Arthroscopic Arthrodesis of the First Metatarsophalangeal Joint in Hallux Varus

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Abstract: Hallux varus deformity most commonly occurs as a complication of bunion surgery. Surgical option depends on the underlying cause, flexibility of the deformity, and presence of osteoarthritis of the first metatarsophalangeal joint. Joint-preserving surgery including medial soft tissue release, metatarsal osteotomy, and tendon transfer can be considered in flexible deformity without degeneration of the first metatarsophalangeal joint. First metatarsophalangeal arthrodesis is indicated in cases of inflammatory arthritis, avascular necrosis, osteoarthritis, neuromuscular disorder, or failed previous hallux varus corrective surgery. The purpose of this technical note is to describe the technique of arthroscopic arthrodesis of the first metatarsophalangeal joint to correct hallux varus deformity. It has the potential advantages of less surgical trauma, preservation of blood supply, less postoperative pain, and better cosmetic results.

Hallux varus is a deformity of the great toe where the toe is deviated medially from the longitudinal axis of the first metatarsal bone. Fixed hallux varus deformity is nearly always symptomatic, with difficulty of footwear fitting and osteoarthritis of the first metatarsophalangeal joint.1,2 The deformity is most commonly a complication of bunion surgery.3 The surgical option depends on the underlying cause, flexibility of the deformity, and presence of osteoarthritis of the first metatarsophalangeal joint.2-7 First metatarsophalangeal arthrodesis is indicated in cases of inflammatory arthritis, avascular necrosis, osteoarthritis, neuromuscular disorder, or failed previous hallux varus corrective surgery.1,3,8-10 Classically, arthrodesis is performed in an open manner with extensive soft tissue dissection. The technique of arthroscopic arthrodesis of the first metatarsophalangeal joint in fixed hallux varus deformity has been reported.11 It has the potential advantages of less surgical trauma, preservation of blood supply, less postoperative pain, and better cosmetic results.12-14 This technical note describes the technique of arthroscopic arthrodesis of the first metatarsophalangeal joint to correct fixed hallux varus deformity. This is indicated for symptomatic fixed hallux varus deformity, especially when associated with inflammatory arthritis, avascular necrosis, osteoarthritis, neuromuscular disorder, or failed previous hallux varus corrective surgery. This is contraindicated if there is local soft tissue infection or the presence of significant bone loss or poor bone quality requiring open procedures of bone grafting and plating of the arthrodesis site. It is also contraindicated in case of medial skin scarring and scar contracture or the hallux varus is due to bone deformity (Table 1).
Technique

Preoperative Planning and Patient Positioning

On clinical examination, the degree and rigidity of the deformity is evaluated. The local soft tissue condition should also be assessed. A standing radiograph is important to assess the severity of the deformity and the status of the first metatarsophalangeal joint and the adjacent bone (Fig 1).

The patient is in the supine position with the legs spread. A thigh tourniquet is applied to provide a bloodless operative field. A 2.7 mm 30° arthroscope (Henke Sass Wolf GmbH, Tuttingen, Germany) is used. Fluid inflow is driven by gravity, and no arthropump is used.

Release of Abductor Hallucis Tendon and Medial Capsuloligamentous Structure

A 5 mm skin incision is made about 5 to 10 mm from the plantar proximal margin of the first metatarsal head. The abductor hallucis tendon is identified and released via this proximal plantar medial incision (Fig 2). The incision is retracted distally, and the medial capsule of the first metatarsophalangeal joint is incised. The medial capsule is stripped from the metatarsal head by means of a periosteal elevator (Fig 3). The capsular release should be extended distally to the metatarsophalangeal joint, dorsally to the dorsum of the metatarsal head, and plantarly to the sesamoid apparatus. If there is associated plantarflexion deformity of the first metatarsophalangeal joint, the plantar capsule can be released at its proximal insertion to the metatarsal neck by the periosteal elevator. After the medial release, the medial joint space of the metatarsophalangeal joint can be opened up for establishment of the medial portal.

Portal Placement

First metatarsophalangeal arthroscopy is performed via the standard medial and dorsolateral portals. The medial portal is at the medial midpoint of the first metatarsophalangeal joint, and the dorsolateral portal is at the lateral side of the extensor hallucis longus tendon. Three-millimeter skin incisions are made at the portal sites, and the subcutaneous tissue is dissected bluntly with a hemostat. The joint capsule is perforated by the tip of the hemostat. These 2 portals are interchangeable as the viewing and working portals throughout the first metatarsophalangeal arthroscopy (Fig 4).

Removal of Articular Cartilage

With the medial portal as the viewing portal and the dorsolateral portal as the working portal, the remaining articular cartilage of the base of proximal phalanx and

Table 1. Indications and Contraindications of arthroscopic Arthrodesis of the first Metatarsophalangeal joint in hallux Varus

| Indication                                                                 | Contraindications                                      |
|--------------------------------------------------------------------------|--------------------------------------------------------|
| Symptomatic fixed hallux varus deformity especially if associated with inflammatory arthritis, avascular necrosis, osteoarthritis, neuromuscular disorder or failed previous hallux varus corrective surgery. | Local soft tissue infection<br>Presence of significant bone loss or poor bone quality requiring open procedures of bone grafting and plating of the arthrodesis site.<br>Medial skin scarring and scar contracture<br>The hallux varus is due to bone deformity |
the metatarsal head are removed with an arthroscopic shaver (Dyonics; Smith & Nephew, Andover, MA) to expose the underlying subchondral bone (Fig 5). The portals can be switched to complete the cartilage removal.

**Microfracture of the Subchondral Bone**

With the medial portal as the viewing portal and the dorsolateral portal as the working portal, the subchondral bone of the base of proximal phalanx and the metatarsal head is microfractured with an arthroscopic awl (Fig 6).
awl (Smith & Nephew) (Fig 6). The portals can be switched to complete the procedure. The tourniquet is then released, and bleeding from the microfracture holes can be observed.

**Correction of hallux Varus Deformity and Insertion of Cannulated Screws**

After the arthroscopic procedures, the first metatarsophalangeal joint is reduced to 20° dorsi-flexion and fixed with two 4.0 mm cannulated screws under fluoroscopic guidance. The plantar proximal medial incision is used for insertion of the proximal screw (Fig 7, Video 1, Table 2). The foot is immobilized in a short leg cast with a toe platform for 4 weeks.

**Table 2. Pearls and Pitfalls of Management of arthroscopic Arthrodesis of the first Metatarsophalangeal joint in hallux Varus**

| Pearls                                                                 | Pitfalls                                                                 |
|----------------------------------------------------------------------|--------------------------------------------------------------------------|
| Release of the abductor hallucis tendon and medial capsule of the    | If the associated plantarflexion deformity of the first                  |
| first metatarsophalangeal joint can facilitate subsequent arthroscopic | metatarsophalangeal joint is not corrected, the joint will be fused in    |
| procedures.                                                          | plantarflexed position. The interphalangeal joint will be overloaded     |
| Preservation of the integrity of the subchondral bone can provide    | resulting in hyperextension deformity and painful callosity.             |
| initial stability to the arthrodesis construct.                      |                                                                         |
| Micro-fracture of the subchondral bone can facilitate subsequent     |                                                                         |
| fusion of the first metatarsophalangeal joint.                       |                                                                         |
| The transfixing screw can be incised via the proximal plantar       |                                                                         |
| medial incision.                                                     |                                                                         |

**Table 3. Advantages and risks of Management of arthroscopic Arthrodesis of the first Metatarsophalangeal joint in hallux Varus**

| Advantages                                                                 | Risks                                                                 |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Better cosmetic result                                                    | Digital nerve injury                                                  |
| Minimal soft tissue dissection                                             | Nonunion                                                             |
| Less wound complications                                                  | Malunion                                                             |
| Preservation of the blood supply                                           | Implant failure                                                      |
| Adequate joint debridement under arthroscopic guide                       |                                                                         |

**Discussion**

First metatarsophalangeal arthroscopy is preferably performed via the medial and dorsolateral portals rather than the dorsomedial and dorsolateral portals because spread out of the portals can avoid crowding of instruments and blind spots during the arthroscopy. The cartilage of the plantar one third of the distal metatarsal articular surface may be difficult to remove through the dorsomedial and dorsolateral portals because of the convexity of the metatarsal head.

It is difficult if not impossible to establish the medial portal in the presence of fixed hallux varus deformity because of narrowing of the medial joint space. The solution is to convert the deformity to a flexible one so that the MTP-1 joint can be reduced and first metatarsophalangeal arthroscopy can be performed in the usual manner.

The proximal plantar medial incision is multifunctional. It allows release of the abductor hallucis tendon; release of the medial, plantar, and dorsal capsule of the
first metatarsophalangeal joint; and insertion of the proximal screw.\textsuperscript{11}

In this reported technique, the cartilage is removed, and the subchondral bone is microfractured to facilitate arthrodesis. The subchondral architecture is maintained, and the normal bone contour of the joint and length of the first ray is preserved.\textsuperscript{12}

This facilitates triplanar correction, reduces first ray shortening, and improves stability.\textsuperscript{9,17,18} In contrast to the percutaneous arthrodesis techniques, the completeness of joint debridement can be confirmed by arthroscopic visualization.\textsuperscript{11}

The advantages of this minimally invasive technique include a better cosmetic result, minimal soft tissue dissection, fewer wound complications, preservation of blood supply, and adequate joint debridement under arthroscopic guidance. The potential risk of this technique includes digital nerve injury, nonunion, malunion, and implant failure (Table 3). This technique is not technically demanding and can be attempted by average foot and ankle arthroscopists.

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