Case report

Cite as: Shojaie P, Botchu R, Iyengar K, Drakonaki E, Sharma GK: Ultrasound-guided median nerve hydrodissection of pronator teres syndrome: a case report and a literature review. J Ultrason 2023; 23: e165–e169. doi: 10.15557/JoU.2023.0026.

Submitted: 23.02.2023
Accepted: 28.04.2023
Published: 23.08.2023

Ultrasound-guided median nerve hydrodissection of pronator teres syndrome: a case report and a literature review

Parham Shojaie[1], Rajesh Botchu[2], Karthikeyan Iyengar[3], Elena Drakonaki[4], Gaurav Kant Sharma[5]

[1] *Medical School, Aston Medical School, Aston, United Kingdom*
[2] *Department of Musculoskeletal Radiology, Royal Orthopedic Hospital, Birmingham, United Kingdom*
[3] *Department of Orthopaedics, South Port and Ormskirk Hospital NHS Trust, Southport, United Kingdom*
[4] *Department of Anatomy, Clinical Radiologist University of Crete, Crete, Greece*
[5] *Department of Musculoskeletal Radiology, Jaipur Institute of Pain & Sports Injuries (JIPSI), Jaipur, India*

Corresponding author: Gaurav Kant Sharma; e-mail: dr.gaurav.rad@gmail.com

DOI: 10.15557/JoU.2023.0026

Keywords
ultrasonography; median neuropathy; nerve compression syndromes; nerve hydrodissection; interventional ultrasonography

Abstract

Aim of the study: To describe the sonographic appearance of pronator teres syndrome and the role of ultrasound-guided hydrodissection for its management. **Case description:** Pronator teres syndrome is a well-known compressive neuropathy of the median nerve between the two heads of pronator teres. However, the clinical presentation of this syndrome can be indolent with vague pain at the proximal volar forearm leading to a delay in diagnosis. We describe our experience in the management of pronator teres syndrome in a healthy young badminton player with ultrasound-guided median nerve hydrodissection. We highlight the clinical presentation, the role of dynamic Ultrasound scan (USS) in the diagnosis and effective treatment of pronator teres syndrome. **Conclusions:** In conclusion, managing PTS can be challenging, and this case highlights the importance of ultrasound-guided hydrodissection, when conservative measures have failed to improve the symptoms. Further studies are required to assess and compare the long-term outcomes of these interventions.

Introduction

The median nerve, originating from the brachial plexus (C6-T1 roots), contributes to a significant motor, sensory innervation, and function of the forearm, including the hand[1]. Due to its undulating, long course in the upper limb, the median nerve can get entrapped at several distinct sites, leading to many different clinical syndromes[2]. Though the commonest median nerve compression, neuropathy occurs in the carpal tunnel, its entrapment in the proximal forearm, though well known, is an underdiagnosed condition and responsible for two different entities of either pronator syndrome or anterior interosseous nerve syndrome (AINS)[3,4] (Fig. 1).

Seyffarth initially described pronator teres syndrome (PTS) as compression of the median nerve between the two heads of the pronator teres (PT) muscle in the forearm[5].

PTS is a relatively uncommon condition frequently mistaken for the more common carpal tunnel syndrome (CTS) and other upper limb neuropathies in 13-50% of cases[5,6].

PTS can be a debilitating condition that usually presents with numbness of the thumb and index finger, accompanied by weakness in the hand and vague, chronic pain in the ipsilateral forearm[5,7]. A physical examination may reveal tenderness and positive Tinel's sign over the proximal section of the PT muscle, exacerbated by resisted forearm pronation with the elbow in flexion and sometimes resisted contraction of the flexor superficialis of the middle finger[7]. Additionally, in 50% of the cases, a positive Phalen's sign over the PT muscle can be elicited at the elbow. PTS is usually a clinical diagnosis, and further investigation, including nerve conduction studies (NCS), ultrasound scan (USS), and electromyography (EMG), can help with narrowing down the differentials, leading to a more accurate diagnosis[5].

A focused history and clinical examination are required to exclude other median nerve entrapments such as CTS and AINS. CTS is the most common compression neuropathy affecting the upper limb and distinguishing these two conditions remains a challenge[8]. The distinguishing features are the involvement of the palmar cutaneous nerve in PTS, causing numbness of the thenar eminence of the palm, and the lack of nocturnal worsening of the symptoms in

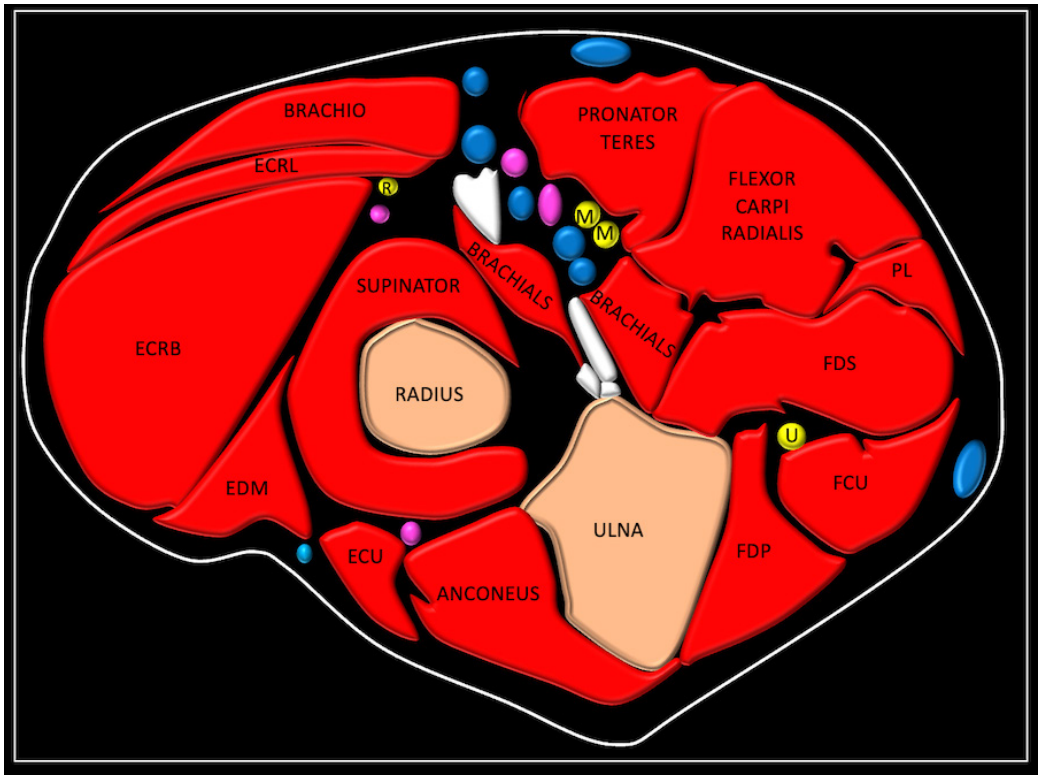

Fig. 1. *Schematic of axial image of proximal forearm. M – median nerve; BRACHIO –brachioradialis; ECRL – extensor carpi radialis longus; ECRB – extensor capri radialis brevis; EDM – extensor digiti minimi; ECU – extensor carpi ulnaris; PL – Palmaris longus; FDS – flexor digitorum superficialis; FDP – flexor digitorum profundus; FCU – flexor capri ulnaris; U – ulnar nerve*

PTS[9]. Additionally, symptoms related to arm pronation are spared in CTS[5]. The similarities and overlaps between PTS and CTS can create a diagnostic dilemma for clinicians, especially if both conditions co-exist. Another form of median nerve entrapment is the AINS, which is rare, occurring in less than 1% of patients with upper limb neuropathies[10]. AINS is a pure motor neuropathy with no sensory fibre involvement and is characterised by paralysis of the flexor digitorum profundus (FDP), the flexor pollicis longus (FPL) and the pronator quadratus (PQ) muscles, which manifests as the inability of patients to make the "OK sign"[11,12].

Ultrasonography plays a crucial role in diagnosing PTS and other upper limb neuropathies due to its low cost and availability as a dynamic modality while providing high spatial resolution. High-resolution ultrasound allows peripheral nerves to be precisely delineated. This modality plays a paramount role in guiding the interventions for pain management of peripheral nerves. Moreover, various ultrasonography techniques have been studied in the literature that can be used as a guide for managing peripheral neuropathies[13]. USS at the level of the elbow joint can allow detection of the entrapment of the median nerve between the two heads of the PT muscle[5].

Nerve conduction studies (NCS) are primarily used to differentiate PTS from other upper limb neuropathies when diagnosing this condition. For instance, despite the reduced velocity and amplitude of the median nerve in the forearm, the distal motor and sensory findings are usually normal in PTS[5].

Following the diagnosis, PTS is predominantly treated using conservative management with physical and occupational therapy. However, patients may need a surgical or endoscopic release if symptoms persist following an attempt at non-operative treatment[5]. Recently, nerve hydrodissection has been utilised as an innovative technique to treat peripheral nerve entrapments[14]. Ultrasound-guided hydrodissection is a minimally invasive technique that separates the nerves from the surrounding or adjacent structures by injecting fluid under high-resolution dynamic assessment and allows nerve decompression. The use of this approach in this patient has been supported by a study of 14 patients treated with ultrasound-guided hydrodissection for pronator teres syndrome, which reported excellent symptom relief in more than 70% of nerves at three-month follow-up review of patients[15].

Case description

A 23-year-old right-handed professional badminton player was referred to our upper limb unit with a five-year-long history of chronic left forearm pain and noticeable weakness in his hand function. He could not hold a bottle or a pen between his thumb and index finger. These symptoms developed after prolonged periods of playing badminton, particularly when the patient engaged in excessive smashing during a game. The pain was also exacerbated by lifting moderate to heavy weights and gymnastic activities. Additionally, he reported a visual analogue scale (VAS) score of 8/10 and experienced two episodes of vasovagal syncope due to the severity of pain while playing badminton. As a result, the patient has been unable to play professional badminton for the past four years. He has been otherwise fit and well, with no associated co-morbidities. He had been prescribed paracetamol and non-steroidal anti-inflammatory

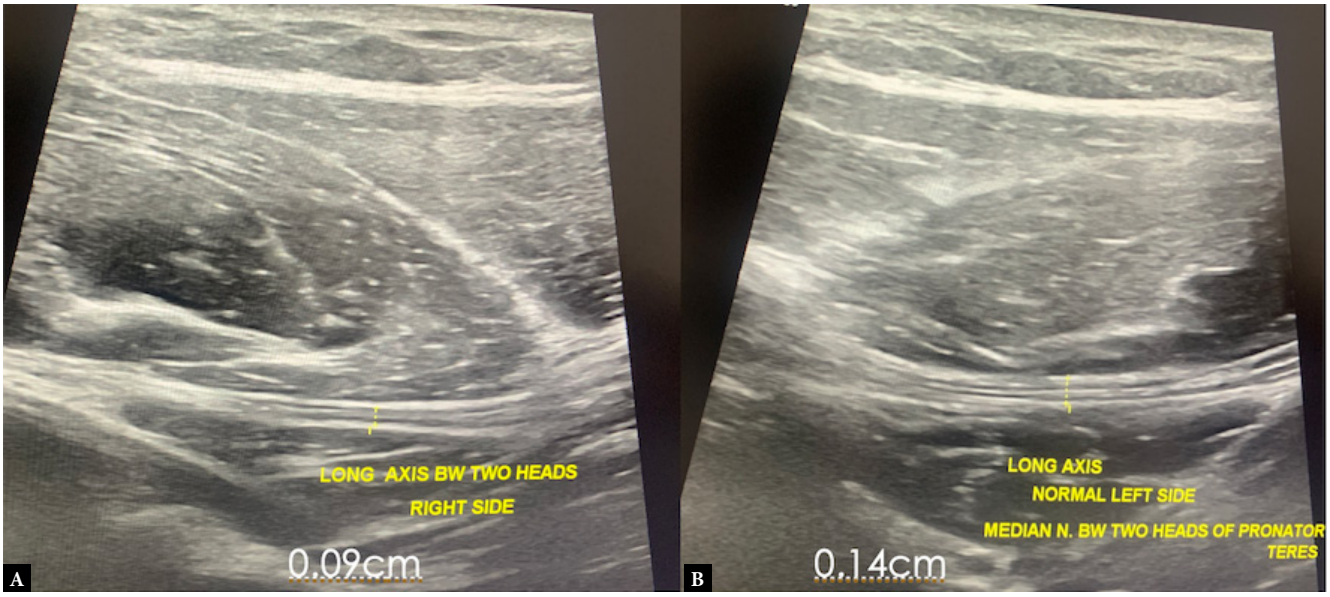

Fig. 2. *Longitudinal sonographic images showing compression of median nerve between the two heads of pronator teres on right (***A***), normal left (***B***)*

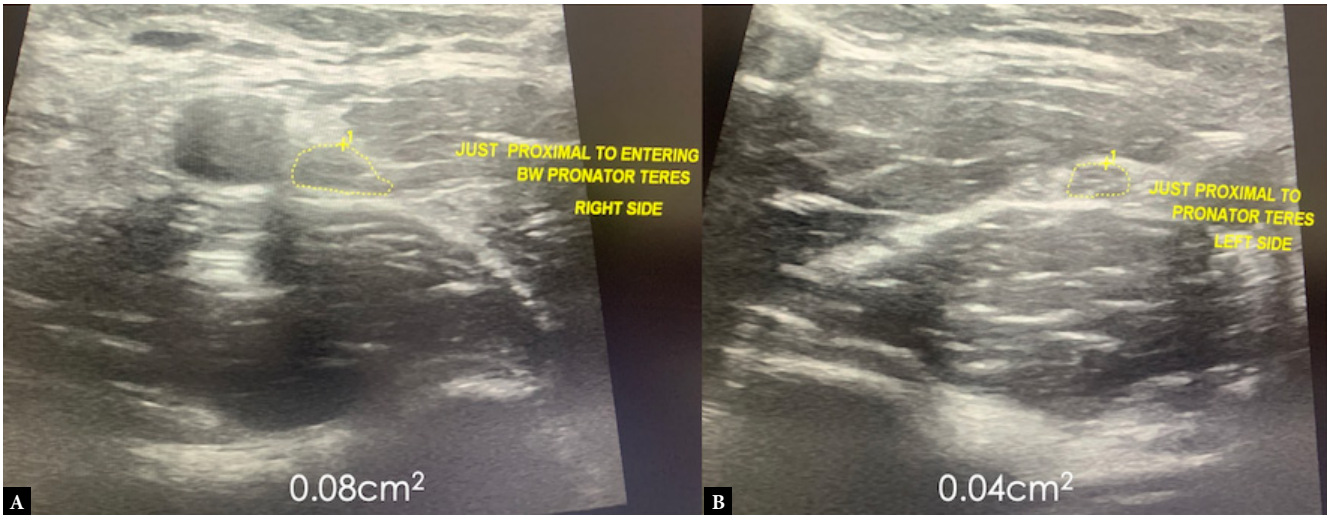

Fig. 3. *Short axis sonographic image showing increased cross sectional area of median nerve proximal to entry into pronator teres which is increased on right (***A***), normal left (***B***)*

drugs to manage his pain. He had tried intermittent physiotherapy sessions without significant relief of symptoms for a while.

Clinical Examination revealed features of PTS with pain on the anteromedial aspect of his right forearm and tingling in his radial-sided fingers. The pain was aggravated in resisted forearm pronation and flexion of the ipsilateral elbow joint. A positive Tinel's sign could be elicited at the proximal edge of the pronator teres (PT) muscle, and the test was negative at the wrist joint. The Phalen's test over the PT was equivocal. The key pinch was weak, with a discernible positive "OK" sign. A clinical diagnosis of pronator teres syndrome (PTS) was suspected.

USS revealed mild compression and narrowing of the median nerve in the affected side while traversing between the two heads of the pronator teres muscle. Moreover, the cross-sectional area of the nerve was also mildly increased just proximal to the point where it entered between the two heads of the pronator teres muscle (Fig. 2, Fig. 3). There was no increased signal on Doppler. The sonographic Tinel sign was positive on compression of the median nerve with a hockey stick probe proximal to the PT level and between the two heads of the muscle.

Since the patient was not responding to analgesics and supervised physiotherapy sessions, further options for treatment, including ultrasound-guided hydrodissection and surgery, were discussed with him. Subsequently, the patient was treated with two sessions of ultrasound-guided hydrodissection of the median nerve at the site of entrapment four weeks apart. Under ultrasound guidance, a combination of 8 mL of 5% dextrose, 3 mL of 2% lidocaine, and 1 mL of triamcinolone was used to hydro-dissect the median nerve between both the short and long-axis planes between the two heads of the PT using a 22G lumbar puncture needle (Video 1).

After the first sitting, the patient reported 50% improvement in his VAS score and ability to carry weights two weeks post-procedure. The second sitting was repeated four weeks later using the same injectate combination and volume. Telephonic follow-up was conducted every four weeks, and three months after the first procedure, the patient's VAS score dropped to 1/10. Follow-up ultrasound imaging revealed a normal size of the median nerve, both proximal and at the pronator teres level, with a negative sonographic Tinel sign.

The patient was happy to be able to return to playing professional badminton without any pain and had remained pain-free for the past seven months following a case of supervised physiotherapy and rehabilitation exercise regime after the ultrasound-guided hydrodissection treatment.

Discussion

The syndrome of pronator teres (PT) is a condition caused by entrapment of the median nerve in the forearm, which results in weakness, numbness, and pain in the forearm and hand. This condition is difficult to diagnose as it can often be mistaken for other conditions with similar symptoms.

In this patient, the development of pronator teres syndrome was likely related to his hobby of playing badminton. The repetitive and quick pronation movements involved in the sport can cause hypertrophy of the PT muscle, leading to entrapment of the median nerve[5,16].

. The patient's symptoms were exacerbated by movements related to the action of the pronator teres muscle, such as pronation actions in badminton, which resulted in further compression of the median nerve and worsening of the symptoms. This compression also reduced the patient's grip and pinch strength, affecting his ability to hold a racquet, pen or bottle[5,16].

In this case, the diagnosis of PTS was established through a combination of clinical examinations and investigations. The ultrasound revealed a mild increase in the cross-sectional area of the median nerve. Studies have established a connection between this increase and symptom severity, duration, and nerve conduction problems[5].

Patients with PTS are usually treated with a conservative approach, including rest, activity modification, and physical and occupational therapy[5]. Adding non-steroidal anti-inflammatory medications and local injections with corticosteroids or local anaesthetic helps diminish the symptoms[5]. Conservative management should generally be considered for six weeks, after which other treatment options, such as surgical management or endoscopic release, should be considered[5].

Hydrodissection has been successfully used in managing peripheral nerve entrapments, such as carpal tunnel syndrome (CTS) and radial tunnel syndrome, as well as mononeuropathies like Meralgia Paresthetica[17–19]. In this patient, the nerve was successfully treated with hydrodissection. Various regimens can be used for hydrodissection; the use of 5% dextrose in this study was supported in the literature, showing more improvement in functional status and symptom severity compared to other regimens in managing CTS[20]. A previous report by Chang *et al*. demonstrated the successful use of ultrasound-guided nerve hydrodissection in managing PTS. Even though both cases share many similarities in terms of presentation and management, there are some differences in the volume of hydrodissection fluid, location of injection, and length of treatment[21].

Cheng et al. reported the use of 10 mL instead of 8 mL 5% dextrose for hydrodissection of the median nerve. Moreover, in their study, only the long axis of the median nerve was targeted for treatment, and more than 50% improvement in strength was achieved after five sessions with two-week intervals. However, in this case, both axes of the median nerve were targeted for hydrodissection, and only two sessions were required for significant improvement of patient symptoms[21].

It is important to note that any injection around the nerve carries a potential risk of nerve damage, and excessive lidocaine injection can be toxic[14]. Removing lidocaine from the injectate solution is recommended to reduce this risk when continuous hydrodissection is considered[14].

Conclusion

In conclusion, managing PTS can be challenging, and this case highlights the importance of considering multiple treatment options, including ultrasound-guided hydrodissection, when conservative measures have failed to improve the symptoms. Further studies are required to assess and compare the long-term outcomes of these interventions.

Conflict of interest

The authors do not report any financial or personal connections with other persons or organizations which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

Author contributions

Original concept of study: PS, GKS, KI. Writing of manuscript: PS, GKS, KI, RB. Analysis and interpretation of data: PS, GKS, KI, RB. Final approval of manuscript: PS, GKS, KI. Collection, recording and/or compilation of data: PS, GKS, KI, ED. Critical review of manuscript: PS, GKS, KI, ED, RB.

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