



Arthroscopic Arthrodesis of the First Metatarsophalangeal Joint in Hallux Valgus Deformity Using Medial and Toe Web Portals

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Abstract: Arthrodesis of the first metatarsophalangeal joint is indicated for severe hallux valgus deformity. Open arthrodesis requires extensive soft-tissue dissection. Recently, a technique of arthroscopic first metatarsophalangeal arthrodesis in hallux valgus deformity has been reported. This approach includes endoscopic lateral release of the first metatarsophalangeal joint via the plantar and toe web portals, followed by arthroscopic arthrodesis of the joint via the medial and dorsolateral portals. Endoscopic lateral release of the first metatarsophalangeal joint can convert the fixed hallux valgus deformity into a flexible one and reduce the stress over the screws and risk of loss of reduction and nonunion. The purpose of this Technical Note is to report a modified technique of arthroscopic first metatarsophalangeal arthrodesis in hallux valgus deformity. In this modified technique, the arthrodesis is performed via the medial and toe web portals and creation of the dorsolateral portal is not needed. A 2.7-mm arthroscope is used for the arthrodesis procedure instead of a 1.9-mm arthroscope. This can improve fluid inflow and visualization.

Arthrodesis of the first metatarsophalangeal joint is a commonly performed operation in the treatment of hallux rigidus, hallux valgus associated with degenerative changes or severe deformity, rheumatoid forefoot deformity, neurogenic deformity of the great toe, avascular necrosis of the first metatarsal head, and infection of the first metatarsophalangeal joint and as a salvage procedure for a previous failed operation on the first metatarsophalangeal joint.¹⁻⁸ Various recent studies have reported fusion rates ranging from 88% to 100% with low revision rates and patient satisfaction scores ranging from 73% to 100%.^{2,9}

Despite its effectiveness, open arthrodesis of the first metatarsophalangeal joint involves extensive soft-tissue dissection for exposure and debridement of the joint. Arthroscopic arthrodesis is desirable with potential advantages of minimally invasive surgery. Classically, arthroscopic arthrodesis of the first metatarsophalangeal joint was used for in situ fusion.^{10,11} Recently, a technique of arthroscopic first metatarsophalangeal arthrodesis in hallux valgus deformity has been reported.¹² This approach includes endoscopic lateral release of the first metatarsophalangeal joint via the plantar and toe web portals,¹³⁻¹⁷ followed by arthroscopic arthrodesis of the joint via the medial and dorsolateral portals. Endoscopic lateral release of the first metatarsophalangeal joint can convert the fixed hallux valgus deformity into a flexible one and reduce the stress over the screws and risk of loss of reduction and nonunion.¹²

The purpose of this Technical Note is to report a modified technique of arthroscopic first metatarsophalangeal arthrodesis in hallux valgus deformity. In this modified technique, the arthrodesis is performed via the medial and toe web portals and creation of the dorsolateral portal is not needed. A 2.7-mm arthroscope is used for the arthrodesis procedure instead of a 1.9-mm arthroscope. This can improve fluid inflow and visualization. The technique is indicated for severe

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Table 1. Indications and Contraindications of Arthroscopic Arthrodesis of First Metatarsophalangeal Joint in Hallux Valgus Deformity Using Medial and Toe Web Portals

Indications	
Severe hallux valgus deformity	
Hallux valgus associated with degeneration of first metatarsophalangeal joint	
Rheumatoid forefoot deformity	
Contraindications	
Failed hallux valgus surgery with significant bone loss	
Presence of active infection	
Bone quality too poor for stable screw fixation	

hallux valgus deformity, hallux valgus associated with degeneration of the first metatarsophalangeal joint, and rheumatoid forefoot deformity.¹⁸ This technique is contraindicated in case of failed hallux valgus surgery with significant bone loss or in the presence of active infection.¹⁹ It is also contraindicated if the bone quality is too poor for stable screw fixation (Table 1).

Technique

Preoperative Planning and Patient Positioning

Preoperative clinical assessment and radiographs should confirm the surgical indication of severe hallux valgus deformity with or without painful degeneration of the first metatarsophalangeal joint (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, Tuttlingen, Germany) is used for this procedure.



Fig 1. Arthroscopic arthrodesis of first metatarsophalangeal joint in hallux valgus deformity of left foot using medial and toe web portals. The patient is in the supine position with the legs spread. A radiograph of the illustrated case shows severe hallux valgus deformity of the left foot. (R, right.)

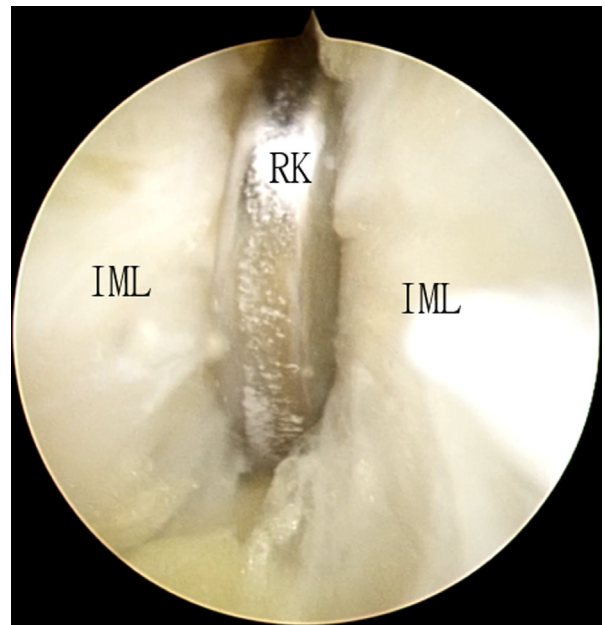


Fig 2. Arthroscopic arthrodesis of first metatarsophalangeal joint in hallux valgus deformity of left foot using medial and toe web portals. The patient is in the supine position with the legs spread. The intermetatarsal ligament (IML) is released by the retrograde knife (RK).

Fluid inflow is by gravity, and no arthro-pump is used. No continuous traction of the first metatarsophalangeal joint is applied.

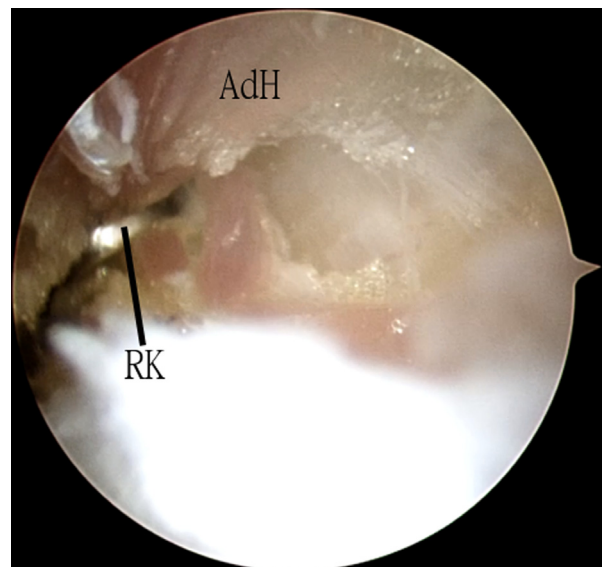


Fig 3. Arthroscopic arthrodesis of first metatarsophalangeal joint in hallux valgus deformity of left foot using medial and toe web portals. The patient is in the supine position with the legs spread. The plantar portal is the viewing portal, and the toe web portal is the working portal. The adductor hallucis (AdH) muscle insertion is released by the retrograde knife (RK).

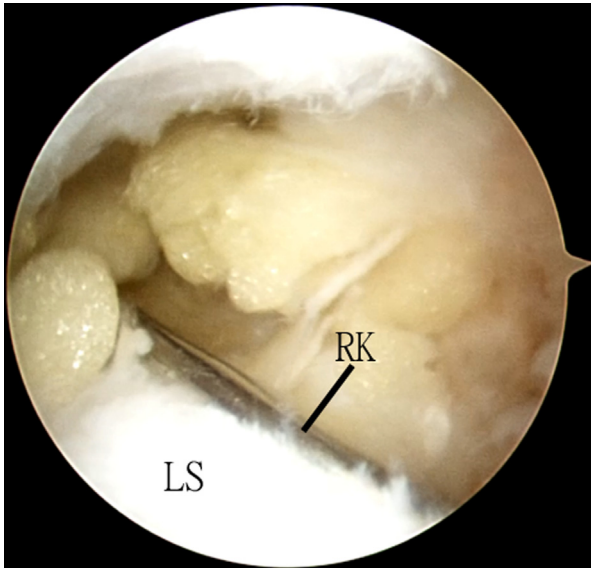


Fig 4. Arthroscopic arthrodesis of first metatarsophalangeal joint in hallux valgus deformity of left foot using medial and toe web portals. The patient is in the supine position with the legs spread. The plantar portal is the viewing portal, and the toe web portal is the working portal. The lateral capsule–ligamentous complex of the first metatarsophalangeal joint is released just above the fibular sesamoid bone by the retrograde knife (RK). (LS, lateral sesamoid bone.)

Portal Placement

The toe web and plantar portals are used for endoscopic lateral release of the first metatarsophalangeal joint, and the toe web and medial portals are used for arthroscopic arthrodesis of the first metatarsophalangeal joint. The toe web portal is made at the dorsal surface of the first toe web.¹²⁻¹⁷ The plantar portal is located at the sole and is established by an inside-out method. The arthroscope-trocar is inserted via the toe web portal and advanced proximally along the deep surface of the intermetatarsal ligament until the trocar tip touches the plantar aponeurosis at the level of the tarsometatarsal joint. The passage of the trocar should be performed gently, and there should not be any resistance before the plantar aponeurosis is reached. The plantar aponeurosis is perforated by the trocar tip, and the plantar portal is made at this point.¹²⁻¹⁷ The medial portal is located at the midpoint of the medial joint line of the first metatarsophalangeal joint.¹²

Endoscopic Release of Intermetatarsal Ligament

The plantar portal is the viewing portal, and the toe web portal is the working portal. A retrograde knife (Smith & Nephew, Andover, MA) passes under the intermetatarsal ligament under endoscopic guidance until the proximal edge of the ligament is reached. The

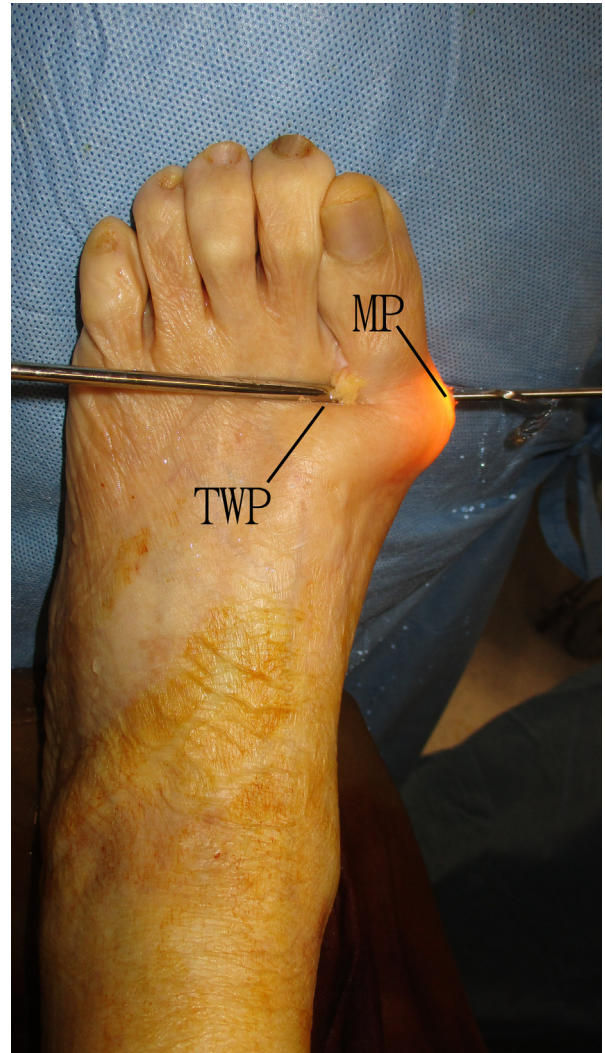


Fig 5. Arthroscopic arthrodesis of first metatarsophalangeal joint in hallux valgus deformity of left foot using medial and toe web portals. The patient is in the supine position with the legs spread. First metatarsophalangeal arthroscopy is performed via the medial portal (MP) and toe web portal (TWP).

proximal edge of the ligament is hooked by the knife, and the ligament is cut by retrieval of the knife under endoscopic guidance (Fig 2).

Endoscopic Release of Adductor Hallucis Insertion

The plantar portal is the viewing portal, and the toe web portal is the working portal. After release of the intermetatarsal ligament, the arthroscope can move dorsally through the cut edges of the intermetatarsal ligament and is turned medially to visualize the adductor hallucis muscle insertion to the fibular sesamoid bone. The muscle insertion is released by the retrograde knife under endoscopic guidance (Fig 3).

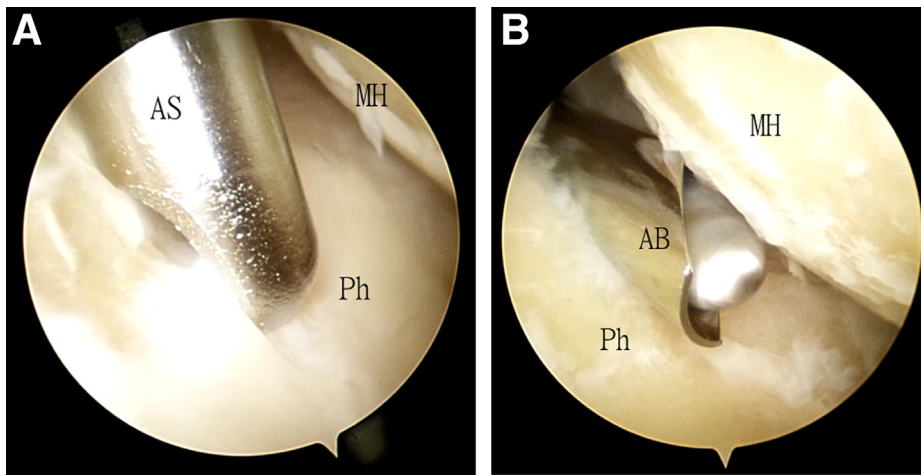


Fig 6. Arthroscopic arthrodesis of first metatarsophalangeal joint in hallux valgus deformity of left foot using medial and toe web portals. The patient is in the supine position with the legs spread. The toe web portal is the viewing portal, and the medial portal is the working portal. (A) The articular cartilage of the medial half of the base of the proximal phalanx (Ph) is removed by an arthroscopic shaver (AS). (B) The articular cartilage of the medial half of the metatarsal head (MH) is removed by an arthroscopic burr (AB).

Endoscopic Release of Lateral Capsule—Ligamentous Complex of First Metatarsophalangeal Joint

The plantar portal is the viewing portal, and the toe web portal is the working portal. The lateral capsule—ligamentous complex of the first metatarsophalangeal joint is released just above the fibular sesamoid bone by the retrograde knife (Fig 4). The most proximal part of the release should be started more dorsally to avoid damage to the hallucal digital nerve.¹⁴ The release should be continued distally enough to cut the suspensory sesamoid ligament.^{12,14} This can ensure complete lateral release and reposition the fibular sesamoid bone under the metatarsal head.

Removal of Articular Cartilage of First Metatarsophalangeal Joint

The toe web portal is the viewing portal, and the medial portal is the working portal. The arthroscope is introduced into the metatarso-sesamoid compartment via the toe web portal and lateral capsular release site.

The toe web portal is retracted proximally, and the scope is then shifted into the metatarsophalangeal compartment (Fig 5). The articular cartilage of the medial half of the joint is removed by an arthroscopic shaver (Dyonics; Smith & Nephew), arthroscopic burr (Dyonics; Smith & Nephew), and arthroscopic osteotome (Acufex; Smith & Nephew). The subchondral bone and the contour of the articular surfaces are preserved as much as possible (Fig 6).

The medial portal is the viewing portal, and the toe web portal is the working portal. The articular cartilage of the lateral half of the joint is debrided in the same manner (Fig 7).

Microfracture of Fusion Surfaces

The toe web portal is the viewing portal, and the medial portal is the working portal. Microfracture of the subchondral bone of the medial half of the metatarsal head and proximal phalanx base is performed with an arthroscopic awl (Acufex; Smith & Nephew) (Fig 8).

Fig 7. Arthroscopic arthrodesis of first metatarsophalangeal joint in hallux valgus deformity of left foot using medial and toe web portals. The patient is in the supine position with the legs spread. The medial portal is the viewing portal, and the toe web portal is the working portal. (A) The articular cartilage of the lateral half of the base of the proximal phalanx (Ph) is removed by an arthroscopic shaver (AS). (B) The articular cartilage of the lateral half of the metatarsal head (MH) is removed by an arthroscopic burr.

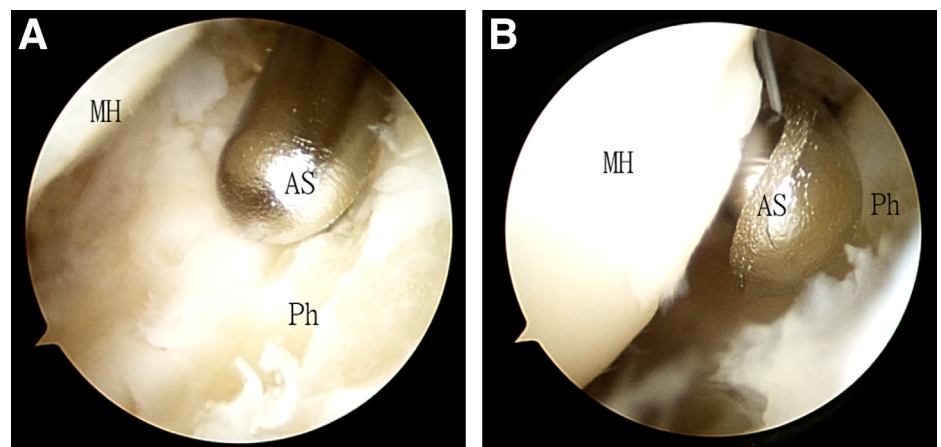
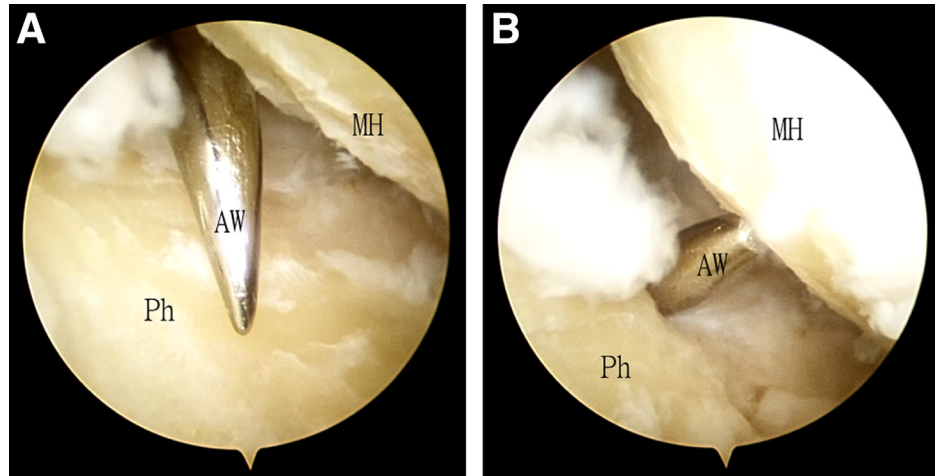


Fig 8. Arthroscopic arthrodesis of first metatarsophalangeal joint in hallux valgus deformity of left foot using medial and toe web portals. The patient is in the supine position with the legs spread. The toe web portal is the viewing portal, and the medial portal is the working portal. (A) Microfracture of the subchondral bone of the medial half of the proximal phalanx base (Ph) is performed with an arthroscopic awl (AW). (B) Microfracture of the subchondral bone of the medial half of the metatarsal head (MH) is performed with an arthroscopic awl (AW).



The medial portal is the viewing portal, and the toe web portal is the working portal. Microfracture of the subchondral bone of the lateral half of the metatarsal head and proximal phalanx base is performed.

Reduction of Intermetatarsal Angle and Hallux Valgus Angle and Insertion of Intermetatarsal Screw

The intermetatarsal angle is closed by a reduction clamp. One arm of the clamp holds the second metatarsal via the toe web portal. The other arm holds the first metatarsal percutaneously. It is important to reduce the sesamoid bones under the metatarsal head before closing up the intermetatarsal angle. By this maneuver, hallux valgus is usually reduced

spontaneously. A 4.0-mm cannulated screw (Synthes, West Chester, PA) is inserted across the first, second, and third metatarsal bases (Fig 9).

Screw Insertion Across First Metatarsophalangeal Joint

The first metatarsophalangeal joint is placed into the desirable position for arthrodesis. To maximize the likelihood of good postoperative function, the fusion sagittal angle should range between 20° and 30°, corresponding to between 10° and 15° of dorsiflexion off the weight-bearing axis.²⁰ The joint is transfixed with two 4.0-mm cannulated screws (Synthes) (Fig 10, Video 1, Table 2).

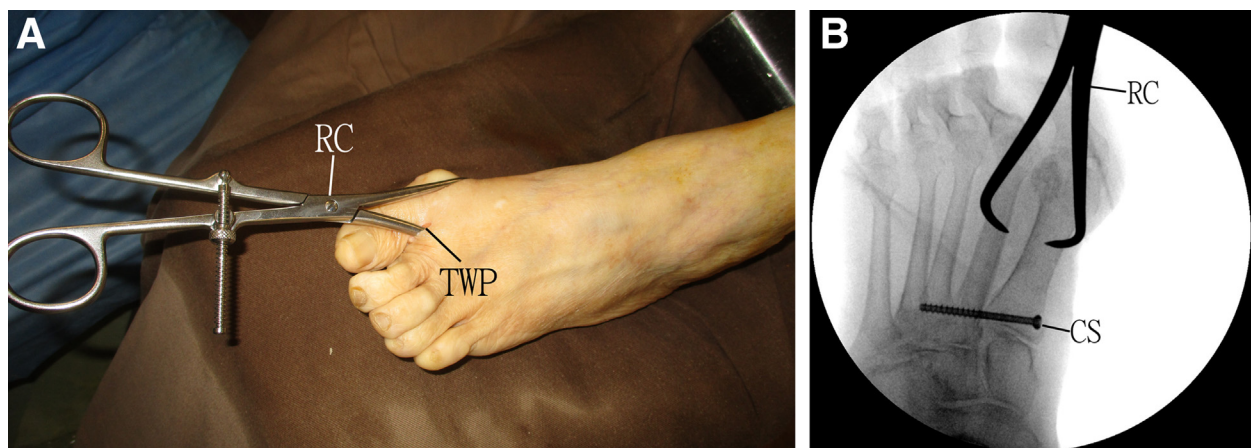


Fig 9. Arthroscopic arthrodesis of first metatarsophalangeal joint in hallux valgus deformity of left foot using medial and toe web portals. The patient is in the supine position with the legs spread. (A) The intermetatarsal angle is closed by a reduction clamp (RC). One arm of the clamp holds the second metatarsal via the toe web portal (TWP). The other arm holds the first metatarsal percutaneously. (B) A 4.0-mm cannulated screw (CS) is inserted across the first, second, and third metatarsal bases.

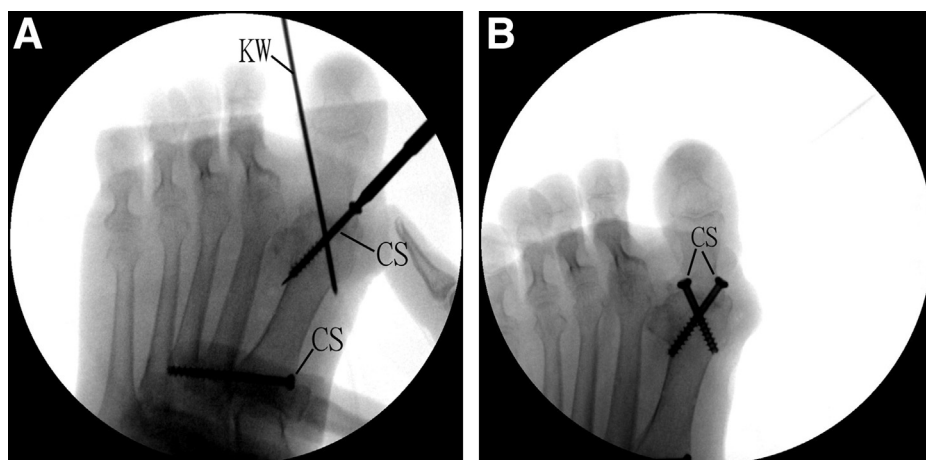


Fig 10. Arthroscopic arthrodesis of first metatarsophalangeal joint in hallux valgus deformity of left foot using medial and toe web portals. The patient is in the supine position with the legs spread. (A) The first metatarsophalangeal joint is placed into the desirable position for arthrodesis and fixed with a Kirschner wire (KW). (B) The first metatarsophalangeal joint is transfixated with crossed cannulated screws (CS).

Postoperative Protocol

Postoperatively, the foot is protected by an ankle-foot orthosis for 4 to 6 weeks before weight-bearing walking with a wood-based sandal is allowed.

Discussion

The goals of successful first metatarsophalangeal arthrodesis are pain alleviation and deformity correction to restore a comfortable gait pattern and to improve shoe wear.¹⁷ After first metatarsophalangeal arthrodesis, patient function relies on proper positioning of the first metatarsophalangeal joint.²⁰

It is difficult to perform first metatarsophalangeal arthroscopy in case of severe hallux valgus or associated degeneration of the joint because the joint is contracted and joint anatomy is distorted. Endoscopic lateral release can relieve the soft-tissue tension around the joint.¹² Correction of the hallux valgus deformity restores the normal arthroscopic anatomy and facilitates subsequent arthroscopic arthrodesis.¹² Compared with a 1.9-mm arthroscope, the use of a 2.7-mm arthroscope can allow better fluid irrigation and removal of cartilage debris, as well as provide clearer arthroscopic visualization.

Table 2. Pearls and Pitfalls of Arthroscopic Arthrodesis of First Metatarsophalangeal Joint in Hallux Valgus Deformity Using Medial and Toe Web Portals

Pearls

- The suspensory sesamoid ligament should be released before the fibular sesamoid can be reduced.
- The toe web portal can be retracted proximally to allow access to the first metatarsophalangeal joint.

Pitfalls

- Release of the proximal part of the lateral capsule–ligamentous complex may injure the nearby hallucal digital nerve.
- The dislocated fibular sesamoid bone should be reduced under the first metatarsal head. Dislocated fibular sesamoid bone will block reduction of the intermetatarsal angle.

Different fixation techniques have been established for first metatarsophalangeal arthrodesis, including compression screws, plates, Kirschner wires, metal screws, and bioabsorbable screws, as well as staples.^{8,21} Crossed-screw fixation is inexpensive and can provide an acceptable amount of biomechanical stability although a longer period of non-weight bearing is required.^{2,9} The reported fusion success rate ranged from 91% to 100%.²² This technique works well in patients with good bone quality and causes less postoperative irritation and discomfort owing to the relatively low profile of the crossed screws.²

The 1-2 intermetatarsal angle is usually acceptably corrected by first metatarsophalangeal arthrodesis.²³ Therefore, additional procedures (e.g., proximal first metatarsal osteotomy) to correct the intermetatarsal angle will not be necessary.¹² In our technique, we perform lateral release of the metatarsophalangeal joint and reduction of the sesamoid bones and intermetatarsal angle. This can alleviate the valgus stress to the first metatarsophalangeal joint and reduce the risk of implant failure and nonunion of the arthrodesis site.

Besides its use as a working portal for endoscopic lateral release, the toe web portal can be used for arthroscopic arthrodesis and alleviates the need for creation of the dorsolateral portal.¹² This toe web portal

Table 3. Advantages and Risks of Arthroscopic Arthrodesis of First Metatarsophalangeal Joint in Hallux Valgus Deformity Using Medial and Toe Web Portals

Advantages

- Better cosmesis
- Less soft-tissue dissection
- Fewer wound complications

Risks

- Malunion of arthrodesis site
- Nonunion of arthrodesis site
- Implant failure
- Injury to hallucal digital nerve

can also be used for insertion of the reduction clamp and reduction of the intermetatarsal angle. Moreover, this portal can be used for arthrodesis screw insertion.

The advantages of our minimally invasive approach include better cosmesis, less soft-tissue dissection, and fewer wound complications. The potential risks of this procedure include malunion or nonunion of the arthrodesis site, implant failure, and injury to the hallux digital nerve (Table 3).

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