DEFINITION
- Recurrent hallux valgus is a partial or complete return of valgus deformity at the first metatarsophalangeal (MTP) joint after surgical correction.
- Metatarsus primus varus is an increase in the first-second intermetatarsal angle due to obliquity or hypermobility of the first tarsometatarsal joint.

ANATOMY
- The first tarsometatarsal joint is 27 to 30 mm deep and irregularly shaped (FIG 1).
- The dorsalis pedis artery and deep peroneal nerve are just lateral to the extensor hallucis longus tendon (FIG 2).
- The two heads of the adductor hallucis muscle converge to a single tendon and insert on the lateral sesamoid at the first MTP joint.
- The sesamoids are contained in the capsuloligamentous complex of the MTP joint.
- The dorsal medial cutaneous branch of the superficial peroneal nerve runs along the dorsal medial aspect of the first MTP joint.
- The plantar medial cutaneous branches of the medial plantar nerve run along the plantar aspect of the first MTP joint near the articulations of the sesamoids.

PATHOGENESIS
- Recurrence of hallux valgus is most often due to an improperly chosen initial procedure or improper surgical technique.
- Less frequently, factors such as poor bone or tissue quality, infection, patient noncompliance, and instrumentation failure can lead to recurrent hallux valgus.
- A major cause of recurrent hallux valgus is unrecognized metatarsus primus varus.
- If uncorrected, metatarsus primus varus creates a valgus moment at the first MTP joint.

NATURAL HISTORY
- Some partial recurrences of hallux valgus may be tolerable with nonoperative treatment.
- If there is an uncorrected metatarsus primus varus, the deformity will most likely progress over time.
- The medial prominence can result in pain, tenderness, and an overlying bursitis.
- Progressive deformity often leads to second toe overload and, ultimately, to arthritis at both the first and second tarsometatarsal joints.
- Lesser metatarsal overload, whether due to shortening of the first metatarsal or subluxation of the sesamoids, is a common reason for secondary surgery.
- Arthritis can develop at the sesamoid-first tarsometatarsal articulations.
- Prolonged hallux valgus, especially with an incongruent joint, can lead to degenerative changes at the first MTP joint.

PATIENT HISTORY AND PHYSICAL FINDINGS
- Patients report valgus deformity at the first MTP joint that either is recurrent or was never fully corrected (FIG 3).
- The examiner should evaluate for symptoms associated with metatarsus primus varus:
  - Hypermobility of the first tarsometatarsal joint
  - Mobility of the first tarsometatarsal joint is tested by holding the lesser metatarsal heads stable with one hand while passively dorsiflexing the first metatarsal head.

![Image of lateral view of the first tarsometatarsal joint. The joint is an average of 30 mm deep.](FIG 1)

![Image of the extensor hallucis longus over the tarsometatarsal joint. The dorsalis pedis and deep peroneal nerve are just lateral to the tendon.](FIG 2)
Hypermobility has been defined as elevation of the first metatarsal head more than 5 to 8 mm above the level of the second metatarsal head (FIG 4).

- Hypermobility at the tarsometatarsal joint creates a valgus moment at the MTP joint, which may contribute to failure of distal hallux valgus correction.
- Degenerative changes at the first tarsometatarsal joint
  - Tenderness at the joint line
  - Osteophytes at the dorsal aspect of the joint
  - Second metatarsal overload
  - Patients may report feeling as if there is a rock in their shoe.
  - Tenderness under the second MTP joint

- Callosity or ulceration under the second MTP joint
- Claw toe deformity (FIG 5)
- Passive correction of the metatarsus primus varus may reduce the hallux valgus deformity.
- The examiner should check for lesser toe overload.
  - The medial lesser toes should be inspected for claw toe or hammer toe deformity, overlap, large plantar callus, or plantar ulcers. The plantar surface of the MTP joints is palpated for tenderness. The proximal phalanx is translated to evaluate for instability of the MTP joint.
  - Lesser toe overload is often associated with hypermobility of the first tarsometatarsal joint or a dorsiflexion deformity of the first ray.
  - Range of motion of the first MTP joint with the hallux valgus deformity corrected is an indication of expected motion after surgical correction. Severely limited motion may be an indication for a fusion of the MTP joint.
  - In general, the more severe the deformity, the greater the pronation of first MTP joint on weight bearing.³
  - Patients are evaluated for other potential causes of the recurrent deformity:
    - Infection
    - Failure of fixation
    - Generalized ligamentous laxity
    - Osteoporosis

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**FIG 6** Plantar gapping of the first tarsometatarsal joint as well as dorsal translation of the first metatarsal on weight-bearing radiographs.

**IMAGING AND OTHER DIAGNOSTIC STUDIES**
- AP, lateral, and oblique weight-bearing radiographs of the foot should be obtained and evaluated for the following:
  - Surgical changes from the initial surgery, including any retained instrumentation
  - Congruency of first MTP joint
  - Plantarflexion of the first ray
  - Hallux valgus angle
    - Angle between long axes of first metatarsal and proximal phalanx
    - Normal is less than 15 degrees
  - First-second intermetatarsal angle
    - Angle between long axes of first and second metatarsals
    - Normal angle is less than 9 degrees.
  - Distal metatarsal articular angle
    - Angle between long axis of metatarsal shaft and base of distal metatarsal joint surface
    - Normal is less than 15 degrees.
  - Radiologic signs of metatarsus primus varus
    - Increased first-second intermetatarsal angle
    - Plantar gap at first tarsometatarsal joint on weight-bearing lateral image (**FIG 6**).
  - Claw toe deformity

**DIFFERENTIAL DIAGNOSIS**
- Loss of fixation
- Generalized tissue laxity
- Infection

**NONOPERATIVE MANAGEMENT**
- Shoe wear modification
  - Wide toe box
  - Low heels
- Orthotics
- Medial arch support for associated pes planus
- Metatarsal pad for associated second toe overload
- Activity modification

**SURGICAL MANAGEMENT**
- It is important to determine what the previous procedure entailed.
- Seldom can a failed distal or shaft procedure be revised with another such procedure.
- Most salvage procedures rely on stabilizing the base of the first metatarsal. It is also possible to get more angular correction at the base of the metatarsal.

**Preoperative Planning**
- Retained instrumentation may need to be removed.
- The age and position of previous incisions must be taken into account.
- The surgeon must take into account the need for shortening of the lesser metatarsals, correction of claw toes, and the addition of an Akin phalangeal osteotomy to correct concurrent deformities.

**Positioning**
- The patient is positioned supine.
- A tourniquet is placed on the proximal thigh.
- The foot should be positioned to allow access for intraoperative imaging.

**Approach**
- The approach depends on the procedure to be performed.

**EXAMPLE CASE**

**Background**
- Thirty-three year old woman post distal bunion correction (details unknown).
- Persistent symptomatic hallux valgus deformity (**TECH FIG 1A**)
- Has failed nonoperative management of this problem
- Motion well preserved in first MTP joint
- Overload phenomenon second metatarsal head but no deformity in second toe
- Radiographs (**TECH FIG 1B,C**)
  - Prior distal procedure to first metatarsal head
  - Increased 1–2 intermetatarsal angle
  - Increased hallux valgus angle
  - Questionable increase in the distal metatarsal articular angle
- Relatively short first metatarsal compared to second metatarsal
- No obvious second toe deformity

**Distal Soft Tissue Procedure**
- dorsomedial approach, because that is what was used previously, but extended more proximally to perform the proximal osteotomy.
- Lateral release also performed through a separate first webspace incision
- This puts the blood supply to the metatarsal head at risk if a simultaneous distal osteotomy is performed
- Medial and lateral soft tissues released
- Complete disruption of the intraosseous blood supply to the head
Distal Biplanar Chevron Osteotomy

- Therefore, lateral release must be performed judiciously
- Distal to the lateral capsule that contains vessels to the metatarsal head
- With the exposure, the actual (not radiographic) distal metatarsal articular angle (DMAA) can be evaluated (TECH FIG 2)

Proximal Osteotomy

- In this case, a proximal medial opening wedge osteotomy was performed
- It may not lengthen the first metatarsal but the risk of shortening is diminished
- All traditional osteotomies, when they heal, shorten slightly; however, an opening wedge osteotomy may not have that tendency.
- The goal was to preserve length given that the patient was experiencing a second metatarsal head overload.

Distal Biplanar Chevron Osteotomy

- The proximal osteotomy increases the already greater-than-physiologic DMAA.
- Furthermore, greater correction is warranted in this revision case with considerable hallux valgus deformity
- We check a pin under fluoroscopic guidance to determine the orientation of the osteotomy. (see Tech Fig 3G)
- A distal biplanar chevron osteotomy (Reverdin-Green osteotomy) affords greater correction, satisfactory stability, and a simple means of correcting the increased DMAA (TECH FIG 4A).
The osteotomy has a long plantar limb that provides a large surface area for healing and excellent contact for screw placement (TECH FIG 4B).

The short dorsal limb may be modified with a medial closing wedge osteotomy that allows correction of the increased DMAA. (TECH FIG 4C-G)

We routinely secure this osteotomy with a single screw placed in lag fashion (TECH FIG 4H).

The medial prominence is resected (TECH FIG 4I).

**Akin Osteotomy**

- We typically employ an oblique Akin osteotomy (TECH FIG 5A-H).
  - Abundant surface area for healing.
  - Screw can be placed from proximal to distal perpendicular to the osteotomy.
  - Some rotation is still possible to correct the pronation deformity.
TECH FIG 4 • Biplanar distal chevron osteotomy.

Chapter 15 REVISION HALLUX VALGUS CORRECTION

Closure

- The capsule is reapproximated (TECH FIG 6A).
- The correction of the axial deformity is achieved with the bony realignment, not the capsular closure (TECH FIG 6B).
- However, we attempt to correct pronation by suturing the distal plantar capsule to proximal dorsal capsule.
- Motion should be maintained after the capsule is closed (TECH FIG 6C,D).

- Final fluoroscopic images to confirm alignment is appropriate (see Tech Fig 6B).
- We strive for a slight overcorrection since the tendency is for recurrence, particularly in a revision procedure (TECH FIG 6E; see Tech Fig 6B).
- Postoperative management is the same as for other bunion procedures (TECH FIG 7A-D).

**TECH FIG 6** • Closure. A. Capsule reapproximated. B. Fluoroscopic view confirms that correction is satisfactory. C,D. Adequate motion confirmed. E. Clinical view on operating room table after skin closure.

**TECH FIG 7** • A. Early follow-up clinical view. B. Weight-bearing AP foot radiograph. C. Another clinical perspective at early follow-up. D. Lateral foot radiograph.
LAPIDUS PROCEDURE (FIRST TARSOMETATARSAL FUSION)

First Tarsometatarsal Joint Preparation
- Make a 6-cm incision over the dorsum of the first tarsometatarsal joint.
- Identify the interval between the extensor hallucis longus and the extensor hallucis brevis.
- Incise the capsule over the first and second tarsometatarsal joints and expose the joints. Release the capsule all around the medial and lateral borders of the joint to allow adequate exposure (TECH FIG 8A, B).
- Remove the cartilage from the first tarsometatarsal joint using small osteotomes and small curettes.
  - If the first metatarsal is shortened, only cartilage should be removed.
  - If the first metatarsal is long, a small laterally based wedge can be removed from the medial cuneiform.
  - A small plantarly based osteotomy can be performed to plantarflex the first metatarsal if necessary.
- Use a 2.0-mm drill to perforate the subchondral surfaces of the joint.
- Expose and decorticate the medial aspect of the base of the second metatarsal and the lateral aspect of the base of the first metatarsal (TECH FIG 8C).

Lateral Soft Tissue Release
- Make a 2-cm incision in the first web space.
- Use blunt dissection to identify the adductor hallucis tendon.
  - Identify and protect the terminal branch of the deep peroneal nerve.
- Incise the adductor hallucis tendon at the lateral aspect of the fibular sesamoid.
- Incise the lateral capsule longitudinally to allow reduction of the sesamoids.
- Force the MTP joint into varus to complete the lateral release.

Medial Exostectomy
- Make a direct medial incision over the first MTP joint.
- Incise the capsule in line with the incision.
  - A wedge of capsule can be removed to facilitate reduction of the sesamoids.
  - Remove any residual prominence. Most of this was probably done with the primary procedure.

Fixation of the First Tarsometatarsal Joint
- Reduce the first metatarsal parallel to the second.
  - Confirm that the first metatarsal is parallel and properly rotated.
- Place a 3.5-mm cortical screw across the first tarsometatarsal joint from proximal to distal using a compression technique.
- Place a second 3.5-mm cortical screw from the medial aspect of the base of the first metatarsal into the base of the second metatarsal.
- Bone graft obtained from removal of the medial prominence can be placed in the first-second intermetatarsal space to augment the fusion.
- Use intraoperative imaging to confirm the position of the screws and reduction of the deformity (TECH FIG 9).

Capsular Repair and Wound Closure
- Repair the medial capsulectomy with absorbable suture.
  - It should not be necessary to overtighten the capsule to maintain the alignment of the MTP joint.
- Close the wounds in layers.

TECH FIG 8 • A, B. With the initial exposure, only the dorsal 10 to 15 mm of the tarsometatarsal joint is visualized. A small lamina spreader or distractor is required to expose the plantar half of the joint. This is a requirement of the procedure to avoid fusing the joint in dorsiflexion. With the distractor in place, the medial aspect of the base of the second metatarsal can be denuded of soft tissue to prepare for intermetatarsal fusion. C. Decortication of the lateral aspect of the base of the first metatarsal and the medial aspect of the second metatarsal to allow fusion.
Chapter 15 REVISION HALLUX VALGUS CORRECTION

Screw placement for a salvage of a failed distal procedure. A. The first metatarsal length was well preserved with the initial procedure. B. The first metatarsal length was such that a second metatarsal shortening was indicated to limit second metatarsal overload.

TECH FIG 9

Screw placement for a salvage of a failed distal procedure. A. The first metatarsal length was well preserved with the initial procedure. B. The first metatarsal length was such that a second metatarsal shortening was indicated to limit second metatarsal overload.

LUDLOFF METATARSAL OSTEOTOMY

This procedure could be used instead of a Lapidus procedure (TECH FIG 10).

Indications

- Smokers or patients with other medical issues that would delay a tarsometatarsal fusion
- Patients unable to be non-weight-bearing for an extended period (e.g., obesity, rheumatoid arthritis, contralateral joint problems, shoulder problems)
- Patients with less severe deformities: correction achieved will be 8 to 16 degrees

Technique

- Make an incision over the medial aspect of the first metatarsal.
- The optimal osteotomy starts on the dorsum, 1 cm from the tarsometatarsal joint, and extends distal and plantar to a point just proximal to the sesamoid articulation.
- The osteotomy should be angled 10 degrees plantarly in the coronal plane.
- The axis of rotation should be within 5 mm from the proximal end of the osteotomy.
- Insert the proximal screw first. It is usually done from dorsal to plantar. This serves as the axis of rotation of the distal (capital fragment).
- Once the desired reduction is obtained, a second screw is inserted (TECH FIG 11).

TECH FIG 10

Ludloff osteotomy: long oblique from dorsal-proximal to plantar-distal.

TECH FIG 11

Ludloff osteotomy. The proximal screw is placed first, from dorsal to plantar. The distal (capital) portion of the metatarsal is now rotated laterally to correct the intermetatarsal angle. This is followed by the second screw, usually from plantar to dorsal. (continued)
For a failed Lapidus procedure, the osteotomy is done through the previous fusion site. Place a triangular, tricortical bone graft with the wide surface placed dorsally to plantarflex the first metatarsal. Either an allograft or an iliac crest autograft can be used. A small distractor is helpful in distracting and keeping the osteotomy open.

Fix the osteotomy with a small fragment screw from distal to proximal across the bone graft or with a dorsal plate that spans the bone graft (TECH FIG 12B).

**TECH FIG 12 • A.** Dorsiflexion malunion of a proximal metatarsal osteotomy. **B.** Dorsal open-wedge osteotomy and bone grafting of a malunion of a Lapidus procedure.
Wound Closure and Postoperative Care

- Close the wound in layers.
- Apply a well-padded short-leg cast in the operating room.
- The patient may be partial weight bearing on the heel only for 6 to 8 weeks.

- At 2 weeks the cast is removed to allow suture removal and a wound check.
- A new short-leg cast or a cast boot is applied for another 4 to 6 weeks until bony healing is seen on radiographs.

GREAT TOE FUSION

Indications
- Severe degenerative changes of the first MTP joint secondary to previous bunion surgery
- Avascular necrosis of the metatarsal head
- Severe recurrence of a hallux valgus in a rheumatoid patient

PEARLS AND PITFALLS

Lapidus procedure: Indications
- Depending on the pathology, there are simpler treatment options for primary bunion surgery.
- A modified Lapidus procedure is not indicated in the absence of metatarsus primus varus or first ray hypermobility.
- The modified Lapidus procedure does not correct an increased distal metatarsal articular angle. If there is a significant increase in the distal metatarsal articular angle, a distal medial closing-wedge osteotomy or an Akin procedure is also required.
- If there is a dorsiflexion malunion from a previous proximal osteotomy, a corrective osteotomy may be necessary instead of a Lapidus procedure.

First tarsometatarsal joint preparation
- Take care not to inadvertently shorten the first metatarsal. Use a saw very sparingly, if ever.
- The first tarsometatarsal joint is about 25 to 30 mm deep, and take care to expose and prepare the entire joint surface to avoid fusing the joint in dorsiflexion.
- A small Inge retractor or a smooth lamina spreader is invaluable in exposing the joint.

Lateral soft tissue release
- The terminal branch of the deep peroneal nerve is vulnerable to injury in the first web space.
- Excessive lateral release can lead to a hallux varus deformity.

Medial exostectomy
- Only a minimal medial exostectomy may be needed.
- Avoid dorsiflexion and pronation of the first metatarsal.
- Failure to appropriately expose and denude the plantar aspect of the joint can lead to a dorsiflexion malunion.
- To ensure appropriate position, it is helpful to hold the metatarsals in one hand while the screws are placed.
- Careful preparation of the first-second intermetatarsal joint is mandatory to minimize the incidence of nonunion.

Shortening of the first metatarsal
- It is not uncommon to find the first metatarsal shortened with the initial bunion procedure.
- If that is the case, and if there are signs of significant second metatarsal overload, a second and sometimes third metatarsal shortening osteotomy should be done.

POSTOPERATIVE CARE

- The wounds are dressed.
- A slipper great toe spica fiberglass cast is placed in the operating room.
- At 2 weeks, the cast is removed to allow wound check and suture removal.
- A new slipper cast or a postoperative bunion shoe is applied for an additional 4 weeks.

- Patients are non-weight-bearing on the operative foot for 6 weeks.
- If there is radiographic and clinical evidence of fusion at 6 weeks, then the cast is removed and physical therapy is begun.
- At 8 weeks, patients can often return to swimming and biking.
- More vigorous physical activity is delayed until 3 months after surgery.
OUTCOMES

- In appropriately chosen patients, the Lapidus procedure is a reliable option for recurrent hallux valgus.
- A prospective cohort study reported an 80% satisfaction rate after the Lapidus procedure for recurrent hallux valgus in carefully selected patients.
- The same prospective cohort study suggested an increased risk of nonunion in smokers.²

COMPLICATIONS

- Nonunion of the first tarsometatarsal fusion is the most common complication (6% to 10%).
- Transfer metatarsalgia due to dorsiflexion malunion of the first metatarsal or lesser metatarsal length discrepancy
- Failure to reduce the sesamoids due to rotational malunion of the first metatarsal or inadequate lateral release
- Hallux varus due to excessive lateral release
- Painful instrumentation
- Nerve injury
- Infection

REFERENCES