CHAPTER 7

Scarf Osteotomy

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SURGICAL MANAGEMENT

- The primary indication for a scarf osteotomy is symptomatic hallux valgus deformity with an intermetatarsal angle of less than 20 degrees. The first metatarsocuneiform joint should be stable.
- It is a versatile osteotomy that can allow shortening, lengthening, rotation, displacement, or plantarization of the first metatarsal head. Thus, indications include symptomatic hallux valgus with or without mild transfer symptoms, juvenile hallux valgus with an abnormal distal metatarsal articular angle, arthritic hallux valgus not severe enough for a fusion, and revision surgery in suitable cases.

Preoperative Planning

- Anteroposterior (AP) and lateral weight-bearing radiographs of the foot are evaluated for metatarsal length, intermetatarsal angle, hallux valgus angle, distal metatarsal articular angle, and interphalangeal angle for cases that may require a proximal phalangeal osteotomy to obtain complete correction.
- Congruency of the joint, presence of osteophytes, the size of the bony medial eminence, and position and condition of the sesamoids are noted.

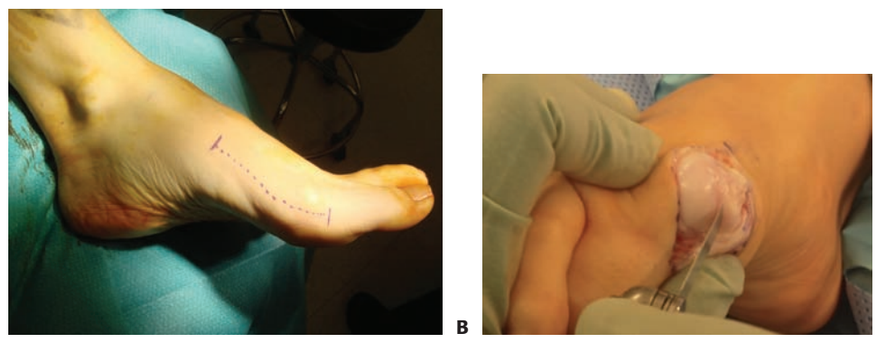
Positioning

- Surgery is performed on an outpatient basis.
- Prophylactic antibiotics are administered.
- A thigh tourniquet is applied.
- The patient is positioned supine with a sandbag under the ipsilateral buttock so the big toe points to the ceiling.

TECHNIQUES

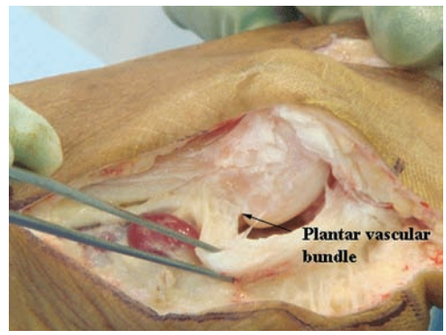
Soft Tissue Release and Bunionectomy

- Approach the metatarsal through a medial longitudinal incision extending from the first tarsometatarsal joint to the medial flare of the proximal phalanx (**TECH FIG 1A**). This can be extended distally if a phalangeal osteotomy is required.
  - Identify the dorsal medial cutaneous nerve and incise the medial capsule sharply in a single longitudinal direction.
  - Expose the medial eminence and resect it 1 mm medial to the sagittal sulcus (**TECH FIG 1B**). Overresection can lead to a postoperative varus deformity.
  - Expose the metatarsal shaft using subperiosteal sharp dissection, taking care to protect the plantar neck vascular bundle to the metatarsal head (**TECH FIG 1C**).
  - The proximal plantar exposure can be performed safely without any disruption to the plantar blood supply.
  - Use a large Langenbeck retractor to protect and retract the plantar flap.
  - The tarsometatarsal joint is identified but does not need to be exposed.



A B

TECH FIG 1 • **A.** The incision is made from the tarsometatarsal joint to the base of the phalanx. **B.** Resection of the medial eminence. (*continued*)



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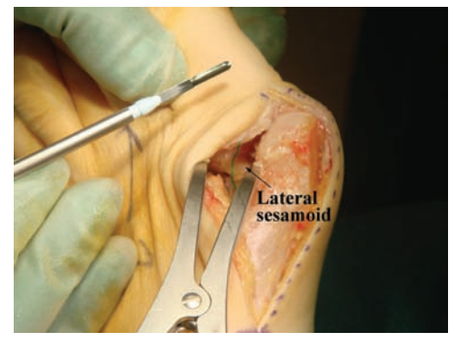


D

E

TECH FIG 1 ● (*continued*) **C.** Plantar exposure, protecting vascular supply to metatarsal head. **D.** First web space exposure and adductor release using a banana blade. **E.** Varus force is applied to complete lateral release.

- Perform a lateral release of the first metatarsophalangeal (MTP) joint by exposing the first web space with aid of a lamina spreader as an over-the-top technique. This does not compromise the plantar blood supply.
  - Use a banana blade to perform the sharp dissection (**TECH FIG 1D**). Release the tendinous insertion of the adductor hallucis muscle onto the fibula sesamoid and proximal phalanx.
  - Release the suspensory metatarsal–sesamoid ligaments and make multiple sharp perforations in the lateral capsule at the joint line if required.
  - Apply a varus force to the hallux, completing the capsular release (**TECH FIG 1E**).
- This release can also be performed through a separate first web space incision if preferred.

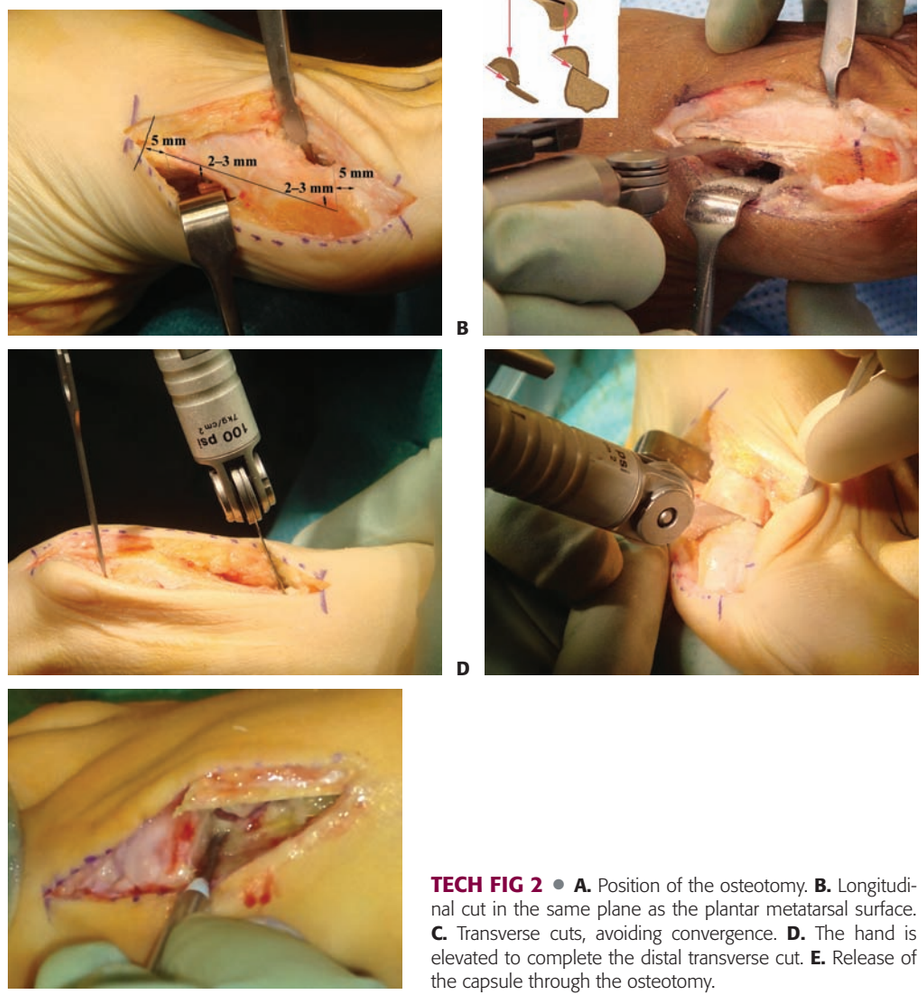
Long Scarf Osteotomy

- Begin by starting the longitudinal cut but only go through the medial cortex. This is begun distally 5 mm from the articular surface and 2 to 3 mm from the dorsal surface of the metatarsal and finished 5 mm from the tarsometatarsal joint, 2 to 3 mm from the proximal plantar surface of the metatarsal (**TECH FIG 2A**).
- Complete the longitudinal cut in the same plane as the plantar orientation of the metatarsal (**TECH FIG 2B**). Also orientate the cut relative to the plantar aspect of forefoot. Slight plantarization of the metatarsal head is optimal. Using a large Langenbeck retractor helps to visualize the plantar metatarsal surface.
- Perform the two transverse cuts at 60 degrees to the longitudinal cut as chevrons.
- Perform the distal transverse cut first and reference from the preoperative x-rays to avoid undue lengthening or shortening of the ray. The cut is dorsal and usually parallel with the articular surface, 2 to 3 mm behind the articular cartilage and directed toward the third or the fourth MTP joint.
- The proximal plantar cut must be parallel or slightly divergent to facilitate lateral translation. (**TECH FIG 2C**)
- When performing the distal cut, elevate the hand to complete the lateral part of the osteotomy (**TECH FIG 2D**).
- The two fragments should separate easily. Avoid levering them apart which risks metatarsal fracture.
- These steps may need to be repeated if there has been failure to complete all the cuts, but take care to avoid double cutting. This can cause excessive hollowing of the cancellous bone, referred to as *troughing*.
- Release of the capsule and periosteum on the lateral side may be needed if it is preventing displacement. This can often be achieved through the osteotomy, particularly distally (**TECH FIG 2E**). In our experience, this release makes a substantial difference to the mobility of the fragments and allows us to easily dial in the correction.

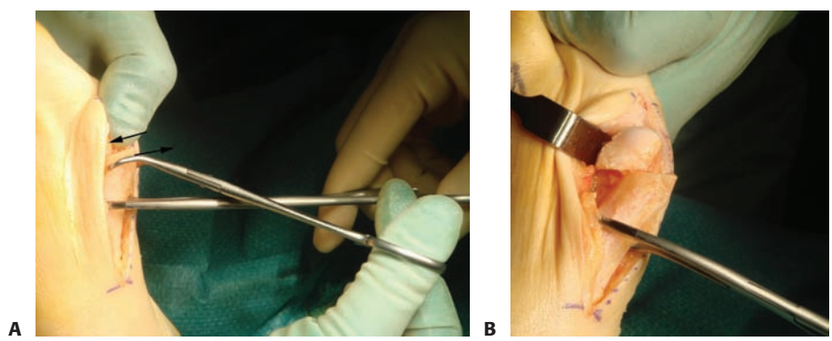
Displacement

- Perform displacement or rotation with guidance from preoperative radiographs by using a pointed clamp on the distal lateral cortex (**TECH FIG 3A**).
- Use the special compression clamp to hold the displacement (**TECH FIG 3B**).
- Up to two-thirds of lateral displacement can be obtained while maintaining a strong lateral strut and good bone apposition.

TECHNIQUES



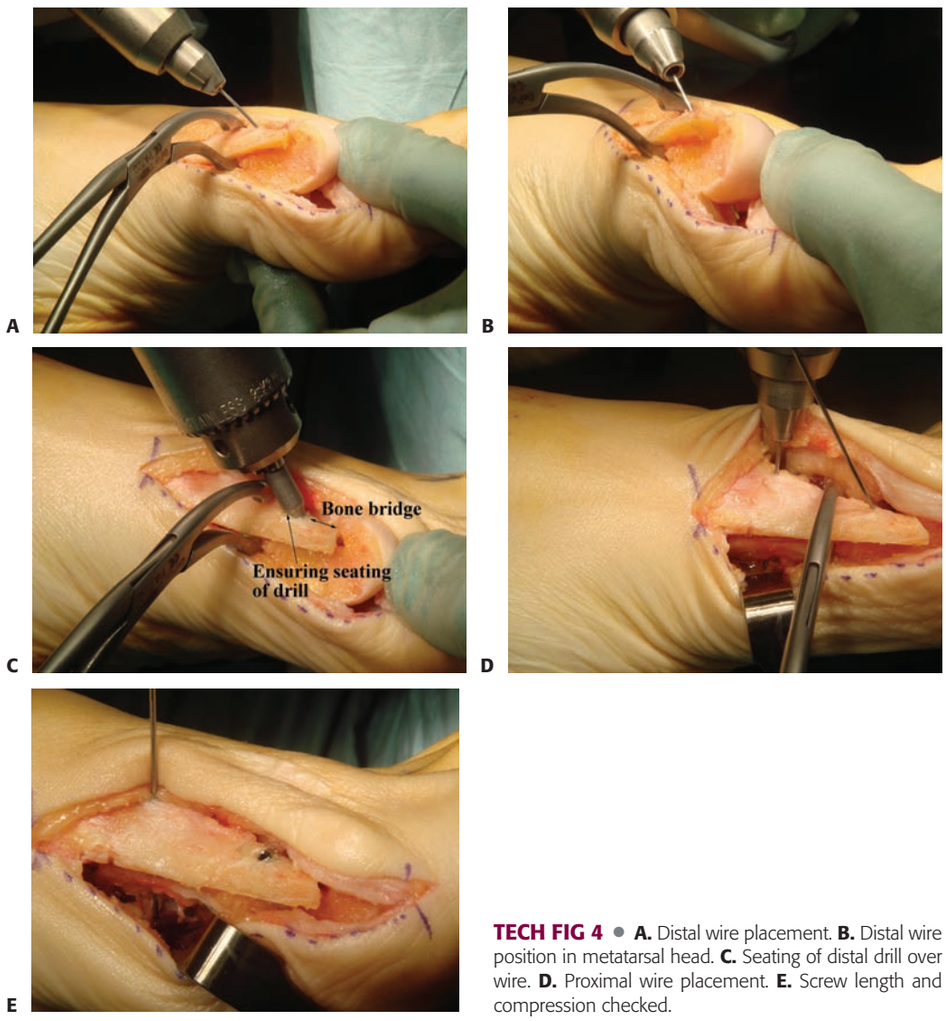
TECH FIG 2 • **A.** Position of the osteotomy. **B.** Longitudinal cut in the same plane as the plantar metatarsal surface. **C.** Transverse cuts, avoiding convergence. **D.** The hand is elevated to complete the distal transverse cut. **E.** Release of the capsule through the osteotomy.



TECH FIG 3 • **A.** Method of displacement of the fragment. **B.** Compression clamp applied after displacement.

Fixation

- Obtain screw fixation using Barouk screws (Depuy, Warsaw, IN). These are cannulated, self-tapping screws with a long distal thread and a threaded head to allow compression and burial of the head.
- Place the distal screw first.
  - Pass the guidewire from the proximal fragment obliquely into the head (**TECH FIG 4A**).
  - Directly visualize the guidewire in the joint, and withdraw it to be flush with the articular surface so that it can be measured (**TECH FIG 4B**). A screw at least 4 mm less than the measured amount is used to avoid intra-articular penetration.
  - During the drilling over the guidewire, ensure that the drill countersink is seated fully to avoid inadvertent fracture of the metatarsal during screw placement (**TECH FIG 4C**).
  - Directly inspect the joint. If the view is limited, tap the guidewire back into the joint. If you only see a wire, then the screw tip cannot have breached the joint.
- Place the second guidewire for the proximal screw in the midline in an oblique direction to reach the plantar cortex of the distal fragment (**TECH FIG 4D**).
  - Measure it by withdrawing the guidewire so as to be flush with the cortex. Retraction of the plantar tissue protects and allows direct visualization of the wire and the drill. This screw length equals the measurement from the wire.
  - Directly visualize the screw to confirm compression and length (**TECH FIG 4E**).

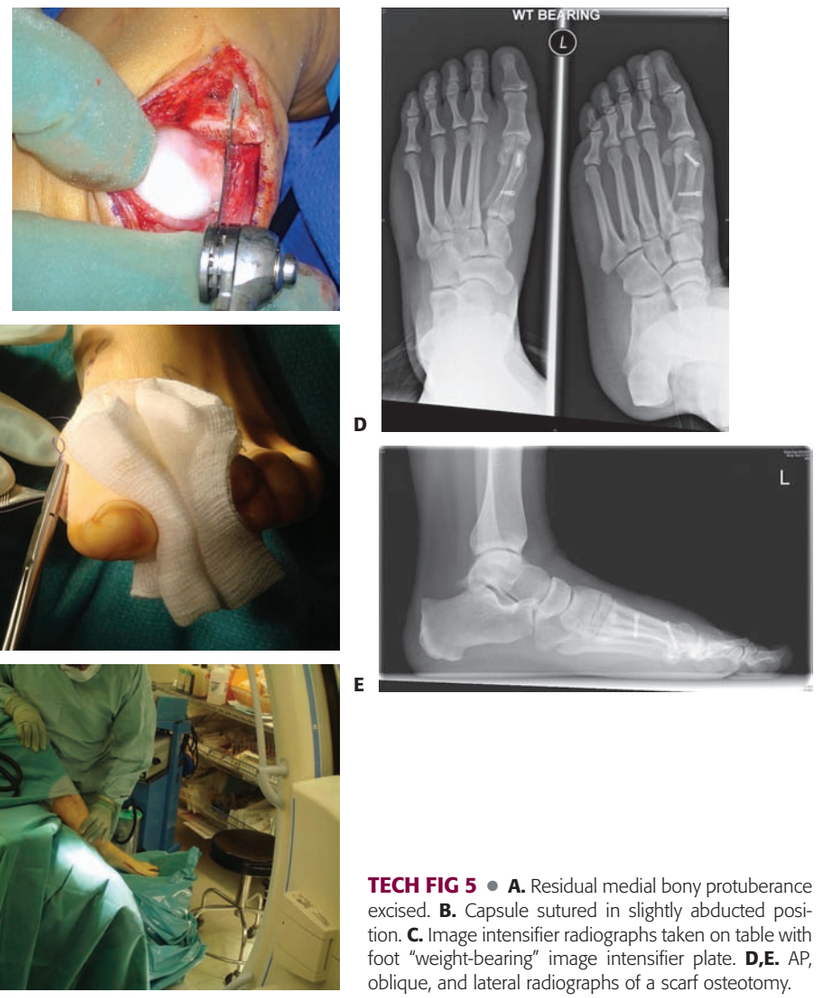


TECH FIG 4 • **A.** Distal wire placement. **B.** Distal wire position in metatarsal head. **C.** Seating of distal drill over wire. **D.** Proximal wire placement. **E.** Screw length and compression checked.

TECHNIQUES

Completion

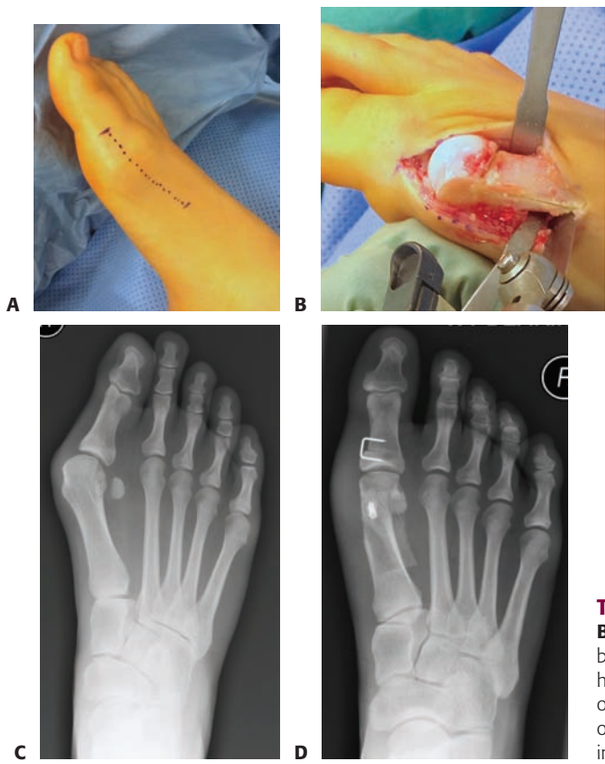
- Resect the medial distal aspect of the dorsal fragment (**TECH FIG 5A**) and check the osteotomy for stability.
- Imbricate the medial capsule with a strong absorbable suture while holding the hallux in a neutral or slightly abducted position with the aid of a swab (**TECH FIG 5B**).
- Confirm the reduction in the intermetatarsal angle, screws, and relocation of the sesamoids with image intensification with the foot flat on the image intensifier (**TECH FIG 5B**). Assess the need for a proximal phalangeal osteotomy.
- Close the wound in layers with continuous 4-0 Vicryl Rapide to skin and apply a forefoot bandage to maintain the correction.



TECH FIG 5 • **A.** Residual medial bony protuberance excised. **B.** Capsule sutured in slightly abducted position. **C.** Image intensifier radiographs taken on table with foot "weight-bearing" image intensifier plate. **D,E.** AP, oblique, and lateral radiographs of a scarf osteotomy.

Short Scarf Modification

- For many foot and ankle surgeons, a short scarf osteotomy has become standard. This modification is safe with similar outcomes and has the advantages of a smaller incision (**TECH FIG 6A**) and exposure plus single screw fixation.[2]
- We use it routinely for nearly all cases, reserving the long scarf for patients with poor bone quality and revision cases.
- The short scarf can be combined with basal osteotomies for correction of severe hallux valgus with intermetatarsal angle of greater than 20 degrees.
- The steps for the short scarf osteotomy are identical to the standard long scarf. The longitudinal cut is shorter, however, and the plantar cut is made in the diaphyseal portion of the metatarsal rather than in the metaphyseal flare (**TECH FIG 6B**).
- The osteotomy is usually just over half the length of the metatarsal.
- Displacement is the same. Care must be taken to avoid rotation (pronation) of the head fragment, as it rests on a narrower lateral cortical ridge.
- Fixation is with a single distal cannulated Barouk screw in the vast majority. Use the technique described earlier.



TECH FIG 6 • **A.** Smaller incision is shown for the short scarf. **B.** The final proximal cut of the short scarf is made in the diaphyseal bone. **C.** Preoperative weight-bearing AP radiograph of a moderate hallux valgus deformity. **D.** Postoperative radiograph after short scarf osteotomy plus Akin osteotomy. Note the proximal end of the osteotomy is in the diaphysis and the single screw is vertically orientated in the coronal plain, finishing in the medial portion of the head.

- Care is taken to place the screw as vertically as possible in the coronal plane. This means the screw ends in the medial portion of the head fragment. This ensures compression is perpendicular to the bone cuts and avoids rotation (pronation) of the head fragment as the screw is tightened (**TECH FIG 6C,D**).
- The plantar tail is a hard cortical bone and should interlock with the cut in the proximal metatarsal, providing excellent rotational stability.
- A second screw is only used if the osteotomy is not rotationally stable. Be aware that this will have cortical hold and the long drill must always be used to drill the far cortex. Otherwise, the screw may push the osteotomy apart rather than compress it.

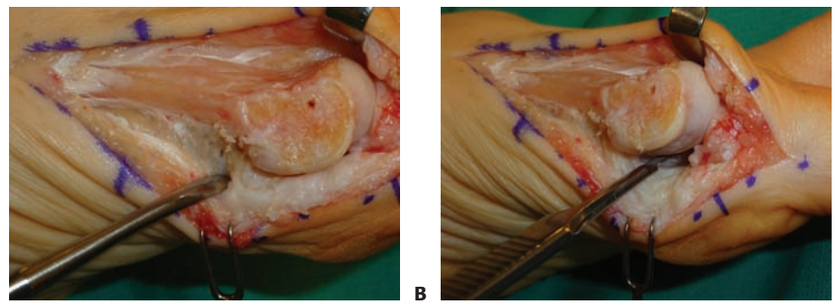
Case Example (Courtesy of Mark E. Easley, MD)

Background, Surgical Approach, and Preoperative Planning

- A 42-year-old woman with symptomatic left hallux valgus
- Preoperative weight-bearing radiograph of left foot suggests intermediate deformity with increased intermetatarsal and hallux valgus angles and an incongruent/asymmetric hallux MTP joint (**TECH FIG 7**).
- Lateral translational scarf osteotomy is planned.
- Medial midaxial longitudinal capsulotomy with the dorsomedial sensory nerve to the hallux and extensor hallucis longus (EHL) tendon protected

TECH FIG 7 • A 42-year-old woman with symptomatic hallux valgus. Preoperative weight-bearing radiograph of left foot suggests intermediate deformity with increased intermetatarsal and hallux valgus angles and an incongruent/asymmetric hallux MTP joint.

TECHNIQUES



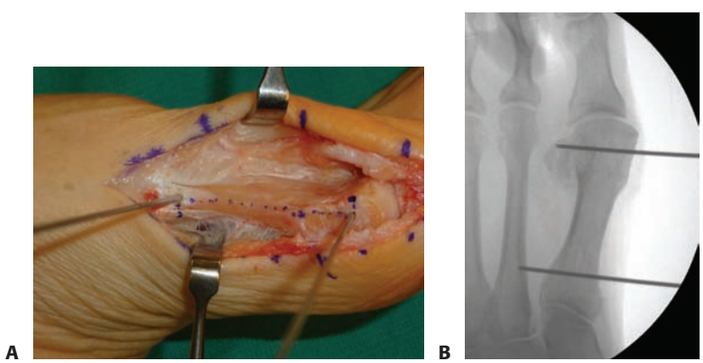
TECH FIG 8 ● Medial approach and lateral release. **A.** Longitudinal midaxial capsulotomy. Because this is a translational osteotomy, the medial eminence resection is performed in line with the metatarsal head and not the metatarsal shaft. **B.** A longitudinal release extending from the base of the proximal phalanx to the proximal aspect of the capsule is judiciously performed.

Distal Soft Tissue Procedure

- Medial eminence resection, medial to the medial sulcus (**TECH FIG 8A**)
  - Because this is a translational osteotomy, the medial eminence resection is performed in line with the metatarsal head and not the metatarsal shaft.
  - With rotational osteotomies, the medial eminence resection is typically performed in line with the medial border of the metatarsal shaft.
- Release of the lateral suspensory ligament (**TECH FIG 8B**)
  - The lateral suspensory ligament connects the lateral capsule with the lateral sesamoid.
  - The knife is carefully directed through the plantar joint, between the plantar metatarsal head and the lateral sesamoid.
  - A longitudinal release extending from the base of the proximal phalanx to the proximal aspect of the capsule is judiciously performed.
  - This release will allow for anatomic repositioning of the metatarsal head on the sesamoids.

Planning the Osteotomy

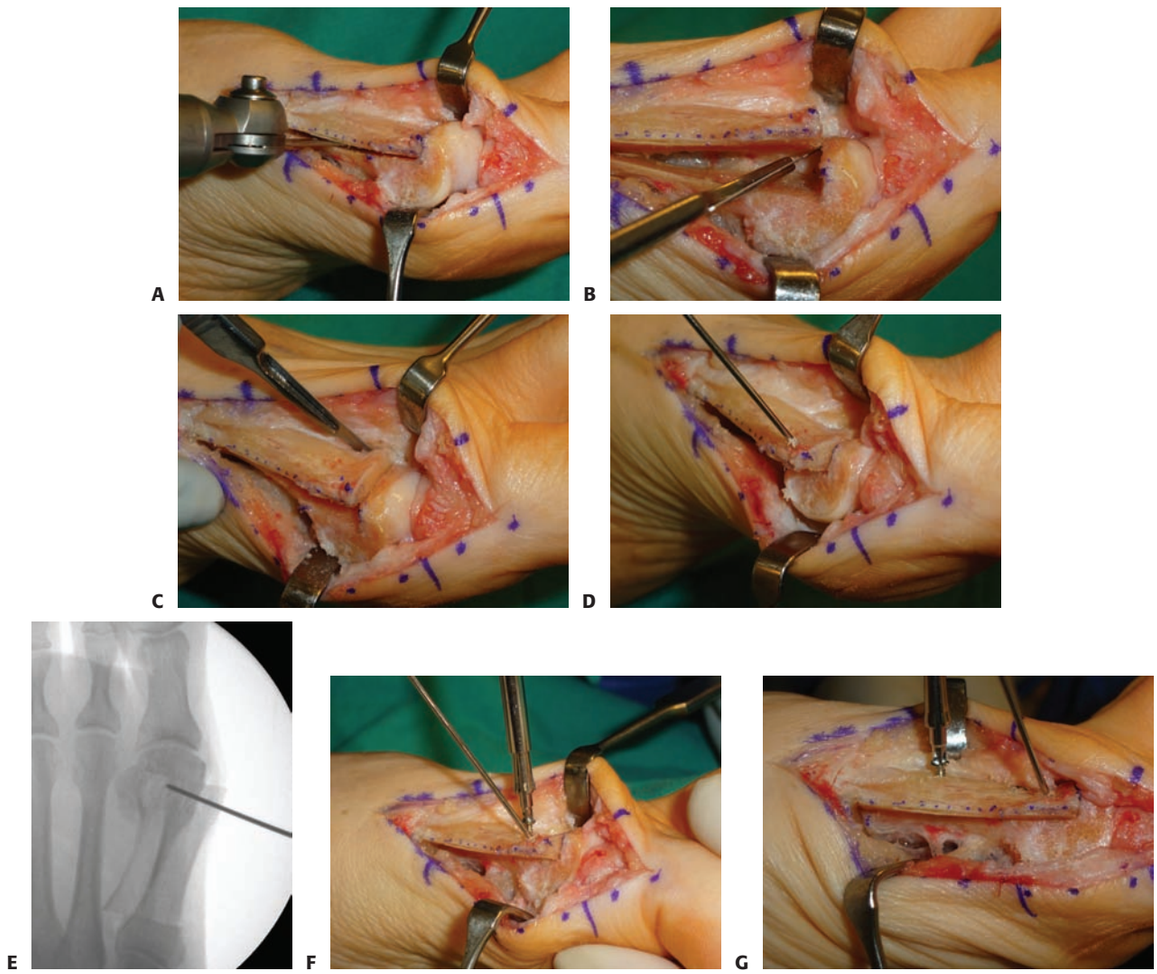
- Two parallel Kirschner wires (K-wires) are placed to define the osteotomy in two planes (**TECH FIG 9A**).
- The distal K-wire should be placed immediately proximal to the articular surface and directed perpendicular to the second metatarsal and is relatively dorsal in the metatarsal head (**TECH FIG 9B**).
  - This way, the widest portion of the osteotomy, the head, affords the greatest surface area to avoid troughing of the osteotomy.
- The proximal K-wire is placed approximately where the first metatarsal begins to flare plantarly and is relatively plantar in the proximal metatarsal.
  - This will keep the proximal vertical limb of the osteotomy from extending too dorsally, where it may risk creating a dorsal cortical stress fracture.
- These parallel K-wires may be used to guide the two vertical limbs of the osteotomy.
  - If the two vertical cuts are not parallel, the two fragments may impinge, preventing lateral translation of the distal fragment.
- The K-wires should also be placed directly medial to lateral to ensure that the distal fragment translates directly laterally.
  - If desired, the K-wires may be directed slightly plantarly, from medial to lateral, creating relative plantarflexion of the first ray.
  - The K-wires should not direct the horizontal limb of the osteotomy into elevation.



TECH FIG 9 ● Planning the osteotomy with two parallel K-wires placed to guide parallel vertical cuts and a horizontal cut that avoids elevation of the distal fragment. **A.** The distal wire is immediately proximal to the articular surface and is relatively dorsal in the metatarsal head and the proximal wire is relatively plantar in the metatarsal shaft. **B.** Intraoperative fluoroscopy shows that the distal K-wire is directed toward the second metatarsal head. The proximal K-wire was not exactly parallel to the distal K-wire and was repositioned.

Osteotomy Creation

- With the soft tissues well protected, the two vertical limbs are created parallel to the K-wires.
- The horizontal limb of the osteotomy is created parallel to the K-wires; elevation (dropping of the hand during the horizontal osteotomy) must be avoided (**TECH FIG 10A**).
- The osteotomy will not shift laterally unless the periosteum is released where the distal lateral vertical and horizontal osteotomy limbs meet (**TECH FIG 10B,C**).
  - This release must be carefully performed to avoid release of the remaining lateral capsule to the metatarsal head.
    - Complete release of the lateral capsule to the metatarsal head, combined with osteotomy and medial release, risks creating avascular necrosis (AVN) of the metatarsal head.
- The osteotomy is shifted laterally as much as possible, maintaining optimal contact between the two fragments.
  - Avoid rotation of the distal fragment relative to the proximal fragment that could lead to malunion or potentially nonunion.
- A provisional fixation pin is placed in the medial aspect of the osteotomy to temporarily stabilize the osteotomy to maintain correction prior to definitive fixation (**TECH FIG 10D,E**).
- Definitive fixation with two screws placed from dorsal to plantar (**TECH FIG 10F,G**)
  - Direct visualization from the medial aspect of the osteotomy ensures that the screws gain satisfactory purchase in the proximal fragment's plantar cortex.

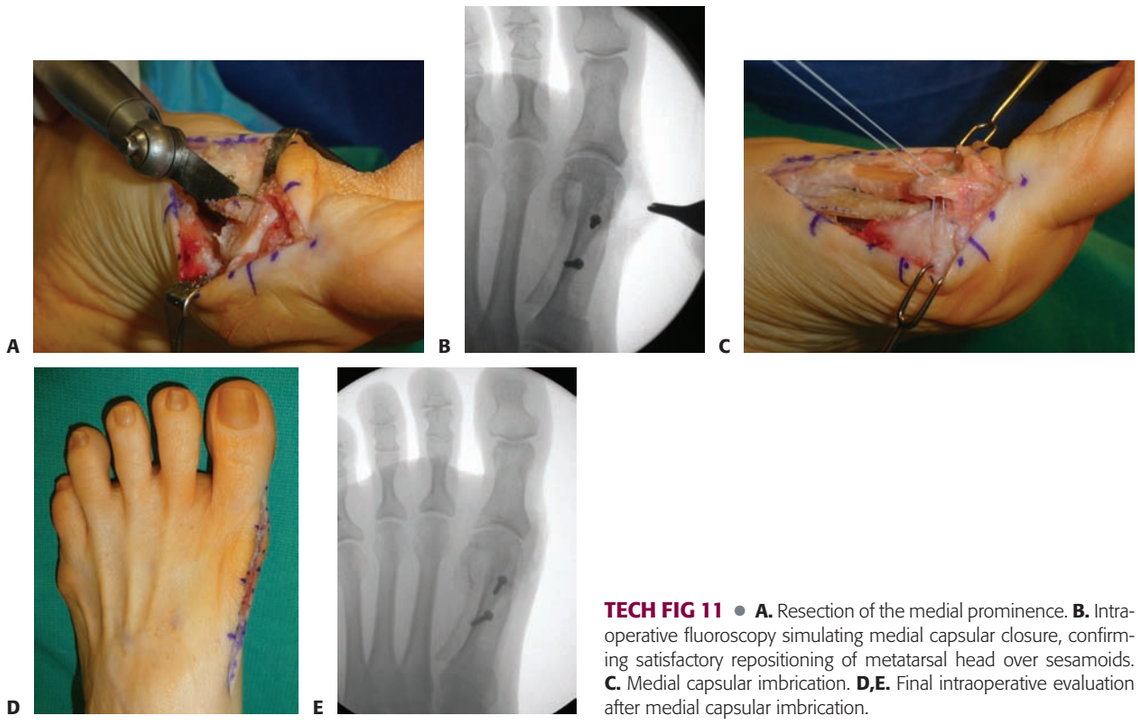


TECH FIG 10 ● **A.** After the vertical limbs have been created, the horizontal limb is undertaken. With the majority of the osteotomy completed, the K-wires are removed so that the osteotomy's vertical and horizontal limbs may be connected. Note that the ankle of the horizontal limb is directly slightly plantarly to avoid elevation of the distal fragment. **B,C.** Releasing the distal lateral periosteum to allow the distal fragment to translate. **B.** Release through the osteotomy. **C.** Release on the dorsal aspect. Note that the residual lateral capsule is not violated. **D.** After lateral shift of the distal fragment, the provisional pin is placed medially so it will not interfere with definitive screw fixation. **E.** Intraoperative fluoroscopy confirming satisfactory correction. **F,G.** Distal and proximal definitive fixation with two lag screws.

TECHNIQUES

Soft Tissue Closure and Follow-up

- Medial prominence resection (**TECH FIG 11A**)
- Simulated capsular closure and fluoroscopic confirmation of satisfactory repositioning of the metatarsal head on the sesamoids (**TECH FIG 11B,C**)
- Capsular closure
- Clinical and fluoroscopic confirmation that anatomic alignment has been achieved (**TECH FIG 11D,E**)
- Follow-up radiographs at 6 weeks and again at 3 months following surgery to confirm satisfactory correction, proper first metatarsal head–sesamoid relationship, and healing of the osteotomy.



TECH FIG 11 ● **A.** Resection of the medial prominence. **B.** Intraoperative fluoroscopy simulating medial capsular closure, confirming satisfactory repositioning of metatarsal head over sesamoids. **C.** Medial capsular imbrication. **D,E.** Final intraoperative evaluation after medial capsular imbrication.

PEARLS AND PITFALLS

Ensure adequate soft tissue release on the dorsal fragment.	■ After completing the cuts successfully, if displacement is still difficult, then check that the periosteum is not tethering the distal lateral corner of the proximal fragment.
Divergent transverse cuts	■ Avoid convergent transverse cuts, as this will make displacement difficult.
Rotational osteotomy to correct distal metatarsal articular angle	■ If using the scarf osteotomy to correct the distal metatarsal articular angle, then excise a wedge of bone from the proximal, lateral plantar fragment to allow for displacement and to avoid impingement onto the second metatarsal. The short scarf can also be used.
Longitudinal cut	■ The direction of the longitudinal cut can depress the metatarsal head depending on the requirements of the patient. Always avoid elevating the head.
Transverse cut	■ Double cutting the transverse cuts can shorten the osteotomy in cases where the joint is very stiff or there is very severe hallux valgus deformity.
Screws	■ Direct visualization of the MTP joint is made to avoid joint penetration. Take care to avoid seating the proximal screw too deep into the very thin dorsal cortex, as this may reduce screw hold.
Proximal plantar exposure	■ This is a safe exposure and does not compromise the blood supply to the metatarsal. It is a vital step: Once completed, it allows orientation of the longitudinal cut parallel to the plantar surface; identification of the flare of the first tarsometatarsal joint ensures the transverse cut is not intra-articular; and a clear view of the lateral plantar surface allows the surgeon to pass the guidewire under direct vision and check the screw length.

POSTOPERATIVE CARE

- If safe, patients are discharged home on the day of surgery, with strict advice to elevate the foot whenever resting for the first 2 weeks.
- In most cases, they are allowed to bear weight on their heel and lateral forefoot in a hard-soled postoperative shoe.
- Cast immobilization is not required.
- The wound is inspected at 2 weeks, at which time the hallux is restrapped and patients are taught simple passive and active toe flexion–extension exercises.
- At 5 to 6 weeks postoperatively, the osteotomy is assessed with radiographs. If there is some consolidation at the line of the osteotomy, the patient is instructed to wear a wide shoe or sneaker and to progress to full weight bearing as tolerated. Strapping of the hallux is discontinued at this time. Delayed union or nonunion is rare with this osteotomy.
  - Follow-up radiographs at 3 months following surgery to confirm satisfactory correction, proper first metatarsal head–sesamoid relationship, and healing of the osteotomy (**FIG 1**).

OUTCOMES

- The scarf osteotomy is now a widely used method of correction for hallux valgus; it is particularly popular in Europe.
- Satisfaction rates range from 88% to 92%,[3,4,9,10] equivalent to those of the chevron osteotomy,[5,6] including patients defined as having severe hallux valgus. In a review of five recent publications,[5,7,9–11] the hallux valgus angle was improved on average by 16 degrees (range 11 to 21), the intermetatarsal angle by 6.4 (range 3 to 10), and the American Orthopaedic Foot and Ankle Society (AOFAS) score by 45 (range 37 to 55).
- A learning curve for performing the scarf osteotomy has also been noted, with higher complication rates seen in early series.[1]

FIG 1 ● Six-month follow-up with weight-bearing AP radiograph of the left foot of the patient in **TECH FIGS 7** to **11**.

COMPLICATIONS

- The main complication seen is stiffness, which occurs in up to 5% of cases.[8] Other complications include wound problems, infection, undercorrection, overcorrection, fractures, chronic regional pain disorder, and deep vein thrombosis.
- Delayed union and osteonecrosis are rare complications.
- Fracture risk can be reduced by preserving the lateral strut when placing the proximal screw.

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