

Revision Lapidus Arthrodesis by Bone Endoscopy



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Abstract: Revision arthrodesis is indicated in symptomatic nonunion of the first tarsometatarsal joint. Revision by first tarsometatarsal arthroscopy cannot deal with the dilated screw tract and associated bone cysts. Revision by bone endoscopy is indicated in symptomatic nonunion of the first tarsometatarsal joint, which is previously fixed by trans-articular screw along with loosening of the screw and bone cyst formation. The screw tract makes up the portal tract, with the proximal and distal ends of the tract corresponding to the proximal and distal portals, respectively. In this technical note, we describe zonal debridement and bone grafting of the bone cysts, nonunion site, and the screw tract via the bone endoscopy. This can resolve all the co-pathologies of nonunion of the first tarsometatarsal fusion.

The Lapidus procedure refers to arthrodesis of the first tarsometatarsal joint.¹ This procedure is indicated in symptomatic hypermobility or degenerative arthritis of the joint. It is also indicated as part of the surgical correction of severe hallux valgus or other foot deformity involving the medial foot column.²⁻⁶ It is classically performed as an open procedure. Recently, the technique of arthroscopic Lapidus arthrodesis has been reported with the advantage of preservation of the soft-tissue envelope.^{7,8}

Nonunion of the first metatarsocuneiform joint fusion is the most frequent complication, with a reported rate range from 3.3% to 12%.^{9,10} In case of symptomatic nonunion, revision arthrodesis is indicated. Revision by arthroscopic Lapidus arthrodesis has been reported recently for nonunion cases with good positioning of the first metatarsal and no loosening of the screw.¹¹ In the presence of screw loosening with associated bone cyst, arthroscopic Lapidus arthrodesis is unable to resolve the nonunion as a result of the co-pathologies. We describe a technique of revision Lapidus arthrodesis by bone endoscopy. This can be performed alone or together with the arthroscopic Lapidus procedure to

resolve all the pathologies associated with the nonunion (Table 1).

Technique

Preoperative Planning

Preoperative radiographs and computed tomogram are useful to assess the relationship of the screw tract and the bone cysts and nonunion site and aids surgical planning (Fig 1).

Patient Positioning and Setup

The patient is in supine position with the legs spread. A thigh tourniquet (Zimmer, Warsaw, IN) is applied to provide a bloodless surgical field. Fluid inflow is by gravity, and no arthro-pump is used.

Removal of Screw and Portal Placement

The screw is removed through a dorsal stab wound over the screw head. This incision is the dorsal portal of the subsequent bone endoscopy. The cannula-trocar of the 2.7-mm 30° arthroscope (Henke Sass Wolf, Germany) is inserted through the screw tract and penetrates the plantar aponeurosis. The plantar portal incision is then made over the tip of the trocar. The passage of the cannula-trocar through the plantar soft tissue should be gentle until the plantar aponeurosis is reached.¹²⁻¹⁶ This can reduce the risk of injury to the plantar neurovascular structures. Sometimes, the plantar screw hole is obliterated. This can be refreshed by a 5-mm cannulated drill (Synthes, West Chester, PA) along a guide pin (Synthes) (Fig 2). After the cannula-trocar passes through the plantar portal, the trocar is removed and a Wissinger rod (Richard Wolf, Knittlingen, Germany)

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Table 1. Pearls and Pitfalls of Revision Lapidus Arthrodesis by Bone Endoscopy

Pearls	Pitfalls
<ol style="list-style-type: none"> 1. It is indicated in case of symptomatic nonunion of the first tarsometatarsal joint that was previously fixed by a transarticular screw and there is screw loosening, with associated bone cyst formation. 2. The screw tract makes up the portal tract with the proximal and distal ends of the tract corresponding to the proximal and distal portals, respectively. 3. Debridement of the screw tract, associated bone cysts, and nonunion site is performed in a zonal manner. 4. Bone grafting is performed in a zonal manner. 	<ol style="list-style-type: none"> 1. The technique cannot debride the whole nonunion site. 2. It is difficult to bone-graft the whole nonunion site. 3. If the nonunion site is ankylosed in an unfavorable position, first tarsometatarsal arthroscopy should also be performed to achieve adequate periarticular soft-tissue release. 4. It is not suitable in case of significant bone loss and shortening of the first ray.

is inserted. The cannula is then removed and reinserted along the rod through the plantar portal. The rod is removed, and the arthroscope is inserted into the cannula.

Debridement of the Proximal Part of the Screw Tract and Cuneiform Bone Cysts

With the plantar portal as the viewing portal, the fibrous tissue of the proximal part of the screw tract is curetted and debrided. The screw tract is probed for any cuneiform bone cyst in connection with the screw tract. The fibrous tissue of the cyst is curetted by means of an arthroscopic probe (Acufex, Smith & Nephew) and curette (Acufex, Smith & Nephew). The cyst wall is refreshed with an arthroscopic shaver (Smith & Nephew) (Fig 3).

Debridement of the Nonunion Site

After clear-up of the cuneiform portion of the screw tract, an angled arthroscopic awl (Acufex, Smith & Nephew) is inserted through the dorsal portal into the nonunion site. This serves as a dissector to release the fibrous adhesions in the nonunion site (Fig 4). The nonunion site adjacent to the screw tract can be debrided by an arthroscopic shaver.

Debridement of the Distal Part of the Portal Tract and Metatarsal Bone Cysts

After finishing debridement of the proximal part of the screw tract and the nonunion site, the portals are exchanged as viewing and instrumentation portals by Wissinger rod technique. With the dorsal portal as the viewing portal, the distal part of the portal tract and any

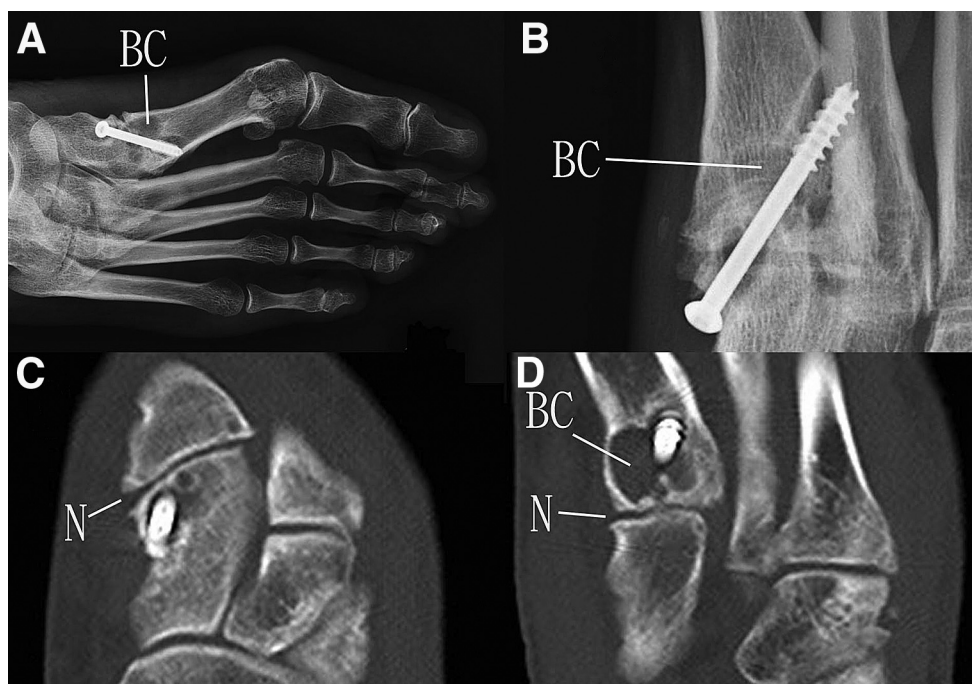


Fig 1. Revision Lapidus arthrodesis of right foot by bone endoscopy. Preoperative radiographs (A, B) and computed tomogram (C, D) of the illustrated case showed nonunion (N) of the Lapidus arthrodesis with screw loosening and associated bone cysts (BC) formation.



Fig 2. Revision Lapidus arthrodesis of right foot by bone endoscopy. The obliterated distal screw hole is refreshed by a 5-mm cannulated drill along a guide pin. (a, dorsal portal incision.)

metatarsal bone cyst in connection with the screw tract is debrided (Fig 5).

Microfractures of the Screw Tract, Cyst Walls and Nonunion Site

After debridement, the portals are exchanged again. The awl is inserted through the dorsal portal. Multiple microfractures are made along the screw tract and over the cyst wall. The sclerotic bone of the nonunion site can also be cracked by the awl (Fig 6). The sclerotic bone plates of the nonunion site away from the screw tract can be drilled percutaneously by a K wire (Zimmer).

Bone Grafting and Screw Fixation

After preparation of the screw tract and the nonunion site, zonal bone grafting with autologous cancellous bone graft is performed. A 3.5-mm drill sleeve (Synthes) is used to deliver the bone graft through the dorsal portal. The first zone of bone grafting is the bone cysts (Fig 7). After the bone cysts are grafted, the next zone of bone grafting is the nonunion site. The drill sleeve is positioned close to the nonunion site and the bone graft is delivered to the level of the nonunion site (Fig 8). The graft is packed into the nonunion site by means of a small periosteal elevator. The last zone of bone grafting is the screw tract itself. The bone grafting should be across the nonunion site aiming to create a bone bridge across the nonunion site. Once bone graft is delivered to the tract, it is pressed toward the periphery of the screw tract. The screw tract is narrowed until it is completely closed by the bone graft. Finally, the first tarsometatarsal joint is put in desirable position and transfixed with two crossed 4.0-mm cannulated screws (Synthes) (Fig 9, Video 1). Postoperatively, the foot is immobilized in a short leg cast with a toe platform and the patient is advised on nonweightbear for 4 to 6 weeks before

weightbearing walking starts. After removal of the cast, the patient is instructed on ankle mobilization exercise and partial-weightbearing walking with a wooden-based orthopaedic shoe. Increases in weightbearing are allowed on a weekly basis and are governed by pain. Return to conventional shoes is often dictated by swelling and may take several months.

Discussion

There are several potential complications of Lapidus arthrodesis, including first metatarsal shortening, metatarsal elevatus, and nonunion.¹⁷ Classically, the

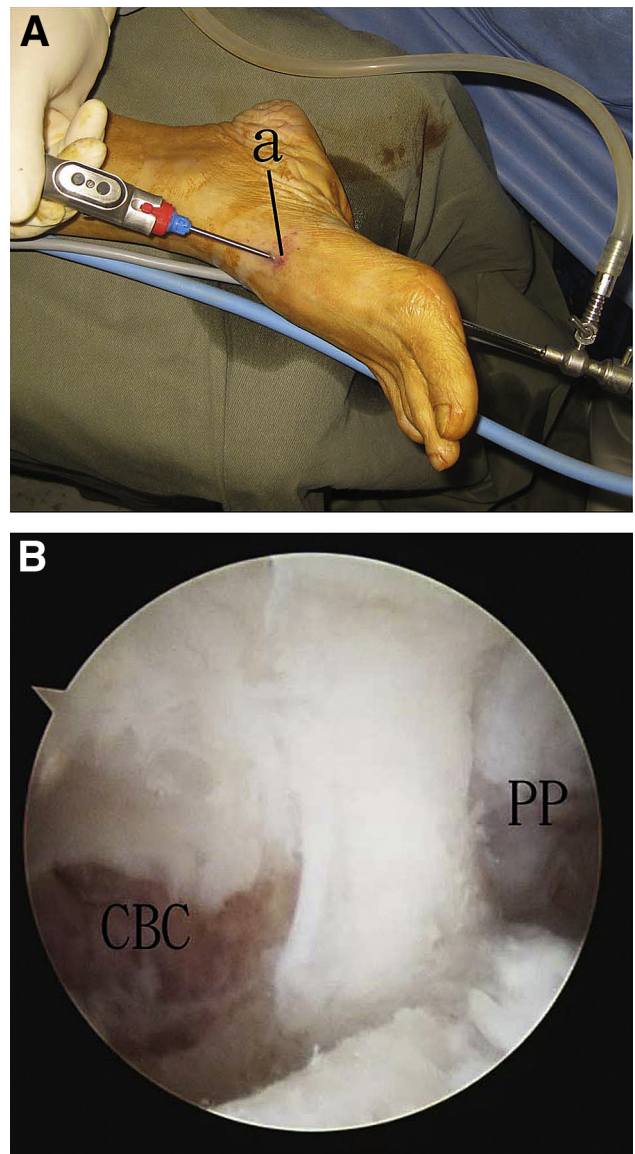


Fig 3. Revision Lapidus arthrodesis of right foot by bone endoscopy. (A) Plantar portal as the viewing portal. The proximal part of the screw tract and cuneiform bone cysts are debrided. (a, dorsal portal incision.) (B) Arthroscopic view of the cuneiform bone cyst (CBC) after debridement. (PP, proximal portal.)

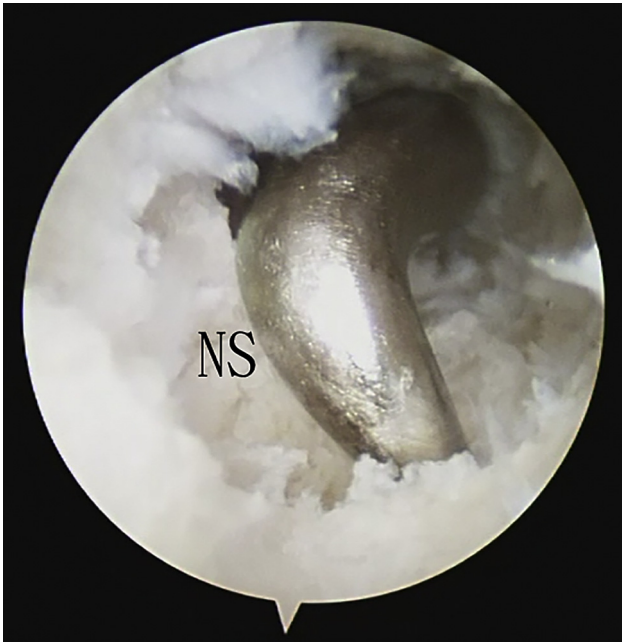


Fig 4. Revision Lapidus arthrodesis of right foot by bone endoscopy. Plantar portal as the viewing portal. An angled arthroscopic awl is inserted through the proximal portal to the nonunion site (NS) to break down the adhesions.



Fig 6. Revision Lapidus arthrodesis of right foot by bone endoscopy. Plantar portal as the viewing portal. The subchondral bone (SB) of the nonunion site is cracked by an arthroscopic awl through the dorsal portal.

symptomatic first metatarsocuneiform nonunion is revised through an open approach. In case of stable fixation and good initial positioning of the first metatarsal, the nonunion can be revised by first tarsometatarsal arthroscopy.¹¹ As an arthroscopic procedure, advantages associated with this technique include better cosmesis, better visualization, limited bone resection and less soft-tissue dissection (Table 2).^{7,8,11} However, the working space of the nonunion site is limited and the arthroscopic approach was technically difficult. Moreover, in case of screw loosening, there would be dilatation of the screw tract and associated bone cyst formation. This cannot be dealt with by first

tarsometatarsal arthroscopy alone. The indication for the reported bone endoscopy technique is symptomatic nonunion of the first tarsometatarsal joint, which has been previously addressed through a transarticular screw as well as loosening of the screw and bone cyst formation. Smoking should be considered a relative contraindication to this revision surgery.¹⁸ This approach is technically not difficult as the working area (screw tract) is more spacious and well defined. It can be divided into 3 zones: screw tract itself, nonunion site and the associated bone cysts. This classification allows systemic debridement and bone grafting of the different zones. The dorsal and plantar

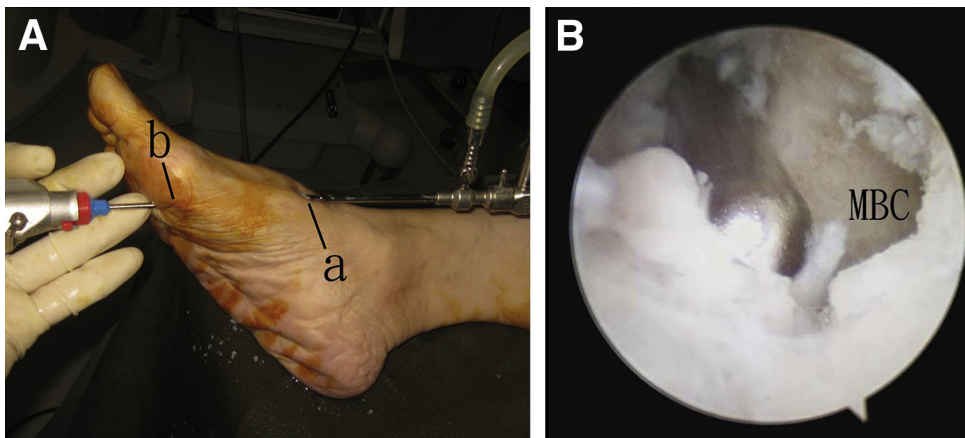


Fig 5. Revision Lapidus arthrodesis of right foot by bone endoscopy. (A) Dorsal portal as the viewing portal. (a, dorsal portal incision; b, plantar portal incision.) (B) The distal part of the screw tract and the metatarsal bone cyst (MBC) is debrided.

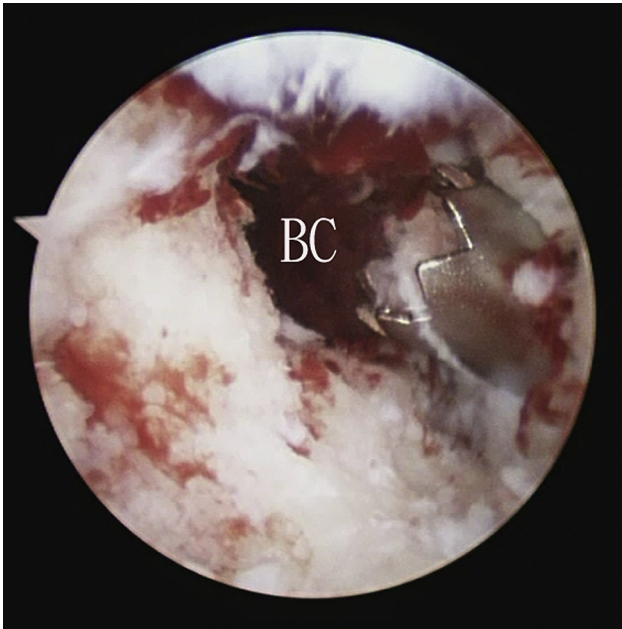


Fig 7. Revision Lapidus arthrodesis of right foot by bone endoscopy. Plantar portal as the viewing portal. Bone cyst (BC) is grafted by means of a drill sleeve through the dorsal portal.



Fig 8. Revision Lapidus arthrodesis of right foot by bone endoscopy. Plantar portal as the viewing portal. Nonunion site (NS) is grafted by means of a drill sleeve through the dorsal portal.

portals are coaxial portals and interchangeable as viewing and instrumentation portals. However, insertion of the arthroscopic awl through the plantar portal should be avoided as its sharp tip can put the neurovascular structures and tendons of the sole at risk. The angled awl can serve as a dissector to break down the adhesions of the nonunion site. It can also

microfracture the wall of the cysts and screw tract and crack the sclerotic bone plate of the nonunion site to facilitate the subsequent fusion. However, the area of fusion surface preparation of the nonunion site is limited and centered at the screw tract. This can be supplemented by percutaneous drilling of the nonunion site by a K wire.

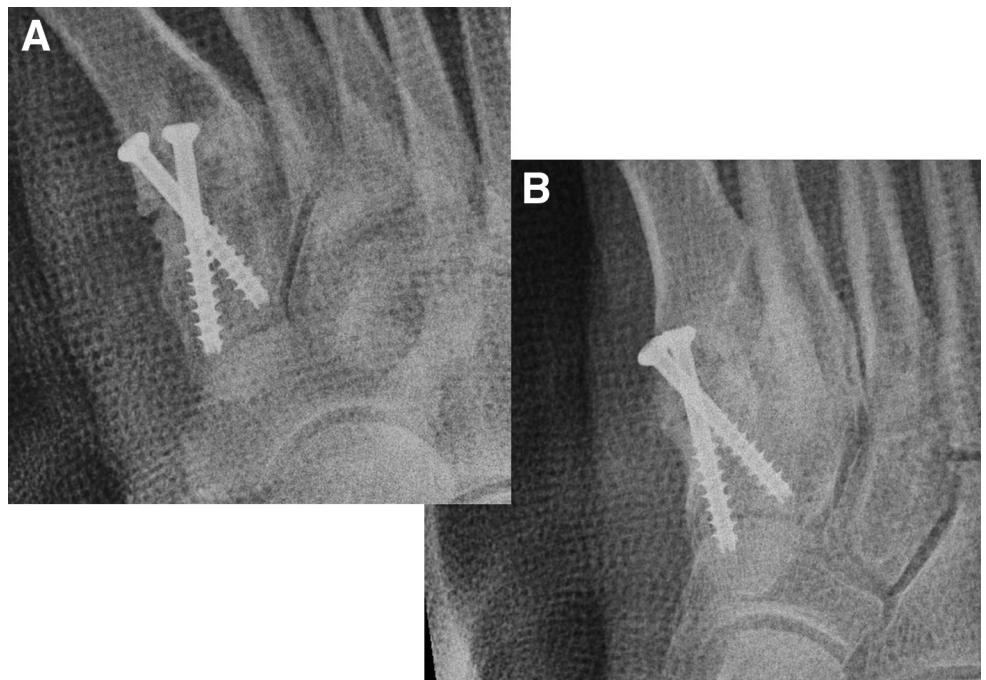


Fig 9. Revision Lapidus arthrodesis of right foot by bone endoscopy. After bone grafting, the nonunion site is placed in the desired position and fixed with crossed 4.0-mm cannulated screw and immobilized in a short leg cast. (A) Dorsoplantar view and (B) oblique view.

Table 2. Advantages and Risks of Revision Lapidus Arthrodesis by Bone Endoscopy

Advantages	Risks
1. Can resolve all the pathologies associated with the nonunion	1. Injury to the tendons of the sole during instrumentation via the plantar portal
2. Better cosmesis	2. Injury to the medial plantar nerve or its branches during instrumentation via the plantar portal
3. Better visualization	
4. Limited bone resection	
5. Less soft-tissue dissection	

Bone grafting should be through the dorsal portal as the drill guide is not long enough to reach the screw tract through the plantar portal. Bone grafting should be performed in zonal manner. The cysts are grafted initially, followed by the nonunion site. Finally, the screw tract is grafted across the nonunion site to form a bone bridge. This procedure can be supplemented by the first tarsometatarsal arthroscopy if the nonunion site is ankylosed in an unfavorable position and cannot be adequately released through the bone endoscopy. First tarsometatarsal arthroscopy allows more extensive periarticular and intra-articular soft-tissue release.

Although many different fixation methods have been proposed,¹⁹⁻²² we use percutaneous cannulated crossed screws to fix the nonunion site. The screws inserted in the sagittal plane can resist cantilever loads applied to the first metatarsal during midstance.^{9,23} The crossed screw construct also allow early weightbearing without an increased complication rate.⁶

In summary, nonunion of first metatarsocuneiform joint fusion with screw loosening and associated bone cyst formation can be revised by bone endoscopy through the screw tract.

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