Ultrasound Intervention Techniques in Patellar Tendinopathy: A Review

Paul German Terán[1], Estefania Anabel Lozada[1], Juan Felipe Giraldo[2]

Abstract

Patellar tendinopathy is a very common, yet very difficult pathology to treat. Its' frequency in elite athletes, especially in jumping sports, can go as high as 14%. Recently it has been suggested that chronic tendinopathy may be an active process of ongoing tendon degeneration bearing close relation with inflammation-mediated responses, the intensity of pain in patellar tendinopathy appears to have a stronger relation with the number of newly formed blood vessels observed on Doppler ultrasound. This article is a descriptive review of the available information which was obtained during a 1-month period (September 2021) and the following search keywords were used: interventional ultrasonography; patellar ligament; tendinopathy. Based on the information obtained, a total of 787 articles were revied, mainly published in the last 10 years in Pubmed, Medline, and SciELO databases; out of these, a total of 15 articles were used as citations. Even though conservative treatment is preferred as a first-line treatment, if, during a 6-month period it fails, then surgical treatment is proposed; however, recovery time is a crucial issue for elite athletes. Treatment by ultrasound-guided interventionism is presented as an effective alternative and allows athletes to return to their regular activities in less time, with optimal results. In the literature there are not many articles that describe the various techniques of ultrasound-guided interventionism for the treatment of patellar tendinopathy, thus, we have carried out this bibliographic review.

Keywords: Interventional ultrasonography, Patellar ligament, Tendinopathy

Introduction

Patellar tendinopathy is a common yet difficult to treat condition. Patients usually describe a gradual onset and an increase in symptoms such as a dull ache in the anteroinferior region of the knee [1, 2]. The prevalence in elite athletes, mainly in jumping sports, is estimated to be up to 14% at any given time, increasing up to 22% over the course of their career, particularly in basketball and volleyball. In contrast, non-elite athletes have an estimated prevalence of 8.5% [3]. The precise etiology and cause of pain remain unclear in tendinopathies.

It had been accepted that pain cause by overuse tendinopathies has a non-inflammatory mechanism, however, a recently published work has suggested that chronic tendinopathy may be an active process of tendon degeneration with close relation with inflammation-mediated responses, among the structural findings are mucoid degeneration and angiofibroblastic neoplasia, therefore the term tendinopathy has been introduced [4, 5, 6, 7, 8].

The intensity of pain in patellar tendinopathy appears to be more related to the number of newly formed vessels that are observed during a Doppler ultrasound than to the volume of blood in those vessels [9]. In the Doppler ultrasound diagnosis, images that reveal hypoechogenicity, focal sonolucent regions (cysts), intratendinous calcification, and neovascular infiltration can be observed.

Conservative treatment is the first available option which includes eccentric physical therapy, cold therapy treatment, activity modification, and nonsteroidal anti-inflammatory drugs that could lead to several long-term side effects [4, 5].

Persistent cases can also be treated with ultrasound, shock waves, sclerosing injections, plasma-rich platelets, or percutaneous electrolysis in combination with eccentric exercises. Although conservative treatment has high success rates, in some cases, failure can lead to prolonged disability. When conservative treatment for more than 6 months has not proven successful, surgical treatment is indicated.

Approximately 10% of patients do not respond and subsequently undergo surgery, mainly due to the chronic nature of their symptoms. Arthroscopic techniques, open procedures, and percutaneous tenotomy have been described; however, recovery time is a crucial issue for elite athletes [4].

Materials and Methods

This paper is a descriptive review of the available information which was obtained during a one-month period (September 2021) and the following search keywords were used: interventional ultrasonography, patellar ligament, and tendinopathy. Based on the information obtained, a total of 787 articles were revied, mainly published in the last 10 years in Pubmed, Medline, and SciELO databases; out of these, a total of 15

[1]Traumatología y Ortopedia, Centro de Especialidades Ortopédicas, Quito, Ecuador, [2]Medicina del Deporte, Instituto Colombiano del Dolor INCODOL, Medellín, Antioquia, Colombia.

Address of Correspondence
Dr. Paul German Terán MD, Traumatología y Ortopedia, Centro de Especialidades Ortopédicas, Quito, Ecuador.
E-mail: paulteranmd@gmail.com


Dr. Paul German Terán


Dr. Estefania Anabel Lozada


Dr. Juan Felipe Giraldo

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Ultrasound-guided Patellar Tendon Debridement

Ultrasound and Doppler ultrasound-guided arthroscopic tendon debridement can be performed under general or local anesthesia. Patients are placed in a supine position with extension of the knee. Standard anteromedial and anterolateral portals, controlled pressure pump, and non-tourniquet techniques were used. A routine arthroscopic evaluation of the knee joint was performed, the procedure is guided by ultrasound in a longitudinal and transverse view. Debridement is done with a 4.5 mm full radius shaver blade, the purpose is to remove vessels and nerves adjacent to the tendinopathic tissue on the deep side of the tendon (by separating the Hoffa fat pad from the patellar tendon) [10].

This technique uses ultrasound and color Doppler to detect peritendinous regions with high blood flow, it is mainly extratendinous and differs substantially from more traditional intratendinous surgical techniques. There are several advantages in the use of an extratendinous technique, the most important been that it allows an early use of tendon's load capacity with full weight support.

In the tissue biopsies' studies of patellar tendinopathy, abnormal sensory and sympathetic neural infiltration were detected in close relation to the blood vessels in the peritendinous regions. Eliminating this abnormal neuronal growth by ultrasound-guided tendon debridement could reduce pain and allow for more aggressive rehabilitation with improved symptoms and structure. Moreover, the positive results seen with this surgery could be due to the indirect effects of mandatory rest and progressive rehabilitation that could only be achieved during the post-surgery recovery face.

Ultrasound-guided Scraping Technique

To perform this technique, a needle was used to mechanically separate the Hoffa fat pad from the surface of the posterior tendon, using a scraping movement, with the bevel directed backward pointing mainly to the region of tendinosis and neovascularization. A 20 ml sterile saline syringe can also be used using hydro dissection technique.

The procedure is considered successful when the fat pad is completely separated from the surface of the posterior tendon, which can be observed by the free flow of sterile saline and the absence of flow in Doppler images. According to Hall and Rajasekaran in an article published in 2015, they concluded that the ultrasound-guided scraping technique is better than the high-volume injection technique because it uses less volume of saline, is more effective in releasing the posterior surface of the tendon from the fat pad and does not involve the use of a corticosteroid with its potentially harmful effects on tendon healing [9].

Ultrasound-guided High-volume Injections (UGHVI)

The mechanism behind the success of this new ultrasound technique is the local mechanical effect that stretches, breaks, or occludes the new vessels and the accompanying nerve function, which is thought to mediate tendon pain [1, 11]. The procedure is performed by an aseptic technique under real-time ultrasound guidance with 10 ml of 0.5% bupivacaine mixed with 25 mg of hydrocortisone followed by 30 ml of normal saline at the interface between the tendon and the Hoffa fat pad using a 21G needle, adjacent to the neovascularization zone. The volumes were administered using 10 ml syringes one after another to maintain high pressure as quickly as allowed [12].

The knee is placed at a 90° angle for injection and the needle could easily be moved using ultrasound guidance to ensure that the areas of maximum neovascularization were in focus. After the UGHVI an eccentric rehabilitation program led by a physiotherapist should be followed, its purpose is to perform a progressive loading weight and thus reshape the tendon, promote recovery of muscle function and allow a quicker return to optimal activity [13].

In 2014 Maffulli et al. conducted a case series study on high-volume image-guided injections for patellar tendinopathy. The study comprised twenty patients with ultrasound-confirmed proximal patellar tendinopathy. For outcome measurement, prospective subjects were asked to complete an online questionnaire on the day of submission that included the Victorian Institute of Sports Assessment-Patella tendon questionnaire (VISA-P). As a result, it was found that the VISA-P score improved from 45.0 to 64.0 ($P < 0.01$) for all subjects, 37.5% of patients returned to sporting activities within 12 weeks [12, 13].

Ultrasound-guided Neovascular Electrocoagulation

It is an eco-guided percutaneous technique with Doppler support, in which electrocoagulation is performed in the neovascularization area, isolating the patellar tendon. When electrocoagulation is performed through a small incision, the tendon is visualized by ultrasound imaging and neovascularization is easy to identify since there is no interference from air or serum or need for epinephrine application. Therefore, this procedure has high accuracy and few risks of tendon injury.

To perform this procedure the patient is positioned in supine position with a lateral fixation pole just proximal to the knee, the knee is flexed at a 90° angle. Before starting the intervention, an ultrasound and color Doppler is performed with the knee in a 90° flexion angle; then the knee is extended to reduce the tension on the tendon and provide a better view of the neovascularization zone in the patellar tendon, which is usually on the medial side.

With the knee bent, a small vertical parapatellar incision is made using a #11 scalpel blade parallel to the main inflammatory area. This incision should be as small as possible to prevent air infiltration and consequent image interference. The subcutaneous tissue is gently dissected to locate the plane of division between the patellar tendon and the Hoffa fat pad. A 90° bipolar radiofrequency probe is used to perform thermal sclerosant therapy. Images in Doppler mode are evaluated again; the RF probe is then placed 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 [4].

This technique uses a less aggressive method for sclerosing thermal therapy and allows a faster return to sport activity than surgical techniques.

Ultrasound-guided Platelet Factor Infiltration Platelet-Rich Plasma (PRP)

Platelet factors are secreted by alpha granules from platelets and act locally and systemically

producing specific responses for tissue repair. The regeneration of the tendon can be achieved with the injection of autologous growth factors obtained from the blood of the patient, there is very specific evidence that indicates injections should not be made with autologous whole blood.

To perform the procedure, the affected site of the tendon must be identified by ultrasound, which will be then infiltrated, we perform a sterile preparation and then infiltrate the needle advancing into the tenosynovial space or into the tendon until it reaches the damaged area, it is important to place the needle in the same direction as the transducer to have a better control. After infiltration, resting is indicated for 24–48 h with the support of analgesic medication [14].

Ultrasound-guided Hyaluronic Acid (HA) Injections (500-730 kDa)

HA is a key molecule in several cellular activities and is normally present in the extracellular matrix of tendons and ligaments. Among its properties, HA injections can reduce pain and determine the disease-modifying effects [15]. In vitro models suggest that HA may increase tenocyte viability and collagen I production and deposition, with a positive collagen I/collagen III ratio in a dose-dependent manner. Its viscoelastic properties allow a reduction in the surface friction of the tendons increasing the sliding capacity.

To perform this technique, 2 ml of HA is injected distally into the lower pole of the patella with the needle oriented in the cranio-caudal direction at an 45° angle in relation to the Hoffa pad. In 2017 Fogli et al. conducted research to analyze the efficacy of ultrasound-guided HA (500–730 kDa) injections for patellar tendon tendinopathy. The study was conducted in 62 patients with painful tendinopathy, and they were treated with a cycle of ultrasound-guided peritendinous injections one injection per week for three consecutive weeks. In this study, it was found that pain, sagittal thickness, and neovascularization measured by Doppler, decreased significantly from the beginning [5].

Percutaneous Intratissular Electrolysis (PID) Guided by Ultrasound and Eccentric Exercise

PID is a minimally invasive ultrasound-guided technique that consists of the application of a high-intensity galvanic current through an acupuncture needle that stimulates a local inflammatory process in soft tissues, enabling phagocytosis and repair of the affected tissue [15].

Echo-guided punctures of three milliamps are performed with the ultrasound device to obtain a controlled debridement of the injured tendon, in addition, it is combined with two weekly sessions of eccentric exercise using isoinertial resistance machines consisting of 3 sets of 10 repetitions; each repetition was performed with the concentric phase with both limbs while the eccentric phase was only performed with the affected limb at a maximum of a 60° angle of knee flexion [3].

According to a study by Abat et al. The combination of intratissular percutaneous electrolysis and eccentric exercise offers excellent results in terms of clinical and functional improvement in patellar tendinopathy with low morbidity in the middle of the study period [3].

Infiltration of Corticosteroids Guided by Ultrasound

The benefits of corticosteroids are known for their anti-inflammatory and analgesic effect for a period of 6–8 weeks because they prevent the release of lysosomal enzymes, inhibiting the accumulation of inflammatory cells, especially neutrophils and synthesis of inflammatory mediators, however, it blocks the function of fibroblasts and collagen synthesis. To perform the procedure, if the tendon has a sheath, the tenosynovial space will be sought and if the tendon has paratenon it will be injected into the periphery and the substance of the tendon will never be invaded due to the risk of rupture that it originates, therefore, the tip of the needle must be constantly monitored.

An 18G–23G needle can be used, depending on the size that will be infiltrated, 5 cc syringe and betamethasone, triamcinolone, and methylprednisolone can be used. It should not be performed in hypertensive patients, diabetics, a history of peptic ulcer disease, psychotic states, women in pregnancy, and lactation [14].

Conclusions

Ultrasound-guided intervention techniques offer us various advantages in the treatment of patellar tendinopathy such as a lower cost, minimal invasion and allows athletes to return to their sports activities in less time with better results. Treatment of ultrasound-guided chronic patellar tendinopathy has been shown to have excellent results when conservative treatment has failed.

The techniques of ultrasound interventionism in patellar tendinopathy allows the elimination of abnormal neuronal growth by debridement of the tendon, which decreases pain

Clinical Relevance

According to what has been reviewed in the literature on the optimal results of ultrasound-guided treatment techniques in patellar tendinopathy, more research should be done in this field to increase the evidence and can be established with a treatment option of choice.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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