Technical Note

Local Percutaneous Radiofrequency for Chronic Plantar Fasciitis

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Abstract: Plantar fasciitis is the most common cause of heel pain. It accounts for 80% of the cases and has an estimated prevalence rate of up to 7% in the general population, with bilateral involvement in 20% to 30% of those patients. This condition affects people of working age, thereby limiting and diminishing their quality of life. There are a wide range of treatment options for the management of plantar fasciitis that include both conservative and surgical treatments. Although surgical treatment based on partial or total plantar fascia release has success rates of some 70% to 90%, it is not free of complications. These complications, soft-tissue healing problems, superficial infection, or longitudinal arch collapse in cases of a greater than 40% release of the fascia. Bipolar radiofrequency appears to be a safe procedure for refractory plantar fasciitis that can provide outcomes equivalent to open plantar fascia release with less morbidity. The purpose of this article is to describe the local percutaneous radiofrequency technique for patients with chronic, recalcitrant plantar fasciitis.

Plantar fasciitis is the most common cause of heel pain. It accounts for 80% of the cases[1] and has an estimated prevalence rate of up to 7% in the general population, with bilateral involvement in 20% to 30% of those patients.[2] This condition affects people of working age, thereby limiting and diminishing their quality of life.

Although the cause of plantar fasciitis remains unclear, there are many associated risk factors. They include cavus foot, obesity, and reduced ankle dorsiflexion.[3] The pathogenesis involves localized inflammation and degeneration of the proximal plantar aponeurosis near its origin at the medial tuberosity of the calcaneus.[4] These inflammatory changes are usually present with pain when patients take their first steps in the morning or after long periods of rest. The symptoms of plantar fasciitis tend to progressively improve. However, this condition can be persistent in a small percentage of cases and become a limiting factor in daily activities.[5]

There are a wide range of treatment options for the management of plantar fasciitis that include both conservative and surgical treatments. Conservative treatment encompasses rest, anti-inflammatory drugs, stretching exercises, physical therapy, foot padding, and orthotic devices.[5] This treatment has a success rate of up to 90%.[6] Surgical treatment is necessary in fewer than 10% of patients.[7]

Although surgical treatment based on partial or total plantar fascia release has success rates of some 70% to 90%,[7] it is not free of complications. Those complications may include medial plantar nerve injuries, soft-tissue healing problems, superficial infection, or longitudinal arch collapse in cases of a greater than 40% release of the fascia.

To prevent these complications, many presurgical options such as steroid injections, extracorporeal shockwave therapy, or bipolar radiofrequency (BRF) in the plantar fascia have been proposed. BRF treatment has a long medical history in treating several conditions. It has been used in orthopaedics for upper-limb tendinopathy, epicondylitis, Achilles tendon injuries, or knee pain and

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is an effective option in cases of recalcitrant plantar fasciitis.[8] It is a minimally invasive technique used in the treatment of acute and chronic painful processes in which a probe emits an electrical field. It is applied to soft tissue damaged from a vascular point of view and is thought to mediate the therapeutic effects. In the case of plantar fasciitis, some studies have shown it to have a significant degree of clinical efficacy and safety. Furthermore, an average satisfaction rate of around 83%,[8] low complication rates, and improvements in clinical outcomes were seen.

In summary, BRF appears to be a safe procedure for refractory plantar fasciitis that can provide outcomes equivalent to open plantar fascia release with less morbidity. The purpose of this article is to describe the local percutaneous radiofrequency technique for patients with chronic, recalcitrant plantar fasciitis.

Surgical Technique

Percutaneous BRF for chronic plantar fasciitis is performed with the patient under spinal anesthesia with a tourniquet applied to the ankle. The patient is positioned supine with the ankle draped and hanging freely over the edge of the table.

Before local anesthesia is administered, the painful heel area is tested and outlined with a sterile marker with the ankle in dorsiflexion. The points where radiofrequency will be applied are marked inside the painful area, with a distance of 5 mm between them (Fig 1).

At this point, the calcaneal branch of the posterior tibial nerve is blocked under local anesthesia with mepivacaine 1% at 2 cm distal to the tip of the medial malleolus (Fig 2A). For this purpose, ultrasound-guided blocking can be performed to identify this branch (Fig 2B).

After local anesthesia administration, the radiofrequency skin entrance points are punctured with a 1- to 1.5-mm Kirschner wire to facilitate the introduction of the radiofrequency probe under the skin (Fig 3A). Although the microdebrider catheter has a diameter of 0.502 mm, we recommend puncturing the skin entrance points with a 1- to 1.5-mm Kirschner wire to prevent catheter-tip bending (Fig 3B).

For BRF, a TOPAZ microdebrider (ArthroCare, Austin, TX) is used. After the microdebrider is connected, the console must be configured in position 4 (Fig 4B). The radiofrequency microdebrider is attached to a sterile saline solution drip that is set at a drip rate of 1 drop every 2 seconds (Fig 4A).

The TOPAZ radiofrequency catheter has a diameter of 0.502 mm and a scope of 2.5 mm with a setting at 175 V. The activation timer is automatically set at 0.5 seconds (500 milliseconds).

Then, radiofrequency is delivered sequentially through each previously created percutaneous microincision, with 2 applications through each perforation, as described by Sorensen et al.[9] and Weil et al.[10] One application is performed at the junction of the superficial and deep fascia layers, and the second, through the deep plantar fascia. Although this step can be performed without ultrasound assistance, some authors recommend its use to determine the depth of radiofrequency application (Fig 5).

Postoperatively, a soft ankle bandage is applied. The patient is kept non−weight bearing for 2 days after surgery and is then allowed weight bearing as tolerated (Fig 6). One week after surgery, the bandage is removed. With the aim of preventing plantar fascia retraction, it is important to start stretching exercises at this time. After 4 weeks, the patient returns to normal activities with ongoing stretching exercises.

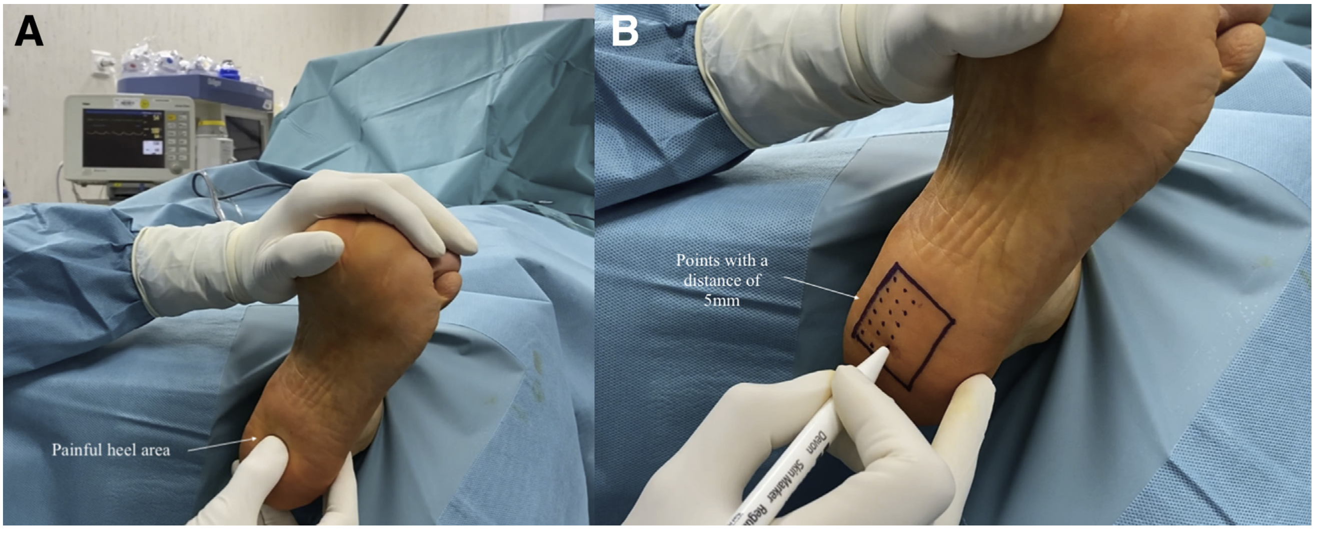

Fig 1. Left foot, plantar view, with the patient positioned supine and the ankle draped and hanging freely over the edge of the table. (A) The painful heel area is tested and outlined with a sterile marker with the ankle in dorsiflexion. (B) The points where radiofrequency will be applied are marked, with a distance of 5 mm between them.

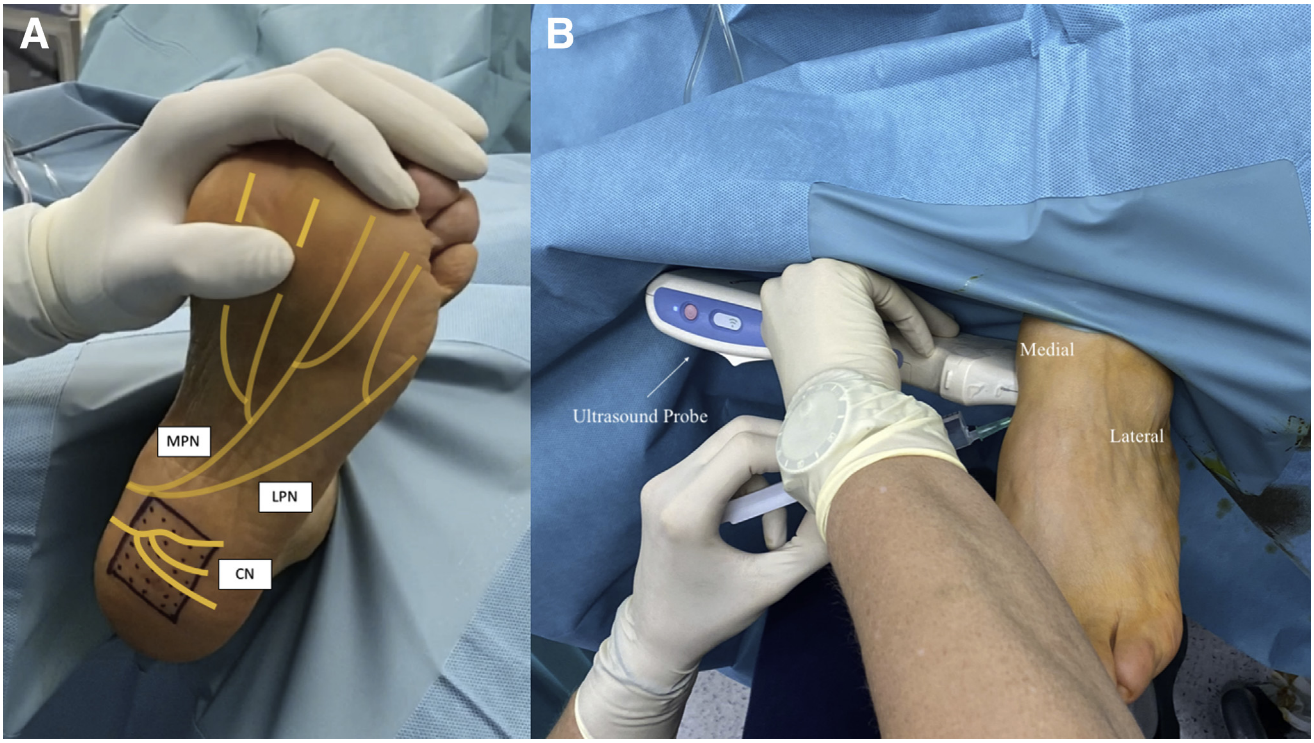

Fig 2. (A) Left foot, plantar view. The calcaneal branch of the posterior tibial nerve is blocked under local anesthesia with mepivacaine 1%. The calcaneal nerve (CN), medial plantar nerve (MPN), and lateral plantar nerve (LPN) are shown in yellow. (B) Left foot, dorsal view. Ultrasound-guided blocking is performed to identify the calcaneal branch of the posterior tibial nerve.

A step-by-step description of the surgical technique is summarized in Table 1. Table 2 provides pearls and pitfalls in performing this procedure. Table 3 shows its advantages and limitations. Video 1 shows the whole technique in detail.

Discussion

The presence of vascular hyperplasia and a disorganized collagen network in patients with chronic plantar fasciitis suggests that their vascular tissue is compromised.[11] For this reason, one of the main goals in treating recalcitrant plantar fasciitis is to generate a healing process based on an organized angiogenic response. This creates an environment of improved vascularity that promotes collagen remodeling and leads to the resolution of pain and functional impairment.[9]

The biological healing response activated by BRF, based on the increased presence of basic fibroblastic growth factor and vascular endothelial growth factor, seems well suited for the quiescent healing environment

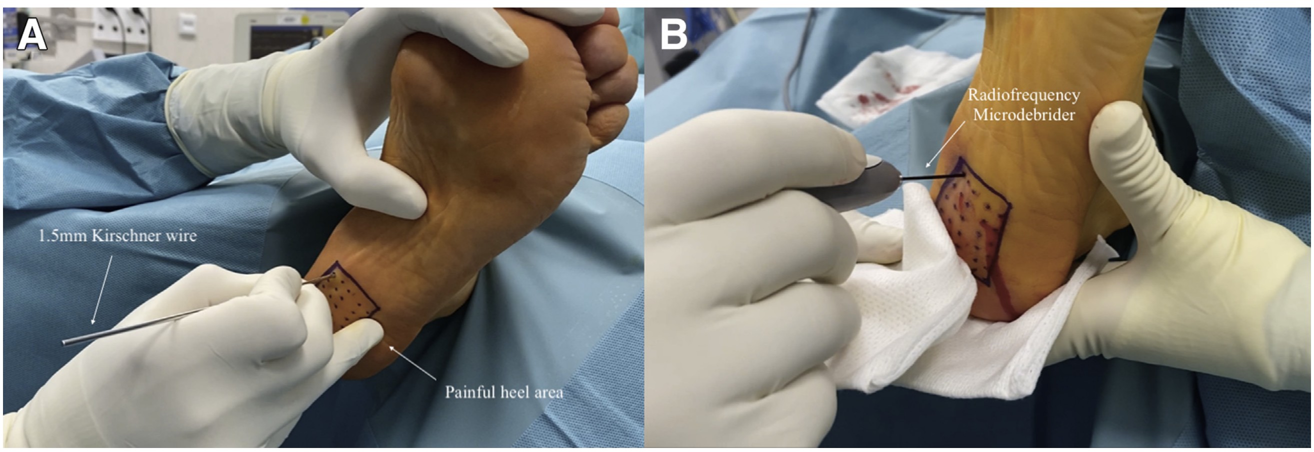

Fig 3. Left foot, plantar view. (A) The radiofrequency skin entrance points are punctured with a 1- to 1.5-mm Kirschner wire. (B) Puncturing the skin entrance points with a 1- to 1.5-mm Kirschner wire is recommended to prevent catheter-tip bending.

Fig 4. (A) Radiofrequency microdebrider attached to a sterile saline solution drip, set at a drip rate of 1 drop every 2 seconds. (B) Microdebrider console configured in position 4.

of chronic tendinosis.[12] Moreover, more extensive vascular networks have been observed in treated areas when compared with untreated areas.[12] Tissue proliferation and accelerated wound healing have also been associated with BRF microdebridement.

Good to excellent results with BRF microdebridement have been reported in 95% of patients with tendinosis involving either the Achilles or patellar tendon or the lateral or medial epicondyle of the elbow.[13] The use of percutaneous BRF for chronic plantar fasciitis was described by Sorensen et al.[9] and Weil et al.[10] They observed significant improvement in the American Orthopaedic Foot & Ankle Society hindfoot and mid-foot scores at 6 months when compared with baseline.

Of late, good results have been reported after BRF in patients with recalcitrant plantar fasciitis, with an average satisfaction rate of around 83% being obtained among these patients.[8] Early improvement (within 2 weeks after procedure) has been attributed to the elimination of excessive nerve ingrowth fibers associated with the pathology of tendinosis and fasciosis, whereas long-term pain relief has been associated with angiogenesis and collagen remodeling due to BRF.[9,14]

The main advantages of the described technique versus other techniques are the avoidance of soft-tissue dissection and retraction as compared with open procedures, which leads to a faster recovery. Moreover, this technique reduces the risk of the plantar nerve injuries associated with open plantar fasciotomy.[15] Other advantages of this technique are that patients are able to wear normal shoes within 2 weeks and no immobilization is necessary, thus preventing the risk of

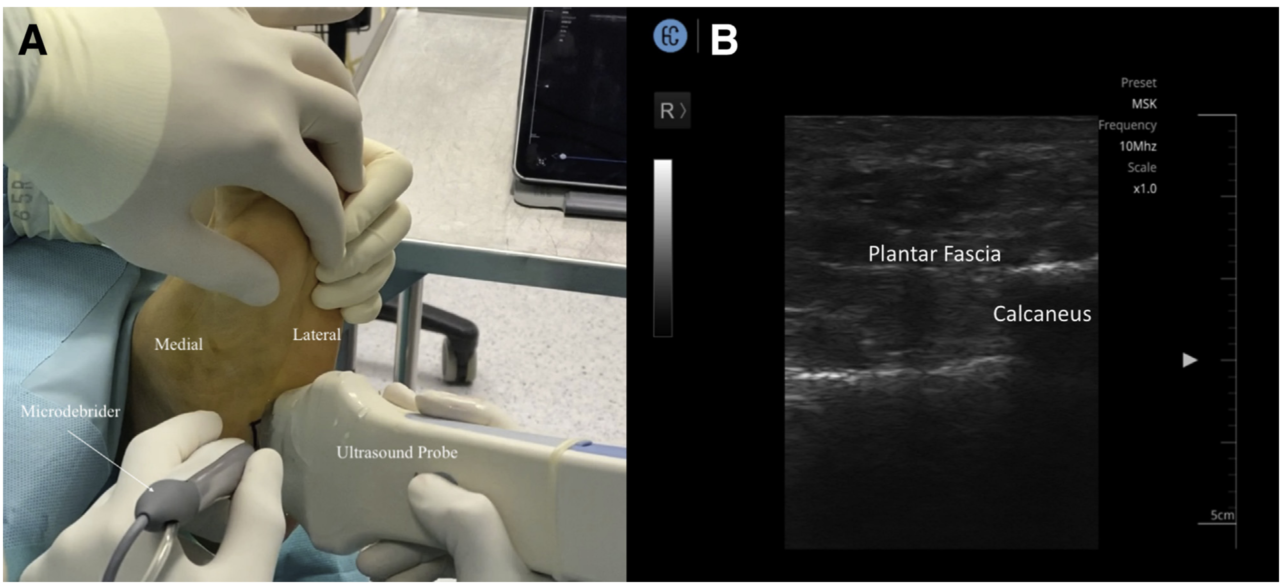

Fig 5. Left foot, medial view. (A, B) Ultrasound assistance to determine the depth of radiofrequency application.

Fig 6. Left foot, medial view. Soft ankle bandage applied in 90° of flexion.

deep venous thrombosis. In our institution, local anesthesia is applied to reduce the risks associated with general or spinal anesthesia. Finally, some authors have reported instability of the longitudinal arch after plantar fascia release.[16] This complication is avoided with conservative treatment with the BRF microdebrider. Moreover, performing BRF does not have any effect on whether more aggressive treatments are called for in the future.

One of the keys to success is to map the painful area before local anesthesia is applied. Although the diameter of the microdebrider is 0.502 mm, we recommend puncturing the skin and subcutaneous soft tissue with a Kirschner wire of at least 1 mm to prevent catheter-tip bending. Two pulses should be applied, and the puncture depth must be carefully controlled. For that purpose, the procedure should be performed under ultrasound guidance if possible. Ultrasound guidance can prevent complications such as flexor hallucis longus tendinosis caused by an excessively deep puncture. Starting weight bearing and calf stretching as soon as possible is important to achieving a faster recovery and preventing plantar fascia retraction. Weight bearing is permitted 2 days after the procedure and stretching exercise, 1 week after it.

A risk of tendinosis of the flexor hallucis longus was described by Sorensen et al.,[9] occurring in 1 of 21 patients. Although the cause of this complication is not clear, it is possible that the catheter tip went too deep, placing it close to the flexor hallucis longus tendon. Ultrasound guidance is recommended to minimize this risk. Although connective tissue has been reported to be weaker than uninjured connective tissue during the

Table 1. Steps of Local Percutaneous Radiofrequency for Chronic Plantar Fasciitis

Step	Description
1	The patient is positioned supine with the ankle draped and hanging freely over the edge of the table.
2	With the ankle in dorsiflexion, the painful heel area is tested and outlined with a sterile marker. The points where radiofrequency will be applied are also drawn inside the painful area, with a distance of 5 mm between them.
3	The calcaneal branch of the posterior tibial nerve is blocked under local anesthesia with mepivacaine 1%, 2 cm distal to the tip of the medial malleolus (ultrasound guidance can be used).
4	The radiofrequency skin entrance points are punctured with a 1- to 1.5-mm Kirschner wire.
5	The TOPAZ microdebrider is connected to the console and attached to a sterile saline solution drip, set at a drip rate of 1 drop every 2 seconds (the console must be set in position 4).
6	Two radiofrequency impulses are delivered sequentially through each previously created percutaneous microincision (ultrasound guidance can be used).
7	Postoperatively, a soft ankle bandage is applied and weight bearing as tolerated is allowed 2 days after the procedure.

Table 2. Pearls, Pitfalls, and Risks

Pearls
The painful area should be tested and mapped before local anesthesia is administered.
Although the microdebrider catheter has a diameter of 0.502 mm, a 1- to 1.5-mm Kirschner wire is recommend for puncturing the skin entrance points to prevent catheter-tip bending.
Before radiofrequency application is started, one must be sure the console is configured in position 4 and the microdebrider is attached to a sterile saline solution drip.
Two applications should be performed at each point: one at the junction of the superficial and deep fascia layers and the second through the deep plantar fascia.
Previous experience in ultrasound procedures is recommended to perform this technique under ultrasound guidance.
The patient should start complete weight bearing and complete stretching exercises as soon as possible to prevent plantar fascia retraction.
Pitfalls and risks
Local anesthesia with ultrasound guidance should be carried out by someone experienced in these procedures.
The anesthetic blocking of the calcaneal branch may be insufficient, requiring general anesthesia.
The described technique is not useful for the treatment of pain located in the medial plantar arc.

Table 3. Advantages and Limitations

Advantages
Percutaneous technique
Short duration of procedure
Although ultrasound guidance or radioscopy can be used, neither is necessary
Soft-tissue injury is minimized
More aggressive procedures are avoided, including plantar fasciotomy
Shorter recovery time and early postoperative mobilization
No exclusion of posterior procedures if necessary
Limitations
Specific material needed
Only indicated in patients in whom the painful area is the insertional plantar fascia area
Regarding ultrasound, experience in ultrasound-guided procedures is necessary

reparative state, biomechanical data have indicated no evidence of biomechanical weakness and no cases of post-microdebridement rupture of the plantar fascia have been reported.[17]

In conclusion, to prevent surgical complications related to plantar fascia release, BRF is a safe and reproducible treatment option with good results in terms of pain for patients with plantar fasciitis and no response after conservative treatment.

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