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ORIGINAL ARTICLE

CLINICAL OUTCOMES OF SUPRASCAPULAR NERVE PULSED RADIOFREQUENCY IN ELDERLY PATIENTS WITH ADHESIVE CAPSULITIS: A RETROSPECTIVE COHORT STUDY

Abstract

Introduction: Adhesive capsulitis causes severe pain and limited movement, particularly in older adults. Treating this condition in elderly patients is difficult because standard therapies can carry risks due to age-related health issues and multiple medications. Suprascapular nerve pulsed radiofrequency provides a potentially safer, minimally invasive option. This study assessed the effectiveness and safety of this method in patients aged 65 and older.

Materials and Method: Thirty-two patients with adhesive capsulitis received ultrasound-guided suprascapular nerve pulsed radiofrequency. The primary outcome was the Shoulder Pain and Disability Index; secondary outcomes included Numeric Rating Scale scores for activity and rest pain. Assessments occurred at baseline, 4, and 12 weeks.

Results: Post-procedure assessments at 4 and 12 weeks demonstrated statistically significant reductions in Shoulder Pain and Disability Index scores and Numeric Rating Scale scores compared to baseline. While Shoulder Pain and Disability Index pain scores stayed consistent between weeks 4 and 12, a small but statistically significant rise in resting pain was observed at week 12 compared to week 4; however, pain levels remained significantly lower than pre-treatment levels. No serious procedure-related adverse events were reported.

Conclusion: Ultrasound-guided Suprascapular nerve pulsed radiofrequency seems to be an effective and safe treatment for chronic shoulder pain in elderly patients with adhesive capsulitis. Besides pain relief, long-lasting functional improvements may help reduce the social and psychological challenges linked to the condition. Due to its good safety profile, this method offers a valuable option for vulnerable patients with few other treatment choices.

Keywords: Pulsed Radiofrequency Treatment; Shoulder Pain; Aged; Ultrasonography; Bursitis.

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INTRODUCTION

Adhesive capsulitis (AC), commonly referred to as frozen shoulder (FS), is a disabling condition characterized by pain and stiffness of the shoulder joint. Although its exact cause is not fully understood, AC has been linked to prolonged immobilization, trauma, and systemic conditions such as diabetes and thyroid disorders (1). It affects approximately 2% to 5% of the general population (2) and typically presents with marked shoulder pain, often worsening at night, together with substantial limitations in both active and passive ranges of motion (ROM) (3,4). The disorder generally follows a characteristic course, progressing through painful (freezing), stiff (frozen), and recovery (thawing) phases, with spontaneous resolution occurring within one to two years in many cases (5).

AC most commonly occurs in individuals in their fifth and sixth decades of life, with peak incidence in the mid-50s, while onset before 40 years of age is rare. Women are affected more frequently than men, and involvement of the nondominant shoulder is slightly more common. The contralateral shoulder may become affected in 6% to 17% of patients within five years (6). Current evidence indicates that the disease likely begins with inflammation involving the axillary fold, anterosuperior joint capsule, coracohumeral ligament, and rotator cuff interval (7), followed by synovial adhesion formation and progressive fibrosis (8). These changes lead to capsular thickening, contraction, and a reduction in glenohumeral joint volume.

Although AC is often regarded as a self-limiting condition, complete functional recovery is not achieved in a considerable proportion of patients. Evidence guiding optimal treatment remains limited, and no single management strategy has been universally accepted (9). Current treatment options include oral or intra-articular corticosteroids, physiotherapy, hydrodistension, manipulation under anesthesia, and surgical approaches such as arthroscopic or open capsular release (10). Suprascapular nerve block (SSNB) has emerged as an alternative method for pain control by targeting the suprascapular nerve, which supplies nearly 70% of the sensory innervation to the shoulder and acromioclavicular joints (11). When the duration of analgesia provided by local anesthetics is inadequate, pulsed radiofrequency (PRF) lesioning may be used to extend pain relief, with encouraging results reported in the literature (12).

The impact of AC extends beyond physical limitations. Ongoing pain and restricted shoulder function can interfere with daily routines and social participation, often leading to fear of movement, activity avoidance, and increased pain-related distress (13). Dependence on others for routine activities may result in frustration and feelings of guilt, while symptoms that are underestimated in the workplace can contribute to reduced confidence and withdrawal from professional roles (14).

In older adults, these physical and psychosocial consequences may be particularly pronounced, given the additional challenges associated with aging. Despite growing interest in suprascapular nerve pulsed radiofrequency (SSN-PRF) as a treatment option for adhesive capsulitis, evidence focusing specifically on patients aged 65 years and older remains limited. Therefore, the present study aimed to evaluate the efficacy and safety of SSN-PRF in elderly patients with adhesive capsulitis.

MATERIALS AND METHOD

Study Design and Patients

This retrospective observational cohort study was conducted from June 2022 to June 2023 at tertiary training and research hospitals in Istanbul, Turkey. The study was designed and reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. Ethical approval was obtained from the Istanbul Kanuni Sultan Süleyman Training and Research Hospital Ethics Committee (KAEK/2024.09.192). The study is also registered on ClinicalTrials.

gov (NCT07088562). Research was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki, as revised in 2024. All participants provided written informed consent.

Patients aged 65 years and older diagnosed with adhesive capsulitis (symptom duration over 3 months), who had a Numeric Rating Scale (NRS) score higher than four despite receiving conservative medical and physical therapy, and who provided written informed consent were screened for eligibility. The exclusion criteria included: a history of shoulder surgery; primary shoulder conditions such as shoulder impingement syndrome, osteoarthritis, or other causes of shoulder pain; recent shoulder injections within the last three months; psychosis; cardiac pacemakers or implantable cardioverter-defibrillators (ICDs); decompensated chronic illnesses; bleeding disorders; active malignancy or infection; advanced cervical disc herniation; allergies to medications used; and inability to communicate or refusal to undergo the procedure.

For each included patient, the diagnosis of adhesive capsulitis was established based on clinical criteria, including shoulder pain persisting for at least three months predominantly spontaneous in nature and restriction of both active and passive range of motion, most notably in external rotation. Imaging studies, including MRI, X-ray, and ultrasonography, were used mainly to rule out other shoulder conditions that could mimic adhesive capsulitis, such as rotator cuff tears, neoplasms, bursitis, cervical disc herniation, or inflammatory arthropathies. Although the diagnosis was primarily clinical, MRI findings suggestive of adhesive capsulitis such as thickening of the coracohumeral ligament, obliteration of subcoracoid fat within the rotator interval, and thickening of the axillary recess were regarded as supportive findings.

Procedure

All procedures were performed by a single experienced physician specializing in musculoskeletal procedures, using a Toshiba TUS-A300™ ultrasound (USA) device equipped with an 11L4 linear transducer. A Cosman™ RFG-4 RF generator was used for the radiofrequency (RF) procedures. The procedures were conducted using Unified™ EchoRF™ hybrid needles, which are 100 mm long, 20G gauge, and have a 10 mm active tip (containing an electrode, cannula, and injection tube).

A diagnostic suprascapular nerve block was performed under ultrasound guidance using 5 mL of 0.25% bupivacaine. Pain intensity was reassessed 30 minutes after the injection, and a positive response was defined as a reduction of at least 50% in Numeric Rating Scale (NRS) scores during shoulder movement. Patients who demonstrated a positive response were scheduled for the PRF procedure one week later, allowing sufficient time for the effect of the local anesthetic to subside and baseline pain levels to return before proceeding with the intervention. For the SSN-PRF procedure, patient was seated between the physician and the ultrasound monitor, facing the monitor, with the ipsilateral arm resting on the contralateral shoulder. To visualize the suprascapular notch, the physician placed the ultrasound probe parallel to the scapular spine, superior to the acromion, and slowly adjusted it medially. Once the suprascapular notch was visualized, a 20-G, 3.5-inch hybrid RF needle with a 10 mm active tip was carefully advanced beneath the transverse scapular ligament. The RF electrode was then connected to perform sensory and motor stimulation tests of the target nerve. Sensory stimulation at 50 Hz and 0.3-0.5 V elicited paresthesia in the shoulder; during motor tests at 2 Hz and 0.3-0.5 V, visible contractions of the supraspinatus and infraspinatus shoulder muscles were observed. After confirming the correct needle position and obtaining appropriate responses, pulsed radiofrequency (PRF) was applied to the suprascapular nerve at 42°C and 45 volts for 240 seconds. This was followed by negative aspiration and an injection of 5 mL of 0.25% bupivacaine into the same area to prevent procedural pain (Figure

1). All procedures were performed under sterile conditions, and local skin anesthesia was applied before needle insertion.

One week after the procedure, all patients received an exercise booklet to start a home rehabilitation program. A physiotherapist demonstrated exercises, including self-stretching, range-of-motion activities, and strengthening exercises. Patients were advised to take 500 mg of paracetamol (up to four tablets per day) and/or 200 mg of ibuprofen as needed. They were instructed not to take any analgesics on the day of or the day before follow-up assessments, as these could influence clinical outcome measurements.

Outcome Measures

All patients were evaluated by the researchers for both primary and secondary outcome measures at baseline (before procedure) and at 4- and 12-week post-procedure. The primary outcome was the Shoulder Pain and Disability Index (SPADI) score, while secondary outcome measures included Numeric Rating Scale (NRS-11) scores. All adverse events occurring during the procedure or follow-up visits were documented.

Primary Outcome Measures

The SPADI is a shoulder-specific index consisting of 13 items that evaluate pain and disability across two separate subscales. Each item is scored from 0 to 10, and the total scores for the pain, disability, and overall subscales are converted to a 100-point scale. Higher SPADI scores indicate more shoulder-related pain and disability. A reduction of 18 points or more in the total SPADI score from baseline to week 12 (final follow-up) was considered a sign of treatment success (15). The validity and reliability of the Turkish version of SPADI have been previously confirmed (16).

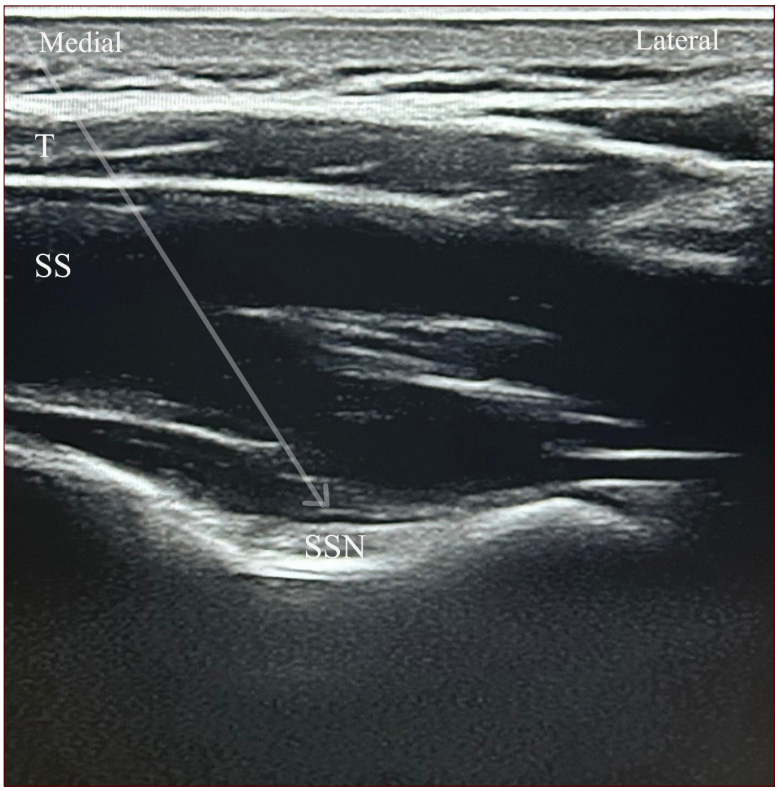

Figure 1. Ultrasound-guided pulsed radiofrequency of the suprascapular nerve via the suprascapular notch using an in-plane approach

T: Trapez muscle, SS: Supraspinatus muscle, SSN: Suprakapuler notch, Arrow: Needle direction

Secondary Outcome Measures

Pain intensity was measured using an 11-point Numeric Rating Scale (NRS), where 0 meant "no pain" and 10 indicated "worst pain imaginable." Separate NRS scores were recorded for pain during activity and rest.

Statistical Analyses

Statistical analyses were conducted using SPSS software (version 22.0, IBM Corp., Chicago, IL, USA). Descriptive statistics were presented as mean ± standard deviation and median (min–max) for continuous variables, and as frequencies and percentages for categorical variables. The Shapiro–Wilk test was employed to evaluate the normality of continuous data. For normally distributed data, comparisons between independent groups were made with the independent samples t-test, while the Mann–Whitney U test was used if the data were not normally distributed. Categorical variables were compared using the chi-square test. Paired comparisons of dependent variables were conducted with the Wilcoxon signed-rank test, and correlations between continuous variables were evaluated using Spearman's rank correlation coefficient. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 47 patient records were screened for eligibility. After nine patients who met the exclusion criteria were excluded, an additional six patient records were removed because these patients did not continue their follow-up. As a result, 32 patients (n=32) who met the inclusion criteria were enrolled in the study (Figure 2).

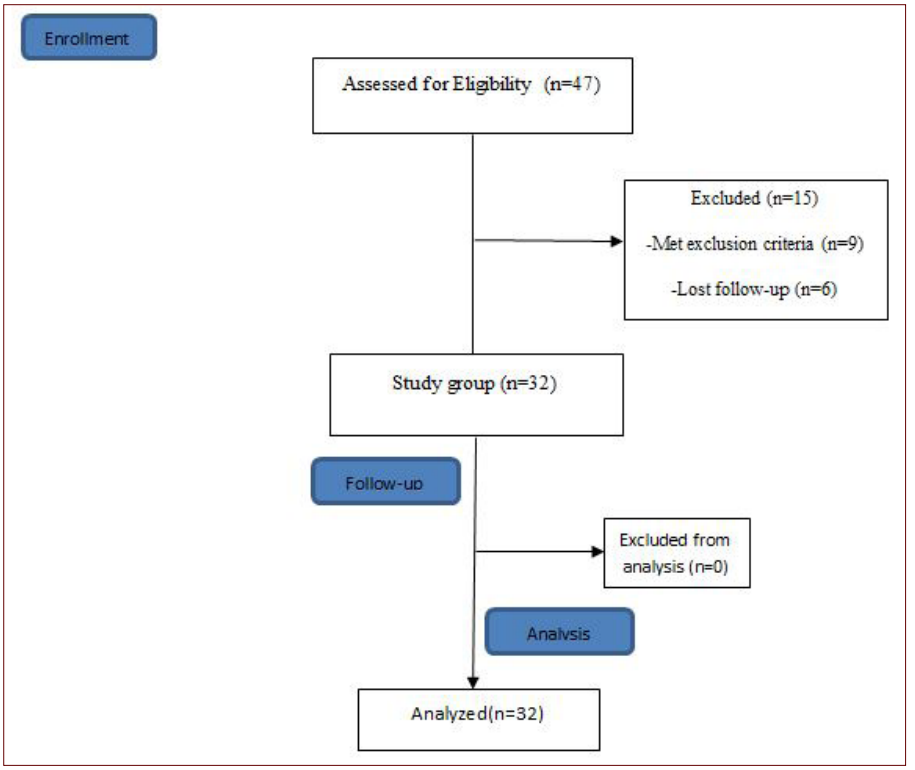

Figure 2. STROBE guideline flow diagram for the study.

STROBE: Strengthening the reporting of observational studies in epidemiology

Table 1. Demographic and clinical characteristics

Sex	**n**	**%**
Man	6	18.8
Woman	26	81.3
Total	32	100.0
Side	**n**	**%**
Left	20	62.5
Right	12	37.5
Total	32	100.0
DM	**n**	**%**
No	22	68.8
Yes	10	31.3
Total	32	100.0

DM: diabetes mellitus

All 32 patients in the study were aged 65 years or older and diagnosed with adhesive capsulitis. Of these, 26 patients (81.3%) were female, 20 patients (62.5%) had left shoulder involvement, and 10 patients (31.3%) had diabetes mellitus (Table 1). No significant correlations were found between age, sex, symptom duration, BMI, affected side, or diabetes mellitus and NRS or SPADI scores.

At both the 4-week and 12-week post-procedure assessments, NRS activity and rest scores were significantly lower than their pre-procedure baseline values ($p<0.05$ for both). While NRS activity levels did not differ substantially between weeks 4 and 12 ($p>0.05$), the NRS rest score at week 12 showed a significant increase compared to week 4 ($p<0.05$) (Table 2).

Table 2. Changes in NRS and SPADI scores at baseline, 4, and 12 weeks post-procedure

		Mean±SD	**Wilcoxon Signed Test**	**p**
NRS(Activity)	T_0-T_1	6.34+1.82	-4.95	0.00
	T_0-T_2	6.59+1.24	-4.99	0.00
	T_1-T_2	0.25+1.43	-0.084	0.39
NRS (Rest)	T_0-T_1	1.75+0.98	-4.77	0.00
	T_0-T_2	0.75+1.29	-2.78	0.00
	T_1-T_2	-1.00+1.16	4.05	0.00
SPADI (Pain)	T_0-T_1	65.45+18.19	-4.93	0.00
	T_0-T_2	65.23+15.46	-4.93	0.00
	T_1-T_2	-0.21+14.21	-0.20	0.83
SPADI (Disability)	T_0-T_1	65.37+17.66	-4.93	0.00
	T_0-T_2	64.90+16.45	-4.93	0.00
	T_1-T_2	-0.46+14.97	-0.30	0.75
SPADI (Total)	T_0-T_1	63.20+19.21	-4.93	0.00
	T_0-T_2	62.80+18.86	-4.93	0.00
	T_1-T_2	-0.39+14.48	-0.35	0.87

Data are shown as mean±SD

T0= Before the procedure, T1= 4th week of the procedure, T2= 12 th week of the procedure

NRS: Numeric Rating Scale; SPADI: Shoulder Pain and Disability Index; SD: Standart Deviation

Pre-procedure SPADI (pain, disability, and total) scores were significantly higher than follow-up scores at both 4 and 12 weeks ($p<0.05$ for each). However, no statistically significant difference was observed between SPADI pain scores at week 4 and week 12 ($p>0.05$) (Table 2).

Adverse events were rare, nonsevere, and transient. Presyncope occurred in only one patient and transient motor block developed in another, with both resolving without intervention.

DISCUSSION

In this retrospective observational cohort study, the effectiveness and safety of ultrasound (US)-guided suprascapular nerve pulsed radiofrequency (SSN-PRF) application at the suprascapular notch level were assessed in patients aged 65 and older with chronic shoulder pain caused by adhesive capsulitis (AC). We hypothesized that SSN-PRF at the suprascapular notch level would effectively reduce pain and disability in this group. Our results showed that SSN-PRF significantly decreased pain and improved function from baseline to week 12 in patients with chronic shoulder pain.

Another significant finding of our study was that patients' resting pain intensity (NRS rest) increased significantly at week 12 compared to week 4. Nevertheless, despite this increase, the resting pain score at week 12 was still substantially lower than the baseline pre-treatment score. This observation might be attributed to a partial decline in the neuromodulatory effect of the applied pulsed radiofrequency (PRF) treatment over time. However, PRF is known for its long-lasting analgesic effect; individual responses and effect duration can vary. Additionally, phase changes in the natural progression of adhesive capsulitis or increased mobility in patients whose pain decreased after treatment could also be contributing factors.

On the other hand, although this increase in the NRS rest score was statistically significant, its clinical significance should be carefully evaluated. Most importantly, pain remained significantly lower than baseline values, and functional outcomes (SPADI) also showed significant improvement at week 12. Furthermore, no significant change in pain during activity (NRS activity) was observed. This indicates that the negative impact of this partial increase in resting pain on patients' quality of life and daily activities is limited, and the long-term effectiveness of SSN-PRF continues.

Another important finding of the study was the generally mild and temporary nature of procedure-related adverse events. Therefore, US-guided SSN-PRF can be considered both effective and safe for this patient group.

In addition to SSNB and SSN-PRF, non-surgical treatments for adhesive capsulitis include oral nonsteroidal anti-inflammatory drugs (NSAIDs), physical therapy, and intra-articular corticosteroid injections (IACSI). Elderly individuals are more at risk for medication-related harm due to multimorbidity, polypharmacy, and physiological changes that affect drug absorption, distribution, metabolism, and excretion (17). As a result, NSAID use in elderly people is significantly limited because of their higher risk of serious cardiovascular, renal, hepatic, and gastrointestinal side effects.

While physical therapy is commonly used in AC treatment, evidence supporting its effectiveness is limited. It is often the first treatment option for patients with early-stage AC. However, because there is limited evidence to support using physical therapy alone, it is usually combined with other treatment methods (18). Some studies indicate that adding SSNB to physical therapy is better than physical therapy alone. Conversely, others suggest that SSNB, combined with both physical therapy and the IACSI, offers additional benefits (19, 20, 21). Although IACSI is considered a good option for AC treatment, comparative studies show that SSNB is more effective for pain relief and improved function (22, 23). Additionally, given the potential local and systemic side effects of the IACSI, especially in

diabetic patients, extra caution is needed when planning the IACSI for elderly patients.

Although there are no specific safety studies directly on SSN-PRF, research and reviews on SSNB have shown that the block procedure is safe. In our study, only one patient experienced presyncope. A study by Shanahan et al. involving 1,005 patients who underwent SSNB reported only six side effects: three cases of transient dizziness, two instances of temporary arm weakness, and one case of facial flushing (24). From the perspective of side effects and complications, SSN-PRF seems to be safer than many other treatment options for AC.

The persistent severity of symptoms in AC patients results in impaired social relationships, activity avoidance, and psychological distress. This greatly limits daily, recreational, and work activities by increasing perceived pain and disability. Difficulties within the family and insecurity at work weaken patients' independence and reduce their quality of life. In older adults, the additional challenge of adhesive capsulitis and the need for effective treatment are even more critical. The reductions in pain and improvements in function shown in our study have significant potential to alleviate the social and psychological impacts of adhesive capsulitis.

To date, the available literature addressing suprascapular nerve pulsed radiofrequency (SSN-PRF) specifically for adhesive capsulitis in patients aged 65 years and older remains limited. In this context, the present study adds to the emerging evidence in this area. Unlike neurolytic techniques, PRF exerts its effect through neuromodulation, allowing sustained pain relief without structural nerve injury (12). Given the potential risks associated with corticosteroid use and surgical interventions in older adults, SSN-PRF may represent a well-tolerated therapeutic option in this population. Nevertheless, several limitations should be acknowledged, including the retrospective design of the study, the relatively small sample size, and the absence of a control group. Further prospective studies with larger patient cohorts are warranted to confirm and expand upon these findings.

CONCLUSION

This study indicates that ultrasound (US)-guided suprascapular nerve pulsed radiofrequency (SSN-PRF), applied at the suprascapular notch, may be an effective and safe option for elderly patients (65 years and older) with chronic shoulder pain caused by adhesive capsulitis. Procedure-related adverse events were typically mild and temporary. These results suggest that SSN-PRF is a safe alternative, especially for elderly patients with comorbidities where other treatments might be limited. Since adhesive capsulitis greatly impacts daily activities and quality of life in older adults, our findings imply that SSN-PRF could be an important part of managing this condition in this patient population.

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Conflict of Interest: The authors declare that they have no conflict of interest.

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