CHAPTER 17

LAPIDUS XL: Gaining Stability Without Compromising Length

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The Lapidus procedure has long been recognized as an effective means of correcting the large intermetatarsal angle bunion and sagittal plane instability of the first ray. As the procedure gains rigid correction of the deformity, concerns of recurrence and dynamic loss of correction are not items of concern with this procedure. Shortening of the first ray however has been a well-recognized complication of this procedure. In the patient with a long first metatarsal, this way be tolerable or even desirable, however in a patient with a short first ray and predislocation syndrome this can be disastrous.

Because shortening is a well-recognized problem with the procedure, several approaches have been taken in the past in an efforts to minimize or compensate for this problem. The approaches have included plantar translation of the metatarsal on the cuneiform after joint resection, plantar wedging performed to generate plantarflexion of the first metatarsal with closure of the site, and curettage to limit shortening from the start. While all of these techniques have merit and deserve consideration, all will result in some shortening and functional elevation of the metatarsal head.

Of other concern is the nonunion rate associated with this procedure that is generally accepted to be around 10%. Although not all of the radiographic non-unions are symptomatic this is still of significant concern. One must consider whether in our pursuit of attempting to minimize shortening, we may have sacrificed adequate joint resection thus increasing the non-union rate and actually increasing shortening after the subsequent repair is undertaken.

It is with this problem in mind that the author began to look for methods of achieving fusion with minimal or no shortening. The answer to the problem lies in resecting the minimal length of bone to achieve healthy bleeding surfaces for fusion and then interposing a bridge of bone that aids in repositioning of the distal metatarsal to its desired location. The bone bridge may be allogeneic or autogenous, depending on the size of the graft, host factors, and intraoperative conditions. Simply put, the larger the desired/needed graft the greater the need for the graft to be autogenous, containing the patient's own living bone cells and bone proteins. Alternatively, in a healthy patient with good circulation and good ability to comply with strict non-weightbearing for extended periods of time, use of allogeneic bone allows good correction without the increased operating room time and potential increase in complications associated with the harvest procedure and site.

In the author's experience, grafts of approximately 5 mm may be allogeneic with little concern in the appropriate patient. Grafts of a larger size, and even smaller grafts in the compromised host should be limited to autogenous bone. Donor sites for harvesting graft include the iliac crest, distal tibia and calcaneus. The author most frequently uses the superior lateral edge of the tuberosity of the calcaneus, routinely harvesting a bicortical section measuring slightly greater than 1 cm in width (Figures 1-4).

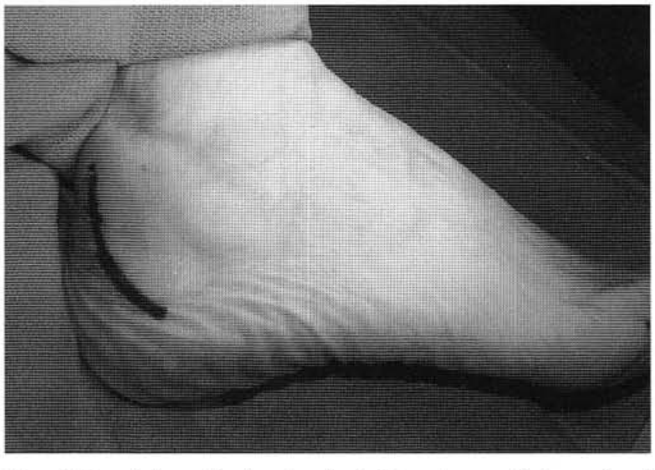

Figure 1. Lateral view of the foot showing incision placement for harvesting of calcaneal allograft.

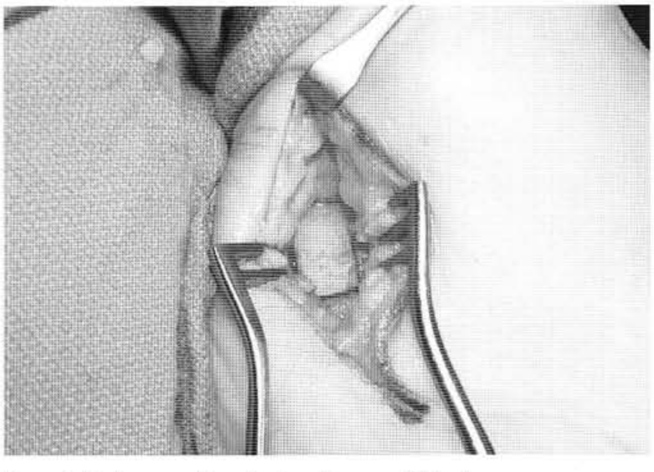

Figure 2. Periosteum reflected and graft cuts established.

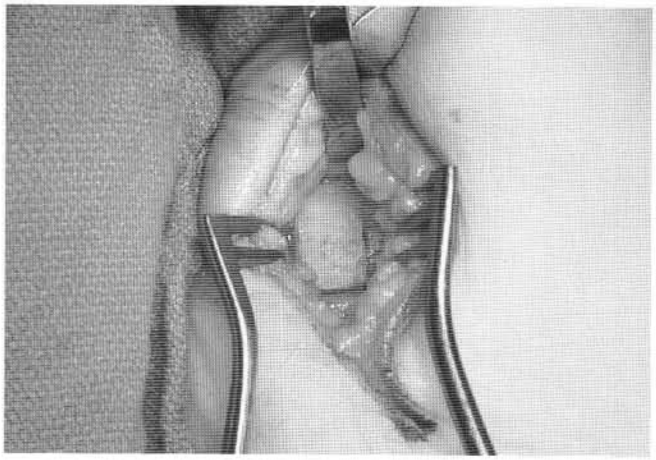

Figure 3. Curved osteotome in place gently manipulating and extracting the graft.

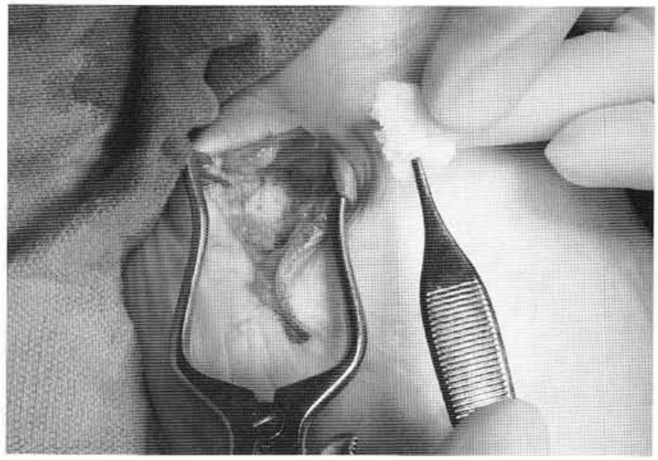

Figure 4. Defect being back filled with allograft product.

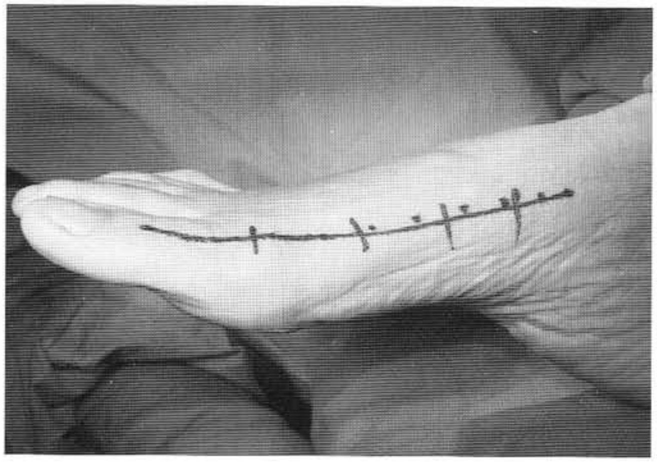

Figure 5. Incisional placement allowing metatarsophalangeal joint and metatarsocuneiform exposure and subsequent hardware placement.

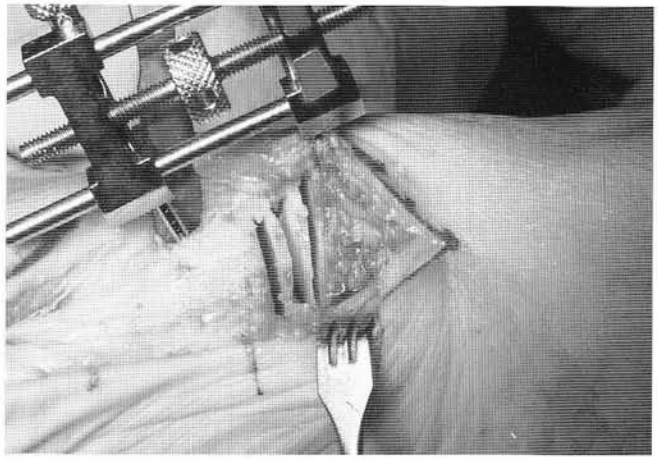

Figure 6. Planal joint resections undertaken with distractor in place dorsally

Both the distal tibia and iliac crest can provide larger sections of bone when needed, as well as providing adequate volumes of cancellous bone for packing defects around the arthrodesis site. Other advantages of the iliac crest graft specifically lie in its superior strength when compared with the other options. Conversely the iliac crest donor site is typically much more painful and may result in more severe complications at the donor site.

TECHNIQUE

Based on preoperative planning, graft is harvested from the appropriate site. Figures 1-4 illustrate incisional placement, graft procurement and backfilling of the defect created by harvesting of the graft. It is the author's opinion that by filling the defect, stress risers will be minimized and the potential for later fracture is reduced. The author typically utilizes allogeneic products such as Opteform, Osteofil or Grafton for this purpose. Arthrodesis of the first metatarsocuneiform joint is accomplished after careful preoperative planning to determine the size and type of graft to be used.

Typical metatarsophalangeal joint release is undertaken initially and after complete release, attention is directed proximally. Complete exposure of the metatarsocuneiform joint and cuneiform itself is needed to allow for adequate site preparation and later fixation (Figure 5). Care should be taken, however, to avoid compromise to the tibialis anterior tendon insertion plantarly.

After the joint has been exposed, the joint is distracted to allow adequate resection of the articular cartilage and minimum fenestration of the subchondral bone plate. It is short sighted for the surgeon to perform conservative resections here. The guide should be healthy,

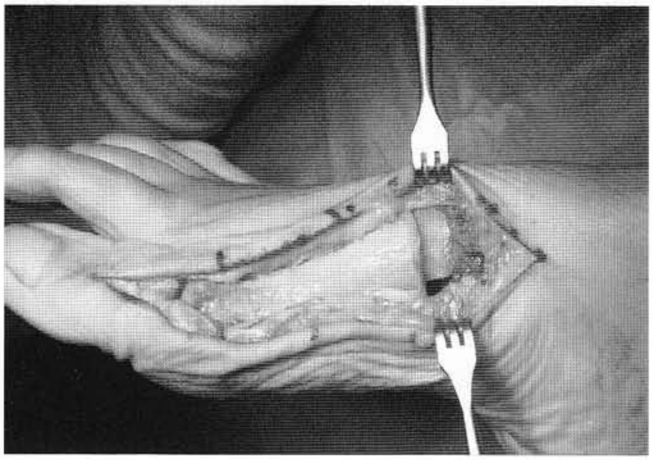

Figure 7. Calcaneal autograft interposed and fitted into metatarsocuneiform fusion site

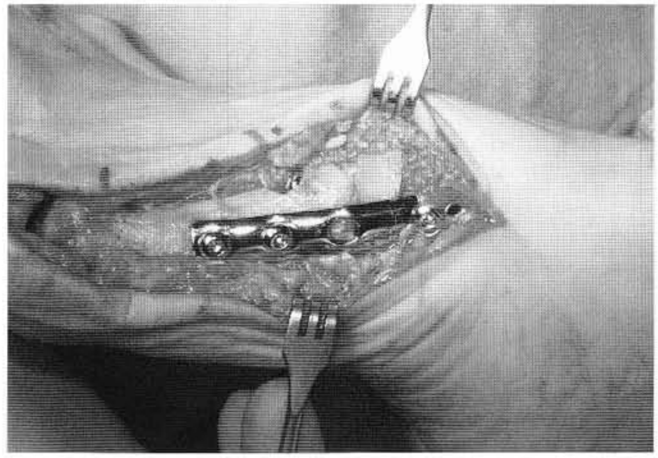

Figure 8. Fusion site with completed fixation

Figure 9. Intraoperative C-arm view showing temporary fixation of graft in the fusion site

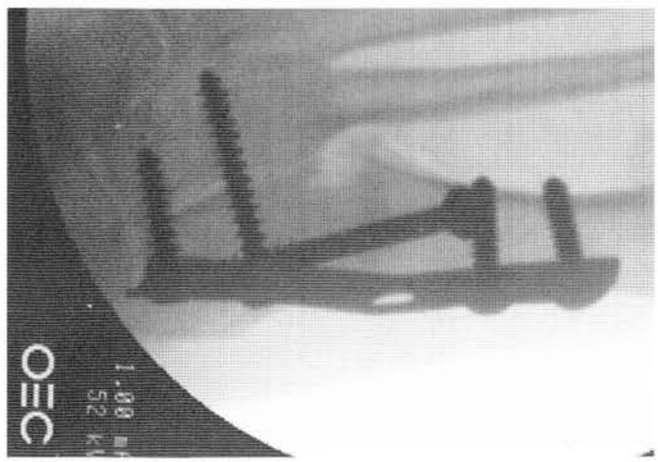

Figure 10. Final fixation of the Lapidus XL. Intraoperative C-arm view confirming placement prior to closure.

bleeding, cancellous bone and this resection should be taken into consideration when planning graft harvest. The author prefers planal resection of the anterior face of the cuneiform and proximal metatarsal because this facilitates graft placement and stability. Figure 6 illustrates this resection. After resection of the joint, aggressive fenestration of the site is undertaken, typically with a 0.045" Kirschner wire.

Following irrigation of the site, the graft is interposed and distraction released (Figure 7). The metatarsal position is carefully evaluated and any final fitting or planning is accomplished as needed (Figure 8). Once position is judged acceptable then temporary fixation is placed using an axial guide pin for later placement of a cannulated screw (Figure 9).

Pin position is confirmed and fine-tuned as needed under C-arm guidance, then the screw is placed. Reinforcement of the site is typically accomplished using a 5- or 6-hole 1/3 tubular plate (Figure 10). Plate fixation affords excellent rigidity and stability to allow for primary bone healing. After fixation, final rebalancing of the MPJ is accomplished as needed and closure is then performed in an anatomic layered fashion.

The patient is then placed into a modified Jones compression dressing for approximately 72 hours until the first dressing change. If edema is well controlled, the patient is placed into a well padded non-weight-bearing short-leg cast for a minimum of 8 weeks. The patient is monitored during the postoperative period with serial radiographs. At approximately 8 weeks, a slow, gradual increase in weightbearing is allowed in a fracture walker. Between 10 and 12 weeks, full weightbearing is typically allowed in the brace. Weightbearing is immediately suspended if any significant increase in pain or swelling is noted, and the patient is further evaluated radiographically.

COMPLICATIONS

To date, this procedure has resulted in 3 significant complications. In the first case the patient underwent fusion with interpositional bone graft for chronic predislocation syndrome that was unresponsive to conservative care. The patient's recovery was uneventful, and the patient was released to regular shoes at approximately 12 weeks. On the next 2 follow-up appointments the patient had vague concerns of arch discomfort. Subsequently radiographs revealed graft resorption at approximately 6 months postoperative. Patient was placed back into the fracture walker and ultrasound bone stimulation was instituted. After approximately 6 additional months, the patient's discomfort resolved and early subtle reconsolidation of the site began to be visible on radiographs. This occurred with no loss of positional correction and no recurrence of the original sub-2 symptoms. Analysis of this case showed the site to be fixated using crossed 4.5mm cannulated screws. Since that time, it is the author's policy to reinforce the axial screw with a medial plate for optimum stability.

In the second case, interpositional allograft was used. The patient underwent metatarsus adductus repair, and due to the severe obliquity of the metatarsal cuneiform joint, bone graft was placed to aid in realignment. The patient's recovery was again relatively uneventful, however the patient complained of continuing pain in the arch/metatarsal-cuneiform area after returning to weight bearing. Serial radiographs revealed graft resorption. The procedure was then revised using autogenous iliac crest bone graft. Unfortunately the patient went on to continued/recurrent non-union. Since then the patient has had all hardware removed and a mini external fixator placed for further compression of the attempted arthrodesis sites. Retrospective analysis failed to show definitive cause for problems with the second case. The patient was however, post-gastric bypass and despite being moderately obese, may have had some nutritional deficits that contributed to the problem.

One additional catastrophic failure has occurred in a case with a large allogeneic graft and inadequate mechanical stabilization. In this case only 1 screw was anchored in the plate proximally and this ultimately resulted in graft resorption/non-union and failure of the fixation.

SUMMARY

The author has presented a possible solution to the problem of shortening of the first ray associated with fusion of the first metatarsal cuneiform joint. As with all "new" procedures there is potentially a large learning curve. It is the author's hope that readers may benefit from our complications and analysis of failure so as to take advantage of this technique with minimal patient morbidity.

Key points for this technique would include 1) Careful analysis of graft size, demands and patient factors preoperatively, and 2) Understanding the need for absolute rigidity/stability of the graft-host interface and critical understanding of AO principals of fixation to achieve that stability.