CHAPTER 3

THE MBA SUBTALAR JOINT ARTHROEREISIS IMPLANT IN THE ADULT FLEXIBLE FLATFOOT: Preliminary Data And Experience

Stephen J. Miller, D.P.M.

Pronation is an important part of the stance-phase function of the human foot. It provides shock-absorption, helps the foot adapt to uneven surfaces and aids in the transmission of motion. Excessive pronation, either in extent or duration, is abnormal for effective function and sets the stage for pathologic changes the longer it is left untreated. Excessive pronation in the adult is unique in that it has usually been present from birth, therefore allowing more adaptive and degenerative changes to have taken place by the time symptoms develop. As a result, it can be more challenging to treat, as opposed to the much more supple structures in the child's foot.

During the maneuver of prolonged or excessive closed kinetic chain pronation, the talus moves within three planes, creating a dysfunctional syndrome best described as "peritalar subluxation" as both the subtalar joint and midtarsal joint become unstable. In the sagittal plane the longitudinal arch collapses; in the frontal plane the heel tilts into valgus; and in the transverse plane the forefoot will abduct on the midtarsal joint, sometimes dramatically. The predominant plane of compensation is determined by the orientation of the subtalar joint axis, as well as the joint surfaces themselves, a concept clearly defined as planal dominance.[1]

Understanding this principle of planal dominance is central to selecting the most effective treatment options such as orthotics, shoes, or surgery. In the flexible flatfoot, the treatment is best directed to the source of the fundamental pathology: the subtalar joint. Unfortunately, by the time the patient reaches adulthood, other significant pathologic changes have been allowed to take place, some more flexible than others (Table 1).[2-9] These changes often must be addressed concurrently, with attention directed to realigning the subtalar joint in order to obtain an overall successful result.

RATIONALE FOR TREATMENT BY ARTHROEREISIS

Assuming there has been a poor or inadequate response to conservative management, the ideal treatment is best directed toward the source of the pathology, while preserving the affected joint and its function. The goal is to prevent excessive pronation while allowing enough for proper function, and at the same time maintaining a full range of inversion. This is best done by blocking the excess relative movement between the talus and calcaneus.

Since the calcaneus is locked onto the supporting surface, arthroereisis is aimed at blocking talar motion without entering or destroying the subtalar joint itself. Placing a device in the sinus tarsi effectively blocks excessive talar adduction as well as anterior displacement, and remarkably prevents calcaneal eversion. Such realignment makes the cuboid more effective as a fulcrum for the peroneus longus tendon, allowing it to restore plantarflexion of the first ray and thereby reducing forefoot varus. Often, the forefoot abduction is also

Table 1

PATHOLOGIC CHANGES IN THE ADULT FLATFOOT

Midtarsal joint instability
Forefoot abduction
Talonavicular subluxation
Cuboid nutcracker impingement
Midfoot collapse and faults
DJD in midfoot joints
Metatarsus primus elevatus
Hallux limitus
Calcaneal valgus
Achilles muscle-tendon contracture
Posterior tibial tendon dysfunction

reduced. Advanced adaptive changes in the adult may prevent restoration of functional alignment requiring the implementation of ancillary surgical procedures.

THE ARTHROEREISIS IMPLANT

After it was discovered that the insertion of bony wedges interferes with the subtalar joint motion, surgeons have implemented the use of various prosthetic blocks (Table 2). The result has been a progressive simplification of the procedure with less risk to the patient as the subtalar joint function is preserved.

By far, the majority of the techniques and results reported have been in juvenile cases.[10-18] Although some surgeons have experimented with subtalar arthroereisis in adults, it has not been reported extensively in the literature.[19] The reason is largely because of the unreliability of the plastic implants when subjected to the greater weights and forces as generated by adults. Langford reported on a series of young patients using the Valenti arthroereisis implant, precursor to the Maxwell-Brancheau Arthroereisis (MBA) implant.[20]

THE MBA IMPLANT

The MBA implant prosthesis is a 15mm titanium threaded screw with slots for force absorption and tissue in-growth. It is cannulated, and comes in four sizes: 6mm, 8mm, 10mm, and 12mm diameters (Fig. 1). The distal end is rounded, and the proximal end has a hexagonal slot which fits an AO hexagonal screw driver.

Constructed of titanium and slotted for shock absorption, the MBA implant has several advantages. It will not fragment, yet is strong enough to block bone movement without fracture. By absorbing compressive forces, the surrounding bone is unlikely to crush, an advantage for use in adults.

Methylmethacrylate cement is not necessary for fixing the device in place, thereby avoiding some of the associated complications such as

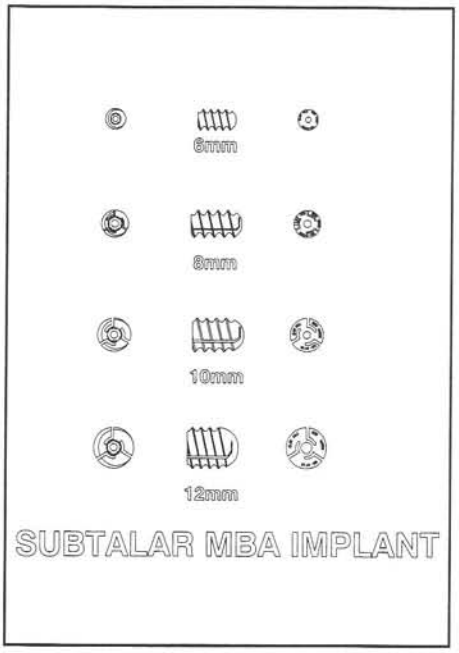

Figure 1. Design and sizes of the MBA implant.

Table 2

ARTHROEREISIS SUBTALAR JOINT IMPLANTS HISTORY: PROSTHETIC BLOCKS

DATE	SURGEON	DEVICE
1974	Subotnick	Carved Silastic Block
1976	Smith et al.	Polyethylene STA-peg
1976	Valenti	Polyethylene threaded screw
1977	Viladot	Elastomer umbrella
1978	Samuelson	Polypropylene & SS 2 component
1979	Lanham	Swanson hemi-implant stem
1982	Addante	Silastic silicone sphere
1983	Sgarlato	Mushroom-shaped Silastic cap
1984	Pisani	Silastic-capped screw
1985	Lundeen	Polyethylene STA-peg (new design)
1995	Maxwell/Brancheau	Cannulated & slotted titanium screw

thermal necrosis, cement fragmentation or pathological reactions.[21,22] By its screw design, the MBA implant can be seated in a graduated fashion and is unlikely to extrude as it is anchored in place by its threads. Even moderate trauma will not cause fracture or displacement of the implant.[23] The MBA metal device is also readily visible on radiographs, avoiding the need for a more expensive CT scan for visualization (Fig. 2)[24] It is further cannulated for exact placement within the sinus tarsi using a guide pin.

Figure 2. The titanium MBA implant is easily visible on x-ray.

INDICATIONS AND CONTRAINDICATIONS

The adult collapsing flatfoot has had much more time to develop adaptive changes and associated symptoms. Therefore, relief of pain that is unresponsive to conservative care is the primary indication for surgical correction. The deformity must be flexible and primarily frontal plane, as evidenced by calcaneal eversion. A vertical calcaneus is a contraindication since an implant will create functionally unstable calcaneal inversion, which most patients will not be able to tolerate.

Although a certain amount of sagittal plane and transverse plane correction can be expected, midtarsal joint instability is a contraindication to subtalar joint arthroereisis. In those situations, lateral column lengthening procedures such as the Evans opening osteotomy or a calcaneocuboid fusion with interpositional bone graft should be considered. Limited motion in the subtalar joint is another contraindication for arthroereisis, as the implant is likely to lock up the remaining motion. A severely "tracking" subtalar joint, adapted from years of functioning in a pronated position, precludes use of this implant, as does degenerative arthritis.

One of the ideal indications for the MBA implant in the adult is Stage I or Stage II posterior tibial tendon dysfunction. Often, the implant is all that is necessary for correction (with perhaps some additional attention to the Achilles tendon).

ANCILLARY PROCEDURES

Because the adult flexible flatfoot has had more time to develop associated compensatory deformities, ancillary surgical procedures are frequently needed. The subtalar arthroereisis is seldom performed singularly in the adult, although if indicated, it can be performed alone.

Any contracture of the Achilles muscle-tendon complex is the most important deformity to address. Even when the shortening is marginal, a lengthening procedure should be performed, since limiting subtalar joint motion uses up a great deal of Achilles length, preventing compensation. Although ankle dorsiflexion may appear to be sufficient when evaluated preoperatively, it may not be adequate once the implant is in place, creating a potentially painful result.

Lack of plantarflexion of the medial column can similarly result in failure of arthroereisis if it is not anticipated or dealt with. For example, if there is a metatarsus primus elevatus remaining because the forefoot varus fails to reduce with subtalar joint realignment, then an adverse outcome is likely. A fixed forefoot varus may develop that the stabilized subtalar joint cannot compensate for. A hallux limitus deformity may result from an uncorrected metatarsus primus elevatus. Procedures that may help stabilize or fully plantarflex the medial column include: arthrodesis of the talonavicular, naviculocuneiform, or first metarsocuneiform joints; Kidner tibialis posterior tendon advancement; transfer of the flexor digitorum longus into the tibialis posterior; or a modified Young's tendosuspension.

THE MBA IMPLANT PROCEDURE

Implementation of the MBA device in the adult generally follows the same protocol as that described for children using either the Valenti or MBA implant.[9,20] Care must be taken not to advance the implant too far into the sinus tarsi and jam it between the posterior and middle facets of the subtalar joint. This often results in prolonged pain and may lock up the joint completely.

When the trial implant sizer is in place with guide pin, an AP radiograph should be taken to analyze the position of the implant. The leading edge should not be across the bisection of the talar neck, and the trailing edge should not be more than one centimeter (preferably less) past the lateral wall of the calcaneus. Correct size of the implant is determined by observing 4 to 6 degrees of eversion remaining of the subtalar joint motion. This is best seen with the patient prone, a position the surgeon might consider if the arthroereisis is performed alone or in conjunction with an Achilles lengthening.

POSTOPERATIVE MANAGEMENT

Adults do not tolerate this surgery as well as children. If only the arthroereisis procedure has been performed, the postoperative care consists of protected weight bearing in a below-knee removable walking cast. The patient is then graduated into a walking or athletic shoe. Physical therapy is seldom necessary. The patient should be advised that the sinus tarsi may be "sore" periodically for 3 to 4 months postoperatively. Also, the patient should be advised that custom-made orthotics are a necessary part of the postoperative treatment. The use of the orthotics can be decreased in many instances as a full return to foot function is accomplished.

If ancillary procedures are performed, then the postoperative care must be tailored to those procedures. Achilles muscle-tendon lengthening alone requires a non-weight-bearing cast for four weeks, followed by a walking cast for two weeks, then rehabilitation strengthening exercises and physical therapy as indicated. Arthrodesis procedures require longer periods of non-ambulatory casting for healing, and rehabilitation for the associated cast disease.

POSTOPERATIVE COMPLICATIONS

Complications from the MBA procedure in the adult generally fall into one of four categories. The first category is inappropriate application, particularly in situations where there is an unstable midtarsal joint, a rigid flatfoot, subtalar joint tracking, limited joint motion, or advanced arthrosis present. These problems should be dealt with using alternate procedures as indicated. Correction involves removing the implant and carrying out the alternative procedures.

The second category implicates surgeon error, resulting in over-correction, under-correction or even displacement of the implant via extrusion or rotation. Correction is usually attained by a minor adjustment of the implant.

The third category of complications is adaptation/irritation by the implant itself. It may be as simple as sinus tarsitis type pain which is common in the adult, presenting either early in the postoperative course or even several months later. This pain is effectively treated with injection therapy, as is soft tissue entrapment when it is suspected. When the implant is inserted too deeply, it may cause sufficient irritation to instigate peroneal spasm. This requires injection therapy and/or adjustment of the implant itself. Finally, the sural nerve and the intermediate dorsal cutaneous nerve are both susceptible to damage or entrapment.

A fourth category of implant complications involves biomaterial compromise. Titanium metal has been known to stain local tissues. Local bone erosions or impaction and reactive synovitis have not been observed. Nor has the implant loosened or displaced as it is prevented by tissue ingrowth and the implant threads.

RESULTS AND EXPERIENCE

The following are the preliminary results of a prospective study involving the placement of the MBA implant in adults for the treatment of various manifestations caused by flexible flatfoot. To date, 13 implants have been placed in 10 adults ranging in age from 19 to 70 years. Three of the adults had implants placed in both feet, one simultaneously, a 49-year-old pharmacist who had been plagued by a lifetime of painful feet (Figs. 3A, 3B). Nine patients were female, and one was male; seven

Figure 3A. Preoperative realignment of the talus and calcaneus using an MBA implant in a 49-year-old male.

Figure 3B. Postoperative view.

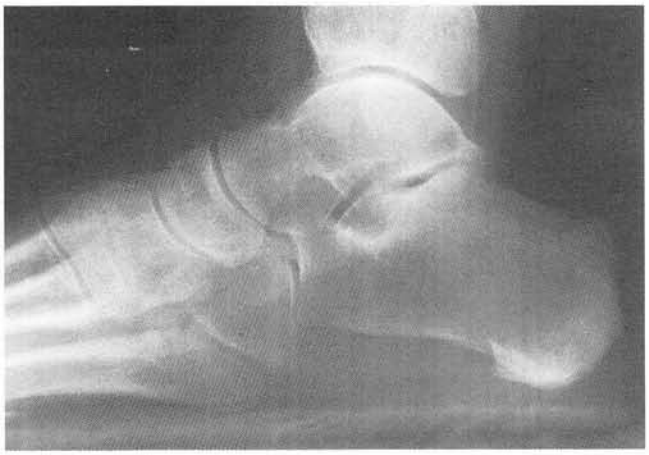

Figure 4A. Preoperative view of implant properly seated in the sinus tarsi of a 70-year-old female with osteoporosis.

Figure 4B. Postoperative view.

were left feet, six were right feet. Follow-up in this series ranges from 6 months to 17 months.

Four patients (five feet) required no Achilles lengthenings. One patient underwent an unplanned, but successful, percutaneous TAL on the operating table when ankle dorsiflexion was completely lost upon placement of the implant. Other associated procedures performed in conjunction with the implant include hallux valgus repair, naviculocuneiform fusion and a Kidner tendon advancement.

Initially, the patient with the medial column fusion had a metatarsus primus elevatus and uncompensated forefoot varus, but this rotated out over four months as the peroneus longus regained its function around the realigned cuboid bone. Three feet have a vertical calcaneus which is slightly uncomfortable; one is scheduled for adjustment. No additional procedures have been necessary in these adults, including the need for removal of the implant.

One patient had the complication of Type II complex regional pain disorder although it was resolved with extensive treatment. A 70-year-old female with documented osteoporosis has tolerated her implant relatively well, with no sign of bone collapse (Figs. 4A, 4B).

Probably the most common surgeon error is to insert the implant too deeply into the sinus tarsi and overly restrict motion. Several adult patients had prolonged or delayed sinus tarsi pain postoperatively, which required definitive treatment until comfortable. Patients should be warned of this possibility in advance. All were advised to wear custom-made orthotics after the surgery, although not all complied.

The most important ancillary procedure is the Achilles lengthening which should be performed even when indications are marginal. Otherwise, the implant procedure will likely fail. The medial column deformity must be addressed definitively. At this point for plantarflexion of the first ray, the author favors the Cotton procedure (opening osteotomy of the medial cuneiform).

All patients were pleased with the results, even when complete recovery seemed prolonged. The preoperative symptoms had been reduced substantially in all cases, and completely in the majority. Important angular relationships as seen on radiographs showed marked improvement post-operatively, consistent with previous studies analyzing arthroereisis implants.

CONCLUSION

More data should be gathered as additional cases of implantation are available for evaluation. The information needs to be analyzed in greater depth and statistical analysis performed when numbers are sufficient to warrant it. The results can then be analyzed beyond that gained through experience only.

So far, the experience has been invaluable in improving both patient selection and execution of the procedure along with ancillary surgeries. Because of the substantial information available regarding various arthroereisis techniques for flat-foot correction, the MBA implant is less of an experiment and more of a fulfillment of a significant need. It is performing like an "internal orthotic" and the results look more than promising - they look revolutionary.

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