INTRODUCTION

Dr. Daniel Schulman provided a consultation to a 54-year-old healthy female clinical nutritionist for a painful right bunion and great toe joint pain after wider shoes and padding failed to deliver any relief.

Upon examination, pain was palpated along the medial first metatarsal head without bursa formation. No effusion was noted, although the right first metatarsophalangeal joint (MPJ) range of motion was limited without crepitus.

Review of the radiographic findings (Figures 1-3) revealed an elevated hallux abductovalgus angle, moderately increased first intermetatarsal and metatarsus adductus angles, abnormal fibial sesamoid position, slightly elevated first metatarsal and mild dorsal osteophyte first metatarsal head. There was also a slightly elevated distal articular set angle.

The surgeon selected a distal first metatarsal osteotomy (long-arm “V” type Austin), Valenti arthroplasty, and repositional hallux phalangeal osteotomy (Akin) as the procedures to correct the above clinical and radiographic abnormalities for the right foot. Instead of cannulated cortical/cancellous metallic screws traditional for this type of operation, this case features the use of two 2.4 mm diameter allograft cortical bone pins (Schulman Cortical Bone Pins) as the preferred method to fixate the distal first metatarsal and a third cortical bone pin to fixate the phalangeal osteotomy.

Each of these osteotomies may utilize one to two allograft cortical bone pins per surgeon’s preference.

Keywords: Cortical Bone Pin, Allograft, Austin, Valenti, Akin, Bunionectomy, MPJ, Arthrodesis, Fusion, Regenerative Medicine

SURGICAL TECHNIQUE

This study includes the following techniques:

- Bone remodeling of the first metatarsal head and phalangeal base of hallux using a sagittal saw;
- Passage of a McGlamery elevator beneath the first metatarsal head to release fibrous adhesions of the sesamoid apparatus;
- Two converging osteotomies involving the dorsal aspect of the first MPJ (Valenti).

Upon completion of the dorsal long-arm “V” osteotomy and lateral displacement of the metatarsal head, manual compression is utilized along with one 3/32” Steinmann pin and one temporary 0.45” K-wire or two 3/32” Steinmann pins, depending on whether one or two bone pins will be utilized for fixation. Steinmann pins and/or K-wire are positioned parallel with each other, angled from dorsal-distal-lateral to plantar-proximal-medial. No bone clamp is necessary.

NOTE: It is extremely important to perform all bone remodeling with power saw/burr before insertion of allograft cortical bone pins to prevent loosening of implant.
The distally positioned Steinmann pin is used to fabricate the hole for the first of the potential two 2.4 mm diameter allograft cortical bone pins. Each bone pin measures 40 mm in length and can be conveniently cut to the appropriate length for each usage (usually between 16-18 mm) before pound-in insertion using a suitably sized tamp and mallet.

After completion and stabilization of the first metatarsal osteotomy, an oblique phalangeal osteotomy (Akin) is performed and stabilized using a small bone clamp. Only minimal to zero tension on the proximal-lateral hinge of the osteotomy is necessary to avoid immediate opening of the osteotomy after bone clamp release. The bone pin increases in girth after insertion, making this risk less likely to occur than with a metallic screw.

A second bone pin crossing the osteotomy is necessary if there is instability due to complete severance of proximal-lateral hinge. An appropriately sized Steinmann pin is used to stabilize the osteotomy from proximal-plantar-medial to distal-dorsal-lateral and a 2.4 mm diameter allograft cortical bone pin is inserted after adequate dilation of the insertion hole using a mallet and tamp (Figure 4).

After wound closure and sterile compressing dressing, a walker boot is applied in the operating room suite before transferring patient to recovery room. The first ray is immobilized partial weight-bearing for 6 weeks following surgery with a long walker boot. Normal shoe gear is allowed at 6-8 weeks post-op after radiographs are taken.

Removal of stress shielding (reduction in bone density/osteopenia) from the bone healing equation will allow a stronger osseous construct to evolve at the arthrodesis site. If non-osteocgradable materials (such as traditional metallic implants) are used, the site of arthrodesis can be left temporarily or permanently devoid of critical osseous bridging and microvascularization across the interosseous implant locations. Therefore, surgeons must begin with a biologically stable environment where there is minimal fixation site inflammation and the graft can be easily incorporated with an uninterrupted bony union. Additionally, to maintain osseous alignment and stability, the compression force of the arthrodesis site must be equal to or greater than the distraction/separation force.

Regardless of the osteotomy fixation technique, three of the four highly cited AO (Arbeitsgemeinschaft für Osteosynthesefragen) principles must be followed: 1) good anatomic reduction; 2) stable fixation; and 3) preservation of blood supply. The author’s surgical experience using these allograft cortical bone pins led to the discovery that these implants perform in a hybrid-type fashion with some elements of both rigid fixation and splintage. An amount of clinically relevant expansion in the girth of the implant after insertion aids in the rigidity and stability of the fixation. This desirable anti-pistoning effect is hypothetically due to the cortical pin being freeze-dried: post insertion into the recipient bone, the implant swells from rehydration and due to the cortical pin being freeze-dried: post insertion into the recipient bone, the implant swells from rehydration and produces a tight fit.

There are three large advantages of osteobiologic implants:
1. The radiopaqueness of an allograft cortical bone implant allows easy visualization;
2. The insertion hole of the implant can be filled with an allograft bone substitute and subsequently re-drilled if needed due to poor implant position; and
3. There is no need to remove failed hardware in revision cases of malunion or non-union (which could lead to bone loss/fracture).

The use of allograft cortical bone implants appears to be a highly viable option for effective fixation in many different clinical scenarios. Ultimately, it is very desirable to avoid leaving patients with retained hardware that may or may not be problematic in the future.