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Case Report

Two- and Three-Dimensional Ultrasound Imaging to Facilitate Detection and Targeting of Taut Bands in Myofascial Pain Syndrome

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Abstract

Introduction. Ultrasound imaging has gained acceptance in pain management interventions. Features of myofascial pain syndrome have been explored using ultrasound imaging and elastography. There is a paucity of reports showing the benefit clinically. This report provides three-dimensional features of taut bands and highlights the advantages of using two-dimensional ultrasound imaging to improve targeting of taut bands in deeper locations.

Case Report. Fifty-eight-year-old man with pain and decreased range of motion of the right shoulder was referred for further management of pain above the scapula after having failed conservative management for myofascial pain syndrome. Three-dimensional ultrasound images provided evidence of aberrancy in the architecture of the muscle fascicles around the taut bands compared to the adjacent normal muscle tissue during serial sectioning of the accrued image. On two-dimensional ultrasound imaging over the palpated taut band, areas of hyperechogenicity were visualized in the trapezius and supraspinatus muscles. Subsequently, the patient received ultrasound-guided real-time lidocaine injections to the trigger points with successful resolution of symptoms.

Conclusions. This is a successful demonstration of utility of ultrasound imaging of taut bands in the management of myofascial pain syndrome. Utility of this imaging modality in myofascial pain syndrome requires further clinical validation.

Key Words. Myofascial; Ultrasound

Introduction

Myofascial pain syndrome is characterized by the presence of taut bands, tenderness to palpation, radiation of pain on palpation, and sometimes a twitch response of the taut bands. Patients with trigger points often have decreased range of motion of the affected area. Although there is some consensus regarding signs and symptoms relevant to the diagnosis of myofascial pain syndrome, no objective diagnostic criteria have yet been established [1]. The lack of a "gold standard" makes diagnosis of myofascial pain syndrome challenging, and also leads to difficulty in measuring severity and response to therapy [1]. Thermography, pressure algometry, elevation of inflammatory mediators, magnetic resonance elastography, endplate changes on electromyography, and sonoelastography have provided insight about myofascial pain syndrome [2–7]. However, these diagnostic tools are either nonspecific and unreliable or not applicable in routine clinical practice, and their value remains controversial.

Ultrasound imaging is a cheap, portable, noninvasive method used routinely, especially for musculoskeletal imaging, due to its clarity. Ultrasound imaging of trigger points has been reported with contradictory image characteristics due to its operator-dependent image acquisition [7,8]. No study has yet demonstrated the clinical utility of ultrasound imaging for the visualization and subsequent real-time management of visualized taut bands.

Following is a report where three-dimensional ultrasound imaging was utilized to study the features of taut bands followed by real-time injection of the trigger points using two-dimensional ultrasound image guidance.

Case Presentation

Fifty-eight-year-old man, 6′0″ tall, and weighing 112 kg, with pain and decreased range of motion of the right shoulder was referred to us for further management of his myofascial pain above the scapula. He had tried muscle relaxants, anti-inflammatory agents, and trigger point

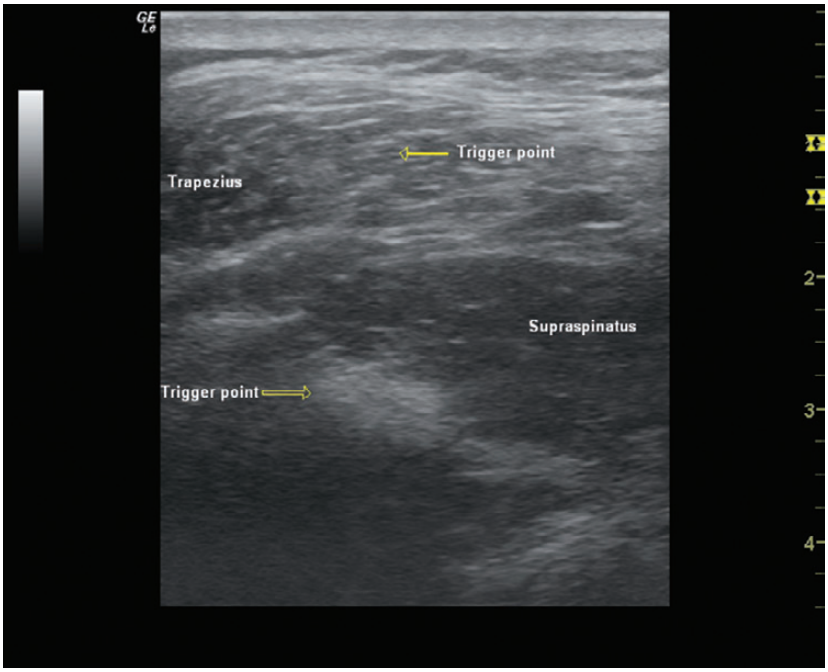

Figure 1 Ultrasound image over a taut band showing the trapezius and supraspinatus muscles with areas of hyperechogenicity corresponding to the taut bands.

injections with local anesthetic followed by incomplete pain relief. Participation in physical therapy was hindered by pain. His initial numerical rating of his pain was 7/10. On examination, he had a taut band over the trapezius, tenderness to palpation over the taut band with radiation of pain to the shoulder and cervical paraspinal area. Elevation of the arm above the head and shrugging of the shoulder was restricted due to pain. Internal and external rotation of the shoulder was normal with no tenderness over the shoulder joint. His muscle strength was 5/5 and equal bilaterally. Sensation was intact. Deep tendon reflexes were normal. His imaging studies revealed no abnormalities in his shoulder and multilevel cervical degenerative disc disease with no loss of disc height or foraminal narrowing.

As he was very muscular, we elected to use ultrasound imaging to localize the taut band. Using a linear array transducer at a frequency of 10 MHz (model 12L-RS Linear Array Transducer of LOGIQ e BT08 US machine, GE medical systems, 9900, W. Innovation Drive, RP-2139, Wauwatosa, WI-53226-4856), the area over the taut band was scanned longitudinal to the trapezius muscle fascicles as well as in transverse plane. Uniformly distributed hyperechoic dots signifying normal muscle fascicles were visualized in the transverse plane. Localized areas of hyperechogenicity having the appearance of a “cotton ball” were visualized in the trapezius and more clearly, in the supraspinatus muscles at a depth of approximately 3 cm (Figure 1). A manually swept, mechanically scanned three-dimensional imaging of the area was also performed in a longitudinal plane over the area using the same linear transducer in parallel with the muscle fascicles of the trapezius (Figure 2). The obtained image was subsequently sectioned sagittally (translation) in the ultrasound machine by the company provided software. The images were also rotated to view in all the planes. Post-imaging processing of the three-dimensional pictures provided clear features of aberrancy in the architecture of the muscle fascicles in the area of the

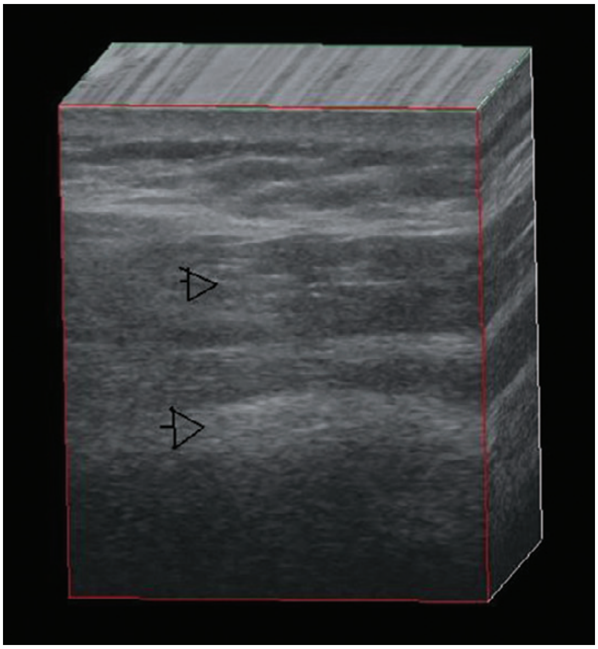

Figure 2 Three-dimensional view of the taut band showing hyperechogenicity in the trapezius and supraspinatus muscles.

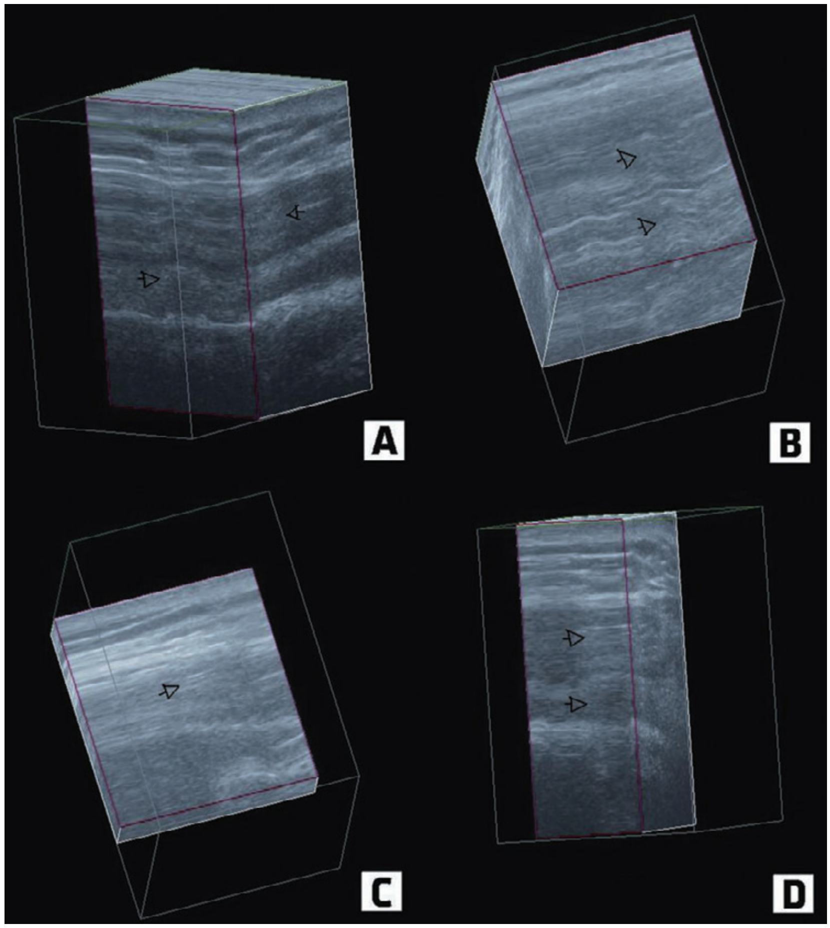

Figure 3 Post-image acquisition processing of the three-dimensional ultrasound picture by serial sectioning. A: Section at the level of taut bands showing irregularity in the fascicles corresponding to the taut bands. B: Section at the mid level of the supraspinatus taut band showing irregularity in the fascicles. The trapezius taut band is starting to form as evidenced by the slight changes in the normal straight lines of the fascicles. C: Section at the mid level of the trapezius trigger point showing irregularity in the fascicles as the normal straight lines start to become deformed. D: Section at the level of the trapezius trigger point showing irregularity in the fascicles. The supraspinatus trigger point is starting to disappear and appears hypoechoic.

taut band, as indicated by clumping together of the muscle fascicles, compared to the adjacent normal muscle tissue (Figure 3).

Subsequently, using real-time ultrasound image guidance and with an out-of-plane approach, a 25G, 5 cm needle was introduced into the taut band. 1 mL of 1% lidocaine was injected into each of the taut bands in the trapezius and supraspinatus muscles with immediate relief of pain using a total volume of 2 mL for the two injections (Figure 4). During needle insertion into the trigger points, his pain with radiation was also reproduced. Immediately following the injection, he reported >80% reduction in pain with improved range of motion. His numerical rating dropped to 2/10. He was subsequently able to participate in physical therapy, as his pain was more tolerable and was transitioned on to a home exercise program.

Discussion

This report reinforces the importance of ultrasound imaging during musculoskeletal pain clinic interventions. In our report, ultrasound imaging facilitated the detection of the additional taut band in the supraspinatus muscle. The cross-sectional two-dimensional sonographic images of normal muscles, “starry sky” appearance of white spots in a dark background, appeared to be lost in the area of taut bands. In the longitudinal axis, the normal linear fascicular pattern appeared either discontinuous, wavy or clumped at the taut band. Depending on the angle of insonation,

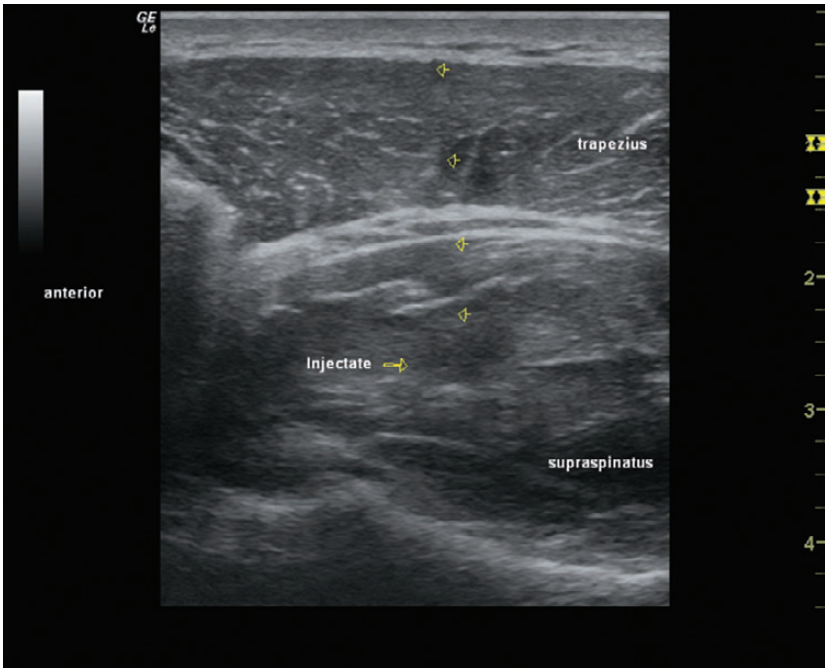

Figure 4 Ultrasound image of out-of-plane injection of local anesthetic into the supraspinatus trigger point. The arrowheads point to the needle.
Supplementary file: Video clip of out of plane injection of local anesthetic into the supraspinatus trigger point. The initial hyperechoic appearance of the taut band transitions to a hypoechoic area as the local anesthetic is being injected.

myofascial taut bands may appear as hypo- or hyperechogenic areas compared to surrounding muscle tissue [7,8].

One of the earliest reports of identification of trigger points using ultrasound imaging described it as an area of hyperechogenicity similar to our findings [8]. Prior studies had demonstrated that grayscale echogenicity and color-variance ultrasound imaging is capable of differentiating myofascial trigger points from the surrounding tissue [7]. Blood flow waveform characteristics differentiate active from latent myofascial trigger points [7]. On elastography, the color variance images demonstrate focal areas of decreased variance at the myofascial trigger points, suggesting increased stiffness [7]. These studies, despite establishing the role of ultrasound imaging in myofascial pain syndrome, may not be applicable clinically to the average practitioner as they are more in the realm of the laboratory.

Trigger points were described earlier as hypoechoic areas on three-dimensional ultrasound images [7]. A major limitation of their three-dimensional images was the use of low frequency, curved array transducer to visualize structures at a depth of only a few centimeters [7]. This impacts the resolution and hinders their interpretation. We were able to demonstrate for the first time, subtle changes in the appearance of the muscle fascicles with the use of a higher frequency, linear array transducer during three-dimensional imaging. The features of the taut band were further elucidated by serial sectioning. Hyperechogenicity is a feature of many structures due their absorption coefficient. Three-dimensional ultrasound examination provides an opportunity to explore the reasons for different echogenicities of muscle architecture, e.g., atrophy, calcification. By serial sectioning, the three-dimensional imaging provides finer interpretation of the area of lesion. The use of this technology may further aid in the diagnosis of various musculoskeletal disorders with the potential to replace the currently used magnetic resonance imaging (MRI). Real-time injectate spread may only be visualized using four-dimensional ultrasound imaging, and hence we elected to use two-dimensional imaging for the injection.

Both in-plane and out-of-plane approaches are commonly used for ultrasound-guided interventions. Proponents of the in-plane approach claim better needle visualization. Out-of-plane approach is a widely accepted technique as it offers the smallest trajectory. In addition, sonographic visualization of a small 25G needle may be challenging even with the in-plane approach. No distinct advantages in needle visualization have been demonstrated with either technique [9,10]. With both approaches, hydrolocalization and tissue movement permit identification of the needle tip prior to medication delivery.

Of the various therapeutic options available for myofascial pain syndrome, trigger point injection has become widely accepted as one of the most effective. Blind injections, besides the potential for complications, may be imprecise in targeting the taut band [11]. Ultrasound guidance enables real-time confirmation of needle placement and subsequent injection into the taut band [12]. It may be possible that, the prior blind trigger point injection, in our patient, may not have reached the supraspinatus muscle target as it was approximately 2.5 cm deep, which was deeper than the documented needle length. Documentation of the injected muscle, a requirement for billing, is also likely to be more precise with the clarity of ultrasound in musculoskeletal imaging.

Conclusion

This is a successful demonstration of the use of both two-dimensional and three-dimensional ultrasound imaging of taut bands in the management of myofascial pain syndrome. Routine use of ultrasound guidance for myofascial pain syndrome has the potential to diagnose and provide guidance during trigger point injections. Utility of this imaging modality in myofascial pain syndrome requires further clinical validation due to its individual, operator-dependent, technical differences.

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