THE MBA ARTHROEREISIS IMPLANT: Early Prospective Results

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"Flatfoot is a biomechanical dysplasia of tarsal joint function."[1] Certain deformities such as metatarsus adductus, equinus, internal tibial torsion, and forefoot varus can contribute to excessive pronation of the subtalar and midtarsal joints. During the contact phase of gait, the foot is a mobile adapter secondary to pronation of the rearfoot. At midstance, the subtalar joint will begin to resupinate in order to form a rigid lever during propulsion. Certain deformities can cause the subtalar joint to pronate excessively during contact. When this occurs, resupination does not occur during the late midstance phase, and the foot remains pronated and hypermobile for propulsion. This imbalance of joint position and muscle function during gait plays a major role in the development of hallux valgus, Morton's neuroma, hammertoes, posterior tibial dysfunction, and degenerative joint disease later in life.

Closed kinetic chain pronation of the subtalar joint is a triplanar motion consisting of simultaneous eversion of the calcaneus, and adduction and plantarflexion of the talus. As the talus adducts and plantarflexes, it also displaces anteriorly. The concept of arthroereisis is to allow the normal amount of subtalar joint motion, but to restrict the abnormal, excessive motion at the subtalar joint.[2]

HISTORICAL REVIEW

Chambers, in 1946, was the first to apply arthroereisis concepts to the subtalar joint. His technique involved an "abduction block," which was a wedge-shaped bone graft that was placed into the sinus tarsi to prevent excessive anterior displacement of the talus during pronation.[3] Subsequently, Baker and Hill in 1964, developed a pronation deterring osteotomy of the calcaneus in the form of a laterally-based opening wedge with bone graft. This improved the weight-bearing alignment of the calcaneus.[4] LeLievre, in 1970, described the use of an accessory bone graft placed into the sinus tarsi.[5] Subotnik followed, and in 1974 replaced the bone graft with a make-shift silastic plug.[6]

This brought new insight to the arthroereisis procedure by the use of a high molecular weight silicone polymer device, rather than bone. In 1976, Smith et al. created a high molecular weight plug that was cemented into the calcaneal sulcus against a resected portion of the posterior facet.[7] This is known as the STA-peg device that is commonly used today. This procedure does not block excessive pronation, but rather, alters the axis of motion of the subtalar joint. Also in 1976, Valenti introduced his polyethylene threaded arthroereisis device. In 1995, the senior author and Dr. Steve Brancheau of Greenville, Texas, in conjunction with Kinetikos Medical Incorporated (KMI), developed the MBA subtalar joint arthroereisis device for treatment of congenital and acquired flexible pes planus deformities.

INDICATIONS AND CONTRAINDICATIONS

The prime indication for performing surgery on hyperpronated individuals is the presence of pain. In a pediatric patient, this may include the parameters outlined by Smith et al. such as walking intemperance, night cramps, athletic abstinence, sedentary hobby pursuits, arch pain, and postural pain in the foot and leg.[7] The prominent feature of the clinical exam is a foot which appears essentially normal when weight bearing, but displays prominent calcaneal eversion and collapse of the medial longitudinal arch when standing (Fig. 1). Other clinical findings may include medial bulging of the talar head, excessive forefoot abduction, equinus, and forefoot supinatus.

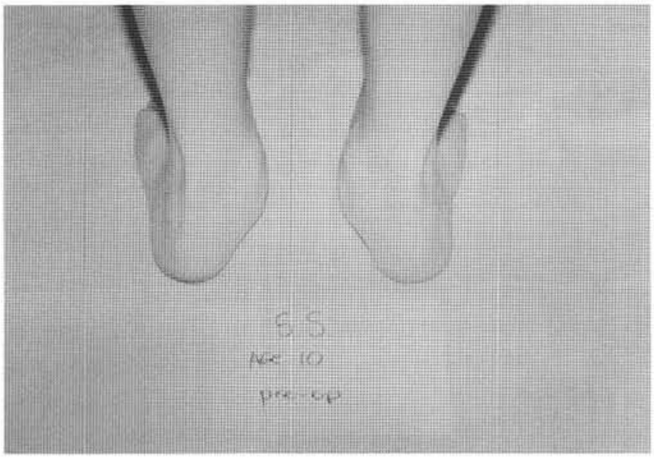

Figure 1. Clinical appearance of a patient with a flexible flatfoot deformity. Note the severe calcaneal valgus and collapse of the medial longitudinal arch.

Contraindications to the MBA procedure include a flatfoot deformity with an absence of calcaneal eversion. This stems from the fact that the MBA procedure is geared towards correcting a rearfoot deformity with a frontal plane dominance. Lanham et al.[8] state that children with little or no calcaneal eversion in closed kinetic chain motion do not meet the criteria for subtalar arthroereisis stating that this would result in a supinated foot. A rigid flatfoot deformity would also be a relative contraindication for an arthroereisis procedure. The etiology of a rigidly fixed flatfoot should be evaluated and treated appropriately. Commonly, a rigid deformity is the result of a tarsal coalition. If the coalition is resected, and the deformity is now a flexible one, then arthroereisis may be indicated.

RADIOGRAPHIC FINDINGS

Standard dorsoplantar and lateral weight-bearing radiographs taken in the angle and base of gait are necessary to properly evaluate the flexible flatfoot. Also helpful is a Harris-Beath projection which may yield information about the posterior and middle facets of the subtalar joint complex. There are several radiographic indicators of a flatfoot. When evaluating a dorsoplantar projection, one will find an increase in the talocalcaneal divergence angle, or Kite's angle. This angle is normally reported to fall between 20 and 25 degrees. The increase in this angle is a result of the talar adduction, and in flatfoot deformities is often greater than 30 degrees. As the forefoot abducts and the talus adducts, there will be a subluxation at the talonavicular joint. This subluxation is often greater than 50 percent. An increase in the cuboid abduction angle may also be seen, denoting increased abduction of the forefoot at the midtarsal joint (Fig. 2A).

When evaluating a lateral projection, one sees a decrease in the calcaneal inclination angle, and an increased talar declination angle, both leading to an increase in the lateral talocalcaneal angle. An anterior break in the Cyma line, and faulting of the medial column may be present, and are easily identified (Fig. 2B).

Figure 2A. Dorsoplantar radiograph demonstrating the increased Kite's angle and excessive abduction of the forefoot.

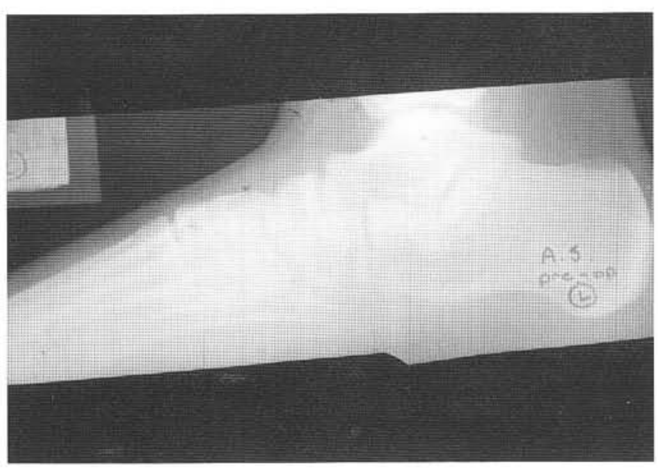

Figure 2B. Lateral radiograph demonstrating the decreased calcaneal inclination along with excessive declination of the talus. Also note the anterior break in the Cyma line.

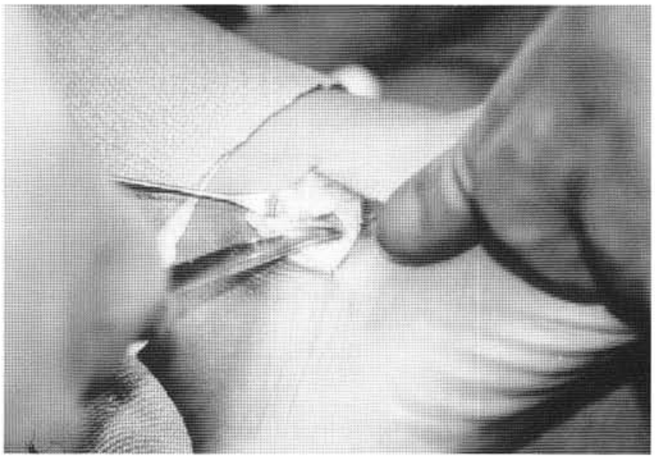

Figure 5. Transection of the interosseus talocalcaneal ligament, a crucial component of the dissection.

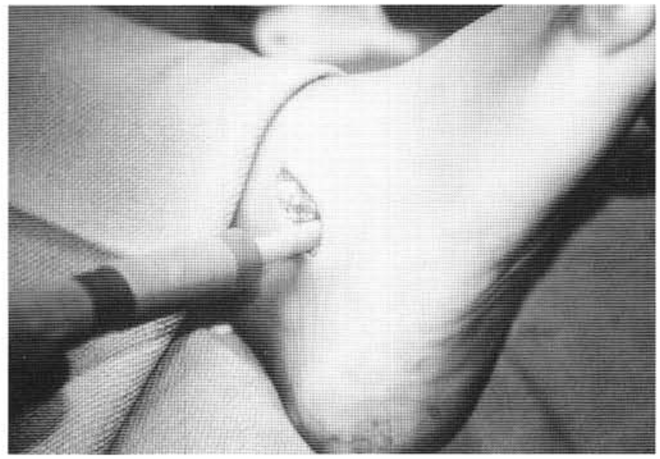

Figure 6. Intra-operative view with the appropriate sizer in place; limiting the subtalar motion to about 4 degrees of eversion.

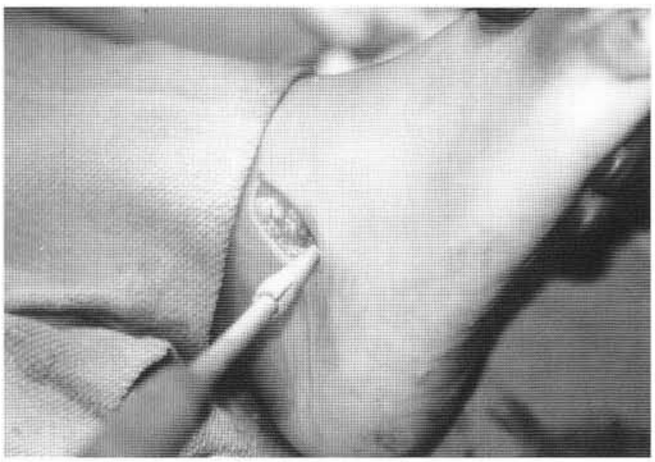

Figure 7. Intra-operative view showing the implant being inserted into the lateral wound. The implant is inserted about 6 mm to 8 mm from the lateral wall of the calcaneus.

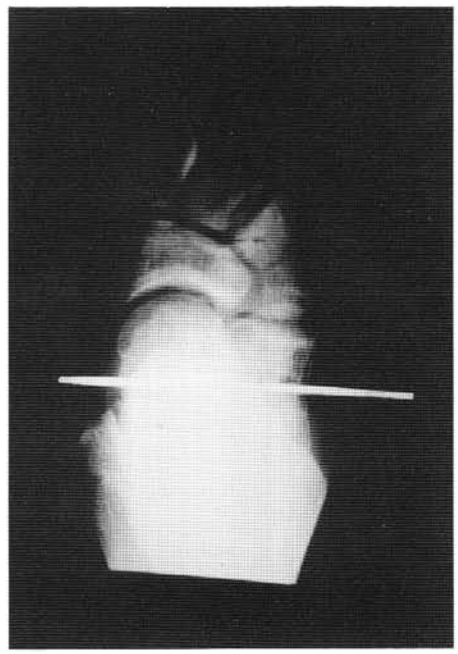

Figure 8A. Intra-operative dorsoplantar radiograph demonstrating adequate placement of the MBA device. Note that the leading edge of the implant does not extend beyond the midline of the talus.

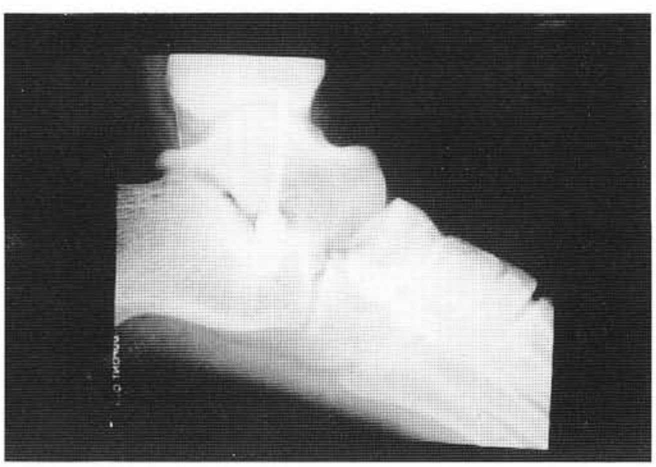

Figure 8B. Intra-operative lateral radiograph.

ADJUNCTIVE PROCEDURES

The MBA implant is not the panacea for flexible flatfoot. It is always important to fully evaluate any coexisting deformities that need to be addressed when reconstruction is to occur. Occasionally, if the symptomatic flatfoot is reconstructed before secondary adaptive changes such as equinus or medial column faulting have occurred, arthroereisis may be the only procedure necessary.

The single, most important coexisting deformity may be the presence of equinus. Equinus may be the primary deforming force, or it may be a secondary adaptation. Regardless of the origin of the equinus, it must be addressed at the time of surgery. If the flatfoot is reconstructed during late adolescence or adulthood, then selective joint fusion may also be indicated.

MATERIALS AND METHODS

Twenty-seven MBA procedures have been performed on seventeen patients. All patients had subjective complaints of leg cramps, arch pain, and the inability to engage in strenuous activity. Clinical examination revealed a resting calcaneal stance position of nine degrees or greater. Twenty-two feet were manually correctable, while 5 feet had either an osseous or fibrous coalition. Of the 27 feet, 19 were found to have a co-existing equinus deformity that was addressed at the time of surgery with a gastrocnemius recession. Five patients also required additional medial arch reconstruction procedures. Four modified Kidner procedures were performed, as well as one Young's tenosuspension. All patients were evaluated at follow-up for subjective complaints, and were objectively assessed. Preoperative and postoperative weight bearing dorsoplantar and lateral radiographs were also evaluated.

RESULTS

A total of 17 patients (27 feet) were evaluated. The average patient age at the time of surgery was 10.9 years, with a range of 6 to 16 years. Five patients were male and eight were female. The average length of follow-up was 6.9 months, with a range of 3 to 18 months.

Clinical examination at follow-up revealed an average resting calcaneal stance position of 2.4 degrees everted, with a range of 1 to 6 degrees of valgus. The foot assumed a normal, rectus appearance upon weight bearing. Preoperative radiographs revealed an average talar declination angle of 41.8 degrees. Preoperative calcaneal inclination and Kite's angles were 7.6 and 32.5, respectively. Preoperative radiographs also demonstrated an average talar declination angle of 26.4 degrees. Postoperative calcaneal inclination and Kite's angles were 13.2 and 26.4 degrees, respectively. Talar declination decreased an average of 15.4 degrees (36.8%). The calcaneal inclination angle increased an average of 5.6 degrees (42.4%). Kite's angle decreased an average of 6.1 degrees (18.7%)(Table 1).

Table 1

SUMMARY OF PREOPERATIVE AND POSTOPERATIVE DATA

	RCSP	Kite's	TDA	CIA
Preoperative Measurement	8.4	32.5	41.8	7.6
Postoperative Measurement	2.4	26.4	26.4	13.2

One complication occurred in a patient who underwent bilateral reconstruction. The MBA implant at initial follow-up was noted to be dislocated medially on radiographs. The foot was locked into valgus, rigid, and symptomatic. The implant was removed and the tarsal canal was allowed to fibrose. The patient is currently awaiting re-implantation. The contralateral foot healed well without complication. It was felt that the implant was placed too far medially, which allowed for the medial dislocation of the implant.

DISCUSSION

The MBA device is a threaded, self-locking implant that can be utilized in the surgical reconstruction of flexible pes plano valgus. It is composed of titanium alloy, providing excellent biocompatibility with human tissues. All MBA implants are 15 mm in length, and are available in 6, 8, 10, and 12 mm diameters. The authors have found that the 8 mm and 10 mm sizes are the most common fit. The

MBA has several advantages over other forms of arthroereisis. First, the procedure is technically easy to perform. The instrumentation is simple, and there are very few steps to perform. There is minimal dissection, and the procedure is completely reversible. The implant is also slotted, which serves a dual purpose. The slots allow for some compressibility of the implant, providing shock absorbing qualities to the device. Slotting of the device also allows for some fibrous ingrowth into the device itself, which helps to anchor the implant in its location and prevent dislocation, a problem reported by other authors using other forms of arthroereisis.[8-12]

The implant is also entirely extra-articular. Therefore, no bone resection or drilling is required. This reduces the chance of osteomyelitis and detritic synovitis, as may occur when the device is intra-articular or requires resection of bone for implantation.[9] Finally, the MBA requires no polymethylmethacrylate (PMMA) for cementing purposes. PMMA has the potential for a variety of adverse effects on human tissue, which are eliminated when using the MBA device.[10]

The authors also performed a modified gastrocnemius recession on 19 of the 27 patients, and believe that the equinus deformity was a secondary adaptation, and not the primary deforming force, since none of the younger patients had an equinus. The authors further believe that if symptomatic flexible flatfeet present at an early enough age, only a STJ arthroereisis may be indicated. This will allow the patient to adapt to the new rearfoot position and prevent some long-term sequelae of excessive pronation.

Figures 9A-9D and 10A-10D represent weight-bearing preoperative and postoperative dorsoplantar and lateral radiographs of two cases in which the MBA device was used. Note that in all three preoperative cases, the talar declination angle is severely increased, and the talonavicular joint is subluxed. The Cyma line is broken anteriorly, and the talo-calcaneal divergence angle is increased. Figures 11A and 11B represent the postoperative radiographs of the patient shown in Figure 2. All three postoperative cases demonstrate normal congruency of the talonavicular joint, and a return of the talar declination angles to normal values. The Cyma lines are normal, and Kite's angle has been returned to a satisfactory value.

The authors have concluded that the MBA procedure is a predictable and reliable procedure in limiting excessive subtalar pronation in the pediatric hypermobile pes plano valgus. The authors have also begun use of the MBA implant as an adjunctive procedure for the treatment of adult posterior tibial dysfunction. Clinical follow-up and postoperative weight-bearing radiographs have shown the MBA procedure to achieve desired results with few complications.

Figure 9A. Preoperative dorsoplantar radiograph

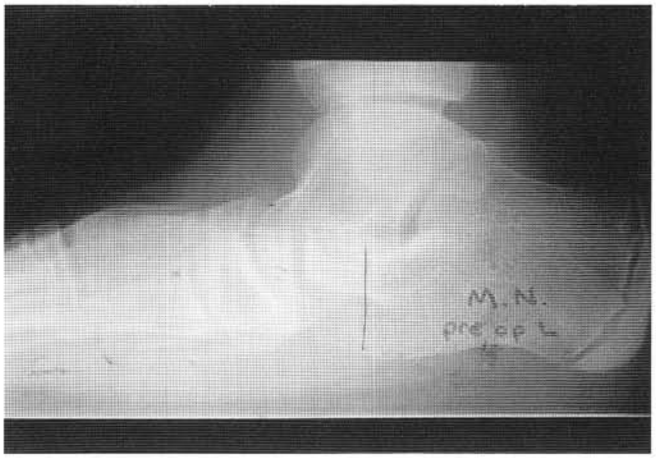

Figure 9B. Preoperative lateral radiograph.

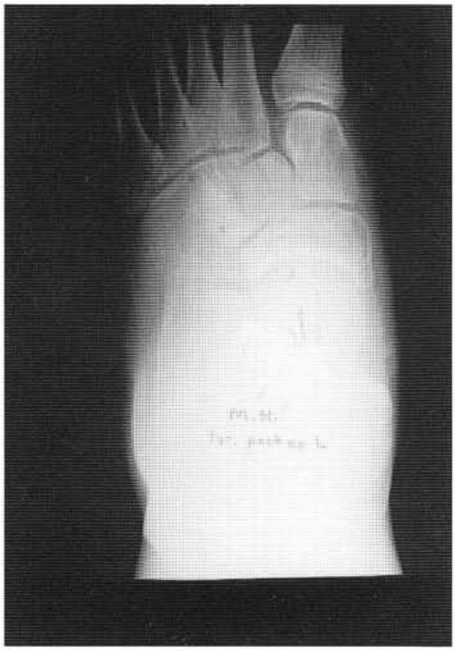

Figure 9C. Postoperative dorsoplantar radiograph.

Figure 9D. Postoperative lateral radiograph.

Figure 10A. Preoperative dorsoplantar radiograph

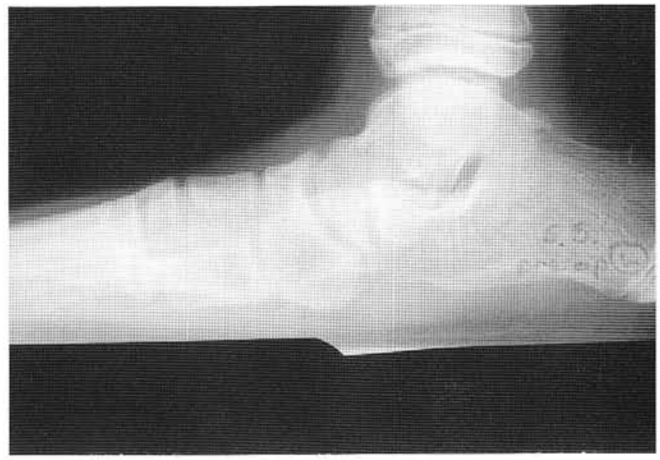

Figure 10B. Preoperative lateral radiograph.

Figure 10C. Postoperative dorsoplantar radiograph.

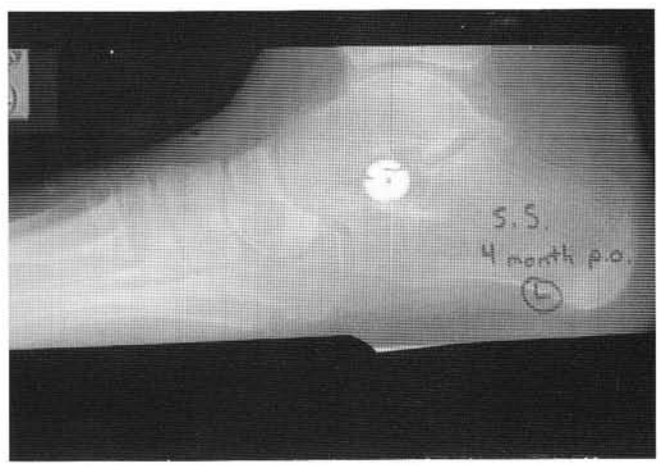

Figure 10D. Postoperative lateral radiograph.

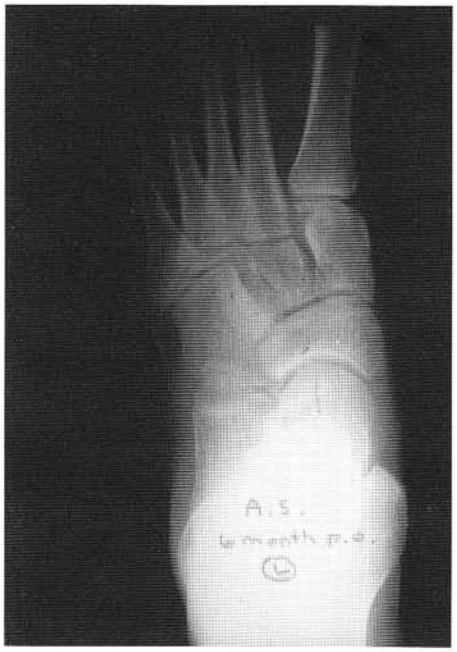

Figure 11A. Postoperative dorsoplantar radiograph of the patient shown in Figure 2.

Figure 11B. Postoperative lateral radiograph.

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