Correction of Severe Flatfoot Deformity by 3-Portal Arthroscopic Triple Arthrodesis

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Abstract: Severe flatfoot deformity with lack of coverage of the talonavicular joint is frequently treated by triple arthrodesis. Various arthroscopic triple arthroscopic techniques have been described to reduce the extent of soft-tissue dissection. The purpose of this Technical Note is to describe the details of 3-portal arthroscopic triple arthrodesis for correction of severe flatfoot deformity. This approach allows thorough preparation of all fusion surfaces, and the bone removal by decortications facilitates reduction of the talonavicular joint and correction of the forefoot supination.

Severe flatfoot deformity usually requires open corrective surgery (e.g., triple arthrodesis). Frequently, this involves extensive soft-tissue dissection. This may result in potential devitalization, greater postoperative swelling, and increased risk of wound complications especially in patients afflicted by poor soft-tissue envelopes. The technique of arthroscopic triple arthrodesis with the advantage of minimally invasive surgery was first described on 2006. The arthroscopic approach to the triple joints would appear to provide good visualization and preparation of the fusion surfaces while preserving the soft-tissue envelope. Initial descriptions included a 6-portal approach with preparation of fusion surfaces by microfracture of the subchondral bone. Modified techniques had been described with a 2-portal approach and preparation of the fusion surfaces by decortication; however, it is difficult to approach the calcaneocuboid joint and the medial half of the talonavicular joint. This incomplete preparation of the talonavicular joint will affect reduction and fusion of the joint in case of severe flatfoot deformity. In this Technical Note, we report the technique of 3-portal arthroscopic triple arthrodesis arthroscopic triple arthrodesis in correction of severe flatfoot deformity. It is indicated for correction of severe chronic flatfoot deformity, especially if the 3 joint surfaces are degenerated and the skin quality is poor.

Technique

Preoperative Planning and Patient Positioning

The degree of deformity is assessed clinically and radiologically. The flexibility of the deformity and the degree of possible passive correction of the hindfoot,

Table 1. Indications and Contraindications of Correction of Severe Flatfoot Deformity by 3-Portal Arthroscopic Triple Arthrodesis

| Indications                                                                 | Contraindications                                      |
|----------------------------------------------------------------------------|--------------------------------------------------------|
| 1. Correction of severe chronic flatfoot deformity, especially if the 3 joint surfaces are degenerated and the skin quality is poor | 1. Active infection of the soft-tissue envelope         |
| 2. Deformity with extensive bone loss requiring bone block grafting         | 2. Deformity with extensive bone loss requiring bone block grafting |
| 3. Rigid deformity                                                         | 3. Rigid deformity                                      |

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midfoot, and forefoot deformity is assessed clinically. Any significant soft-tissue imbalance is determined. Standing radiographs of the foot and ankle are important for studying the different components of the deformity and the presence of arthritic joints (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 4.0-mm 30° arthroscope (Dyonics, Smith and Nephew, Andover, MA) is used for this procedure. Fluid inflow is by gravity and no arthro-pump is used.

**Portal Placement**

Anterolateral subtalar, dorsolateral midtarsal, and medial midtarsal portals are used for this procedure. The anterolateral subtalar portal is just dorsal to the angle of Gissane. The dorsolateral midtarsal portal is at the junction between talonavicular and calcaneocuboid joints. The medial midtarsal portal is at the medial edge of the talonavicular joint, just dorsal to the navicular insertion of the posterior tibial tendon. Five-millimeter incisions are made at the portal sites.2-5

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**Fig 1.** Correction of severe flatfoot deformity of the right foot by 3-portal arthroscopic triple arthrodesis. The patient is in the supine position with the legs spread. Radiographs of the illustrated foot showed severe flatfoot deformity with no coverage of the talar head. (A) Dorsoplantar view. (B) Lateral view.

**Fig 2.** Correction of severe flatfoot deformity of the right foot by 3-portal arthroscopic triple arthrodesis. The patient is in supine position with the legs spread. (A) The anterolateral subtalar portal is the viewing portal and the dorsolateral midtarsal portal is the working portal. (B) The cartilage and the subchondral bone of the anterior and lateral parts of the joint are removed by an arthroscopic shaver and arthroscopic acromionizer. (ALP, anterolateral subtalar portal; C, calcaneus; DLP, dorsolateral midtarsal portal; T, talus.)
Posterior Subtalar Arthroscopy

Posterior subtalar arthroscopy is performed via the anterolateral subtalar and dorsolateral midtarsal portals. The portals are interchangeable as the viewing and working portals.

The anterolateral subtalar portal is the viewing portal and the dorsolateral midtarsal portal is the working portal. The cartilage and the subchondral bone of the anterior and lateral parts of the joint are removed by an arthroscopic shaver (Smith and Nephew) and arthroscopic acromionizer (Dyonics) (Fig 2).

The dorsolateral midtarsal portal is the viewing portal and the anterolateral subtalar portal is the working portal. The cartilage and the subchondral bone of the posterior and medial parts of the joint are removed by the shaver and acromionizer. The surgeon should be careful not to damage the flexor hallucis longus tendon at the medial side of the joint (Fig 3).

![Fig 3](image1.jpg)

**Fig 3.** Correction of severe flatfoot deformity of the right foot by 3-portal arthroscopic triple arthrodesis. The patient is in supine position with the legs spread. (A) The dorsolateral midtarsal portal is the viewing portal and the anterolateral subtalar portal is the working portal. (B) The cartilage and the subchondral bone of the posterior and medial parts of the joint are removed by the shaver and acromionizer. (ALP, anterolateral subtalar portal; C, calcaneus; DLP, dorsolateral midtarsal portal; FHL, flexor hallucis longus tendon; T, talus.)

![Fig 4](image2.jpg)

**Fig 4.** Correction of severe flatfoot deformity of the right foot by 3-portal arthroscopic triple arthrodesis. The patient is in supine position with the legs spread. (A) The anterolateral subtalar portal is the viewing portal and the dorsolateral midtarsal portal is the working portal. The foot is inverted to facilitate access to the lateral part of the talonavicular articulation. (B) The cartilage and the subchondral bone are removed by means of the shaver and acromionizer. (ALP, anterolateral subtalar portal; DLP, dorsolateral midtarsal portal; Na, navicular bone; TH, talar head.)
Talocalcaneonavicular Arthroscopy

Talocalcaneonavicular arthroscopy is performed via all 3 portals. The lateral part of the anterior talocalcaneal and talonavicular articulation can be accessed via the anterolateral subtalar and dorsolateral midtarsal portals. Foot inversion can facilitate access to the lateral part of the talonavicular articulation. The portals are interchangeable as viewing and working portals. The cartilage and the subchondral bone of the anterior talocalcaneal articulation are removed by means of the shaver and acromionizer (Fig 4).

The talonavicular articulation is accessed via the dorsolateral and medial midtarsal portals. Because of the severe deformity, the surface landmarks of the medial midtarsal joint are distorted. The medial midtarsal portal is established by inside out technique. The arthroscopic trocar-cannula is inserted via the dorsolateral midtarsal portal through the plantar part of the articulation to the medial midtarsal portal. The hindfoot valgus deformity is corrected manually and the great toe is dorsiflexed during passage of the trocar-cannula. This can facilitate passage of the trocar-cannula and reduce the risk of medial plantar nerve injury (Fig 5).7 With the dorsolateral midtarsal portal as the viewing portal and the medial midtarsal portal as the working portal, the cartilage and subchondral bone of the medial part of the anterior talocalcaneal articulation are removed (Fig 6).

The dorsolateral and medial midtarsal portals are interchangeable as the viewing and working portals for arthroscopy of the talonavicular arthroscopy. The cartilage and the subchondral bone are removed (Fig 7).

Calcaneocuboid Arthroscopy

Calcaneocuboid arthroscopy is performed with the medial midtarsal portal as the viewing portal and the dorsolateral midtarsal portal as the working portal. The arthroscope passes through the medial portal and the talonavicular joint to get a bird’s-eye view of the calcaneocuboid joint. The cartilage and subchondral bone are removed (Fig 8).
Deformity Correction

The hindfoot deformity is corrected and the subtalar joint are transfixed with 7.3-mm cannulated screws (Synthes, West Chester, PA).

A 2-mm K wire (Zimmer, Warsaw, IN) is inserted into the navicular as a joystick to correct the forefoot supination deformity before insertion of the guide pin (Fig 9). The talonavicular joint is then transfixed with 2 to 3 4.0-mm cannulated screws (Synthes) (Fig 10, Table 2, Video 1).

Postoperatively, the foot is immobilized in a short leg cast and the patient is advised to be non-weightbearing for 6 to 8 weeks. After that, the patient can start partial weightbearing walking with a removable rocker boot for another 4 weeks before full weightbearing is allowed.

Discussion

The inclusion of the anterior subtalar joint in this arthroscopic triple arthrodesis approach increases the
area of fusion without the need of additional portal. Decortication of the fusion surfaces is used in this approach because bone removal may facilitate deformity correction especially reduction of the talonavicular joint and rotatory correction of midfoot deformity. In contrast to the 2-portal approach, this 3-portal approach allows a thorough preparation of all fusion surfaces as the 6-portal approach.

This arthroscopic technique has the advantage of improved intra-articular visualization, thorough fusion surface preparation, preservation of osseous blood supply, and fewer soft-tissue complications such as wound dehiscence and infection, neurovascular damage, and scar tethering. The potential risks of this technique include injury to the superficial and deep peroneal nerves, sural nerve, peroneal tendons, and long extensor tendons, nonunion, and malunion (Table 3). This is technically demanding and should be reserved for the experienced foot and ankle arthroscopist.

Fig 9. Correction of severe flatfoot deformity of the right foot by 3-portal arthroscopic triple arthrodesis. The patient is in supine position with the legs spread. (A) K wire is inserted into the navicular and is used as a joystick to derotate the midfoot. Fluoroscopic views: (B) dorsoplantar, (C) lateral; correction of the flatfoot deformity is shown. DLP, dorsolateral midtarsal portal; GP, guide pin; KW, K wire.)

Fig 10. Correction of severe flatfoot deformity of the right foot by 3-portal arthroscopic triple arthrodesis. The patient is in supine position with the legs spread. Postoperative radiographs showed correction of the flatfoot deformity. (A) Dorsoplantar view. (B) Lateral view.
Table 2. Pearls and Pitfalls of Correction of Severe Flatfoot Deformity by 3-Portal Arthroscopic Triple Arthrodesis

| Pearls                                                                 | Pitfalls                                                                 |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------|
| 1) The hindfoot is inverted and the great toe is plantarflexed during establishment of the medial midtarsal portal facilitate passage of the trocar-cannula through the talonavicular joint and reduce the risk of medial plantar nerve injury. | 1) Uneven decortications of different joints may avoid even compression of the fusion surfaces. |
| 2) Manipulation of the navicular bone by joy-stick technique can ensure correct positioning of the talonavicular joint which is the key to realign the hindfoot and midfoot. | 2) The trocar-cannula should exit dorsal to the navicular insertion of the posterior tibial tendon to avoid injury to the medial plantar nerve. |

Table 3. Advantages and Risks of Correction of Severe Flatfoot Deformity by 3-Portal Arthroscopic Triple Arthrodesis

| Advantages                                                                 | Risks                                                                 |
|--------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1) Improved intra-articular visualization                                | 1) Injury to the superficial and deep peroneal nerves and sural nerve. |
| 2) Thorough fusion surface preparation                                    | 2) Injury to the peroneal tendons and long extensor tendons.           |
| 3) Preservation of osseous blood supply                                   | 3) Nonunion                                                             |
| 4) Fewer soft-tissue complications such as wound dehiscence and infection, neurovascular damage, scar tethering. | 4) Malunion                                                             |

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