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A Tale of Two Shoulders: Comparative Outcomes of Coracohumeral Ligament Release With and Without Percutaneous Peripheral Nerve Stimulation in Adhesive Capsulitis

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Background: When traditional treatments for adhesive capsulitis (AC) fail, new modalities, such as percutaneous tenotomy of the coracohumeral ligament (CHL), can provide meaningful relief and improved function. However, it remains unclear which patients will benefit, and which will continue to experience pain.

Case Report: A 59-year-old woman experienced significant pain relief and improved function after CHL release via Tenex® (Tenex Health, Lake Forest, CA) for AC of the right shoulder. Two years later, she developed AC in the left shoulder and underwent the same Tenex procedure. However, this time, her symptoms did not improve. She then received percutaneous peripheral nerve stimulation (PNS) targeting the left axillary and suprascapular nerves using the SPRINT system (SPR Therapeutics, Cleveland, OH), leading to durable pain relief and improved function at a 12-month follow-up.

Conclusions: Our case highlights the evolving treatment landscape of AC and underscores the need for further research into the optimal roles of Tenex and PNS in its management.

Key words: Adhesive capsulitis, percutaneous tenotomy, Tenex, neuromodulation, SPRINT

BACKGROUND

Typically, adhesive capsulitis, or AC, is treated non-operatively using a stepwise progression of therapy, medication, or corticosteroid injections. Patients who do not respond to conservative management often receive surgical intervention, such as arthroscopic release or manipulation under anesthesia to achieve relief (1). However, patients with AC frequently have additional comorbidities, such as diabetes, hyperlipidemia, and obesity, which may prevent them from being ideal surgical candidates (2-5).

Recent studies have begun to emerge establishing the use of percutaneous coracohumeral ligament (CHL) release via Tenex® (Tenex Health, Lake Forest, CA) in patients with refractory AC, providing them with improvements in pain, range of motion (ROM), and function without resorting to invasive procedures. As clinical adoption of this technique increases, variability in outcomes—especially when comparing different shoulders within the same patient—may offer insight into the limits of CHL-targeted approaches and the potential value of multimodal treatment. Our case follows a patient who underwent bilateral CHL release for AC and experienced improvement of her pain in one shoulder, but not the other, requiring incorporation of adjunctive treatment modalities for pain.

CASE PRESENTATION

The patient is a 59-year-old woman with a past

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medical history of systemic scleroderma and diabetes who originally presented for chronic right shoulder pain secondary to AC. She had undergone conservative management with physical therapy, nonsteroidal anti-inflammatory medications, and multiple steroid injections, all of which failed to provide her significant pain relief or improve her function.

The patient underwent a right CHL release using Tenex, through which she achieved 80% symptom relief and improved ROM. She was able to resume her activities of daily living and home exercises without interference. Four years later, her right shoulder continued to demonstrate durable benefit, maintaining external rotation of 75° and abduction of 110°.

Two years after the initial procedure, the patient began to experience similar symptoms in her left shoulder. She reported decreased ROM and pain consistent with her prior presentation. At the time of evaluation, her left shoulder demonstrated restricted external rotation to 25° and abduction to 60°. Due to the success of her prior procedure, the patient requested a second CHL release on her left shoulder. After undergoing the procedure, she did experience increased ROM, but pain relief remained limited in the weeks that followed.

A magnetic resonance imaging (MRI) of the left shoulder revealed tendinopathy of the rotator cuff and long head of the biceps, labral degeneration, and acromioclavicular degenerative disease. After engaging in shared decision making, the patient gave consent to undergo SPRINT peripheral nerve stimulation (PNS) therapy (SPR Therapeutics, Cleveland, OH) for the axillary and suprascapular nerves, to be performed 2 weeks apart, respectively.

Both procedures were performed using sterile technique and ultrasound guidance. Test stimulation was used to identify the optimal lead location, with the probe advanced to a depth of approximately 3 cm—about 1 cm proximal to standard needle insertion depth. The amplitude was adjusted to produce visible and comfortable muscle tension in a region overlapping the patient's typical pain distribution. Once the ideal stimulation site was confirmed, a percutaneous lead was inserted through the introducer sleeve to the same depth and secured. The proximal end of the lead was attached to a lead connector and external pulse generator, and the stimulation response was verified again. The introducer was removed, excess lead trimmed, and the external portion of the lead coiled and secured to allow for strain relief. The wearable stimulator was positioned on the lateral arm just below the lead exit site. Final stimulation confirmed optimal lead placement and coverage.

Following treatment, the pain in her left shoulder improved by approximately 70%, allowing her to utilize her left arm for activities of daily living and participate in therapy. Her relief persisted over multiple subsequent outpatient visits, even after lead removal at 60 days. At her most recent follow-up—approximately one year after her left axillary and suprascapular SPRINT treatment—the patient reported pain in both shoulders was no more than 3 out of 10 on the numeric rating scale, with no difficulty performing daily tasks.

DISCUSSION

The introduction of ultrasound-guided CHL release via Tenex represents an expansion of the treatment algorithm for refractory AC. The CHL is frequently cited as a prominent contributor to the pain and limited ROM that patients with AC experience. Prior studies (6-8) have found that a thickened CHL on MRI is highly specific for AC, and that increased thickness is positively associated with further ROM restrictions. Patients with refractory AC who receive CHL release have been shown to achieve long-lasting pain relief and ROM in multiple studies (9-11). While this procedure can be performed with a scalpel under ultrasound guidance, the use of Tenex eliminates the need for blades, which are poorly visualized under ultrasound, reducing the risk of damaging adjacent structures, such as the axillary artery. The improvement our patient experienced in her AC of the right shoulder following CHL release via Tenex, even 4 years later, further highlights the technique's effectiveness.

In cases where CHL release fails to fully address pain, adjunctive therapies may offer additional benefit. One such option is percutaneous PNS. Percutaneous PNS is a new form of neuromodulation that has been shown to provide effective and durable pain relief in a wide range of conditions (12,13). It differs from contemporary PNS, which initiates treatment with a 7-day trial of a temporary stimulator, followed by placement of a permanent stimulator if the patient responds. Percutaneous PNS, however, involves placing a thin wire lead adjacent to the target nerve for up to 60 days. Patients then undergo lead removal, but often continue to experience relief for months despite its absence.

The mechanism for this continued pain relief is not yet fully understood. In Pritzlaff et al (12), Latremoliere

et al (14), and Deer et al (15), it is hypothesized that the proximity of open coil percutaneous PNS systems to target nerves drives a "reconditioning process" that opposes the central sensitization that often occurs in patients with chronic pain.

Deer et al (15) go into further detail, describing how the open coil design of percutaneous PNS leads allows for the generation of larger and more homogenous electric fields compared to conventional PNS leads. This increased range and control allow for the activation of a greater number of afferent Aα/β fibers, without simultaneously activating nearby Aδ/C fibers. By activating afferent Aα/β fibers, PNS systems reduce nociceptive signaling via a variety of mechanisms, including inhibition of wide dynamic range neurons and activation of inhibitory γ-aminobutyric acid-synthesizing neurons within the dorsal horn of the spine.

Percutaneous PNS is theorized to be able to maintain this effect following lead removal by initiating reorganization of the primary somatosensory cortex. Persistent and robust afferent signals, triggered by the wire lead, lead to expansion of the nonnociceptive zone within the somatosensory cortex, while reducing the size of the region responsible for perceiving pain. Deer et al (15) termed this phenomenon the "new theory of Peripherally Induced Reconditioning of the Central Nervous System." This theory would explain why our patient experienced continued pain relief even a year after treatment.

The improvement our patient experienced with SPRINT therapy is consistent with the findings of other studies that suggest that percutaneous PNS is effective for shoulder pain of various etiologies (12,16,17). However, no large-scale studies have yet evaluated its role in AC specifically.

AC is rarely a patient's sole shoulder pathology, and often coexists with other conditions, including rotator cuff tears, acromioclavicular or glenohumeral arthritis, and tendinopathy (18). In our patient, MRI of her shoulders revealed tendinosis of the supraspinatus on the right, as well as tendinosis of the supraspinatus, infraspinatus, and biceps tendons on the left. Her left shoulder was also found to have labral degeneration, AC joint arthrosis, and fibrocystic changes to the humeral head.

These findings suggest that CHL fibrosis may have been the primary driver of right shoulder pain, whereas multiple overlapping pain generators likely contributed to persistent symptoms in the left shoulder. While CHL release has been demonstrated to be effective for AC, the pain relief it provides may be enhanced by the addition of SPRINT therapy, allowing for the targeting of multiple pain generators simultaneously. This enhancement could explain the difference in outcome between this patient's left and right shoulders.

Importantly, this report reflects a single patient's experience and must be interpreted cautiously. Broader generalizability remains limited, and careful patient selection is critical when considering PNS as an adjunctive strategy.

CONCLUSIONS

Larger randomized controlled trials are still needed to determine whether a statistically significant difference exists between the CHL release alone and the CHL release combined with SPRINT therapy in patients with refractory AC. If combination therapy proves superior, this may offer a minimally invasive treatment pathway for patients with AC and overlapping shoulder pathology.

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