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The impact of suprascapular nerve block on physiotherapy outcomes in chronic shoulder pain: A randomized controlled study

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ABSTRACT

Aim: To investigate the addition of suprascapular nerve block (SSNB) to physiotherapy in the treatment of chronic shoulder pain.

Methods: 110 patients were included in the randomised, controlled, single-blind study. While patients in group 1 were subject to only physiotherapy, patients from group 2 were subject to SSNB additionally. All patients received 15 sessions of standard physiotherapy for 3 weeks. Patients were evaluated using visual analogue scale (VAS), Shoulder Pain and Disability Index (SPADI) and Nottingham Health Profile (NHP) three times before treatment (T1), at the end of treatment (T2) and at 3 months after the end of treatment (T3).

Results: Pain-VAS and SPADI scores: Significant differences were found between T1, T2, and T3 in both within-group and intergroup comparisons. NHP scores: Significant differences were found between T1, T2, and T3 for all parameters except fatigue at T2 (Group 1). Inter-group comparison showed significant differences across most parameters. Pain-VAS, SPADI, and NHP difference scores: statistically significant difference was found in all evaluation parameters of T2 and T3 compared to T1.

Conclusion: We found that SSBN may increase physiotherapy's effectiveness in improving pain, functional status, and quality of life of patients.

Keywords: Chronic pain, disability, physical therapy, shoulder, suprascapular nerve block.

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1. Introduction

Painful shoulder syndrome is a frequently seen condition in adults. Causes of the painful shoulder syndrome are glenohumeral joint, acromioclavicular joint, sternoclavicular joint, rotator cuff and other soft tissue pathologies in the shoulder complex [1]. Rotator cuff disorder, glenohumeral instability, osteoarthritis, acromioclavicular joint disorder, and adhesive capsulitis are the more prominent ones of these diseases. In around %40 -50 of the patients' treatment resistant pain is seen, or it can repeat after one year [2].

Chronic shoulder pain (CSP), which is a significant health issue, can result in serious socioeconomical problems. CSP is a frequent reason to consult with a doctor and can cause functional inability also it can result in reduced quality of life [1,3]. Because shoulder pain involves multifactorial origins, complicating diagnosis and treatment.[4]. Main objectives in

the treatment of shoulder pain are halting the inflammation, reducing the pain, improving the function and quality of life. Generally conservative treatment plans are opted for conservative treatment consists of treatments such as medical treatment, physiotherapy, balneotherapy and manual therapy. Physiotherapy programs include treatment methods such as electrotherapy agents, exercises, and manual joint mobilizations. In medical treatment non-steroidal anti-inflammatory drugs, analgesics, opioids are usually chosen. When physiotherapy and/or oral medication treatment are unsuccessful to provide pain relief and functional recovery, oral medication cannot be tolerated, as well as when developed side effects caused by overuse different treatment methods such as intra-articular steroid injections, suprascapular nerve block (SSNB), radiofrequency ablation are used [5]. Even though there are variety of treatment methods in treatment of CSP there is not a unified view about the standard treatment method. Due to the hard comings of treatment, different treatment modalities are used.

Physiotherapy applications in the treatment of CPD have been shown to have both long- and short-term positive effects. Within physiotherapy applications in the treatment of CPD, superficial and deep heating agents (infrared, hot pack, short wave diathermy, ultrasound (US), high intensive laser therapy (HILT) and low intensity laser etc.), electrotherapy modalities (transcutaneous electrical nerve stimulation (TENS), diadynamic therapy, galvanic current etc.) and exercises are used alone or in combination [6–8].

In clinical practice as an addition to treatments, analgesic and anti-inflammatory therapies are usually added to treatment, especially to control pain and disease activity. Also, steroid injections or a nerve block involved in shoulder innervation can be done. Shoulder innervation is provided by essentially suprascapular (SSN) and axillary nerves. Due to SSN is responsible for %70 of sensory shoulder innervation SSNB has an immense value in treatment of CPD [9]. SSNB is utilized for various disorders leading to neuropathic and/or nociceptive shoulder pain such as adhesive capsulitis, arthritis, arthrosis, rheumatologic disorders, trauma, postoperative pain, pain after stroke with neoplasm and hemiplegic complications [10]. It is reported that corticosteroid usage in this block provides longer relief from pain and inflammation [11]. However, mechanisms which contribute to clinical efficacy of SSNB are uncertain. In the studies it is reported that shoulder problems cause reduction in functional capacity, weakness in muscles, pain, limits in the joint movement and by correlation significant negative impact on person's quality of life [1]. Yet there is a limited number of studies evaluating the contribution of SSNB to conventional physiotherapy in chronic cases.

The aim of the study was to investigate whether the addition of SSNB to physiotherapy, widely used in the treatment of CPD, affects expected clinical improvement in pain, functional status, and quality of life in patients.

2. Materials and methods

2.1 Study design

The study was planned as a prospective, randomized, controlled, single-blind study. All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

2.2 Study setting and participants

110 patients who presented to the physiotherapy and rehabilitation outpatient

clinic with complaints of pain and limitation of motion in the shoulder and approved the patient information form were included in the study. Patients between 18-65 years of age with; active-passive full range of motion, clinical and radiologic evaluation of biceps tendinitis, impingement syndrome, rotator cuff diseases (tendinosis, calcific tendinitis, etc.) and pain for more than 3 months were included in the study. Patients with inflammatory rheumatic disease (rheumatoid arthritis, ankylosing spondylitis, etc.), full-thickness rotator cuff tear, severe fluid increase in the shoulder on radiologic imaging, glenohumeral disorders (arthritis, osteoarthritis, osteonecrosis, glenohumeral instability), regional disorders (cervical radiculopathy, brachial neuritis, entrapment neuropathies, reflex sympathetic dystrophy, neoplasms, etc.), metabolic syndrome, diabetes mellitus (DM), hypertension (HT), diagnosed neuro-psychiatric problem, malignancy, bleeding disease, febrile infectious diseases, patients who had undergone surgery on the shoulder and received physiotherapy and/or intra-articular or SSNB injections in the last 1 year were excluded.

2.3 Randomization and blinding

110 patients who qualify for study were divided with basic randomization between two groups consisting of 55 patients by computer generated randomized number chart. Evaluations were done by the researcher who is unaware of the patient's group. Statistical analyses of the results are done by biostatistician who was unaware of the treatments received by the patient groups.

2.4 Initiatives

While patients in group 1 were subject to only physiotherapy, patients from group 2 were subject to SSNB additionally. All patients accepted received 15 sessions of standard physiotherapy for 3 weeks, 5 times a week.

Physical treatment protocol: All patients were treated with hot pack for 20 minutes and conventional TENS at 80 Hz for 20 minutes also US therapy in continue mode with 3 MHz frequency, 1.5 w/cm² intensity, 25 cm² area for 5 minutes by an experienced physiotherapist. All patients received a superficial heat application using a hydrocollator hot pack. The packs were stored in water at approximately 60 °C; however, before application they were wrapped with multiple layers of towels as per standard clinical safety procedures, resulting in an effective skin-contact temperature within the therapeutic range (approximately 40–45 °C). The US device head, with an area of 5 cm², was applied in full contact with the area to be treated and in a 90° vertical position. US application was done with patient sitting position, subject arm in the natural position, to shoulder area, with gel between device head and the skin and by rotational movements.

All patients were given a home exercise program that consists of standard exercises for range of motion, stretching and isometric strengthening. They were told to do the program twice a day with five repetitions of each exercise.

SSNB application protocol: All interventions done with a sterile technique and in the sitting position. Skin cleaned and covered in a normal sterile manner. 8-18 MHz linear US probe in a sterile casing was used. The transducer was placed parallel to the scapula in the supraspinous fossa after that moved laterally to visualize the supraspinatus muscle and the underlying bony fossa. SSN visualized in the suprascapular notch. Needle directed from medial to lateral with in plane technique. Aspiration was performed to check if needle was not in a vascular branch and then 10 mL 0.25% bupivacaine and 40 mg methylprednisolone mixture injected.

Patients were told not to take any oral or topical analgesic medication for pain complaints and to inform the follow-up researcher if they had to.

2.5 Data Sources/ Measurement

Patients were evaluated using visual analogue scale (VAS), Shoulder Pain and Disability Index (SPADI) and Nottingham Health Profile (NHP) three times before treatment (T1), at the end of treatment (T2) and at 3 months after the end of treatment (T3).

VAS is a common technique used to determine pain level. It consists of horizontal or vertical drawn 100mm line. In our study, pain intensity during active and passive movements were measured. The numerical values of the patient's pain intensity were determined by measuring the distance from the lowest VAS value to the patient's sign in mm (0-100) [12,13].

SPADI, which is designed to evaluate shoulder pain and movement, consists of two parts [14]. In section one, a total of 5 questions in the pain subgroup evaluate the patient's pain in the last week (VAS, 0 no pain, 10 the most severe pain), and in section two, a total of 8 questions in the disability subgroup evaluate the degree of difficulty in the movements the patient performed in the last week (VAS, 0 no difficulty, 10 receiving assistance). In our study, SPADI was evaluated separately as Shoulder Pain Index (SPI) and Shoulder Disability Index (SDI).

NHP, is an overall quality of life survey that measures patient's perception of their medical problem and these problem's amount of impact on their lives [15]. It consists of 38 questions and 6 subgroups which are energy level, pain, emotional, reaction, sleep, social isolation, and physical activity. Questions are answered yes or no. Every subgroup is given points 0 to 100. For every section "0" represents best medical condition "100" represents worst medical condition.

2.6 Sample Size: The number of patients included in this study was determined according to the results of study in the literature [7]. Using the G*Power 3.1.9.2 programmer, the minimum number of patients needed was calculated as 50 per group using α risk 5% and ß risk 5% for an effect size of 0.6651901. Considering patient losses, 55 patients per group were included in the study.

2.7 Statistical analysis: Data acquired from research analyzed using free trial version of SPSS Statistics (Statistical Package for Social Sciences) for Windows 25.0 programmer. While evaluating the data descriptive statistics methods (frequency, percentage, min-max values, median, average, and standard deviation) are used. Chi-square analysis was applied to test the correlation between groups and categorical variables. It was researched whether the variables showed normal distribution according to the Kolmogorov-Smirnov test. Accordingly, in the evaluation of the variables, parametric tests were used when the variables had a normal distribution, and nonparametric tests were used when it was concluded that variables were not normal. When the normality test indicated a normal distribution, an independent T-test was utilized. Conversely, when the normality test indicated a non-normal distribution, the Mann-Whitney U test was utilized. Friedman test was applied for comparisons of more than 2 dependent stages. When a difference was found, Bonferroni was used to find out which group/stage the difference originated from. Values with a probability (p) less than p=0.05 were accepted as significant and there is a difference between the groups, values with a value greater than p=0.05 were accepted as insignificant and there is no difference between the groups.

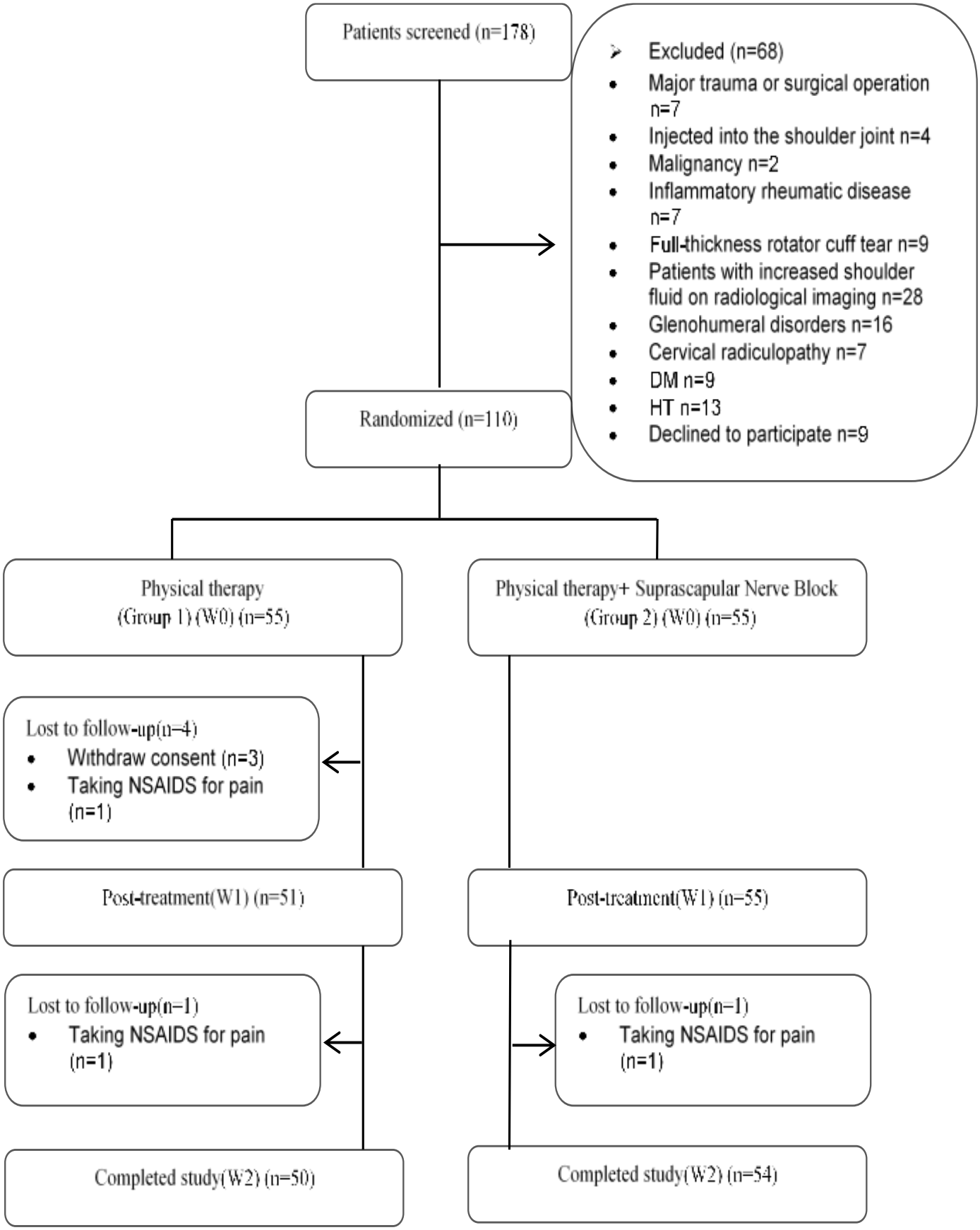

Figure 1. Flow diagram of participants in the study.

3. Results

178 patients who were admitted to the clinic for shoulder pain after January 2021 were evaluated for eligibility for the study. The study included 68 patients (some patients met more than one exclusion criterion) (major trauma or surgery n=7, shoulder joint injection n=4, inflammatory rheumatic disease n=7, full-thickness rotator cuff tear n=9, Patients with increased intra-shoulder fluid on radiological imaging n=28, glenohumeral disorders n=16, cervical radiculopathy n=7, DM n=9, HT n=13, malignancy n=2, and refused to participate in the study n=9) were excluded from the study. 110 patients were included in the study. While in treatment, in Group 1 3 patients revoked their consent, 2 patients used NSAI because of the pain, in group 2 1 patient used NSAI because of the pain therefore they were removed from study. In Group 1 50 patients, in Group 2 54 patients completed the study. While in treatment in group 2 2 patients experienced mildly elevated blood pressure, 2 patients had post injection ecchymosis, 1 patient experienced pain radiating to the neck area, 3 patients in both groups developed upper respiratory tract infection, but they completed

Table 1. Demographic characteristics of the patients.

Parameters		**Group 1**		**Group 2**		**Test Value**	**p**
Age ($\bar{X}$±SS)		58.54±5.99		57.07±8.72		-0.023**	0.982
Disease duration (week) ($\bar{X}$±SS)		5.3±1.88		5.59±2.28		-1,277***	0.205
		n	**%**	**n**	**%**	**Test Value**	**p**
Gender	Female	23	46.0	37	68.5	5.394****	**0.020***
	Male	27	54.0	17	31.5		
Bursitis	No	16	32.0	11	20.4	1.827****	0.177
	Yes	34	68.0	43	79.6		
Supraspinatus partial tear	No	20	40.0	28	51.9	1.467****	0.226
	Yes	30	60.0	26	48.1		
Bicipital tendinitis	No	37	74.0	39	72.2	0.042****	0.838
	Yes	13	26.0	15	27.8		
Impingement syndrome	No	16	32.0	18	33.3	0.021****	0.885
	Yes	34	68.0	36	66.7		
ACJ degeneration	No	42	84.0	50	92.6	1.878****	0.171
	Yes	8	16.0	4	7.4		

**p<0.05 ** Mann Whitney U test **Independent sample t test ****Pearson Chi-Square ACJ: Acromioclavicular joint.*

Table 2. Intra-group and inter-group evaluation of rest/activity pain-VAS scores.

		Group 1					**Group 2**					**Test Value**	**p**
		Min	**Max**	**Med**	**$\bar{X}$**	**SS**	**Min**	**Max**	**Med**	**$\bar{X}$**	**SS**		
Pain - rest VAS	**T1**	40.00	80.00	50.00	54.40	11.28	40.00	100.00	70.00	68.89	14.62	-4.939**	**0.000***
	T2	20.00	50.00	30.00	30.60	9.98	10.00	50.00	30.00	25.00	11.29	-2.388**	**0.017***
	T3	0.00	30.00	10.00	15.80	7.31	0.00	10.00	0.00	4.07	4.90	-7.279**	**0.000***
	Test Value	98.569***					107.028***						
	p	**0.000***					**0.000***						
	Bonferroni	**1>2, 1>3, 2>3**					**1>2, 1>3, 2>3**						
Pain–activity VAS	**T1**	50.00	100.00	60.00	66.80	12.53	50.00	100.00	80.00	80.93	12.63	-5.055**	**0.000***
	T2	20.00	60.00	35.00	37.60	10.41	10.00	50.00	30.00	31.67	10.05	-2.379**	**0.017***
	T3	10.00	40.00	20.00	22.40	7.16	0.00	10.00	10.00	6.85	4.65	-8.477**	**0.000***
	Test Value	99.030***					108.000***						
	p	**0.000***					**0.000***						
	Bonferroni	**1>2, 1>3, 2>3**					**1>2, 1>3, 2>3**						

**p<0.05 **Mann Whitney U test ***Friedman test; T1 (1): Pre-treatment- first evaluation, T2 (2): Post-treatment 1st day – second evaluation, T3 (3): Post-treatment 3th month- third evaluation, VAS: Visual analogue scale.*

Table 3. Intra-group and inter-group evaluation of SPADI scores.

		Group 1					Group 2					Test Value	p
		Min	**Max**	**Med**	$\bar{X}$	**SS**	**Min**	**Max**	**Med**	$\bar{X}$	**SS**		
Pain-SPADI	**T1**	22.00	48.00	30.00	32.00	6.08	24.00	50.00	39.00	39.17	6.21	-5.169***	**0.000***
	T2	9.00	33.00	16.50	17.90	5.20	0.00	24.00	14.00	14.20	5.34	-3.086***	**0.002***
	T3	4.00	19.00	9.00	10.54	3.48	0.00	10.00	4.00	2.93	2.22	-8.371***	**0.000***
	Test Value	100.000****					106.037****						
	p	**0.000***					**0.000***						
	Bonferroni	**1>2, 1>3, 2>3**					**1>2, 1>3, 2>3**						
Disability-SPADI	**T1**	28.00	75.00	46.50	47.30	9.09	39.00	80.00	60.00	60.30	10.18	-6.847**	**0.000***
	T2	15.00	43.00	24.00	26.66	7.59	8.00	35.00	21.00	20.81	7.71	-3.151***	**0.002***
	T3	7.00	29.00	13.00	15.20	5.47	0.00	20.00	4.00	3.91	3.51	-8.346***	**0.000***
	Test Value	100.000****					107.507****						
	p	**0.000***					**0.000***						
	Bonferroni	**1>2, 1>3, 2>3**					**1>2, 1>3, 2>3**						

**p<0.05 ** The independent t-test ***Mann Whitney U test ****Friedman test; T1 (1): Pre-treatment- first evaluation, T2 (2): Post-treatment 1st day – second evaluation, T3 (3): Post-treatment 3th month- third evaluation, SPADI: Shoulder pain and disability index.*

Table 4. Intra-group and inter-group evaluation of NHP scores.

		Group1					Group 2					Test Value	p
		Min	**Max**	**Med**	$\bar{X}$	**SS**	**Min**	**Max**	**Med**	$\bar{X}$	**SS**		
Pain- NHP	**T1**	30,96	100.00	44.70	48.86	24.91	32,8	100.00	88.78	82.02	20.99	-6.006***	**0.000***
	T2	9.99	80.26	27.04	28.45	15.55	8,96	46.49	20.48	18.66	8.85	-3.644***	**0.000***
	T3	9.99	33.39	9.99	13.97	7.21	0.00	9.99	0.00	4.71	5.03	-6.621***	**0.000***
	Test Value	78.112****					97.652****						
	p	**0.000***					**0.000***						
	Bonferroni	**1>2, 1>3, 2>3**					**1>2, 1>3, 2>3**						
Physical mobility- NHP	**T1**	21.91	54.47	32.48	29.45	7.32	21.91	75.77	38.19	38.21	13.12	-3.489***	**0.000***
	T2	9.30	32.70	21.91	23.57	4.61	9.30	32.70	21.91	21.51	5.66	-1.928***	0.054
	T3	0.00	32.48	21.91	17.99	6.61	0.00	21.91	9.30	7.69	6.37	-6.078***	**0.000***
	Test Value	54.899****					99.576****						
	p	**0.000***					**0.000***						
	Bonferroni	**1>2, 1>3, 2>3**					**1>2, 1>3, 2>3**						
Energy- NHP	**T1**	0.00	100.00	36.80	51.09	31.73	0.00	100.00	91.36	72.48	32.42	-3.241***	**0.001***
	T2	0.00	100.00	36.80	38.88	28.84	0.00	100.00	0.00	23.07	30.19	-2.915***	**0.004***
	T3	0.00	100.00	0.00	14.44	25.13	0.00	27.26	0.00	0.51	3.74	-3.937***	**0.000***
	Test Value	50.567****					82.635****						
	p	**0.000***					**0.000***						
	Bonferroni	**1>3, 2>3**					**1>2, 1>3, 2>3**						
Sleep- NHP	**T1**	0.00	100.00	48.96	51.09	21.57	0.00	100.00	77.63	80.06	21.78	-6.376***	**0.000***
	T2	0.00	100.00	41.60	42.99	19.75	0.00	100.00	41.60	43.20	24.74	-0.089***	0.929
	T3	0.00	77.63	27.26	30.31	16.62	0.00	43.36	27.26	20.44	13.35	-2.914***	**0.004***
	Test Value	49.364****					84.071****						
	p	**0.000***					**0.000***						
	Bonferroni	**1>2, 1>3, 2>3**					**1>2, 1>3, 2>3**						
Social isolation- NHP	**T1**	0.00	77.99	15.97	26.13	21.54	0.00	100.00	38.50	41.18	26.56	-3.117***	**0.002***
	T2	0.00	62.02	15.97	16.75	16.14	0.00	77.47	0.00	12.61	17.78	-1.444***	0.149
	T3	0.00	38.50	0.00	7.56	10.57	0.00	0.00	0.00	0.00	0.00	-4.962***	**0.000***
	Test Value	49.466****					83.164****						
	p	**0.000***					**0.000***						
	Bonferroni	**1>2, 1>3, 2>3**					**1>2, 1>3, 2>3**						
Emotional reactions- NHP	**T1**	13.95	71.46	32.84	35.68	11.31	30.79	100.00	54.26	51.89	16.18	-5.517***	**0.000***
	T2	0.00	44.78	23.71	26.31	9.02	0.00	39.92	23.71	20.94	10.37	-2.427***	**0.015***
	T3	0.00	34.18	13.95	16.11	6.36	0.00	36.56	13.95	9.61	8.39	-4.016***	**0.000***
	Test Value	72.753****					101.172****						
	p	**0.000***					**0.000***						
	Bonferroni	**1>2, 1>3, 2>3**					**1>2, 1>3, 2>3**						
Total- NHP	**T1**	92.45	423.22	229.09	240.83	81.00	148.22	543.68	364.57	365.86	89.23	-7.462**	**0.000***
	T2	81.48	318.20	169.45	176.90	61.93	19.77	321.54	132.28	139.75	71.14	2.831**	**0.006***
	T3	22.56	235.81	85.57	98.77	47.46	0.00	95.44	49.84	42.65	23.64	-7.048***	**0.000***
	Test Value	85.720****					102.111****						
	p	**0.000***					**0.000***						
	Bonferroni	**1>2, 1>3, 2>3**					**1>2, 1>3, 2>3**						

**p<0.05 ** independent sample t test ***Mann Whitney U test ****Friedman test; T1 (1): Pre-treatment- first evaluation, T2 (2): Post-treatment 1st day – second evaluation, T3 (3): Post-treatment 3th month- third evaluation, NHP: The Nottingham Health Profile.*

the study in accordance with the study rules. Flow diagram is shown in the Figure 1. When the demographic characteristics of the patients were analyzed, there was no statistically significant difference between the groups in terms of age, disease duration and diagnoses except for gender distribution (p<0.05) (Table 1).

Pain -VAS (Table 2): There was a statistically significant difference between T1, T2 and T3 passive pain and active pain scores in the in-group evaluations of Groups 1 and 2 (p<0.05). T1 passive pain and active pain scores were higher than T2 and T3 scores. T2 passive pain and active pain scores were higher than T3 scores. In the intergroup comparison, there was a statistically significant difference between T1, T2 and T3 passive and active pain scores (p<0.05). At T1, pain scores were significantly lower in Group 1 than in Group 2, whereas at T2 and T3 pain scores were significantly lower in Group 2 than in Group 1.

SPADI (Table 3): There was a statistically significant difference between T1, T2 and T3 pain and movement scores in the in-group evaluations of Groups 1 and 2 (p<0.05). T1 pain and movement scores were higher than T2 and T3 scores. T2 pain and movement scores were

Table 5. Comparison of difference score between groups.

		GROUP 1					GROUP 2					Test Value	P*
		Min	Max	Med	$\bar{X}$	SS	Min	Max	Med	$\bar{X}$	SS		
Pain -rest VAS	T2-T1	-40.00	-10.00	-20.00	-23,80	6.67	-70.00	-20.00	-40.00	-43.89	11.06	-7,811**	0,000*
	T3-T1	-60,00	-20.00	-40,00	-38,60	9,89	-100,00	-40,00	-60,00	-64,81	15,49	-7,596**	0,000*
Pain – activity VAS	T2-T1	-50.00	-10.00	-30,00	-29,20	7,52	-70.00	-20.00	-50.00	-49,26	10.79	-7,869**	0,000*
	T3-T1	-70,00	-30.00	-40,00	-44.40	9,72	-100,00	-40,00	-70,00	-74.07	12.96	-8,166**	0,000*
Pain SPADI	T2-T1	-24,00	-5,00	-15,00	-14,10	3,92	-50,00	-10,00	-24,00	-24,96	6,20	-7,926**	0,000*
	T3-T1	-34,00	-13,00	-20,50	-21,46	4,49	-48,00	-19,00	-36,00	-36,24	6,47	-8,192**	0,000*
Disability SPADI	T2-T1	-34,00	-7,00	-22,00	-20,64	6,34	-72,00	-19,00	-39,00	-39,48	9,10	-8,248**	0,000*
	T3-T1	-51,00	-16,00	-31,50	-32,10	7,46	-76,00	-31,00	-57,00	-56,39	10,61	-8,159**	0,000*
Pain NHP	T2-T1	-90,01	22,90	-19,24	-20,41	19,84	-91,04	31,70	-65,31	-63,36	22,88	-7,354**	0,000*
	T3-T1	-90,01	22,90	-31,88	-34,89	23,66	-100,00	9,99	-82,95	-76,97	21,85	-7,016**	0,000*
Physical mobility NHP	T2-T1	-32,56	10,57	-5,40	-5,87	7,35	-53,86	0,00	-16,24	-16,70	11,83	-5,151**	0,000*
	T3-T1	-34,38	0,00	-10,79	-11,45	9,18	-73,93	-9,30	-31,78	-30,52	13,80	-6,465**	0,000*
Energy NHP	T2-T1	-63,20	63,20	0,00	-12,21	21,76	-100,00	76,00	-39,20	-49,41	38,31	-5,434**	0,000*
	T3-T1	-100,00	63,20	-36,80	-37,56	34,48	-100,00	27,26	-100,00	-72,63	33,72	-4,622**	0,000*
Sleep NHP	T2-T1	-77,63	60,17	-12,57	-8,10	22,23	-100,00	78,30	-36,37	-36,87	33,34	-5,629**	0,000*
	T3-T1	-65,06	48,96	-21,70	-20,78	20,70	-100,00	39,83	-62,61	-59,62	28,51	-6,839**	0,000*
Social isolation NHP	T2-T1	-41,89	22,53	0,00	-10,30	15,39	-100,00	15,97	-22,31	-28,58	24,48	-4,056**	0,000*
	T3-T1	-55,46	0,00	-15,97	-18,41	15,95	-100,00	0,00	-38,50	-41,18	26,56	-4,634**	0,000*
Emotional reactions NHP	T2-T1	-47,75	6,91	-7,23	-9,37	11,05	-86,05	-4,82	-24,46	-30,95	19,58	-6,285**	0,000*
	T3-T1	-57,51	0,00	-17,55	-19,57	10,50	-100,00	-16,84	-41,30	-42,28	19,42	-6,279**	0,000*
Total NHP	T2-T1	-210,00	84,59	-59,64	-63,93	55,98	-443,92	10,96	-212,76	-226,11	105,05	-7,560**	0,000*
	T3-T1	-301,06	0,18	-136,17	-142,06	64,22	-526,75	-87,72	-320,93	-323,21	96,04	-7,703**	0,000*

**p<0.05, **Mann Whitney U test; T1 (1): Pre-treatment- first evaluation, T2 (2): Post-treatment 1st day – second evaluation, T3 (3): Post-treatment 3th month- third evaluation, VAS: Visual analogue scale, SPADI: Shoulder pain and disability index, NHP: The Nottingham Health Profile.*

higher than T3 scores. There is a statistically significant difference between T1, T2 and T3 pain and movement scores in intergroup comparison (p<0.05). At T1, Group 1 had significantly lower pain and disability scores than Group 2, whereas at T2 and T3, Group 2 had significantly lower scores than Group 1.

NHP (Table 4): There was a statistically significant difference between the T1, T2 and T3 pain, physical activity, fatigue, sleep, social isolation, emotional reactions, and total scores of Groups 1 and 2 (p<0.05). There was not a statistically significant difference between T1 fatigue scores and T2 scores of Group 1. In the intergroup comparison, there was a statistically significant difference between all parameters, with Group 1 showing significantly lower scores at T1 and Group 2 showing significantly lower scores at T2 and T3, except T2 physical activity, sleep, and social isolation scores (p<0.05).

Pain -VAS, SPADI and NHP difference scores (Table 5): In the intergroup comparison of T2–T1 and T3–T1 difference scores, a statistically significant difference was found in all evaluation parameters (p<0.05), with Group 2 showing greater improvement than Group 1 at both time points.

4. Discussion

In this study, the effect of SSNB on physiotherapy outcomes in patients with CSP was investigated. In the study, a combined physiotherapy programme consisting of HP, TENS, US, and therapeutic exercises was applied to all patients. SSNB was applied to one group before the combined physiotherapy programme. In the study, a statistically significant difference was found in the evaluation parameters related to pain, disability, and activities of daily living at the end of treatment and at 3 months compared to the beginning of treatment in both groups. In the intergroup comparison, the improvements in Group 2 were found to be statistically significantly better than in Group 1. Skills such as personal care, performing all kinds of social activities and mobilisation are possible through the musculoskeletal system. Shoulder pathologies are one of the most prominent problems in musculoskeletal disorders. In studies, it has been reported that shoulder problems cause muscle weakness, pain and joint movement limitations, which reduce functional capacity (tasks necessary for daily life (e.g. dressing, personal hygiene, eating and working, etc.); in addition, shoulder pain is often associated with impaired sleep ability and this affects mood and concentration, as a result, it significantly affects the quality of life of individuals [16]. Reducing pain and inflammation, maintaining and improving range of motion, restoring lost functions and improving quality of life are among the primary goals of physicians. Although medical treatment is mostly utilized, combined treatments are often preferred to get quicker results. Although there is no consensus on standard treatment management in the treatment of shoulder problems, physiotherapy applications have been shown to have positive effects [6,16–18]. Physiotherapy covers a wide range of applications. General practice usually starts with the application of heat to relieve soft tissue pain and reduce muscle spasm and continues with different electrotherapy methods [18]. TENS and US are popular applications to control pain, improve blood circulation and prepare the patient for exercise [19]. TENS has widespread use for pain control according to the gate control theory, according to which ‘peripheral’ inhibition of pain can be achieved because of stimulation of large non-nociceptive afferent fibres [20]. In addition,

TENS uses analgesic currents and causes the release of endogenous opiates in certain areas of the Central Nervous System, although the mechanism of action is not fully understood [21]. Deep heating agents (US, HILT, etc.) used in physiotherapy applications have been reported to be effective in improving pain, ROM, and function of patients [22]. There is increasing evidence that strengthening and stretching exercises are the most recommended management strategy to improve pain and disability in individuals with shoulder pain [23]. Exercise therapy, which specifically aims to restore muscle flexibility and strength of the shoulder and scapular muscles, should be used as a first-line treatment to improve pain, function, and range of motion in individuals with pain associated with subacromial-derived pathologies before recommending arthroscopic surgery [23]. In our study, we applied the same standard physiotherapy applications and exercise programme to both groups. SSNB was applied to the 2nd group as a difference. In our study, we achieved a statistically significant improvement in both groups compared to baseline levels, but pain, functionality and general well-being improved more in the SSNB group compared to baseline. This situation continued in the 3rd month controls. Although the separate effects of electrotherapy and other physiotherapy modalities are known, combined applications are generally preferred in clinical practice. The main aims of this are to increase the effectiveness of the treatment, to provide benefits through different mechanisms and to accelerate the patient's recovery process.

Although physiotherapy applications are widely used, there are different results regarding its effectiveness in shoulder problems. It has been reported that it may be more useful as an adjunctive method to pharmacotherapy in shoulder diseases [24]. In addition, injection therapies are frequently used in or around the shoulder for pain control and clinical improvement. Local steroid injections are frequently used in the treatment of shoulder pain in practice [25,26]. However, repeated local steroid injections in refractory pain may have adverse effects on tendon homeostasis, healing, and future treatment outcomes in some patients [27]. SSNB may offer an effective alternative to local steroid injections for some patients and there is increasing interest in its use as an adjunct to physiotherapy applications [28].

The SSN is a mixed motor and sensory nerve that provides approximately 70% of the sensory innervation of the shoulder complex [9,29]. Injections aimed at blocking the SSN have been used in the treatment of various chronic shoulder disorders [3,30]. It has been observed that SSNB is an excellent therapeutic tool not only in terms of analgesic efficacy but also in terms of increased safety [31,32]. Therefore, SSNB may be a remarkable alternative to the conventional treatment of shoulder pain [33]. The mechanisms contributing to the clinical efficacy of SSNB injections are unclear. Although its use in clinical practice is increasing, there are a limited number of studies evaluating its contribution to conventional physiotherapy as a result of its use in combination with physiotherapy applications in CSPs [3,34]. In our study, although the pain values of the SSNB group were higher than the other group, the improvement in both pain and functionality and quality of life scales of the SSNB group was statistically more significant than the group that received only physiotherapy. The reason for this may be the differences in the components of existing chronic pain in accordance with the evaluations in previous meta-analyses, as well as the decrease in the effectiveness of physiotherapy

over time or pain of multiple origins that is difficult to treat with a single physical method or therapeutic exercise [34].

4.1. Limitations

This study has some limitations. Firstly, we did not have a control group. However, due to ethical considerations, it was not possible to create a real control group in which no intervention has applied. In addition, the fact that CSP patients included heterogeneous disease groups, SHAM injection was not administered to the physiotherapy group, and although the patients were randomly divided into 2 groups, the higher pain scores at baseline in the SSNB group can be considered as limitations.

4.2. Conclusion

It was found that physiotherapy alone and physiotherapy with SSBN application were effective in improving the pain, functional status, and quality of life of the patients in the treatment of CSP, but the improvements were more significant in the blockage group. Considering the long-term effects, we think that the addition of SSBN to physiotherapy applications will contribute more to the treatment, the recovery processes of the patients will be faster, and it may be helpful in terms of providing treatment diversity and alternatives, but it should be supported by more randomised controlled studies.

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