



Treatment of Malunited Calcaneal Fracture With Posttraumatic Subtalar Osteoarthritis Using Lateral Endoscopic Calcaneoplasty With Posterior Arthroscopic Subtalar Arthrodesis

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Abstract: Malunion of calcaneal fractures is a common complication after improper nonoperative treatment. It may develop into posttraumatic subtalar osteoarthritis, lateral calcaneal wall prominence, and severe foot deformities. This Technical Note reports the technical aspects of lateral endoscopic calcaneoplasty with posterior arthroscopic subtalar arthrodesis for the treatment of malunited calcaneal fracture with lateral calcaneal wall prominence and posttraumatic subtalar osteoarthritis. This technique was chosen because it can reduce the risk of wound complication compared with a conventional lateral extensile approach. This Technical Note describes the use of the technique in a patient with prone position. This offers the advantages of easier access to the lateral surface of the calcaneus and posterior facet of the subtalar joint, and is less invasive to the soft tissue envelope on the lateral side of the foot. Moreover, the concomitant bone void area of the subtalar joint can be dealt with by an arthroscopic procedure.

Malunited calcaneal fracture is a common complication after improper nonoperative treatment. It may develop into posttraumatic subtalar osteoarthritis and severe foot deformities.¹ Late complications of malunited calcaneal fracture involve widening of the calcaneus or lateral calcaneal wall prominence, which may lead to changes in the peroneal tendons, shoe wear difficulties, and often varus deformity of the calcaneus.¹ Appropriate management

of complications associated with calcaneus fractures is crucial for comprehensive care of this injury.² Several authors have described subtalar arthrodesis with bone graft block interposition in the treatment of posttraumatic osteoarthritis along with lateral calcaneal wall prominence resection to correct deformities and hindfoot malalignment with good clinical and radiographic outcomes.^{1,3} However, soft tissue compromise is as much a critical concern with a traditional approach as with a lateral extensile approach. Soft tissue infection may occur more frequently following this approach than with minimally invasive surgery.⁴ This Technical Note describes lateral endoscopic calcaneoplasty with posterior arthroscopic subtalar arthrodesis to treat malunited calcaneal fracture with a reduced risk of wound complication compared with the conventional approach.

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The author reports the following potential conflicts of interest or sources of funding: C.A. reports personal fees from Meditime, Thailand (the representative of Conmed, USA), during the conduct of the study; and personal fees from Device Innovation (Thailand), Novatech Healthcare (Thailand), Pfizer (Thailand), Phoenix Surgical Equipment (Thailand), Smith & Nephew, Eisai Marketing (Thailand), and Symgens, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received August 16, 2017; accepted August 29, 2017.

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2212-6287/17995

<https://doi.org/10.1016/j.eats.2017.08.077>

Technique

Preoperative Assessment and Patient Positioning

Preoperative clinical examination of the ankle and hindfoot is important to delineate the extent of clinical conditions. Radiographs and computed tomography or magnetic resonance imaging are essential to confirming the diagnosis and assessing the extent of the lateral calcaneal wall prominence, posttraumatic osteoarthritis of the subtalar joint, and associated pathology. The

patient is positioned prone with bolster placement under the chest and pelvis with free motion of the abdominal segment. The lower limb is exsanguinated using an Esmarch bandage, and a pneumatic tourniquet is placed in the proximal half of the thigh. The operated foot is positioned beyond the edge of the operating table and lifted up from the table by a towel roll under the anterior side of the distal leg. This position provides sufficient space for presenting arthroscopic or endoscopic procedures. The ankle is allowed to undergo dorsiflexion by gravity. Fluid inflow is by gravity, and no arthropump is used. A 4.0-mm 30° arthroscope (Conmed, Utica, NY) and a 1.9-mm 30° endoscope (Smith & Nephew, Andover, MA) are used for these procedures. An arthroscopic video system (Conmed) is at the head side of the patient.

Posterior Arthroscopic Subtalar Arthrodesis

Posteromedial and posterolateral portals at the medial and lateral sides of the Achilles tendon are used for arthroscopic subtalar arthrodesis. The portals are at the level of the posterosuperior corner of the posterior calcaneal tubercle. An injection with 10 mL of saline with a 21-gauge needle is performed via the posterolateral corner to the posterior part of the subtalar joint with care taken to avoid the neurovascular structures at the posteromedial aspect of the subtalar joint. This step is to create space before the insertion of a trocar sheath. A 5-mm incision is performed at the posterolateral portal. The subcutaneous tissue is bluntly dissected with a straight clamp. The blunt trocar sheath is inserted from the posterolateral corner to the posterior part of the subtalar joint. Blunt dissection using a trocar sheath can be performed to create space at the posterior part of the subtalar joint, again, while avoiding the neurovascular structures at the posteromedial aspect of the subtalar joint. Rather than a trocar, a 4.0-mm, 30° arthroscope is used to examine the subtalar joint. Similarly, a 5-mm incision is made at the posteromedial portal, and the subcutaneous tissue is bluntly dissected with a straight clamp. The clamp should point toward the posterolateral aspect of the subtalar joint while the arthroscope faces the posterolateral portal. A 4.2-mm arthroscopic shaver (Conmed) is used to debride fibrosis and synovitis of the subtalar joint. The portals are interchangeable as the viewing and working portals. Osteophytes and cartilage from the posterior facets of the subtalar joint are removed by a curette and a 4.0-mm arthroscopic acromionizer (Conmed) through the posteromedial portal. The varus position of the subtalar joint and/or a foot position with ankle dorsiflexion by gravity can be used to open up the angle on the lateral and/or posterior side of the subtalar joint providing space to allow easy access by an acromionizer or a curette. The instrument position in relation to the subtalar joint can be assessed by fluoroscopy. A

subchondral bone drilling using a 2.0-mm Kirschner wire with a protecting sleeve and/or microfracture awl penetration is performed to enhance the healing of the arthrodesis site. After correction of hindfoot bone relationships is confirmed by fluoroscopy, two 7.0-mm partially threaded cannulated screws are inserted from the calcaneus to the talus for fixation through the posterior facets. Hydroxyapatite bone graft substitute

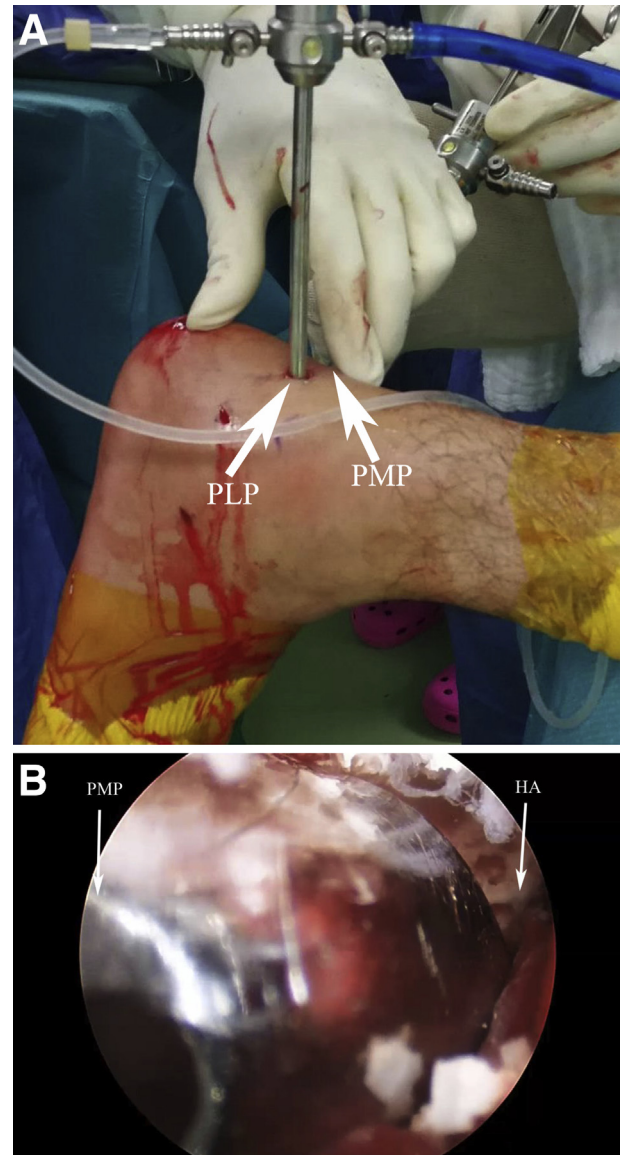


Fig 1. The demonstration of hydroxyapatite bone graft substitute insertion of the right subtalar joint during posterior subtalar arthroscopy in a patient with prone position. (A) A clinical image demonstrates the hydroxyapatite bone graft substitute insertion by a surgical assistant via an arthroscopic sheath in the posteromedial portal (PMP), which is controlled by the surgeon's left hand. (B) An arthroscopic image shows that the posterolateral portal (PLP) is a viewing portal. Hydroxyapatite bone graft substitute (HA) is inserted through the PMP.

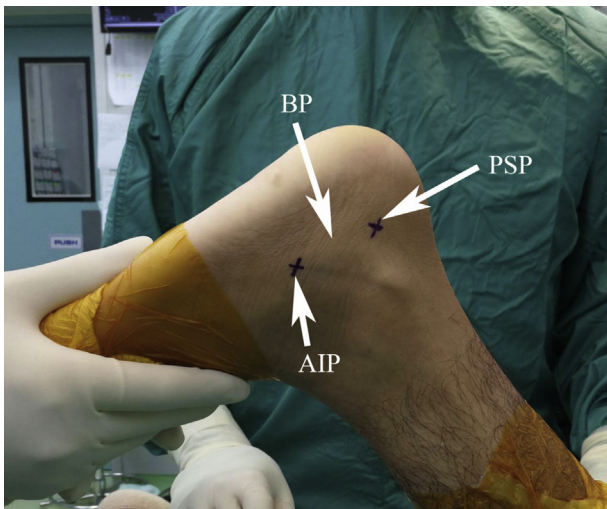


Fig 2. The demonstration of the portals' markings for lateral endoscopic calcaneoplasty on the right foot in a patient with prone position. The lateral endoscopic portals are marked as posteriosuperior portal (PSP) and anteroinferior portal (AIP) along with the peroneal tendon course. The bony prominence (BP) is between the PSP and AIP.

can be used to fill the bone void space, if needed, via an arthroscopic sheath in the other working portal (Fig 1, Video 1). Throughout the procedure, the posteromedial portal is mainly used as the working portal and the posterolateral portal is mainly used as the viewing portal. Caution is taken throughout the procedure to preserve the flexor hallucis longus and medial neurovascular structures.

Lateral Endoscopic Calcaneoplasty

The lateral calcaneal wall prominence is palpated and planned portals are marked with a surgical pen. The lateral endoscopic portals are marked as the posteriosuperior and anteroinferior portals along with the peroneal tendon course (Fig 2). A 5-mm incision is performed at the posteriosuperior portal. The subcutaneous tissue is bluntly dissected with a straight clamp. A dissection is made to approach the lateral wall of the calcaneus with a single dissection toward the bone. Periosteum stripling using a periosteum elevator is performed through each portal to the prominent area. A trocar sheath is inserted via an anteroinferior portal and then a 1.9-mm 30° endoscope (Smith & Nephew) is inserted to replace a trocar. A 2.9-mm acromionizer (Conmed) is inserted and the lateral wall prominence resected via a posteriosuperior portal. The sharp edge of the acromionizer should point toward the bone and its blunt protecting side should point toward the soft tissue. The acromionizer should be moved anteriorly and inferiorly along the course of peroneal tendons and maintained at a level just above the bony surface regarding the tissue planes. This can help to adequately

resect the lateral calcaneal wall prominence with a low risk of iatrogenic injury to the tendons and the sural nerve (Fig 3, Video 1). A small curette can be used to remove the bone prominence in the same manner. Once the resection of the lateral calcaneal wall prominence is satisfactorily achieved, an assessment can be done by palpation or intraoperative fluoroscopy. Skin closure is performed and a posterior plaster splint is applied.

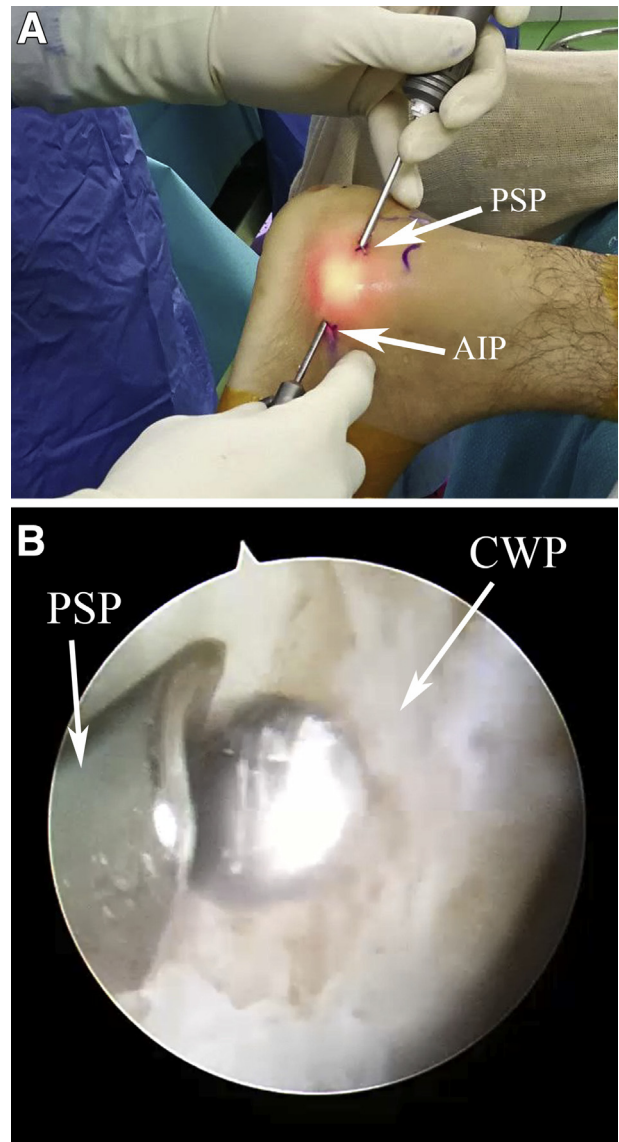


Fig 3. The demonstration of lateral endoscopic calcaneoplasty of the right foot in a patient with prone position. (A) A clinical image demonstrates lateral endoscopic calcaneoplasty, which is performed via the posteriosuperior portal (PSP) and anteroinferior portal (AIP). (B) An arthroscopic image shows that AIP is the viewing portal. The lateral surface of the calcaneal wall prominence (CWP) is resected by an arthroscopic acromionizer through the PSP.

Table 1. Pearls and Pitfalls of Lateral Endoscopic Calcaneoplasty and Posterior Arthroscopic Subtalar Arthrodesis

Pearls

- The operated foot is positioned beyond the operating table edge and lifted up from the table by a towel roll placed under the anterior side of the distal leg
- Varus positions of the subtalar joint and/or foot position with ankle dorsiflexion by gravity can be used to open up the angle on the lateral and/or posterior side of the subtalar joint providing space for easier access by an acromionizer or a curette
- The acromionizer should be moved anteriorly and inferiorly along the course of the peroneal tendons and be maintained at a level just above the bony surface during lateral endoscopic calcaneoplasty

Pitfalls

- The technique is relatively contraindicated when there is extensive bone void space of the subtalar joint in which augmentation by large bone block grafting is needed
- The technique is contraindicated in those with concomitant conditions such as extensive peroneal tendon tears that require open repair

Rehabilitation

The stitches are removed approximately 10 to 14 days after the operation. Then a removable posterior splint is applied. The patient can be allowed to perform ankle dorsiflexion and plantarflexion exercise by himself or herself to prevent the ankle joint stiffness. The patient is permitted to walk via non-weight bearing on a surgical side with the crutches for 3 months after the operation or until the consolidation of the arthrodesis site is shown in the follow-up radiographs. Then the patient is advised to bear weight on a surgical side as tolerated till full weight bearing without the crutches. The patient can be permitted to perform basic activities of daily living and sport activities at 3- and 6-month periods after the operation, respectively.

Discussion

Two-portal hindfoot arthroscopy is an effective procedure that enables direct visualization of posterior ankle pathology with low invasiveness.⁵ This procedure can also be used to approach and treat subtalar pathology. Regarding subtalar arthrodesis, union time and time to return to work, activities of daily living, and sports activities were significantly shorter for the arthroscopic arthrodesis group, and there was no significant difference in union rates and complications overall between the open and arthroscopic groups.⁶ This report described the alternative technique of posterior subtalar arthroscopic arthrodesis, which provides

simple access to the subtalar joint without the need of a special distraction device or accessory portal. Hydroxyapatite bone graft substitute or other types of bone graft can be used to fill the bone void space, if needed, via an arthroscopic sheath in the nonviewing portal. This approach in the prone position also facilitates an easier hindfoot orientation to correct the alignment before screw fixation.

Although endoscopic calcaneoplasty for the resection of posterosuperior calcaneal prominence (Haglund deformity) has been previously reported,⁷ little is known about lateral endoscopic calcaneoplasty for the resection of the lateral calcaneal wall prominence in malunited calcaneal fracture. This Technical Note reports this technique that provides direct visibility and resectability of bony prominences without the need of a conventional approach such as lateral extensile incision. This can decrease disruption of the soft tissue envelope and the risk of wound dehiscence or infection in that area. When performed as described in Table 1, this technique facilitates the resection of the lateral calcaneal wall prominence with a low risk of iatrogenic injury to tendons and the sural nerve. Because the procedure is minimally invasive, the patient also experiences less postoperative pain. Regarding the anatomy of foot and ankle, the surrounding structures are the concerned issues of the presented technique. The peroneus brevis tendon has been reported for its injury after the subtalar arthroscopy via the lateral portals.⁸ The risks and limitations of this

Table 2. The Risks and Limitations of Lateral Endoscopic Calcaneoplasty and Posterior Arthroscopic Subtalar Arthrodesis

Risks

Lateral endoscopic calcaneoplasty

- Potential injuries on the sural nerve, peroneal tendons, and calcaneofibular ligament.
- Risk of hematoma after the extensive calcaneoplasty of large bony prominence.

Posterior arthroscopic subtalar arthrodesis

- Potential injuries on posteromedial neurovascular structures, flexor hallucis longus, and posterior talofibular ligament

Limitations

Lateral endoscopic calcaneoplasty

- There are the necessities of combined lateral endoscopic calcaneoplasty and other procedures for the treatment of severe varus malunion with large bony prominence after the calcaneal fracture or other associated conditions such as extensive peroneal tendon tears, and peroneal tenosynovitis

Posterior arthroscopic subtalar arthrodesis

- The augmentation by large bone block grafting is the limitation of this technique
- There are the necessities of combined posterior arthroscopic subtalar arthrodesis and other surgical approaches in the patient with subtalar arthritis of posterior talocalcaneal articulation which is associated with anterior and/or middle talocalcaneal articulations

technique are summarized in Table 2. Surgeons need to keep these points in mind when they decide to perform these operations.

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