Technical Note

Myotendinous Junction Anesthesia: An Alternative Infiltration Site for Ultrasound-Guided Injections

Julio Rosales, M.D., Guillermo Droppelmann, Ph.D., Nicolás García, M.D., Anthony Saravia, M.D., Claudio Molina, M.D., and Carlos Jorquera, Ph.D.

Abstract: The myotendinous junction is a highly specialized and complex structure between muscle and tendon. In recent years, various procedures have directly targeted the tendon, with corticosteroid, platelet-rich plasma, or biological therapy infiltrations being prominent. However, these interventions are painful, corticosteroids have demonstrated tendon damage, and anesthesia negatively impacts tenocyte proliferation and viability when used with platelet-rich plasma in the same injection site. There is a need to adapt the injection site to improve therapy effectiveness and pain tolerance. This article presents a proposal for an ultrasound-guided anesthetic block procedure in the myotendinous junction.

Recently, interventional radiology has been recognized as a leading discipline in various medical specialties, and although not new, it has become an effective alternative for surgical interventions in certain cases. Interventional radiology in the musculoskeletal system is a rapidly evolving field that uses minimally invasive percutaneous procedures guided by imaging for the diagnosis and treatment of bone and soft tissue injuries.[1]

In particular, the management of multiple musculoskeletal conditions has increasingly relied on ultrasound (US)—guided interventions, aiming to enhance the precision and effectiveness of the procedures. Perineural corticosteroid infiltrations[2] are treatment options for people with biceps injuries,[3] along with the use of platelet-rich plasma (PRP) in hip osteoarthritis and stem cells in osteochondral lesions.[4] Its widespread use is mainly due to its ability to accurately identify the area of interest and ensure access to the appropriate region. Additionally, it offers greater safety, portability, lower cost, and the absence of ionizing radiation compared with other modalities.

In musculoskeletal interventions, local anesthetics are the most commonly used drugs, typically injected in combination with corticosteroids.[5] The choice of anesthetic is determined by the type of procedure and the desired outcome. Lidocaine hydrochloride 2% is the most used, with a short action (30-60 minutes) and a rapid onset (2-4 minutes) of effect. However, in tendon-related interventions, the use of local anesthesia may sometimes fail to provide complete pain relief during the procedure, as seen in some cases of calcific tendonitis in the shoulder or in US-guided fenestrations.[6] Furthermore, international reports have described the cytotoxic effects of local anesthetics on tenocytes when used in combination with PRP, leaving the effect entirely unclear.[7]

On the other hand, lateral elbow tendinopathy is one of the most prevalent musculoskeletal manifestations in the upper extremity. This condition causes significant pain and functional impairment in affected patients, with symptoms typically lasting for up to 12 months. Understanding the specific type of tendon injury is crucial for selecting the appropriate treatment and reducing recovery times. In this regard, infiltration with PRP and performing fenestration could be the procedures of choice for patients with intrasubstance tears in lateral elbow tendinopathy.[8] Both

From Clínica MEDS, Santiago, Chile (J.R., G.D., N.G., A.S.); Harvard T.H. Chan School of Public Health, Boston, Massachusetts, U.S.A. (G.D.); Facultad de Medicina, Universidad Finis Terrae, Santiago, Chile (C.M.); and Facultad de Ciencias, Escuela de Nutrición y Dietética, Universidad Mayor, Santiago, Chile (C.J.).

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Address correspondence to Guillermo Droppelmann, Ph.D., Clínica MEDS, Av. José Alcalde Délano 10581, 7691236, Lo Barnechea, Región Metropolitana, Santiago, Chile. E-mail: guillermo.droppelmann@meds.cl

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strategies are highly recommended, particularly for patients with a prolonged history of pain, pharmacologic treatments, and unsuccessful rehabilitation processes.

However, the real challenge lies not only in selecting which therapeutic strategy to use but in appropriately identifying the optimal injection zone for the local anesthetic, given the complexities of pain during the procedure and the interactions between pharmacologic products and biological therapies.

Patient Evaluation and Imaging Evaluation

Patients with lateral elbow tendinopathy who had complete medical records, specifically focusing on intrasubstance rupture tendinopathy; had been experiencing pain for more than 3 months; had not responded to pharmacologic treatment; and had undergone unsuccessful rehabilitation processes were included. Physical evaluation included assessment of active and passive elbow range of motion, pain during activities involving wrist extension or lifting weights with the hand in a prone position, and specific tests for lateral elbow tendinopathy with intrasubstance rupture tendinopathy.[9] The evaluation also included Cozen's test (resisted wrist extension) and a grip strength test.

We included patients with confirmed intrasubstance rupture in lateral elbow tendinopathy by either US or magnetic resonance imaging (MRI), with dimensions exceeding 3 mm in length, width, or depth and without contraindications to the procedure.

Myotendinous Junction Histology Evaluation

We prepared a histologic section of the myotendinous junction (MTJ) of the wrist extensor origin in cadavers to support our radiologic procedure. We used an S100 protein immunohistochemical technique to recognize and evaluate the area of interest.

Surgical Technique

Our radiologic technique is illustrated in Video 1. We use the Aplio 500 US system (Toshiba America Medical Systems), equipped with a multifrequency linear transducer, using a preferred frequency of 18 MHz. The US-guided procedures take place in a dedicated room. The provider positions the US machine directly in front of the symptomatic side of the patient.

To maintain a sterile environment before the injection, the patient is draped with aseptic towels or a medical pad. We then sterilize the patient's lateral elbow area using a chlorhexidine swab, adhering to strict aseptic techniques. After applying US gel and maintaining strict aseptic conditions, we insert the transducer into a sterile probe cover to ensure optimal hygiene.

The procedure begins with positioning the patient supine on a flat table, with the elbow in semiflexion and forearm pronation (Fig 1). Then a preprocedure scan is performed to precisely locate the common extensor tendon and MTJ (Fig 2). After identifying the target area, we mark the injection site on the skin, prepare the necessary supplies, and organize the sterile tray.

Positioning the transducer on the longitudinal axis of the common extensor tendon at the elbow facilitates easy identification of both the tendon and the MTJ (Fig 3). Using a distal-to-proximal approach, the needle is aligned in the plane with the transducer (Fig 4). The US transducer inserts a bevel-up, 23-gauge sterile needle approximately 0.5 to 1 cm deep from the skin surface.

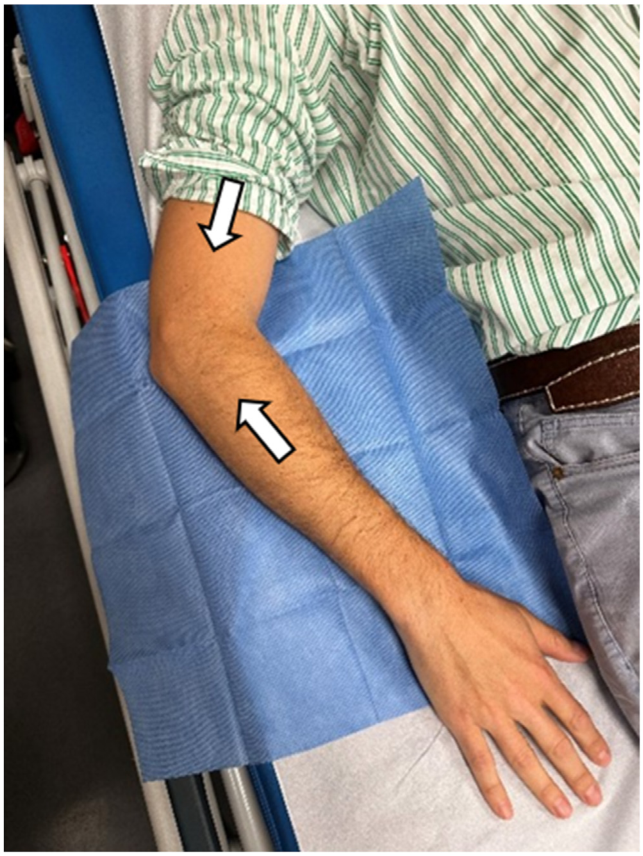

Fig 1. Position of a patient's arm during a radiologic procedure. The patient is lying on a stretcher with the right arm extended on a surface covered with a blue drape. White arrows and labels have been added to indicate specific areas of interest on the patient's arm. The upper arrow points to the mid-arm, while the lower arrow indicates a more distal region on the forearm. The patient is positioned with the elbow in semi-flexion and the forearm in pronation. The position and markings help to orient the reader to the examined areas and relevant anatomic landmarks. The patient is positioned supine, with the right arm uncovered. The elbow is in semiflexion, and the forearm is in pronation.

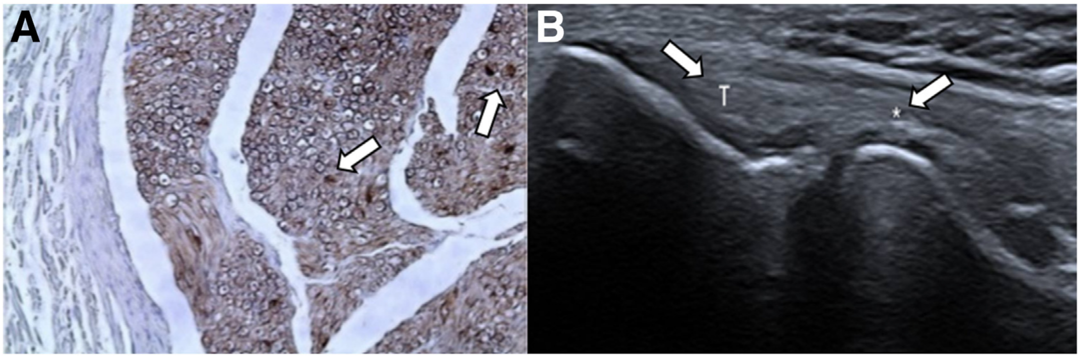

Fig 2. (A) A histological section from a cadaver. The section reveals the myotendinous junction (MTJ), highlighting small black spheres, likely indicative of free nerve endings originating from the tendon. The image demonstrates the structural details of the MTJ, with white arrows pointing to key areas where these nerve endings are located. The detailed cellular arrangement and connective tissue are visible, providing insight into the anatomic and histological features of the MTJ. (B) A long-axis ultrasound view of the common extensor tendon (T) and the myotendinous junction (*). The ultrasound image shows the tendon (labeled T) and the MTJ (marked with *), with white arrows indicating specific points of interest within these structures. This imaging technique highlights the continuity and relationship between the tendon and the muscle, emphasizing the anatomic landmarks and the areas of transition between different tissue types. The patient is positioned supine, with the right arm uncovered. The elbow is in semi-flexion, and the forearm is in pronation.

After positioning the needle correctly in the MTJ, we infiltrate a local anesthetic (2 mL of 2% lidocaine; Euro-Med Laboratories).

The procedure on the common extensor tendon (fenestrations and platelet-rich plasma [PRP] infiltration) takes place after 2 to 4 minutes. The process involves the use of a visual analog scale to measure pain.

Using a freehand technique, 1 hand holds the transducer while the other guides the needle toward the MTJ. The aim is to maintain a perpendicular angle to the US beam for clear visualization of the needle's path. Once the injection is complete, the needle can be safely removed while maintaining continuous visualization. Finally, a small bandage should be applied and the patient's mobilization resumed.

Postprocedural Care

Patients should have a partial restriction on activities involving elbow flexion and extension, as well as avoid weightlifting for at least 3 days based on each patient's tolerance. To help patients manage their pain, 1 g of paracetamol every 8 hours should be prescribed. We also inform all patients about the possibility of skin hematoma and significant pain following the procedure.

Rehabilitation

Rehabilitation protocols and conservative treatment options are well documented for conventional lateral elbow tendinopathy. However, a specific rehabilitation protocol for intrasubstance rupture in lateral elbow tendinopathy after PRP treatment is currently pending. Based on our experience, we recommend initiating rehabilitation on average after the first 4 weeks following the procedure, as patients often experience irritability in the area even before that time. We initially suggest a plan focused on managing pain, avoiding cryotherapy, and incorporating static and dynamic stretching exercises, as well as neural stretching. Subsequently, activation exercises should be introduced, with an emphasis on sports recovery and occupational activities.[10]

Discussion

We describe a radiologic musculoskeletal procedure for MTJ anesthesia with US-guided in intrasubstance rupture in lateral elbow tendinopathy using PRP intratendinous infiltration (Tables 1, 2). This therapeutic option serves as an effective alternative for patients with refractory responses to conventional treatments. Infiltration under US guidance is a widely used procedure in traumatology and orthopaedics due to its safety, cost-effectiveness, and avoidance of exposure to ionizing radiation. Moreover, it can serve as a preliminary option before surgical intervention is considered.

The origin of the extensors plays a crucial role in daily activities involving the wrist and hand. Patients with intrasubstance rupture in lateral elbow tendinopathy often experience extended periods of functional impotence and severe pain, making it essential to find effective therapeutic alternatives to improve their quality of life. Currently, physicians are increasingly recommending the PRP infiltration procedure using guided US for these patients. However, improving the precision of the area for local anesthetic injection remains a clinical challenge, raising significant concerns among specialists regarding potential interactions between pharmacologic products and biological therapies.

Fig 3. Positioning of the transducer and the needle insertion site for a distal-to-proximal approach during an ultrasound-guided procedure. In the foreground, a health care professional, wearing gloves, is holding the ultrasound transducer against the patient's arm. The transducer is placed at the mid-arm, aligned longitudinally along the limb to obtain an optimal ultrasound view of the underlying structures. The patient's arm is positioned with the elbow in semi-flexion and the forearm in pronation, similar to the setup shown in previous figures. White arrows indicate the exact location of the transducer on the arm and the intended needle insertion site. The transducer is positioned distally, with the needle insertion site proximal to the transducer placement. This setup allows for a clear ultrasound-guided view during the needle insertion procedure. The patient is positioned supine, with the right arm uncovered. The elbow is in semi-flexion, and the forearm is in pronation.

In our practice, we achieve excellent pain relief during the procedure, enabling the radiologist to complete it virtually painlessly. Pain experienced during the procedure is a significant factor that could potentially limit the outcome, as seen in conditions like calcific tendinitis in the shoulder with large inflammatory calcifications. In intrasubstance rupture in lateral elbow tendinopathy US-guided fenestrations, the procedure provides much better pain relief than direct local anesthesia. The results have been so favorable that we cannot design a case-control study because it would be unethical to subject patients to a painful procedure while an almost painless alternative exists.

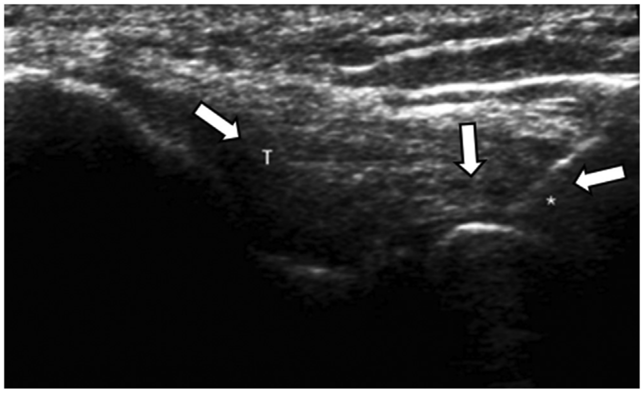

Fig 4. Long-axis ultrasound view illustrating the anatomic structures and needle placement during a radiologic procedure. In this ultrasound image, the common extensor tendon (T) is visible as a dense, fibrous structure extending longitudinally across the image. The myotendinous junction, showing the transition from muscular tissue to the tendon, is marked with an asterisk (*), indicating the site where the needle is placed. White arrows indicate specific points of interest within the image. The first arrow points to the common extensor tendon (T), providing a reference for orientation. The second arrow highlights the needle positioned at the myotendinous junction, demonstrating the precise placement needed for the procedure. The third arrow points to another aspect of the junction area, emphasizing the continuity and relationship between the tendon and the muscle. The patient is positioned supine, with the right arm uncovered. The elbow is in semi-flexion, and the forearm is in pronation.

The MTJ is a highly specialized anatomic region in the locomotor system. In this region, the tension generated by muscle fibers is transmitted from intracellular contractile proteins to extracellular connective tissue proteins (collagen fibers) in the tendon.[11] There are 4 different kinds of nerve endings in the myotendinous junction. Type I is the Ruffini corpuscle, type II is the Pacini corpuscle, type III includes Golgi tendon organs, and type IV includes free nerve endings. Each has its own structure, function, and location. Types I to III are mechanoreceptors, and they participate in movement regulation together with the central nervous system, while type IV functions as pain receptors.[12,13]

At the MTJ, there is limited research on the nerve supply. An author[13] conducted a histologic study on the sensory nerve ending system of 40 MTJs in the human palmaris longus and plantaris muscles, revealing an equal distribution of pain receptors, or free nerve endings, at both sites. Another article[14] reported that both myotendinous and nerve terminals in bone-tendon interfaces provide tendon innervation, but because MTJ anesthesia works so well in the clinic, it looks like there are more pain receptors in this area than at the bone-tendon interface. More studies are necessary to provide a detailed description because we also do not know if all tendons have the same sensory nerve ending distribution.

Table 1. Advantages and Disadvantages

Advantages	
	Cost-effective technique
	Allows a diagnostic and treatment procedure
	Symptom relief in real time
	No radiation exposure
	Outpatient procedure without hospitalization
	Without anesthetic intervention
	Precise and accurate radiologic intervention
	A short learning curve
Disadvantages	
	Local hematoma (infrequent)
	Heavily user dependent
	Need a room for radiologic procedures

Table 2. Pearls and Pitfalls

Pearls	
	Identify anatomic landmarks
	Ensure location and image quality
	Consider aseptic measures during the procedure
Pitfalls	
	Do not injectate local anesthetics near tendon tears

The MTJ anesthesia enables the administration of local anesthetics at a distance from the procedure site, thereby minimizing interaction between the pharmaceutical and pathologic tenocytes (e.g., in US-guided fenestrations for intrasubstance rupture in lateral elbow tendinopathy). Some preliminary reports have indicated cytotoxic effects on tenocytes with local anesthetics, suggesting that this procedure could mitigate potential damage. Similarly, in the early stages of stem cell use, there is an emerging concern. Numerous in vitro studies employing similar concentrations of local anesthetics in clinical settings have suggested potential cytotoxic effects on human stem cells.[15] There are a lot of problems with these in vitro trials, such as small sample sizes, different designs, and results that do not make sense in the real world. However, myotendinous junction anesthesia may be able to help by reducing contact with stem cells.

In conclusion, MTJ junction anesthesia is an US-guided technique that provides excellent pain relief during the procedure and could serve as a viable option for minimizing contact between local anesthetics and other infiltration elements. Further research is also required to evaluate the suggested method against established practices.

Disclosures

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