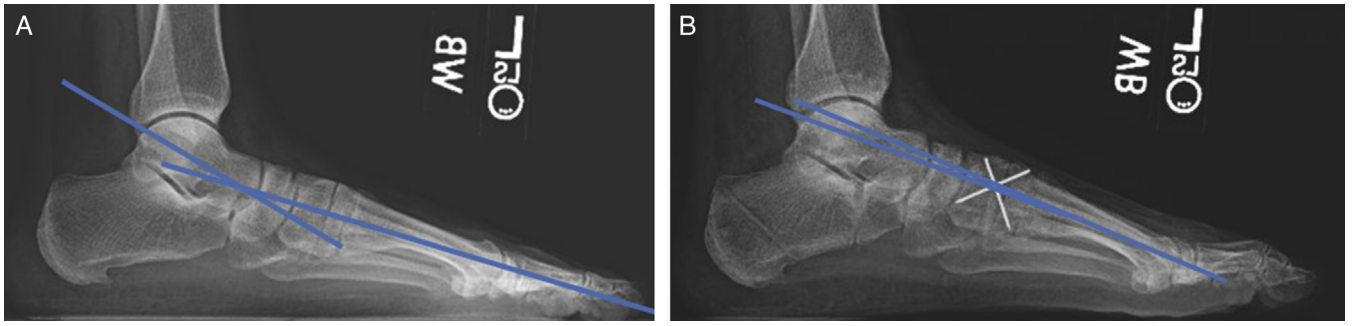

Fig. 1. Meary's angle was assessed on (*A*) preoperative and (*B*) 10-week postoperative weightbearing lateral radiographs. The Cotton osteotomy is particularly useful for correcting an abnormal Meary's angle, although correction of the deformity can be limited in cases involving instability of the medial column joints. Adjunctive procedures can also contribute to correction of Meary's angle.

the first TMT joint is present (8). An NC fault or degenerative joint disease should be treated with NC fusion. A combined approach with multiple joint arthrodesis is also common for a global arch fault or combined medial column fault and hallux valgus deformity (3). However, the Cotton osteotomy is a less invasive extra-articular procedure with a likely lower rate of complications compared with arthrodesis, although this has not been established. The Cotton osteotomy is relatively quick to perform at the end of an already long flatfoot reconstructive procedure and provides substantial correction of deformity that might or might not be achieved with arthrodesis. The surgeon should first rule out medial column joint fault, joint instability or hypermobility, hallux valgus with an increased intermetatarsal angle, and degenerative joint disease through careful clinical and radiographic assessment. In the absence of these findings, the Cotton osteotomy becomes the medial column procedure of choice.

The first peer-reported outcome of the Cotton osteotomy included 15 flatfoot cases in which the Cotton osteotomy was used as an adjunctive procedure. No nonunion or malunion was reported, and statistically significant improvement was found in the radiographic parameters, including lateral talo-first metatarsal angle, calcaneal pitch, and medial cuneiform to floor distance. Hirose and Johnson (5) concluded that the Cotton osteotomy is superior to first tarsometatarsal arthrodesis due to preservation of first ray mobility and the ease of correction.

In a recent study, Aiyer et al (9) demonstrated that the Cotton osteotomy, even without fixation, will be radiographically stable on follow-up examination. They also showed that the Cotton osteotomy provides correction of a medial arch sag but reported that it did not improve Meary's angle when used as an isolated procedure. The procedure was not evaluated, however, when used as an adjunctive procedure (9).

We reviewed consecutive cases performed during the past 15 years in which the Cotton osteotomy was performed as an adjunctive procedure in flatfoot reconstruction. We assessed graft healing at 10 weeks, medial column deformity correction, fixation type, complications, comorbid conditions, and adjunctive procedures.

Patients and Methods

After institutional review board approval, we performed a retrospective analysis of consecutive patients treated with Cotton osteotomy as a part of flatfoot reconstruction from April 2001 to December 2015. Potential subjects were identified using a Current Procedural Terminology (CPT®) code from the American Medical Association. The CPT® code used was 28304, which is specifically used for "osteotomy, tarsal bones, other than calcaneus or talus" (10). A chart review was performed on those subjects who had this CPT® code used as part of documentation of their surgery to see if a Cotton osteotomy was performed and to make sure it was indeed part of a flatfoot reconstructive surgery. Those patients with documentation in the operative notes of a Cotton osteotomy as a part of flatfoot reconstructive surgery were included in the present study.

All osteotomies were performed by 1 surgeon (T.J.B.) as an adjunctive procedure in the correction of pes valgus deformity and posterior tibial tendon dysfunction. The inclusion criteria included a clinic follow-up examination at 10 weeks postoperatively and appropriate preoperative and postoperative weightbearing radiographs. Patients without weightbearing radiographs available at 10 weeks postoperatively or who were lost to follow-up before their 10-week postoperative appointment were excluded. Both investigators (T.J.B., K.R.S.) evaluated the postoperative radiographs to determine the interval to radiographic incorporation of the allograft, which was defined as bridging of the interface between the graft and native bone by bone callus or trabeculae at 3 of 4 cortices and obliteration of the graft interface, as previously described (11). Graft displacement and subsidence were also evaluated. Meary's angle was also measured on

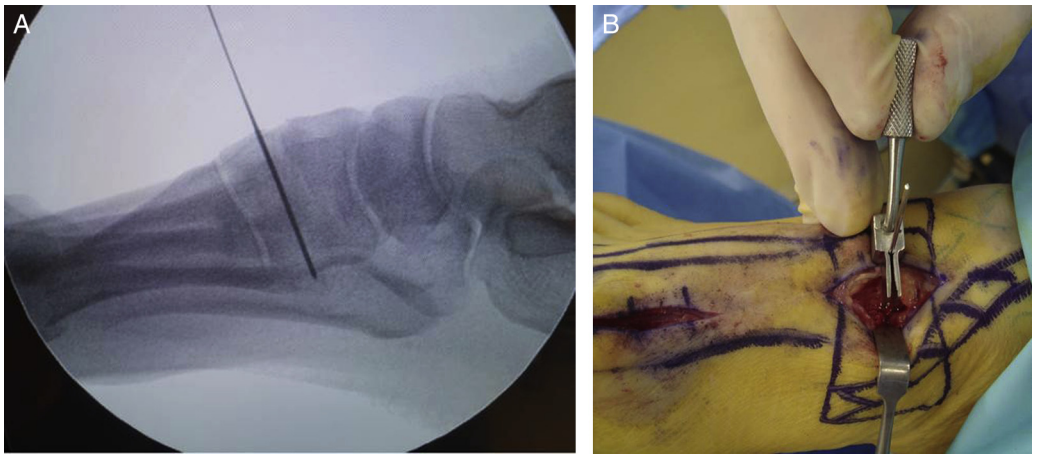

Fig. 2. (*A*) An osteotomy guide pin was placed from dorsal to plantar along the lateral cortex at the mid-medial cuneiform level. The saw would follow along the proximal aspect of the pin for a mid-cuneiform osteotomy. (*B*) An osteotomy guide can be placed over the guide pin, if desired.