Technical Note

Ultrasound-Guided Electrocoagulation of Neovessels for Chronic Patellar Tendinopathy

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Abstract: Chronic patellar tendinopathy remains a challenging problem. The first line of treatment is conservative; when this fails, surgical treatment is indicated. Several open and arthroscopic techniques have been described. We describe an alternative technique using ultrasound-guided electrocoagulation of neovessels that leaves the patellar tendon intact.

Chronic patellar tendinopathy (PT), or "jumper's knee," is a common sport-related pathology. The exact cause is not clearly defined. Several histopathologic studies have identified a degenerative process with tendon thickening, irregular collagen distribution, neovascularization, and increased cellularity with incomplete healing of tendon microtears.[1-4]

Blood vessels and nerves on the dorsal side of the proximal patellar tendon have been shown to be a major source of pain in patients with PT.[1] Conservative management is the first line of treatment, including eccentric physical therapy, icing, activity modification, and nonsteroidal anti-inflammatory drugs.[5,6]

Persistent cases may also be treated with ultrasound, shockwave therapy, sclerosing injections,[1,7,8] platelet-rich plasma,[8] or intra-tissue percutaneous electrolysis (EPI; EPI Advanced Medicine, Barcelona, Spain) in combination with eccentric exercises in an attempt to stimulate a healing response. The results have been promising.[9]

Although nonoperative treatment for PT has high success rates, in a few cases, failure can lead to prolonged disability. When conservative treatment for more than 6 months is unsuccessful, surgical treatment is indicated. Approximately 10% of patients are unresponsive and subsequently undergo surgery, mostly owing to the chronic nature of their symptoms.[10] Arthroscopic techniques and open procedures, as well as percutaneous tenotomy, have been described; however, the recovery time is a crucial topic for elite athletes.

We describe an ultrasound-guided percutaneous technique that is a safe, efficient option for treating PT. This technique uses a less aggressive method for

Table 1. Summary of Procedural Steps: Main Technical Points

Preoperative radiographs and magnetic resonance imaging are obtained to assess the extent of tendon involvement.
Preoperative and intraoperative ultrasound B-mode and color Doppler mode imaging are performed to identify neovascularized areas.
A portal is created with a No. 11 scalpel blade.
The tendon is imaged with the knee in flexion and extension (less tension on tendon).
A 90° bipolar radiofrequency probe is inserted through a stab incision, parallel to the patellar tendon and on the lesion side.
Electrocoagulation is performed under ultrasound guidance, with care taken not to damage the tendon.
After electrocoagulation, the knee is extended to look for any remaining areas of neovascularization.
The incision is closed with an absorbable suture, and a surgical dressing is added.

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The authors report the following potential conflicts of interest or sources of funding: B.S-C. receives personal fees from Arthrex, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received December 22, 2019; accepted February 13, 2020.

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2212-6287/191569

https://doi.org/10.1016/j.eats.2020.02.014

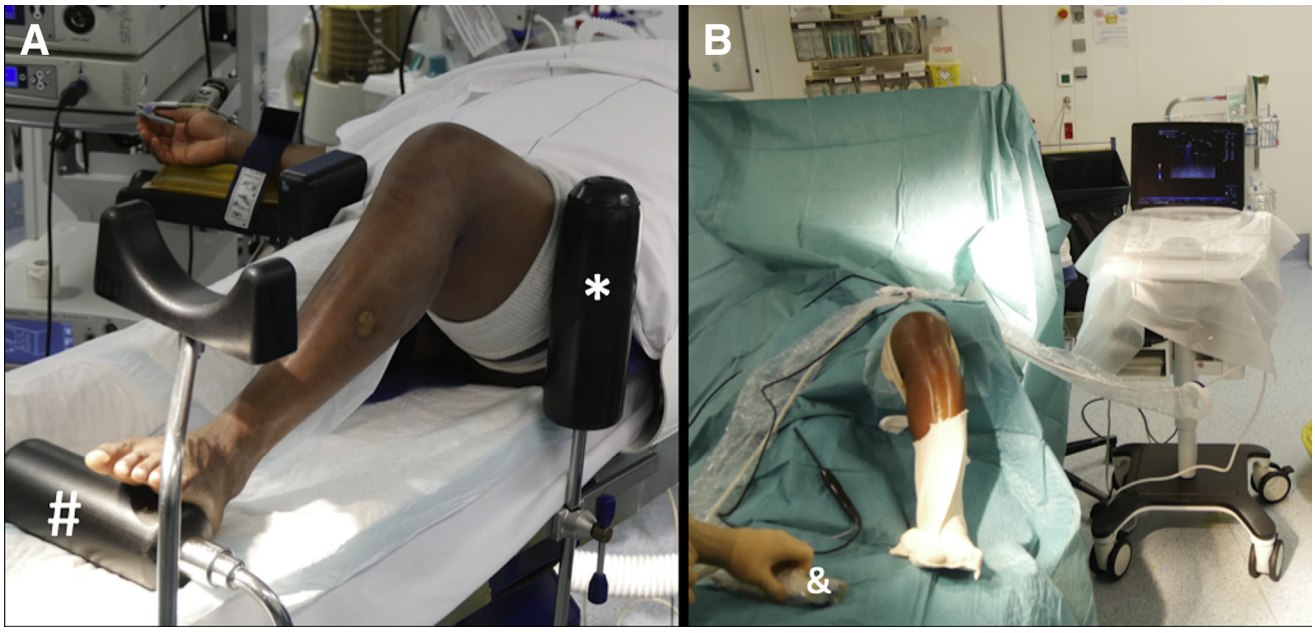

Fig 1. Patient setup. Left knee. (A) A lateral post (asterisk) just proximal to the knee prevents the hip from externally rotating, and a foot roll (hash tag) helps to keep the knee in 90° of flexion. (B) After surgical draping, a transparent sterile cover is placed over the ultrasound probe (ampersand) and workstation.

sclerosing thermal therapy and allows a faster return to sport than surgical techniques.

Technique of Ultrasound- and Doppler-Guided Percutaneous Electrocoagulation by Radiofrequency

Magnetic Resonance Imaging Assessment

Table 1 presents the step-by-step procedure. Preoperative magnetic resonance imaging is used in chronic PT patients to differentiate between the healthy part of the tendon and the inflammatory tissue, which is usually observed within the proximal insertion toward its deep surface, often on the medial side.[11]

Patient Setup

The patient is positioned supine on the operating table in the standard arthroscopy position with a lateral post just proximal to the knee; a foot roll is used to prevent the hip from externally rotating and to maintain 90° of knee flexion. This allows the knee to be moved freely through the full range of motion (Fig 1A). After the patient's skin is disinfected and draped, a transparent sterile cover is placed over the ultrasound workstation and probe (Fig 1B). Perioperative antibiotic prophylaxis is performed with a third-generation cephalosporin.

Preoperative Assessment

Ultrasound B-mode and color Doppler imaging is performed preoperatively, with the knee initially in 90° of flexion. Ultrasound exploration is also performed in extension to reduce the tension in the tendon and provide a better view of the inflammatory zone (neovascularization) in the patellar tendon. The precise location of the inflammatory zone is then

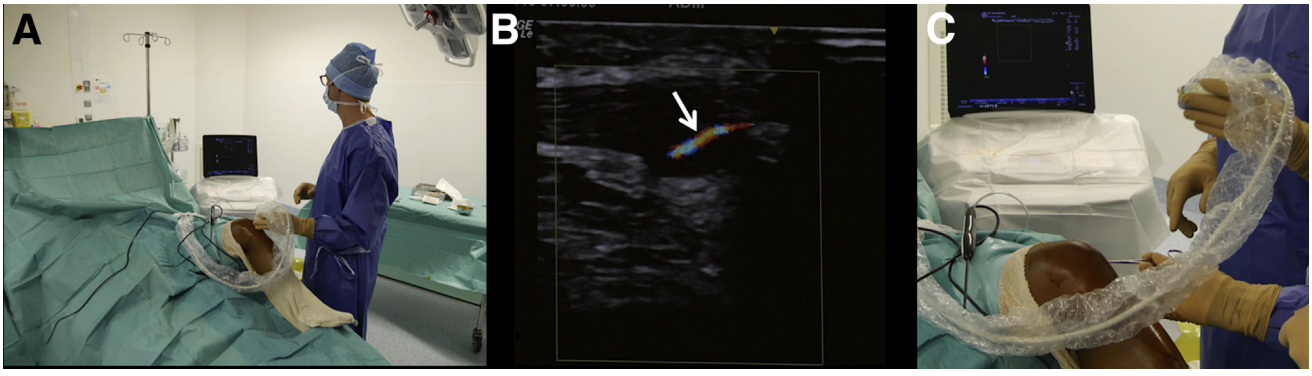

Fig 2. Left knee. (A) Preoperative ultrasound B-mode imaging is performed by the radiologist. (B) Color Doppler mode is used to identify neovascularization (arrow) in contact with the patellar tendon. (C) The neovascularization area is marked on the skin.

Table 2. Pearls and Pitfalls of Surgical Steps for Ultrasound-Guided Percutaneous Treatment of Chronic Patellar Tendinopathy

Surgical Step	Pearls	Pitfalls
Identification of patellar tendon and patella	These structures are useful anatomic landmarks.	Identification is difficult in large patients.
Identification of neovascularized zone in flexion and extension	In extension, the patellar tendon is tension free; thus, neovascularization is easy to see in Doppler mode.	Identification can sometimes be difficult at the beginning. A short learning curve is required.
Stab incision at neovascularized zone	A stab incision is made on the edge of the lesion.	
Electrocoagulation	Under ultrasound guidance, electrocoagulation of the area of neovascularization is performed.	Poor visibility during ablation may lead to tendon damage.

marked; it is usually on the medial side but sometimes can be on the lateral side (Fig 2). Table 2 describes pearls and pitfalls inherent to this step and the following steps.

Intraoperative Assessment

With the knee flexed, a small, vertical, parapatellar stab incision is performed with a No. 11 scalpel blade on the same side as and parallel to the main inflammatory zone (Fig 3). This incision must be as small as possible to prevent air infiltration and subsequent image interference and thus less accurate localization of the neovascularization area. The subcutaneous tissue is gently dissected to locate the cleavage plane between the patellar tendon and Hoffa fat pad (minimal anterior synovectomy).

A 90° bipolar radiofrequency (RF) probe (Dyonics RF System; Smith & Nephew Endoscopy, Andover, MA) is used to perform thermal sclerosing therapy. Imaging in Doppler mode is evaluated again; then, the RF probe is positioned to perform electrocoagulation of the new vessels and associated terminal nerves. Throughout the procedure, the patellar tendon is always monitored by ultrasound imaging to avoid damaging its fibers (Fig 4).

After electrocoagulation, the knee is placed in full extension and the tendon is assessed to make sure no areas of neovascularization remain (Fig 5). The incision is closed with absorbable suture, and a surgical dressing is added.

Rehabilitation

Immediate full weight bearing without a brace and progressive range-of-motion exercises are allowed. Participation in the Stanish and Curwin PT program starts after 2 weeks. Return to sport is encouraged after 3 months.

Discussion

Several techniques for the management of chronic PT have been described. Although the cause of PT has not yet been fully elucidated, immunohistochemical analyses of the tendon have shown that the nerves are in close proximity to the blood vessels and that small amounts of local anesthetic in the neovessel area temporarily cured the tendon pain.[12] These new

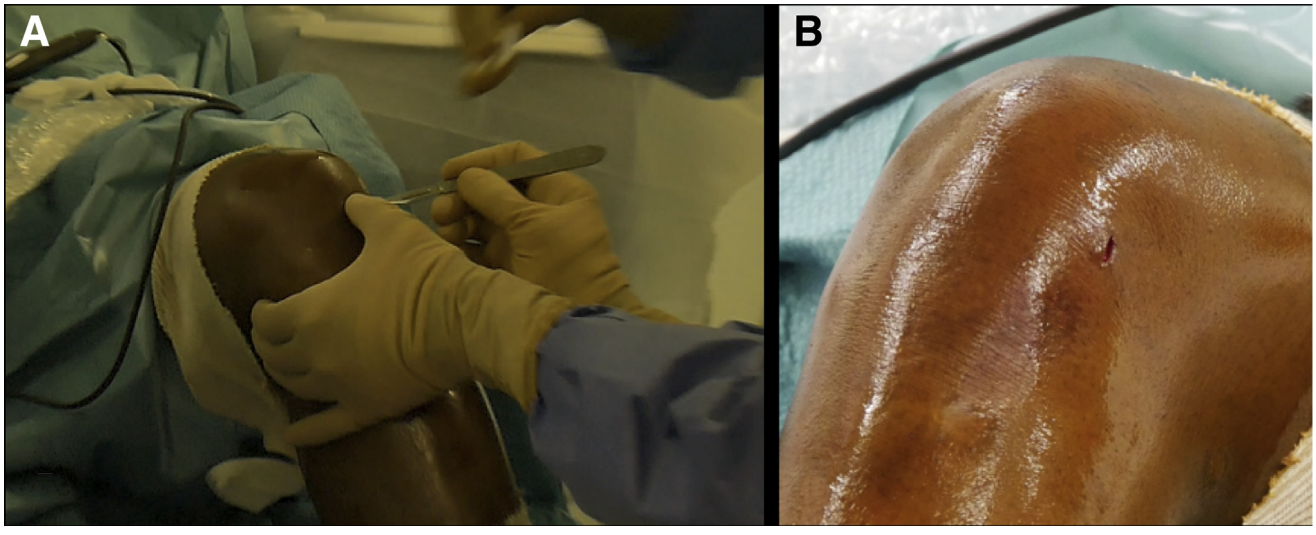

Fig 3. Left knee. (A) A stab incision is performed with a No. 11 scalpel blade. (B) The incision should be as small as possible to prevent air infiltration and subsequent image interference.

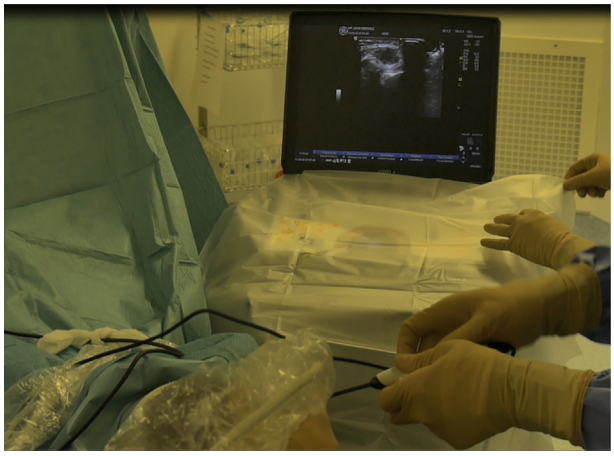

Fig 4. Left knee. Electrocoagulation of new vessels and terminal nerves under ultrasound guidance.

nerves and vessels are usually immediately posterior to the proximal insertion of the patellar tendon. In this article, we have described an ultrasound-guided percutaneous technique with Doppler support, in which electrocoagulation of this area of neovascularization is performed while sparing the patellar tendon (Video 1).

By performing electrocoagulation through a small incision (mini-open approach), the tendon is viewed by ultrasound B-mode imaging and neovascularization is easy to identify because there is no air or serum interference or need for epinephrine application. Thus, this procedure has high precision for the target area (increased vascularization) and few risks of tendon injury.

This technique is not free of risks and limitations. A learning curve is necessary to perform tendon identification with the ultrasound and color Doppler probe. Care should be taken with this technique, especially when performed by beginners, because poor visibility during ablation may lead to tendon damage. Moreover, there are insufficient long-term data to perform comparative series, and further studies are needed to compare this technique with the standard protocol. Table 3 presents advantages and disadvantages of this technique.

In conclusion, compared with other techniques, this minimally invasive and safe technique allows the procedure to be performed with very high accuracy and minimal tendon damage. We believe this procedure will have a high success rate along with an early return to activity without the risk of patellar tendon rupture.

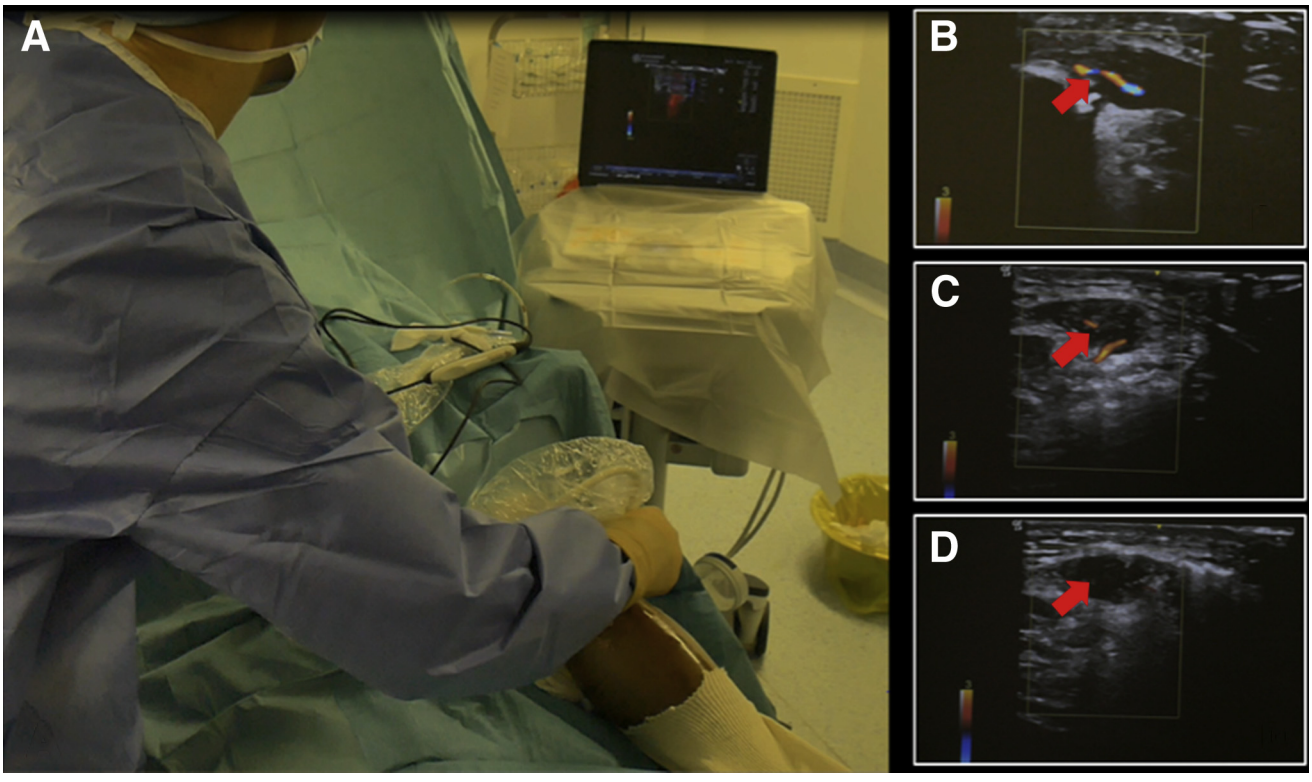

Fig 5. Left knee. (A) Evaluation to find any remaining areas of neovascularization with the knee extended. Color Doppler mode at beginning of procedure (B), during procedure (C), and end of procedure (D). The arrows highlight the neovascularization.

Table 3. Advantages and Disadvantages of Percutaneous Technique

Advantages
The technique is easy and reproducible and is not technically demanding.
A comprehensive view of proximal patellar tendon pathology is obtained.
No (or insignificant) air interference and no serum interference (good view of neovascularization) occur.
A small incision is performed, with less risk of a painful scar and neuroma; acceptable scar cosmetics; and the need for only 1 working portal.
The technique avoids the complications associated with open surgery, such as stiffness and alteration of knee joint biomechanics.
The technique is a tendon-sparing procedure, allowing a fast return to play; only the area of neovascularization or innervation that is the source of pain is removed; and the tendon does not need to regenerate or heal.
There is no adverse effect of sclerotherapy agents.
Burning of tissues reduces the risk of postoperative bleeding.
No tourniquet is used.
No immobilization is required after surgery.
Disadvantages and limitations
There is a learning curve associated with the use of ultrasound imaging.
The pathologic tissues are not viewed directly.
Care must be taken to ensure that no patellar tendon damage or skin burns occur.
Insufficient long-term data are available.

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