



Medial Cuneiform Osteotomy with Allograft Implant without Internal Fixation in Pediatric Patients: A Retrospective Study

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Abstract

The Cotton medial cuneiform osteotomy is a common procedure for treatment of planal deformities in the pes planus foot. Its use with an allograft application makes it a powerful procedure to help restore the medial longitudinal arch, forefoot varus or medial column instability. Though the operative technique is standard among most surgeons, the use of fixation to the allograft varies. The purpose of our study was to determine retrospectively if lack of fixation affected correction values or consolidation rates. Fifty-six pediatric cotton osteotomies and allograft implants without fixation were retrospectively viewed on radiographs to assess consolidation. The radiographs were analyzed by three different surgeons and classified by the postoperative period: immediate, 4 weeks, 8 weeks, and 12 weeks. The amount of correction was determined on a standard lateral radiograph by measuring the length of the osteotomy site using the most distal and proximal portion of the dorsal cortex of the medial cuneiform. The results were found to be excellent as 50 out of 56 (89.28%) cotton procedures displayed radiographic consolidation at post-operative week 8. Five of the remaining six went to consolidation at a later time. No metatarsal primus elevatus was identified long term suggesting that our correction was maintained. This study suggests fixation does not influence consolidation rates as adequate correction is maintained.

Introduction

The Cotton medial cuneiform osteotomy was first described in 1936 for the treatment of planal deformities in the pes planus foot type [1]. The cotton osteotomy with allograft application is a powerful procedure that can be used to help restore the medial longitudinal arch, forefoot varus, medial column instability, or as an adjunct to several other procedures to correct deformities in multiple planes [2].

The technique involves making an incision directly over the medial cuneiform with care to avoid the medial dorsal cutaneous nerve bundle and dorsal venous arch. The incision is then deepened through subcutaneous tissue to bone. Extensor hallucis longus tendon is typically reflected medially to allow complete visualization of the medial cuneiform. The 1st metatarsal cuneiform joint was identified distally and the navicular cuneiform joint proximally. Intra-operative fluoroscopy was used to verify the center of the medial cuneiform through lateral and AP views. An osteotomy was made from dorsal to plantar, perpendicular to the long axis of the bone leaving the plantar cortex intact. The medial cuneiform was then distracted and an allograft was placed in the osteotomy site, tamped flush with the dorsal cortex into its final position.

The operative technique is standard with most surgeons, but the use of fixation to the allograft varies. The purpose of our retrospective analysis was to determine if lack of fixation affected correction values or consolidation rates. We retrospectively viewed radiographs of pediatric patients (n=68, 2005-2014) that underwent cotton osteotomies with allograft implants and no fixation. Radiographs were viewed immediately post operatively and at weeks 4, 8 and 12 for evaluation and analysis.

Patients and Methods

We reviewed and identified patients that received a cotton osteotomy with an MTF Foundation tm allograft implant without the use of any fixation from June of 2005 to December of 2014. Allograft implants were used for all patients, however, the size of the graft varied based on each patient's needs of correction. Specific graft dimensions can be seen below in Table 1. Adjunct procedures were

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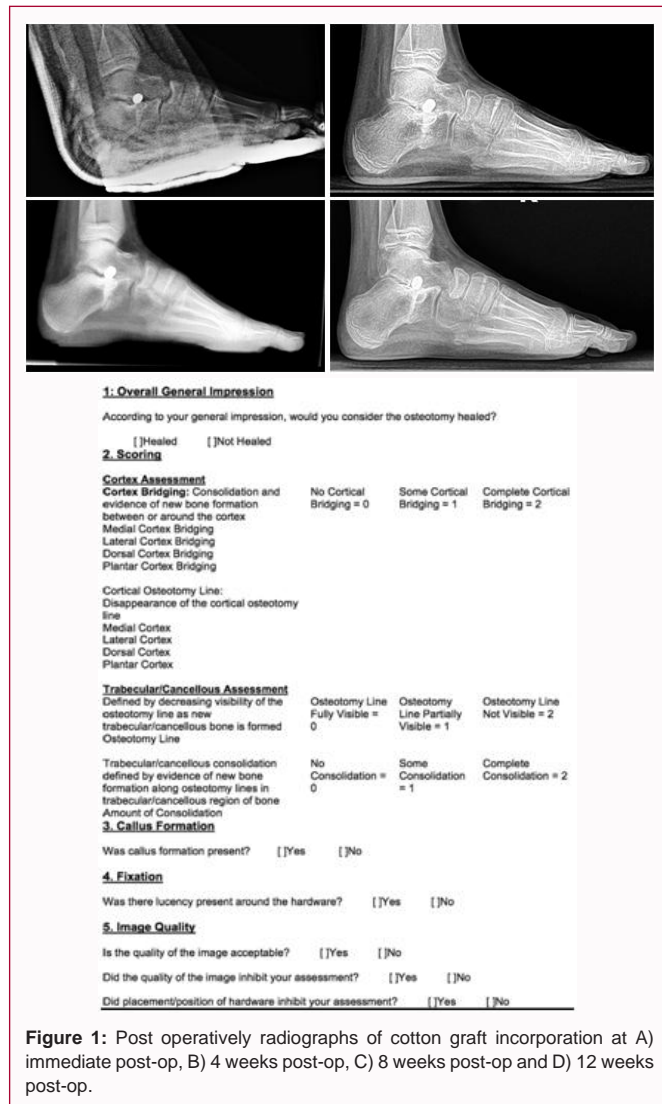


Figure 1: Post operatively radiographs of cotton graft incorporation at A) immediate post-op, B) 4 weeks post-op, C) 8 weeks post-op and D) 12 weeks post-op.

performed with the cotton osteotomy that included the following: Evans osteotomy, medial calcaneal displacement osteotomy, Kidner procedure, Gastroc recession or tendo-achilles lengthening, and subtalar arthroereisis implant. No patient received an isolated cotton osteotomy; each had the procedure in addition to one or more of the procedures listed above.

Post-operative protocol included a period of non-weight bearing in a posterior splint or fracture boot for 6 weeks followed by protected weight bearing in a boot for at least 2-4 weeks. Radiographs were taken immediately post operatively and at weeks 4, 8, and 12 weeks, which are illustrated in Figure 1.

Radiographic evaluation of each patient was done at 4-week intervals and reviewed by three separate surgeons to determine time to consolidation. This was defined as at least 3 continuous cortices or bridging trabeculae in 2 orthogonal views and the absence of gross resorption of the graft [3]. Figure 2 demonstrates a detailed radiographic study to determine osteotomy union rates.

The amount of correction was determined immediately post-operatively on a standard lateral radiograph by measuring the length of the osteotomy site using the most distal and proximal portion of the dorsal cortex of the medial cuneiform. Repeat measurements were taken from the post-operative radiographs at 8,12 and 52 weeks

Table 1: Graft Dimensions.

AGE	
Mean	12.12
Median	12
GRAFT SIZE	
Mean	7.611 mm
Range	5 mm to 10 mm
Average Change in Dorsal Cortex from First Observation	3.74 mm

Table 2: Patient Demographic.

FEET/PATIENTS56/36	
GENDER	
Male	22
Female	14
FOOT	
Left Foot	31
Right Foot	25

when available. It should be noted that pre-surgical measurements were not taken due to the varying amount of sagittal plane correction for each patient. The goal of this study was to see if the post-surgical correction was maintained until consolidation.

We identified 68 patients that met our inclusion criteria of being in the pediatric age group (< 18 years) at the time of surgery and having received a cotton osteotomy utilizing an allograft implant without fixation. 32 of the 68 patients were excluded due to a variable or undocumented post-operative course. This included infection (n=1), radiographs that did not line up with standard protocol of 4, 8, and 12 weeks (n=15) and patients that were lost to follow up prior to 12-week radiograph (n=16). The study did not exclude patients who received adjunct procedures for correction of the pesplanovalgus deformities. Biomechanical angles were not incorporated in the data due to adjunct procedures resulting in variability in the amounts of correction from the cotton osteotomy.

Results

36 patients with 56 cotton osteotomies and allograft were used for this study. These included 14 females, 22 males, 31 left feet and 25 right feet, as depicted in Table 2.

Radiographic consolidation was achieved at post-operative week 8 in 50 out of 56 (89.28%) cotton procedures. Five of the remaining 6 went on to consolidate at later times, while 1 resulted in a delayed union that healed uneventfully without complications at week 14.

Of the 56 cotton procedures performed, we were able to get an accurate immediate post-operative measurement of the medial cuneiform in 30 procedures. Of those 30, correction was maintained in all of them at the time of consolidation. Of the 56 cotton procedures performed, long-term radiographs were available in 17 of them. No metatarsal primus elevatus was identified long-term indicating maintenance of sagittal plane correction until consolidation of the allograft.

Discussion

The Cotton osteotomy with allograft has been described for the correction of various pathology and as an adjunct procedure in the surgical correction of pesplano valgus in the pediatric patient [1].

The common surgical technique has been described with or without fixation and varies based on surgeon preference [1,4]. The authors used a retrospective study to hypothesize and determine if correction of the osteotomy utilizing allograft without fixation would achieve consolidation uneventfully while maintaining position secondary to the mechanical axial load placed on it. The graft consolidates quickly secondary to the medial cuneiform's superior blood supply from branches of the dorsalis pedis artery, medial plantar artery, and superficial medial plantar artery [5]. Studies have also shown that the medial cuneiform has a dense intra-osseous capillary network with a central nutrient artery and several minor nutrient arteries suggesting, areas of hypo-vascularity are infrequent in the medial cuneiform [5].

Of the 17 cotton procedures with long-term radiographs, all had maintained correction. However, we were unable to use our initial method of measurement. It is important to note that all of our patients were pediatric, thus our dorsal measurement of the medial cuneiform actually increased when the measurement was taken after 12 months. This is rationalized based off the influence of bone growth as the patient becomes skeletally mature. However, none of the 17 cottons procedure that we viewed at 12 months or longer had an elevated 1st ray as Meary's Angle was maintained.

This study does have some limitations. First, the consolidation of the osteotomy was determined by radiographic analysis, not computer tomography. Second, there was no control group of fixated versus non-fixated Cotton osteotomies. Finally, the variability of pediatric age and growth rates were not considered.

Conclusion

The cotton osteotomy with allograft is an excellent procedure as an adjunct for correction of pesplano valgus deformities. This study suggests fixation does not influence consolidation rates, as adequate correction was maintained immediately post-operatively up to week 12 and further. Further long-term follow-up would be beneficial in determining the patient's outcome.

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