REVIEW

Proximal metatarsal osteotomy and distal soft tissue reconstruction as treatment for hallux valgus deformity

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(Received for publication on October 26, 2004)
(Revised for publication on March 2, 2005)
(Accepted for publication on April 21, 2005)

Abstract. The correction of a hallux valgus deformity with a proximal 1st metatarsal osteotomy and distal soft tissue repair is achieved with a three-incision technique. A lateral soft tissue release and reconstruction at the first metatarsophalangeal joint releases contracted structures including the lateral capsule, the transverse inter-metatarsal ligament and the conjoint adductor tendon. Rarely is the lateral sesamoid excised. Through a medial incision, the medial eminence or exostosis is resected. The sesamoids are realigned and the medial capsule is reefed. With a third incision, a proximal first metatarsal osteotomy is performed that corrects a widened 1–2 intermetatarsal angle. With correction of the hallux valgus and the 1–2 intermetatarsal angle, pronation of the hallux is corrected. This correction is routinely used for hallux valgus deformities characterized by subluxation of the metatarsophalangeal joint. In the presence of a mild hallux valgus deformity an osteotomy may not be necessary. With degenerative arthritis or a congruent metatarsophalangeal joint, alternative surgical procedures are indicated. (Keio J Med 54 (2): 60–65, June 2005)

Key words: Hallux valgus, bunion, osteotomy

Indications

A distal soft tissue repair combined with a first metatarsal osteotomy is indicated for an incongruent (subluxated) hallux valgus deformity. Typically, hallux valgus angular deformity of 30° or greater and an intermetatarsal angle of 12° or greater are the main surgical indication. Rigidity of the metatarsal cuneiform joint characterized by a lateral intermetatarsal facet requires a first metatarsal osteotomy or some other type of proximal procedure. With an intermetatarsal angle of less than 12°, a distal soft tissue reconstruction alone may be sufficient to achieve correction of the deformity.

Contraindications

For a hallux valgus angular deformity greater than 50° or an intermetatarsal angle greater than 25°, a complete correction of the deformity may not be possible and a first metatarsophalangeal joint arthrodesis may be indicated. A hallux valgus deformity characterized by a congruent first metatarsophalangeal joint may require extra-articular osteotomies to achieve adequate correction. In the presence of significant spasticity or degenerative arthritis, an arthrodesis may be preferable.

Advantages of the Procedure

A distal soft tissue repair and realignment may be performed with or without a proximal first metatarsal osteotomy. A soft tissue procedure can be utilized for mild hallux valgus deformities; with moderate and severe deformities the osteotomy may be added. This type of procedure maintains first ray strength, a normal weight bearing pattern, and metatarsophalangeal joint motion. These factors may be sacrificed with either an arthrodesis or an excisional arthroplasty of the first metatarsophalangeal joint. A crescentic osteotomy maintains first ray length. A closing wedge osteotomy tends to shorten the first ray and an opening wedge

Presented at the 1374th Meeting of the Keio Medical Society in Tokyo, September 29, 2004
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osteotomy tends to lengthen the first ray. Changing the length of the first metatarsal may change tension of soft tissue structures affecting the first metatarsophalangeal joint function.

Disadvantages

This surgical technique is technically demanding and requires careful balancing of both the lateral and medial soft tissue structures with the procedure.

Preoperative Patient Education

Preoperatively, the patient should be apprised of common risks of surgical procedures including over correction (hallux varus), and under correction (recurrent hallux valgus). A malunion or delayed union or nonunion of the osteotomy site is infrequent but may occur. Injury to the dorsal branch of the medial cutaneous nerve may lead to a neuroma or anesthesia along the medial border of the hallux.

Preoperative Assessment

Following a routine physical examination, weight bearing dorsal plantar, lateral, and axial (sesamoid) views should be obtained. The magnitude of the hallux valgus and 1–2 intermetatarsal angle should be quantified. The degree of sesamoid subluxation is measured. The presence of degenerative arthrosis of the first MTP joint should be noted as well (Fig. 1).

Special Surgical instruments needed:

Weitlaner retractor
Homan retractors

Stryker TPS power unit with quick-change adaption for Kirschner wire, power drill, sagittal saw, crescentic saw.

Crescentic saw blade (Stryker crescentic blade #2296-31-416S7 or #277-31-416S1; or Zimmer-Hall crescentic blade #5053-176).

Positioning and Anesthesia

The patient is typically positioned in a supine position with a bump placed under buttock of the involved extremity. Surgery is performed under a peripheral anesthetic block (popliteal and saphenous nerve block) or ankle block just proximal to the medial malleolus. The foot is then cleansed and draped in the usual fashion. An Esmarch bandage is used to exsanguinate the foot and is also used as a tourniquet. Cast padding or bias stockinet is placed just above the medial malleolar region.

Surgical Technique

1. A 3 cm. longitudinal incision is placed in the first intermetatarsal web space in the interval between the first and second metatarsals.
2. The incision is deepened to an adventitious bursa which is identified between the metatarsal heads. The adductor hallucis tendon is identified at its insertion into the lateral sesamoid and the plantar base of the proximal phalanx. An incision is made along the dorsal border of the lateral sesamoid releasing the soft tissue contracture between the lateral sesamoid and the first metatarsal (Fig. 2).
3. The dissection is deepened along the lateral border of the sesamoid releasing the attachment of the conjoint tendon. Approximately 2 cm. proximal to this point, the tendon is severed and the proximal muscle is allowed to retract. A suture is placed in the proximal tendon. The sesamoid is not removed except in the case of a severe contracture or severe arthrosis.
4. The Weitlaner retractor is placed into the intermetatarsal space separating the first and second metatarsals. With tension placed between the metatarsal head, the transverse intermetatarsal the ligament is sectioned. Care is taken to prevent any injury to the underlying common digital nerve in the first web space. Following releasing of the ligament, an elevator is passed along the fibular sesamoid to insure there are no remaining adhesions between the sesamoid and the metatarsal head. The lateral metatarsal capsule is freed from its insertion on the metatarsal head leaving a cuff of tissue that can be later repaired. With a severe deformity there may be a gap present along the distal lateral soft tissue. At the conclusion of the procedure the conjoined tendon stump and the lateral capsule are sutured into soft tissue along the lateral first metatarsal head to promote the formation of scar tissue along the lateral aspect of the metatarsophalangeal joint. All sutures are tied at the conclusion of the procedure.
5. A longitudinal incision is centered over the medial eminence extending from the midportion of the proximal phalanx to a point 1 cm. to 2 cm. proximal to the medial eminence. The incision is carefully deepened through the subcutaneous tissue to the joint capsule and then deepened in both a dorsal and plantar direction. It is important to create a full thickness flap to prevent the possibility of wound edge necrosis. The dorsal neurovascular bundle is identified and protected.
6. An inverted ‘‘L’’ shaped capsular incision is used to release the dorsal medial capsule. The capsule is released at its two weakest attachments (proximal

and dorsal) (Fig. 3). This leaves a very strong distal and plantar capsular attachment. This approach gives an excellent exposure of the medial eminence as well as the medial sesamoid and the dorsal medial cortex of the first metatarsal.

7. The metatarsophalangeal joint is then carefully inspected and the sagittal sulcus is identified. The sagittal sulcus is not a reliable reference for resection of the medial eminence. With a small eminence, the sulcus may be the site of the osteotomy but with a more severe deformity the sulcus may have migrated too far laterally and using this as a reference for an osteotomy will often lead to an excessive resection. The medial eminence is resected with the sagittal saw at a point 2 mm. medial to the sagittal sulcus and the osteotomy is directed in a line with the longitudinal axis of the first metatarsal diaphysis (Fig. 4). The removal of excessive bone should be avoided as this may lead to a hallux varus deformity. Any sharp edges on the dorsal, distal or plantar aspect are removed with a rongeur. (Following removal of the medial eminence, the surgeon should next determine the flexibility of the metatarsal cuneiform joint. If the deformity is easily corrected then an osteotomy may not be necessary. A distal soft tissue realignment will suffice. If there is resistance to correction of the intermetatarsal angle due to rigidity of the metatarsal cuneiform joint, a proximal first metatarsal osteotomy should be performed.)
8. A third longitudinal incision, 3 cm. in length, is centered over the dorsal proximal first metatarsal. It is deepened along the medial aspect of the extensor hallucis longus tendon to the bone. The periosteum is reflected 1.5 cm. distal to the metatarsal cuneiform joint where a crescentic osteotomy is performed using the crescentic blade (Stryker crescentic blade #2296-31-416S7 or #277-31-416S1; or Zimmer-Hall crescentic blade #5053-176). The concavity points in a proximal direction.
9. The plane of the osteotomy is neither perpendicular to the first metatarsal shaft nor to the plantar aspect of the foot but proximally half way in-between (Fig. 5). This way the saw blade is of adequate length to transect the metatarsal but still leaves a large surface area. Care should also be taken to avoid injury to the communicating artery in the first intermetatarsal space. It may be necessary to complete the osteotomy with a 3 mm. to 4 mm. wide osteotome.
10. Often there is a small ridge of bone on the lateral aspect of the distal fragment that must be removed with a rongeur in order to displace the osteotomy site.
11. The osteotomy is displaced by rotating the distal fragment in a lateral direction. The small osteotome is positioned along the lateral aspect of the proximal fragment to stabilize it. The distal fragment is then rotated along the osteotomy site and displaced 2 mm. to 3 mm. laterally (Fig. 6).
12. The osteotomy is then fixed with a 0.062 Kirschner wire. Next, a 3.5 mm. drill hole is created in the distal fragment approximately 1 cm. from the osteotomy site and oriented in a proximal direction parallel to the Kirschner wire. Then a 2.0 mm. drill hole is drilled into the proximal fragment and a fully threaded 4.0 mm. screw is used to stabilize the osteotomy site (Fig. 7).
13. Attention is directed to the medial incision. A small drill hole is placed in the dorsal aspect of the metaphysis and the proximal capsule is repaired with interrupted 0 absorbable suture. The toe is held in a derotated corrected position. The dorsal capsular incision is then repaired with interrupted 2-0 absorbable suture. On occasion, a phalangeal ostetomy is performed to gain added angular correction (Fig. 8).
14. Finally attention is directed to the intermetatarsal incision. With the metatarsals compressed in a medial lateral direction, the intermetatarsal sutures are tied. The conjoined tendon is sutured obliquely across the lateral metatarsophalangeal joint and secured with interrupted 2-0 absorbable suture. Further sutures are placed in order to get good stability to the lateral capsule.
15. Intra-operative fluoroscopy is helpful to ascertain the correction of the alignment of the osteotomy and the distal soft tissue repair.

Postoperative Care

A bulky gauze and tape compression dressing is applied at the conclusion of surgery and changed every ten days for eight weeks (Fig. 9). The patient is initially permitted to ambulate with crutches and a postoperative shoe. Weight bearing is allowed on the lateral aspect of the foot and the heel. A radiographic is obtained postoperatively to assess the position of the osteotomy and soft tissue realignment. The compression dressing may be used to realign the hallux and adjust either valgus or varus alignment over the course of postoperative care.

Typically the procedure is performed on a outpatient basis but may be kept overnight depending on pain management. In an office setting under local anesthesia, six weeks following surgery, hardware is removed. The patient, is instructed in passive range of motion which is commenced ten days after surgery. Physical therapy is occasionally used if a patient has difficulty in achieving dorsiflexion and plantar flexion. Crutches are usually

Fig. 1 Pre-operative radiograph demonstrating moderate hallux valgus deformity.

Fig. 2 Lateral capsular release and abductor tendon release.

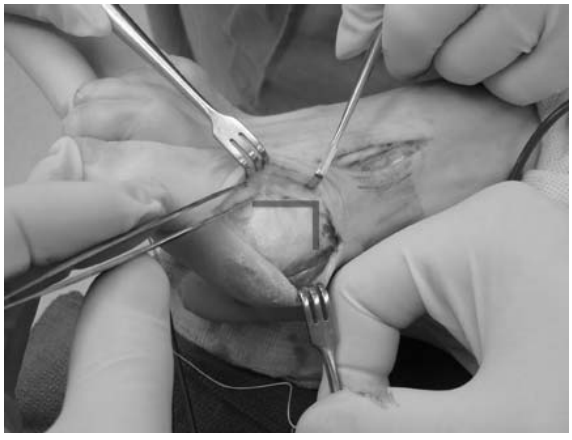

Fig. 3 ''L'' shaped capsular incision.

Fig. 4 Removal of the medial eminence.

Fig. 5 Lateral view of crescentic osteotomy.

Fig. 6 The ostetomy is shift 2–3 mm lateral-ward.

Fig. 7 Internal fixation is placed.

Fig. 8 Post-operative radiograph following DSTR with PMO and phalangeal osteotomy.

discontinued three to four days after surgery. Three to four months following surgery athletic activities are initiated. Between three and six months are required for swelling of the foot to subside.

Fig. 9 Clinical appearance of the foot following surgery.

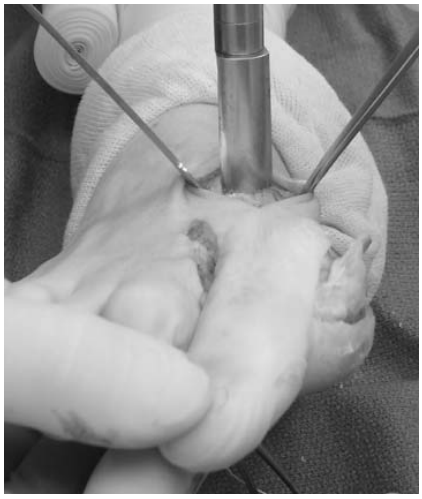

Fig. 10 Correct position of the saw blade in a coronal plane.

Pitfalls in the Surgical Technique

The most common complications are under correction and over correction. The osteotomy must be carefully performed as well as the distal soft tissue reconstruction.

Orientation of the crescentic osteotomy has changed over the last decade. Initially the concavity face was oriented distally. However this created a bump along the medial arch and there was an increased chance of over correction leading to hallux varus. With reversal of the osteotomy (concavity facing proximally) the risk of over correction has been markedly reduced.

Over correction can develop due to excessive medial eminence resection, to over reefing of the medial capsule, or to over correction of the osteotomy. Intraoperative fluoroscopy or radiograph will help to avoid these complications. Delayed union of the osteotomy is uncommon (less than 1% of my patients). If this occurs, a below knee walking cast applied for six weeks will frequently lead to successful union.

Malunion at the osteotomy site can occur with plantar flexion or dorsiflexion. Plantar flexion is uncommon. Dorsiflexion can occur either early or late. The position of the saw blade in cutting the osteotomy is probably the most frequent cause of dorsiflexion malunion. The osteotomy should be perpendicular to the long axis of the first metatarsal (Fig. 10). Often the lower extremity

will rotate in the lateral direction causing the surgeon to inadvertently rotate the saw in a medial direction. Thus when the osteotomy is displaced the first metatarsal elevates. To avoid this, it is helpful to place a Kirscher wire in a vertical direction to the first metatarsal shaft. When one performs the osteotomy, the alignment is checked with the Kirschner wire in order to perform a perpendicular cut.

The other cause of dorsiflexion malunion is early weight bearing or osteoporotic bone. In an unreliable patient or a patient with osteoporosis, a below knee cast may be warranted.

Results

The technique I have described was performed in 27 juvenile patients (33 feet) over an eleven year period.[1] The patient were followed for an average of 60 months. A final follow up the average preoperative hallux valgus angle was 31° and the average postoperative hallux valgus angle was 8° for an average correction of 23°. The average preoperative intermetatarsal angle was 14.4° and the average postoperative intermetatarsal angle was 6° for an average correction of 8.4°. The average forefoot narrowing was 5.5 mm. In a study reported by Mann *et al.*[3] on 79 adult patients (109 feet) using the same technique, the average hallux valgus correction was 24° and the average correction of the intermetatarsal angle was 8°. The incidence of under correction was 2% and 12% had a hallux varus deformity.

In a group of 140 adult patients treated with a similar technique by me,[2] the average preoperative hallux valgus angle was 30° and the average postoperative hallux valgus angle was 10° for an average correction of 20°. The average intermetatarsal angle was corrected from a preoperative value of 15° to a postoperative value of 5° for an average correction of 9°. When patients were rated with an AOFAS score preoperatively and postoperatively these adult patients noted an average preoperative AOFAS score of 57 points and an average postoperative AOFAS score of 91 points.

Conclusion

We have found the distal soft tissue repair with proximal first metatarsal osteotomy to be a very reliable procedure to be used in the treatment of moderate and severe hallux valgus deformities. Attention to the surgical technique is important in order to achieve reliably reliable results.

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