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General

Peripheral Nerve Stimulation for Chronic Shoulder Pain Due to Rotator Cuff Pathology

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Chronic shoulder pain affects millions of patients each year. Various conditions can result in shoulder pain ranging from rotator cuff injury, subacromial impingement, post-surgical pain, bursitis, adhesive capsulitis, and osteoarthritis. Typically, rotator cuff pathology is diagnosed by physical exam maneuvers along with advanced imaging modalities. Initial treatment for rotator cuff injury typically consists of physical therapy, NSAIDs, and possible injections depending on the extent of the injury. If conservative measures fail or the injury is too substantial, surgery is typically the appropriate treatment for healthy patients. For patients who are not surgical candidates or refuse surgery, peripheral nerve stimulation (PNS) can be considered. With the use of PNS, the suprascapular and axillary nerves can be targeted to provide pain relief for a variety of chronic shoulder pain issues. We describe the use of PNS in 2 patients with significant rotator cuff pathology who were not surgical candidates.

INTRODUCTION

Chronic shoulder pain affects millions of patients each year. A recent study has reported that the annual incidence of shoulder pain is 14.7 per 1000 patients with a lifetime prevalence of 70%.[1,2] Various conditions can result in shoulder pain ranging from rotator cuff injury, subacromial impingement, post-surgical pain, bursitis, adhesive capsulitis, and osteoarthritis.[3] Chronic shoulder pain is defined as pain lasting greater than 6 months from the above conditions.

The evaluation of shoulder pain consists of a thorough physical examination to evaluate the origin of the shoulder pain. Various physical examination tests such as Apley Scratch test, Neer's test, and Hawkins test can evaluate the origin of the shoulder pain and differentiate rotator cuff injuries from other causes of shoulder pain.[4] Additionally, imaging modalities can assist in the diagnosis of shoulder pain. Magnetic Resonance Imaging (MRI) of the shoulder typically has a 95% sensitivity and specificity in the detection of rotator cuff tears and tendonitis.[5] Other modalities such as MRI arthrography can be used to detect full-thickness rotator cuff tears and labrum tears. Though they have less utility, CT imaging and ultrasonography can also aid in the detection of dislocations, rotator cuff injuries, and signs of adhesive capsulitis.[5]

Conservative treatment measures for shoulder pain are based on the diagnosis. Initial treatment for rotator cuff injury and subacromial bursitis can consist of physical therapy, NSAIDs, and injection therapy with local anesthetic and a steroid if indicated.[6] If conservative measures fail, further interventional methods can be considered. Recent research has shown the use of peripheral nerve stimulation (PNS) for the treatment of a variety of pain conditions. PNS uses electrical currents to target specific nerves and the first use of this treatment was described in the late 1960s.[7,8] With the use of PNS, the suprascapular and axillary nerves can be targeted to provide pain relief for a variety of chronic shoulder pain issues. The suprascapular nerve is a branch of the upper trunk of the brachial plexus (C5-C6) and innervates the supraspinatus and infraspinatus muscles and provides sensation to the acromioclavicular and glenohumeral joints while the axillary nerve is a branch also originates from the upper trunk of brachial plexus and innervates the deltoid muscle and provides sensation in the axilla.[9]

Here we describe our experience utilizing a temporary 60-day PNS system. (SPRINT PNS System [SPR Therapeutics, Inc., Cleveland, Ohio]). We report our experience utilizing the SPRINT PNS system and our outcomes in treating two patients with rotator cuff pathology.

CASE PRESENTATIONS

Both patients had chronic shoulder pain for greater than 1 year and had MRI evidence of rotator cuff pathology. The patients were both evaluated by a surgical specialist and had declined surgical intervention or were deemed not to be a suitable surgical candidate. Both patients had tried and failed conservative therapy including physical therapy, shoulder injections and medication management. Both pa-

	Patient 1	Patient 2
Pathology	Full thickness rotator cuff tear	Partial thickness rotator cuff tear
PNS Targets	Suprascapular and axillary nerves	Suprascapular and axillary nerves
Percent Relief During Therapy	100%	80%
Percent Relief 3-Months After PNS Lead Removal	90%	80%
Reduction in Opioids	75%	50%

tients were consented and underwent ultrasound placement of a SPRINT PNS lead targeting the suprascapular nerve in the suprascapular notch. A second lead was also placed for each patient targeting the axillary nerve within the deltoid muscle below the acromion process at the axillary nerve motor points. Contraction of the deltoid muscle confirmed appropriate placement.

PATIENT 1

The first patient was a 75-year-old male with a history of a full thickness rotator cuff tear and chronic pain for greater than 2 years. The patient had had completed physical therapy with minimal benefit. He had tried 3 rounds of shoulder injections with short term relief. He also had tried conservative medication management and was utilizing opioids for pain control at 20 morphine milligram equivalents (MME). He opted to proceed with PNS treatment targeting the suprascapular and axillary nerves for his chronic shoulder pain. The patient reported 100% relief of his pain complaints during the 60-day treatment phase and drastically reduced his medication regimen. He continues to endorse 90% relief of his shoulder pain complaints 3 months after PNS lead removal and has reduced his medication usage to 5 MME.

PATIENT 2

The second patient was a 53-year-old male with a history of a partial thickness cuff tear and chronic pain for greater than 1 year. He had completed physical therapy with minimal benefit. He had tried shoulder injections with short term relief. He also tried conservative medication management and was utilizing opioid for pain control at 30 MME. He ultimately underwent PNS targeting the suprascapular and axillary nerves for his chronic shoulder pain. The patient reported 80% relief of his pain complaints during the 60-day treatment phase and reduced his medication regimen. He continues to endorse 80% relief of his shoulder pain complaints 3 months after PNS lead removal and has reduced his medication usage to 15 MME.

DISCUSSION

In recent years, various research studies and have been reported on the use of PNS for chronic shoulder pain. Studies by Yu et. al and Chae et. al demonstrated significant improvement in hemiplegic shoulder pain and shoulder subluxation pain following temporary PNS placement.[10,11] Additional studies have also been published more recently further supporting the use of PNS for hemiplegic shoulder pain complaints.[12,13]

In addition to hemiplegic shoulder pain, further studies have also demonstrated benefit with the use of PNS for subacromial impingement syndrome.[14] In a publication by Wilson et. al, the use of PNS for patients with refractory pain from subacromial impingement was evaluated. In the study, adults with shoulder pain for over 6-months and a diagnosis of subacromial impingement were recruited to the study. 3-weeks of treatment with PNS to the axillary nerve was conducted and patients were followed for 12-weeks. Results showed that the ten subjects recruited reported significant reductions in pain when compared to baseline and improvements in the Disabilities of the Arm Shoulder Hand questionnaire and improvement in shoulder abduction range of motion.[14]

Another study by Mansfield et. al further evaluated the use of PNS of axillary peripheral nerves on pain reduction in chronic shoulder pain. In the study, patients had shoulder pain greater than 6 months from a range of conditions such as subacromial impingement, rotator cuff injury, glenohumeral arthritis, and biceps tendinopathy.[15] In the study, eight patients who did not respond to conservative measures and did not qualify for surgical intervention were recruited. In the study, the primary outcome measured was the percent in pain reduction on the NPRS scale and secondary outcome measures included opioid consumption and patient satisfaction. Results showed that seven out of the eight patients reported a greater than 50% in pain reduction and all eight patients reported decreased opioid use after PNS, and a 100% satisfaction rate.[15]

A case report by Mehech et. al discussed the use of PNS for shoulder pain in a patient after spinal cord injury (SCI), one of the few reported cases of the use of PNS for such a case in literature.[16] The patient had a C4 ASIA D spinal cord injury secondary to a gunshot wound. This patient underwent PNS placement and in addition to pain was evaluated for quality of life (SF-36) improvement and Patient Global Impression of Change (PGIC) after implantation with the patients reporting adequate pain relief and overall improvement of QoL post implantation.

In addition to chronic shoulder pain, PNS has been demonstrated to help with acute post-surgical pain as well as chronic pain after orthopedic surgeries.[17–20] Additionally, there is some growing evidence to support the use of PNS as a non-opioid therapy to assist in the treatment of

chronic axial back pain as well as other neuropathic pain conditions.[20–22] Studies on the use of PNS for chronic pain conditions continue to demonstrate that peripheral nerve stimulation can lead to significant improvement in pain and quality-of-life measures and a reduction in the use of opioids.

CONCLUSION

Neuromodulation and peripheral nerve stimulation is a powerful therapy with expanding indications. PNS has been shown to be an effective therapy for a variety of acute and chronic pain conditions. PNS may benefit patients with chronic shoulder pain due to rotator cuff pathology that is not responsive to more conservative measures. The SPRINT device is temporarily implanted for 60 days and then removed after the duration of treatment. The system can provide sustained pain relief, even after removal, likely due to modulation of central sensitization and can modulate the perception of pain, allowing for prolonged pain relief. This therapy is safe, minimally invasive, and completely reversible.

Our cases demonstrate the utility of PNS for the treatment of chronic shoulder pain related to rotator cuff pathology and adds to the growing literature supporting the utility of PNS for chronic shoulder pain complaints. However, further studies are needed to evaluate the long-term outcomes of these patients as most information on PNS is based on short term outcomes.

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