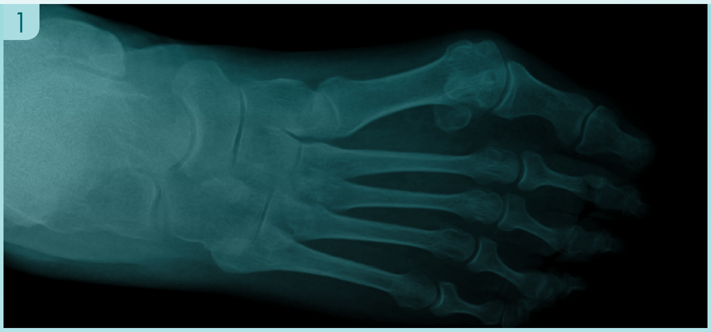
REPOSITIONAL FIRST TARSOMETATARSAL JOINT ARTHRODESIS (LAPIDUS BUNIONECTOMY) USING ALLOGRAFTS

(SCHULMAN CORTICAL BONE PINS)

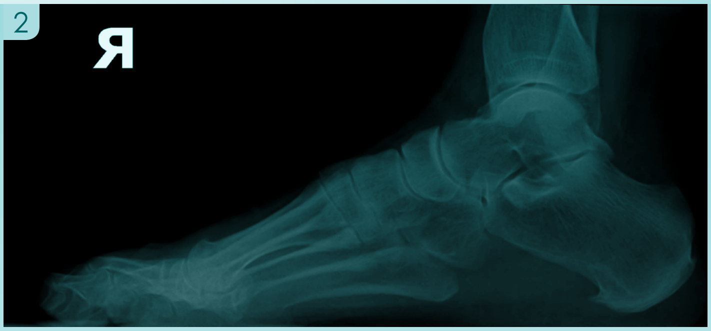
Daniel S. Schulman, DPM, FACFAS

Arizona Institute of Footcare Physicians - Mesa, AZ

1



2



3

[Figures 1-3] Patient's Pre-operative Radiographs:
1) Anteroposterior (AP); 2) Lateral; 3) Lateral Oblique

INTRODUCTION

Arthrodesis of the first tarsometatarsal joint is a time-tested procedure for treatment of severe *hallux valgus,* reoccurring *hallux valgus* from failed bunionectomy, *hallux varus, hallux rigidus,* post-traumatic degenerative joint disease and deformities related to rheumatoid arthritis or neuromuscular instability. Over the years, various surgical and fixation techniques have been described for treatment first metatarsophalangeal and first tarsometatarsal joint arthodeses. However, surgical techniques become more challenging in patients that are compromised (such as by steroid use with or without osteopenia) or have a history of metal allergy. To provide an alternative treatment for these patients and other, the author describes herein a **modified fixation method** using multiple crossed allograft cortical bone pins to achieve fusion of the great toe joint and the first tarsometatarsal joint (Lapidus Bunionectomy). In this study, the author outlines two challenging case examples of patients with hallux abductovalgus deformity.

Keywords: Cortical Bone Pin, Allograft, Lapidus Bunionectomy, Hallux-Abductovalgus Deformity Fusion, Regenerative Medicine

BACKGROUND

Severe Hallux-Abductovalgus Deformity:
Dr. Daniel Schulman provided a consultation to a 59-year-old female who presented with: a dull-aching painful right bunion; painful right second toe; and occasional pain on the ball of her right foot which had been getting worse over the past several years.

The patient refused wearing wider shoes and padding because she stated it does not help her symptoms. She has a significant past medical history of COPD and inhaled steroid use and continues to use tobacco. Patient agreed to have a Lapidus Bunionectomy and second hammertoe correction to attempt to alleviate her pain.

Initial Radiographs:
The patient's initial radiographs *(Figures 1-3)* demonstrated: a mild generalized osteopenia with a large first intermetatarsal angle; moderate to severe proximal articular set angle; mild distal articular set angle; and elevated tibial sesmoid possition. There was mild diastasis between the first and second metatarsal bases. Significantly, there was limited and painful end range dorsiflexion of the first MPJ pre-operatively.

SURGICAL TECHNIQUE

First Metatarsal-Cunieform Joint Arthrodesis (Lapidus Bunionectomy):

- The first metatarsal-cunieform joint capsule was identified and sharply incised in a proximal to distal fashion.
- The capsule and periosteum were reflected and visualization of the joint was achieved.
- Utilizing an saggital saw, the articular surfaces were resected in the form of a wedge with the apex located medially in the saggital plane.
- A parallel osteotomy was made on the base of the left first metatarsal while a second osteotomy was made perpendicular to the long axis of the medial cuneiform.
- After the osteotomized bone was completed, sharp dissection allowed the author to remove all osseous fragments from the fusion site with the aid of a small lamina spreader and a mini-Hohman retractor.
- At this time, both the medial cuneiform and the first metatarsal fusion surface areas were fenestrated with a 0.045" K-wire to facilitate the bone to bleed.
- The first metatarsal and medial cuneiform surfaces were reapproximated with slight first metatarsal plantar displacement of 0.3 cm to compensate for shortening of the first ray, since no apparent cartilage/bone was present in the arthrodesis site after saline irrigation.

Stabilization of the fusion site was accomplished with three 3/32" (2.4 mm) diameter Steinmann pins in the following manner: *(See Figures 4 and 5 for a color coded view of pin alignment)*

- **Red pin:** A Steinmann pin was inserted across the arthrodesis site from medial/distal/plantar to lateral/proximal/dorsal. The target was the second metatarsal base or intermediate cunieform.
- **Blue pin:** A second Steinmann pin was inserted from distal/dorsal/lateral to proximal/plantar/medial.
- **Gold pin:** A third Steinmann pin was inserted from dorsal/proximal/medial to distal/plantar/lateral.

These Steinmann pins were utilized to fabricate three 2.4 mm glide holes for insertion of three 2.4 mm diameter, 40 mm long allograft cortical bone pins **(Schulman Cortical Bone Pins).** Prior to insertion of the allograft cortical bone pins, the author started with the first inserted Steinmann pin and passed each one back and forth four to five times while powering spinning to establish an adequate drill hole diameters for the bone pins.

Once clinical and radiographic stabilization of the fusion site was confirmed, removal of each Steinmann pin and replacement with the insertion of a 2.4 mm diameter, 40 mm long Schulman Cortical Bone Pin was performed one-at-a-time in a clockwork progression.

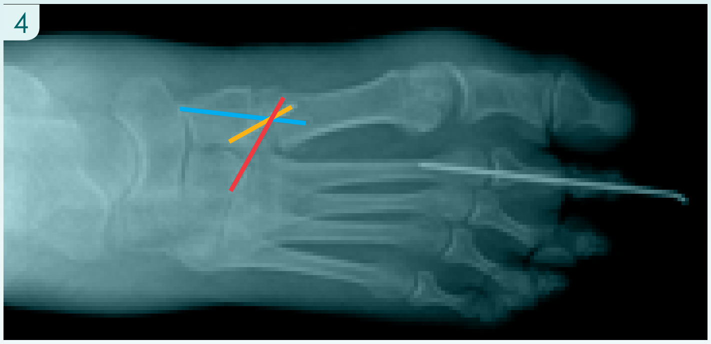
Post-operative Course:
After wound closure and sterile compressing dressing was applied, a posterior splint with an exaggerated forefoot extension was fabricated for the patient in order to prevent excessive dorsiflexion stress on the hallux.

The first ray and the great toe were immobilized non-weightbearing for six weeks following surgery with a distally extended posterior splint. At six weeks, the patient is converted into a long walker boot, full weight-bearing. Normal shoegear is allowed at 8 weeks postoperatively; high impact activities are allowed at 12 weeks post-op. A topical anti-inflammatory gel was prescribed for post-op pain/edema if needed.

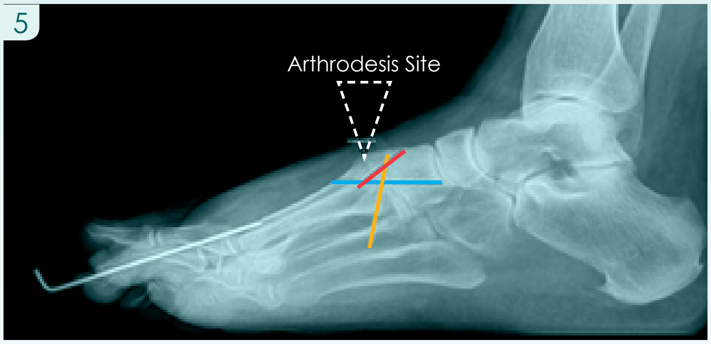
CASE STUDY RESULTS

1-Week Post-op:
At one week post-op, first intermetarsal angle and sesmoid position was successfully reduced with intact three cortical bone pins. Also, adequate bone removal was achieved on the dorsal first MPJ to improve its dorsiflexion. Post-operative protocol was identical to first MPJ arthrodesis post-op protocol without variation except that there was no in-office visit required for K-wire removal.

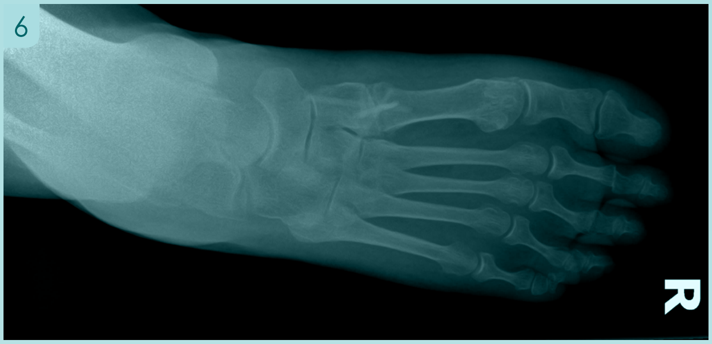
4



5



[Figures 4-5] 1-Week Post-op Radiographs:
One week after left first metatarsocunieform joint arthrodesis: 4) Anteroposterior (AP); 5) Lateral



[Figures 6-7] 5-Month Post-op Radiographs:
6) Anteroposterior (AP); 7) Lateral

6-Weeks Post-op:
The patient healed uneventfully and was asymptomatic at six weeks, even with the negative impacts of tobacco and inhaled steroid use. No bone stimulators were utilized.

5-Months Post-op:
At five months, radiographs were taken in three views weightbearing and osseous alignment was maintained of the first and second rays and visualized on lateral view *(Figure 7)*.

It should be noted that the cortical bone pin exiting the plantar/proximal first metatarsal was almost fully resorbed within the subcutaneous tissues without any post-operative clinical findings.

DISCUSSION

The greatest benefit of human allograft fixation implants such as the Schulman Cortical Bone Pin stems from their osteoconductive capability, converting this from a traditional prodcedure to a regenerative medicine solution.

This capability allows the allografts to promote a healing response that facilitates new bone growth at the site of the recipient-graft interface and within the porous bone of the allograft implant material. This process of incorporation starts immediately with a hydrolysis rate slow enough to allow complete healing of the osteotomy and/or fusion site before loss of integrity of the allograft implant. Consequently, this process discourages distraction or separation of the arthrodesis/osteotomy site. Osteogenic potential will be maximized through a stable and well-approximated fusion site or osteotomy. As such, it is crucial that the site be adequately stable and well-approximated --but not necessarily compressed-- before insertion of the bone implants.

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-osteoconductive 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 produces a tight fit.

One must consider three large advantages of using 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. One area of promising use would be to improve outcomes in Charcot foot reconstruction. Ultimately, it is very desirable to avoid leaving patients with retained hardware that may or may not be problematic in the future.

LEARN MORE
Clinicals@LatticeBiologics.com
DrSchulman@LatticeBiologics.com