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Original Research Article

Adhesive Capsulitis Motor and Sensory Stimulation during Radiofrequency Treatment

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Abstract

Background: Adhesive Capsulitis is a frequent issue that can cause serious impairment. There have been many different treatments explored, with encouraging outcomes, but the effectiveness of these interventions is not well supported by the available data. Anecdotally, pulsed radiofrequency (PRF) to the suprascapular nerve (SSN) has been described as a safe and effective procedure. In addition to the PRF SSN, this study provides evidence of therapeutic motor and sensory stimulation. ***Methods:*** 110 patients with adhesive capsulitis underwent percutaneous PRF to the SSN under ultrasound guidance, and the results were prospectively evaluated. Patients were split into two groups. The SSN was demonstrated by the first group (60) in the suprascapular region. A second group of 50 people used a radio frequency equipment to apply motor and sensory stimulation (MSS) cycles to the proximal SSN in the supraclavicular area in addition to the PRF. At 2, 8, and 12 weeks, respectively, the pain was monitored using the Visual Analog Scale and active range of motion (AROM) in the shoulder. ***Results:*** Patients in both groups reported significantly substantial reductions in pain scores and improved movement all-time points as compared to pre-procedure scores ($P<0.001$). Supraclavicular pRF with stimulation significantly reduced pain scores and improved shoulder motions at 2 and 4 weeks compared to suprascapular PRF with stimulation ($p<0.05$). Regarded 12-month follow-up group showed a substantial improvement in shoulder motions ($p<0.05$), but there was no discernible difference in pain level. ***Conclusion*** Proximal PRF SSN with MSS demonstrated encouraging outcomes for early pain relief and enhancement of shoulder functioning. There are financial advantages. Without the need for hospitalization or extended physical therapy sessions, return to work sooner. However, the sample size was too tiny to allow for any significant interpretation.

Keyword: PRF, SSN, Shoulder pain, Suprascapular PRF, Supraclavicular PRF.

INTRODUCTION

Adhesive capsulitis is a disorder that develops in the shoulder as a result of swelling and scar tissue production. Active and passive glenohumeral mobility in all planes are restricted, and there is a sudden onset of gradually worsening shoulder paint (Vecchio *et al.*,1993, Dahan *et al.*, 2000) As the pain and inflammation increase, the soft and connective tissues of the shoulder become edematous and inflexible, and fibrous adhesions form, severely limiting the joint's range of motion. If this problem is left untreated, it may lead to severe pain, functional impairment, adhesive capsulitis, or frozen shoulder. The last term firstly mention by Codman 1934 (Codman E.A. 1934).

The common goals of the numerous approaches used to treat adhesive capsulitis are to relieve discomfort and return normal shoulder function. Rest, NSAIDs, active and passive mobilization, physiotherapy, intra-articular corticosteroids, intra-articular hyaluronate injection, SSN block, manipulation under anesthesia when conservative treatment fails, and ultimately arthroscopic capsular release are some of the treatments that have been tried (Fernandes 2014, Favejee *et al.*, 2011, Lorbach *et al.*, 2010). Although an SSN block can provide quick pain relief, its limited duration of effect prevents it from being used as a treatment (Williams *et al.*, 1995, Iqbal *et al.*, 2012). Neurolysis or neurectomy can reduce discomfort for longer periods of time; however these procedures may paralyze the muscles in the supraspinatus and infraspinatus permanently (Eljabu *et al*., 2016, Jeon *et al*., 2014, Pitombo *et al.,* 2013). Due to its prolonged duration of action and absence of harm to the targeted and surrounding tissue, pulsed radiofrequency (pRF) therapy has gained popularity in the treatment of persistent shoulder pain, which lowers the risk of neurological injury and neuritis (Rohof 2002), Munglani (1999), Ozsoylar *et al.,* 2008).There are limited studies mention PRF approach to the SSN either in suprascapular fossa or proximal supraclavicular. Siegenthaler *et al*., 2012, prefer the latest approach as the nerve is pretty superficial and frequently visualized by the US (Siegenthaler *et al*., 2012). To our knowledge no study regarding the efficacy of percutaneous PRF with MSS to the SSN had been published.

METHODS AND MATERIALS

All ultrasound guided UG percutaneous radiofrequency suprascapular nerve procedures performed at the Alsadr teaching hospital between September 2016 and July 2019 were prospectively analyzed 110 patients with adhesive capsulitis. The patient divided into 2 groups, Suprascapular PRF (SSpRF) group, 60 patients and supraclavicular PRF (SCpRF) group, 50 patients. Both of them had PRF to the SSN.

Informed Consent and Initial Interview

The Declaration of Helsinki's ethical guidelines for conducting biomedical research on human participants and generally accepted rules governing informed consent were followed in the conduct of this study. The investigators received Institutional Review Board approval before starting the trial.

Patients' mobility and pain were evaluated using the Visual Analog Scale (VAS) score. The Shoulder Pain and Disability Index (SPADI) questionnaire was used to evaluate the shoulder joint's function, and a goniometer was used to quantify the joint's active range of motion (AROM). Clinical history, physical examination, and magnetic resonance imaging (MRI) analysis are used to identify adhesive capsulitis in patients over the age of 18. The study's patient selection and findings were assessed by physical therapists at Jafar Al-Tayar, a facility for both physical and psychological rehabilitation. Additionally, despite taking nonsteroidal anti-inflammatory drugs for three months and receiving physical therapy, the patients had to have a minimum Visual Analog Scale (VAS) score of 4 and a minimum Shoulder Pain and Disability Index (SPADI) score of 60. Patients who had undergone surgery on the same shoulder, had persistent pain from another illness, had a history of allergies to local anesthesia, had abnormal coagulation tests, had cardiac pacemakers, or who had neuropathic pain from a cervical disc problem were excluded. The procedures start after appropriate skin disinfection, with UG (M5 Color Diagnostic Ultrasound System; Sonosite, USA) using 4–12-MHz linear transducer, a 10 cm long, 22 G needle SMK-10 mm tip (Cotop International BV, Amsterdam, the Netherlands) to the SSN using RF generator, Boston Scientific G4™ RF Generator. In SSpRF the patient was in a sitting position the PRF needle was pushed forward towards the floor of the supraspinous fossa using an in-plane approach. While in SCPRF the patient in supine position had applied PRF to the SSN at interscalenic muscle in the Suprascalvicular region.

For both groups initial stimulation test with:

1- Motor stimulation (Frequency; 2Hz, Pulse width; 1ms, Voltage; up to 1V).

This should cause muscle twitches, which were seen in synchrony with the stimulation (shoulder external rotation and/or abduction).

2- Sensory stimulation (Frequency 50 Hz, Pulse width 1ms, Voltage up to 5V).

After testing stimulation PRF had applied with 2 cycles at 42 °C, 45 V, 2 Hz, and 20 ms, with a wide wave for 180 s. For SCpRF group, we adding motor stimulation 2-3 minutes 1V, 2Hz, and 1ms follow by intermittent sensory stimulation for one min. 5V, 200 Hz, and 1ms for each cycle. SPADI and AROM assessments were conducted postoperatively on the 2, 8 and 12 weeks follow-ups. They are also asked to rate their daily pain and activities, analgesic use and give an overall rating as to whether they found the procedure helpful.

RESULTS

SSpRF, table 1 significant improve in comparing pain and AROM with baseline in 2, 8 and 12 weeks follow up with P-value= 0.0001. It was same results when comparing SCpRF pain and AROM with baseline for same duration as we mention in table 2. In comparing both SSpRF and SCpRF together for pain, there are significant improve when examined the patients after 2 and 4 week with p value 0.0001 and 0.002 respectively. While the pain was not significant changes between two group after 12 weeks. Regarding AROM, there were significant improving in AROM in all follow up duration, 2, 4 and 12 weeks with P value 0.0001, 0.0001 and 0.007 respectively (see tables 3 and 4).

Table 1: SSpRF compares pain and AROM with baseline in 2, 8 and 12 weeks follow up

	Pain			M		
	N	**Frequency**	**Percent**	**N**	**Frequency**	**Percent**
T0	2	6	10.0	3	12	20.0
	3	33	55.0	4	28	46.7
	4	21	35.0	5	20	33.3
T1	2	12	20.0	3	26	43.3
	3	48	80.0	4	29	48.3
				5	5	8.3
T2	1	14	23.3	2	15	25.0
	2	34	56.7	3	37	61.7
	3	12	20.0	4	8	13.3
T3	1	38	63.3	1	38	63.3
	2	22	36.7	2	20	33.3
				3	2	3.3
Total		60	100.0		60	100.0

N= number of patients

Friedman's two-way ANOVA by ranks, P-value= 0.0001

Table 2: SCpRF compares pain and AROM with baseline in 2, 8 and 12 weeks follow up

	Pain			M		
	N	**Frequency**	**Percent**	**N**	**Frequency**	**Percent**
T0	2	3	6.0	3	9	18.0
	3	32	64.0	4	24	48.0
	4	15	30.0	5	17	34.0
	1	9	18.0	2	32	64.0
	2	32	64.0	3	17	34.0
	3	8	16.0	4	1	2.0
	4	1	2.0			
T2	1	21	42.0	1	37	74.0
	2	29	58.0	2	13	26.0
T3	1	38	76.0	1	43	86.0
	2	12	24.0	2	7	14.0
Total		50	100.0		50	100.0

Friedman's two-way ANOVA by ranks, P-value= 0.0001

Table 3: Compare pain score between SSpRF and SCpRF

	Group	**N**	**Mean Rank**	**Sum of Ranks**	**P-value**
P1	Classic management	60	71.50	4290.00	
	Motor stimulation	50	36.30	1815.00	0.0001
P2	Classic management	60	63.07	3784.00	
	Motor stimulation	50	46.42	2321.00	0.002
P3	Classic management	60	58.67	3520.00	
	Motor stimulation	50	51.70	2585.00	0.154
Total		110			

P1= Pain level 2 week after treatment P2= Pain level 4 week after treatment P3= Pain level 12 week after treatment

Table 4: Compare AROM between SSpRF and SCpRF

Group		N	Mean Rank	Sum of Ranks	P-value
M1	Classic management	60	76.14	4568.50	
	Motor stimulation	50	30.73	1536.50	0.0001
M2	Classic management	60	78.88	4732.50	
	Motor stimulation	50	27.45	1372.50	0.0001
M3	Classic management	60	61.28	3677.00	
	Motor stimulation	50	48.56	2428.00	0.007
Total		110			

M1= AROM 2 week after treatment M2= AROM 4 week after treatment M3= AROM 12 week after treatment

Restoring shoulder function through manipulation and therapy activities in which the patient must comply and actively participate is one of the key goals of treatment. Pain is the main issue preventing patients from participating in the workout. Therefore, regional nerve block can be performed prior to the exercise program due to its function in pain alleviation (Iqbal *et al.*, 2012). We discovered that having an active range of motion enhanced flexion, abduction, internal rotation, and external rotation considerably.

DISCUSSION

The medical management of shoulder discomfort is frequently challenging and ineffective. Patients who do not respond well to conservative treatment may undergo interventions (Martinez *et al.*, 2011). The SSN supplies sensory innervation to the acromioclavicular joint, subacromial bursa, and coracoclavicular ligament in addition to the posterior capsule of the glenohumeral joint (Dahan *et al*., 2000). As a result, the SSN is the focus of numerous interventional procedures, such as the SSN block, an efficient technique for managing persistent shoulder pain (Shanahan *et al.*, 2003, Vorster *et al.*, 2008, Fernandes *et al.*, 2012). The manipulation of the shoulders was another sort of intervention. Numerous shoulder manipulation methods, such as those involving steroid injections and those performed while sedated or under local or general anesthesia, have been documented (Simopoulos *et al.*, 2012). In addition to shoulder dislocation, post-manipulation discomfort, hemoarthrosis, rotator cuff or joint capsule tears, and traction injury to nerves, fracture of the humerus during shoulder manipulation is a frequent consequence (Khan *et al.*, 2009, Hamdan *et al.*, 2003). Numerous research, (Mitra *et al.*, 2009, Chang *et al.*, 2015, El-Badawy *et al.*, 2014) have examined the effects of glenohumeral joint manipulation after SSNB with or without intra-articular local anaesthetic and steroid to avoid risk of general anesthesia for codman manipulation to relieve pain and improve shoulder function. However, the SSN block's limited effectiveness as a therapeutic is because to the short-lived pain control it offers. The opposite side Due to its lengthy duration of effect and non-destructive process, PRF therapy has grown in popularity as a means of treating persistent shoulder discomfort (Rohof 2002, Munglani 1999).

Wu *et al.*, 2014, carried out the first and only UG PRF treatment of the SSN investigation of the literature. They found that applying SSN PRF 12 weeks before physiotherapy to 21 individuals with adhesive capsulitis improved joint function and reduced discomfort more effectively than treating patients with simply physiotherapy for the full 12 weeks. According to Jang *et al.*, 2013, 10 out of 11 patients with chronic persistent shoulder pain recovered for at least 9 months after receiving 240-pulse 50-V PRF therapy of the SSN. Using the PRF therapy of the SSN, which they carried out for 480 seconds (Lüleci *et al.*, 2011) claimed that they were able to give 6 months of pain relief in 45 (78.9%) of 57 patients. In 74 patients, Ergönenç discovered that the 360 s ultrasound guiding PRF reduced pain, enhanced joint mobility, and enhanced life quality for at least six months. When confirmed by low-current electrical stimulation, the claimed accuracy of the standard suprascapular nerve block performed under ultrasound guidance may be as low as 18.5% (Taskaynatan *et al.*, 2012). In order to target the proximal suprascapular nerve before it turned toward the suprascapular notch Siegenthaler *et al.*, 2012 presented an ultrasound-guided supra- clavicular approach in 2012. The approach was created to get around the issue of the suprascapular nerve's imperceptibility. The authors claimed that the supraclavicular method improved suprascapular nerve visibility and boosted the rate of accurate needle placement to 95% by scanning healthy volunteers and utilizing cadavers for validation. The posterior approach's demand that patients adopt a particular stance, sit, or maintain a lateral decubitus position in order to gain access to the posterior side of the shoulder girdle is one of its drawbacks. The danger of respiratory distress increases and the prone position is less comfortable.

Our SCpRF therapy was carried out while receiving UG, motor, and sensory stimulation due to its safety in experienced hands and can do in the outpatient clinic, thus reducing the coast of operation room and hospitalization. The proximal ultrasonic approach let the patient in supine comfortable postien as comparable with traditional SSN block in the supraspinatus fossa when the patient is inconfortable or intolerated position, sitting or lying prone with might respiratory distress, removing the radiation and minimizing the risks (pneumothorax and intravascular injection) (Siegenthaler *et al*., 2012, Ke Vin *et al.*, 2015). There was a better rate of success and a shorter length of treatment compared to other radiological imaging methods (Khan *et al.*, 2009). In this approach we can control neuropathic pain. We adding motor and sensory stimulation to avoid risk of manipulating the shoulder under general or local anaesthesia and to reduce physiotherapy sessions home exercise is good for rehabilitation. Additionally, there are financial advantages because patients can return to work earlier and avoid hospitalization and lengthy physical therapy sessions. To our knowledge, a clinical trial of this unique technique's efficacy and potential side effects has never taken place. Second, there are a lot of dropouts and a tiny sample size. Furthermore, although psychological factors may influence how pain is perceived, they were not examined in this study.

CONCLUSION

It has been demonstrated that persistent shoulder pain can be promptly and safely alleviated by proximal ultrasonic percutaneous PRF to the SSN with MSS. The AROM significantly recovered, and the function of the shoulder joint significantly improved. However, more extensive, ongoing, randomized controlled trials are required to confirm our findings.

Compliance with Ethical Standards

Conflicts of interest (financial, potential influence over the contents, other relationships or activities, etc.) are not present in this work. Funding the research, writing, and/or publication of this paper were all done without any financial assistance from the authors.

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