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Original Article

Ultrasound-Guided Subacromial Corticosteroid Injections in Comparison to Anatomic Landmark-Guided Injections in Subacromial Impingement Syndrome

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ABSTRACT

Objective: This study aimed to compare the effects of ultrasound-guided in comparison to landmark-guided subacromial corticosteroids injection on shoulder range of motion, pain, and functional status in patients with subacromial impingement syndrome.

Methods: Forty patients who underwent subacromial corticosteroid injections with subacromial impingement syndrome diagnosis in the interventional physiatry clinic were included. Patients were randomly divided into 2 groups according to the line of treatment either ultrasound-guided injection, group 1 which included 21 patients or landmark injection, group 2 which included 19 patients. The patients were assessed before and 4 weeks after treatment by blinded outcomes assessors with the Visual Analog Scale, Shoulder Pain and Disability Index, and the shortened Disabilities of the Arm, Shoulder, and Hand Questionnaire scales.

Results: There was no difference between the groups in terms of age, gender, and shoulder pain duration ($P > .05$). There was a significant improvement in the Visual Analog Scale, range of motion, the shortened Disabilities of the Arm, Shoulder, and Hand Questionnaire, and Shoulder Pain and Disability Index scores 4 weeks after treatment in both groups ($P < .05$). Visual Analog Scale, range of motion, the shortened Disabilities of the Arm, Shoulder, and Hand Questionnaire, and Shoulder Pain and Disability Index scores did not differ significantly between the 2 groups before treatment, 4 weeks after the treatment, and treatment gain ($P > .05$).

Conclusion: The positive effects of landmark and ultrasound-guided subacromial corticosteroid injection on shoulder range of motion, pain, disability, and functionality are similar in subacromial impingement syndrome. Hence, using the injection technique in which the physician is more experienced will provide safer and more successful results.

Keywords: Injections, pain, shoulder, subacromial impingement syndromes, steroids

Introduction

Subacromial impingement syndrome (SAIS) accounts for 44%-65% of all shoulder pain complaints.[1] It can be treated conservatively using physical therapy, activity modification, nonsteroidal anti-inflammatory drugs, and corticosteroid injections. Subacromial corticosteroid injection is a useful therapy, especially in cases where activity modification and medications are ineffective in relieving pain.

Subacromial corticosteroid injection is an effective method in treating SAIS and can be performed blindly or under imaging guidance depending on the clinician's experience. The use of ultrasound (US) in imaging-guided injections has become increasingly popular.[2]

Many studies show positive clinical results of both blinded and imaging-guided subacromial corticosteroid injections.[3-5] While US-guided injections are useful in localizing the subacromial space, landmark injections do not require equipment and localizing the subacromial space based on anatomical landmark points. In both methods, the experience of the clinician is important. There are confusing results in the literature regarding the administration modes of subacromial corticosteroid injections.[6-8] For these reasons, we planned to investigate the effects of blinded and US-guided subacromial corticosteroid injections on the clinical course of patients.

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Methods

Patients diagnosed with SAIS who underwent subacromial corti-costeroids injection in our interventional physiatry clinic between September 2017 and February 2018 were included in this study. Ethics committee approval was received for this study from the ethics com-mittee of Dr. Sadi Konuk Training and Research Hospital (number: 2018/178. Date: May 14, 2018).

Permission was obtained from patients to use their medical data.

Following cases were included in this study: (a) shoulder posterolat-eral pain that increased with shoulder abduction, (b) restriction of the shoulder passive and active range of motion (ROM), (c) patients with positive Neer and Hawkins impingement test, (d) patients with SAIS whose diagnosis was confirmed by magnetic resonance imaging (MRI), and (e) patients with SAIS whose application of corticosteroid in their injections were the same in terms of type and dose as 1 mL betameth-asone dipropionate + betamethasone sodium phosphate (Diprospan).

Following cases were excluded from the study: patients who received corticosteroid, local anesthetic, hyaluronic acid, and platelet-rich plasma injections in the shoulder in the last 1 year; patients who had a previous history of surgery or fracture in their thorax, neck, upper extremity, or shoulder joint; patients with a rheumatological, cognitive or psychiatric, and central or peripheral neurological disease (stroke, spinal cord injury, brachial plexus injury, etc.); patients whose MRI presented a partial or complete rotator cuff tear, calcific tendinitis, or labral tear.

Forty patients who met the study criteria were included in the study. Patients were randomly divided into 2 groups according to injection technique. Group 1 included 21 patients who received US-guided injection, while group 2 included 19 patients who received landmark technique.

The age, gender, and duration of shoulder pain of the patients were recorded in the questionnaire form created by us. Shoulder ROMs, severity of shoulder pain, and shoulder functionality of the patients before and 4 weeks after the treatment were evaluated by a blinded researcher (Ç.Ç.). The Visual Analog Scale (VAS) scores in rest and move-ment were used to evaluate the severity of shoulder pain. The Shoulder Pain and Disability Index (SPADI) and the shortened Disabilities of the Arm, Shoulder, and Hand Questionnaire (Quick DASH) were used for functional evaluation.

The patients did not receive physical therapy during the follow-up process. Patients with shoulder ROM restriction performed a home exercise program consisting of shoulder ROM and pendulum exercises.

Evaluation Parameters

Primary outcome measure: VAS: It is a scale scored from 0 to 10 to evaluate the severity of pain. Patients are asked to rate the pain they feel as 0 for no pain and 10 for the most severe pain they have encoun-tered in their life. [9]

Secondary outcome measures: 1. Shoulder ROMs: Shoulder ROMs were evaluated using a goniometer according to the standard method. Those with shoulder flexion lower than 160° and external rotation lower than 90° were recorded as restricted ROM.[10]

2. Shoulder Pain and Disability Index: It is a scale in which pain and the limitation of shoulder function are evaluated between 0 and 10 points. Five items for the pain are scored 0 for no pain and 10 points for most severe pain. Eight items for disability are scored 0 for no difficulty and 10 points for difficulty-requiring assistance. Shoulder Pain and Disability Index is a useful scale in both clinical practice and clinical trials, as it can also detect changes in the status of patients.[11] High scores indicate pain and impaired shoulder functions. A Turkish validity and reliability study is available for the scale.[12]

3. The Shortened Disabilities of the Arm, Shoulder, and Hand Questionnaire: It is used to evaluate the difficulty in performing various physical activities due to disabilities of the shoulder, arm, or hand (6 items), the severity of pain and tingling (2 items), and the effect of the disability on social activities, work, and sleep (3 items). The shortened version of the Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH) has 11 items.[13] Quick DASH is as sensitive as DASH in evaluating upper extremity disabilities.[14]

Each item is scored between 1 and 5. No difficulty is scored as 1 and unable is scored as 5 points. At least 10 of the 11 items must be answered. The final score is calculated from zero (no disability) to 100 (severe disability).[13] Two optional items of the Quick DASH (work, and sports or music) were not used in this study. A Turkish validity and reliability study is available for the scale.[15]

Statistical Analysis

Mean, standard deviation, median, lowest, highest, frequency, and ratio values were used in the descriptive statistics of the data. The distribution of variables was done with a Kolmogorov–Smirnov test. A Mann–Whitney test and an independent sample *t*-test were used for the analysis of the independent quantitative data. Wilcoxon test, McNemar test, and a paired sample test were used for the analysis of dependent quantitative data. In the analysis of qualitative data, a chi-square test and Fisher's exact test were used. The analyses were conducted using the Statistical Package for Social Sciences version 22.0 (IBM®) software.

Results

The mean age of the patients who underwent US-guided subacromial corticosteroid injection (group 1) was 51.6 ± 12.0 years, and the mean age of the patients who underwent blind subacromial corticosteroid injection (group 2) was 57 ± 10.4. In total, 62% of group 1 was female (n = 13) and 38% were male (n = 8), whereas 79% of group 2 was female (n = 15) and 21% were male (n = 4, Table 1).

The duration of shoulder pain was 16.2 ± 22.0 months in group 1 patients and 17.2 ± 28.3 months in group 2 patients (Table 1).

In Table 2, the VAS scores at rest and movement, shoulder flexion and external rotation limitations, SPADI, and Q-DASH scores were compared within their respective groups before and 4 weeks after treatment.

Table 1. Comparison of the demographic data of the 2 groups

		Group 1		Group 2		
		M ± S.D./n-%	Med (Min-Max)	M ± S.D./n-%	Med (Min-Max)	*P*
Age		51.6 ± 12.0	51 (34-81)	57 ± 10.4	60 (39-81)	.137
Sex	Woman	13 - 62		15 - 79		.240
	Man	8 - 38		4 - 21		
Duration of shoulder pain		16.2 ± 22.0	5 (1-84)	17.2 ± 28.3	6 (1-120)	.978

Table 2. Comparison of VAS, ROM, SPADI, and Q-DASH scores before and after treatment within groups

		Pre-Treatment		Post-Treatment		
Group 1		**M ± S.D. /n-%**	**Med (Min-Max)**	**M ± S.D. /n-%**	**Med (Min-Max)**	***P***
VAS-rest		3.1 ± 2.3	3 (0-9)	0.2 ± 0.7	0 (0-3)	< .001
VAS-motion		7.1 ± 1.1	7 (6-9)	3.2 ± 2.3	4 (6-9)	< .001
ROM-flexion	Limited	15-71		2-10		< .001
	Not limited	6-29		19-90		
ROM-external rotation	Limited	16-76		3-14		< .001
	Not limited	5-24		18-86		
SPADI-pain score		68.9 ± 14	70 (48-92)	31.4 ± 15.1	26 (12-64)	< .001
SPADI-disability score		64.2 ± 20.3	63.7 (23.7-100)	27.2 ± 17.1	23.7(6.2-68.7)	< .001
SPADI-total score		65.9 ± 16	66.1 (36.9-92)	28.8 ± 15.8	26.1(11.5-66.9)	< .001
QDASH score		56.6 ± 17.2	61.4 (18.2-77.3)	25.5 ± 11.9	22.7(11.4-47.7)	< .001
Group 2						
VAS-rest		4.1 ± 2.4	4 (0-10)	0.6 ± 1	0 (0-3)	< .001
VAS-motion		7 ± 1.8	7 (3-10)	2.6 ± 1.3	3 (0-5)	< .001
ROM-flexion	Limited	16-84		1-5		< .001
	Not limited	3-16		18-95		
ROM-external rotation	Limited	11-58		1-5		.002
	Not limited	8-42		18-95		
SPADI-pain score		66.7 ± 0.18	68 (34-100)	33.5 ± 19.1	28 (10-80)	< .001
SPADI-disability score		53.6 ± 20.6	50 (17.5-97.5)	25.9 ± 17.8	20 (7.5-76.2)	< .001
SPADI-total score		58.5 ± 18.9	53 (23.8-98.4)	28.5 ± 18.1	23.8 (8.4-77.6)	< .001
QDASH score		53.7 ± 17.2	50 (22.7-94.5)	26.1 ± 14.6	22,7 (9.1-72.7)	< .001

Q-DASH, shortened Disabilities of the Arm, Shoulder, and Hand Questionnaire; ROM, range of motion; SPADI, Shoulder Pain and Disability Index; VAS, Visual Analog Scale.

Table 3. Comparison of Pre- and Post-treatment VAS, ROM, SPADI, and Q-DASH scores and treatment gains between the 2 groups

		Group 1		Group 2		
		M ± S.D. /n-%	**Med (Min-Max)**	**M ± S.D. /n-%**	**Med (Min-Max)**	***P***
Pre-treatment						
VAS-rest		3.1 ± 2.3	3 (0-9)	4.1 ± 2.4	4 (0-10)	.052
VAS-motion		7.1 ± 1.1	7 (6-9)	7 ± 1.8	7 (3-10)	.241
ROM-flexion	Limited	15 - 71		16 - 84		.457
	Not limited	6 - 29		3 - 16		
ROM-external rotation	Limited	16 - 76		11 - 58		.217
	Not limited	5 - 24		8 - 42		
SPADI-pain score		68.9 ± 14	70 (48-92)	66.7 ± 0.18	68 (34-100)	.667
SPADI-disability score		64.2 ± 20.3	63.7 (23.7-100)	53.6 ± 20.6	50 (17.5-97.5)	.110
SPADI-total score		65.9 ± 16	66.1 (36.9-92)	58.5 ± 18.9	53 (23.8-98.4)	.187
QDASH score		56.6 ± 17.2	61.4 (18.2-77.3)	53.7 ± 17.2	50 (22.7-94.5)	.604
Post-treatment						
VAS-rest		0.2 ± 0.7	0 (0-3)	0.6 ± 1	0 (0-3)	.164
VAS-motion		3.2 ± 2.3	4 (0-7)	2.6 ± 1.3	3 (0-5)	.192
ROM-flexion	Limited	2 - 10		1 - 5		1.000
	Not limited	19 - 90		18 - 95		
ROM-external rotation	Limited	3 - 14		1 - 5		.607
	Not limited	18 - 86		18 - 95		
SPADI-pain score		31.4 ± 15.1	26 (12-64)	33.5 ± 19.1	28 (10-80)	.968
SPADI-disability score		27.2 ± 17.1	23.7 (6,2-68.7)	25.9 ± 17.8	20 (7.5-76.2)	.635
SPADI-total score		28.8 ± 15.8	26.1 (11.5-66.9)	28.5 ± 18.1	23,8 (8.4-77.6)	.694
QDASH score		25.5 ± 11.9	22.7 (11.4-47.7)	26.1 ± 14.6	22.7 (9.1-72.7)	.913
Treatment gain						
VAS-rest		2.9 ± 1.8	2 (0-7)	3.4 ± 1.9	3 (0-8)	.345
VAS-motion		3.9 ± 2.4	3 (0-9)	4.3 ± 2.0	4 (1-8)	.529
SPADI-pain score		37.5 ± 19.1	42 (0-68)	33.2 ± 14.9	36 (3.3-56)	.438
SPADI-disability score		36.9 ± 22.7	41.2 (2.5-77.5)	27.6 ± 14.2	26.3 (4.9-52.5)	.128
SPADI-total score		37.1 ± 19.6	38.2 (2.3-66.9)	30.0 ± 13.8	32.3 (8.4-53.8)	.201
QDASH score		31 ± 16.7	31.9 (0-59.1)	27.6 ± 17.1	22.8 (9.1-83.1)	.525

While a statistically significant decrease was observed in the resting ($P < .01$) and moving VAS ($P < .01$) scores of the group 1 after treatment, the limitation of flexion ROM significantly decreased from 71% (n = 15) to 10% (n = 2) after treatment ($P < .01$). The limitation of external rotation ROM was 76% (n = 16) before treatment and 14% (n = 3) after treatment. Post-treatment limitation of external rotation also reduced significantly ($P < .01$). The Shoulder Pain and Disability Index pain score of group 1 was 68.9 ± 14 before treatment and 31.4 ± 15.1 after treatment ($P < .01$). The Shoulder Pain and Disability Index disability score was 64.2 ± 20.3 before treatment and 27.2 ± 17.1 after treatment ($P < .01$). The Shoulder Pain and Disability Index total score was 65.9 ± 16.0 before treatment and 28.8 ± 15.8 after treatment ($P < .01$). After treatment, SPADI pain score, disability score, and total score decreased significantly compared to the scores before treatment. The Q-DASH score of group 1 significantly decreased after treatment, scoring 56.6 ± 17.2 before and 25.5 ± 11.9 after treatment ($P < .01$, Table 2).

In group 2, VAS scores at rest ($P < .01$) and during movement ($P < .01$) decreased significantly after treatment. The limitation of flexion ROM reduced significantly after treatment, scoring 84% (n = 16) before and 5% (n = 1) after treatment ($P < .01$). While external rotation ROM limitation was 58% (n = 11) before treatment, it was 5% (n = 1) after treatment. External rotation limitation also decreased significantly after treatment ($P = .002$). The Shoulder Pain and Disability Index pain score of group 2 was 66.7 ± 0.18 before and 33.5 ± 19.1 after treatment ($P < .01$). The Shoulder Pain and Disability Index disability score was 53.6 ± 20.6 before and 25.9 ± 17.8 after treatment ($P < .01$). The pre-treatment SPADI total score was 58.5 ± 18.9, whereas the post-treatment SPADI total score was 28.5 ± 18.1 ($P < .01$). After treatment, the SPADI pain score, disability score, and total score each decreased significantly compared to the scores before treatment. Scoring 53.7 ± 17.2 before and 26.1 ± 14.6 after treatment, the Q-DASH score of group 2 reduced significantly compared to the pre-treatment scores ($P < .01$, Table 2).

There was no significant difference between the 2 groups before and after treatment in terms of VAS scores at rest and movement, limitations of flexion and external rotation ROM, SPADI pain-disability-total scores, and Q-DASH scores ($P > .005$, Table 3).
The VAS score gain at rest was 2.9 ± 1.8 for group 1 and 3.4 ± 1.9 for group 2. There was no significant difference in VAS score gain at rest between the 2 groups ($P > .005$). The VAS score gain on movement was 3.9 ± 2.4 for group 1, while it was 4.3 ± 2.0 for group 2. There was no significant difference in VAS score gain on movement between the 2 groups ($P > .005$, Table 3).

While the SPADI pain score gain was 37.5 ± 19.1 for group 1, it was 33.2 ± 14.9 for group 2. The SPADI disability score gain was 36.9 ± 22.7 for group 1 and 27.6 ± 14.2 for group 2. The SPADI total score gain was 37.1 ± 19.6 for group 1 and 30.0 ± 13.8 for group 2. There was no significant difference was found between the 2 groups in SPADI pain-disability and total score gain ($P > .005$, Table 3).

While the Q-DASH score gain was 31.0 ± 16.7 for group 1, it was 27.6 ± 17.1 for group 2. No significant difference was found between the 2 groups in their Q-DASH score gain ($P > .005$, Table 3).

Discussion

The study aimed to investigate which technique of blinded or imaging-guided subacromial corticosteroid injection is effective in terms of clinical improvement in patients with SAIS. Our study demonstrated that shoulder pain and disability decreased, and shoulder functions and ROMs improved similarly in both groups and there was no significant difference between the 2 groups.

Studies demonstrate that needle placement is more accurate in imaging-guided subacromial corticosteroid injections, and this leads to better clinical results and long-term improvement.[6,7] Moreover, reports show that using a needle improves shoulder symptoms, regardless of whether the needle is in the targeted structure.[8]

The primary result of our study showed that both US-guided and blinded subacromial corticosteroid injections significantly decreased the pain scores as assessed by VAS at rest and movement. However, there was no significant difference between the 2 groups in terms of VAS.

In a study, Cole et al[16] applied subacromial corticosteroid injections to 1 group under US guidance and to another group blindly. Then, the patients were followed for 6 weeks. Similar to our study, the level of pain in movement measured by VAS decreased significantly in both groups, but there was no significant difference between the 2 groups.[16] In addition, another study comparing the 2 injection techniques showed that there was no significant difference between the 2 groups in terms of pain and functional evaluation.[3] Moreover, an investigation of the effectiveness of US-guided corticosteroid injections in patients with glenohumeral osteoarthritis showed that there was a statistically and clinically significant improvement in the function and pain of the shoulder up to 4 months after injection.[17]

Independent of the etiology, another study conducted on patients with shoulder pain showed that similar to our study, there was no statistically significant difference between the 2 groups in terms of movement-related pain and the general condition of the upper extremity. However, compared to landmark injections, there was a significant reduction in the resting pain of the patients who received US-guided injections in at the second week and sixth week. It is reported that this reduction may be due to the pain having an inflammatory component.[18] However, in our study, patients with rheumatologic diseases were excluded from both groups. The patients who were included in the study did not describe any inflammatory pain.

Our secondary results are shoulder ROMs, SPADI, and Q-DASH scores that we used in the clinical evaluation of upper extremity functions. While shoulder ROM, SPADI, and Q-DASH scores improved significantly in both groups after subacromial corticosteroid injections, no significant difference was found between the 2 groups.

In a Cochrane review, subacromial corticosteroid injection was found to improve ROM.[19] In our study, the limitation of shoulder flexion and external rotation significantly decreased in both groups after treatment. However, there was no significant difference between the 2 groups.

Compared to landmark injections, US-guided subacromial corticosteroid injections cause a more significant improvement in the upper extremity's general condition and functional status and more effective pain reduction.[20,21] In addition, similar to our study, reports show no superiority of 1 injection technique to another. For example, in a study that compared both injection techniques, both groups showed a significant improvement in shoulder ROM, pain, and functions. In contrast, there was no significant difference between the 2 groups.[4] Moreover, a recently reported prospective study comparing the results of landmark and US-guided subacromial corticosteroid injections in patients with SAIS showed a significant improvement in terms of shoulder pain (VAS), active ROM, and DASH scores in both groups 4r weeks after treatment.[22]

Another study comparing both injection techniques showed a significant improvement in shoulder ROM and pain in both groups. There

was a statistically significant improvement in shoulder abduction, flexion, and SPADI disability scores in patients who underwent US-guided subacromial corticosteroid injections compared to the blind injection group. However, similar to our study, there was no significant difference between the 2 groups in terms of VAS, SPADI pain score, and shoulder external rotation angles.[5] Unlike our study, injections in this study were performed by a radiology clinician experienced in soft tissue sonography. This may have caused the physician to inflict superior results in the technique he is more experienced with. Similar to our study, the decrease in pain scores did not show a significant difference between both groups.

Bhayana et al[3] showed that US-guided subacromial injections were more accurate than landmark injections, but this did not make any difference in clinical outcomes. Additionally, in a randomized double-blind prospective study in which the accuracy of injection sites for US-guided or blind subacromial corticosteroid injections was evaluated using MRI, US-guided injections were performed by a musculoskeletal radiologist while blinded injections were performed by a physiatrist using a posterior approach. There was no significant difference between the 2 groups.[4] This has led us to think that the success of the injection may be due to the experience of the injecting physicians in blind injection or in the US.

According to the literature and the results of our study, while the severity of pain was significantly reduced in both groups, no significant difference was found between the 2 groups. In this case, we can state that a subacromial corticosteroid injection reduces the severity of pain regardless of the injection technique and etiology. Other clinical results differed according to the experience of physicians in terms of US or blind injections.

We also investigated a reduction in the severity of pain regardless of the injection technique. A study comparing US-guided local subacromial corticosteroid injection and systemic corticosteroid injection in patients with rotator cuff problems showed that there was no significant difference between the groups in terms of shoulder ROM, pain, and functions.[23] In our opinion, the fact that the injection technique did not make a difference in the clinical results may have been due to the systemic effect of the corticosteroid rather than the regional effect.

The first strength of this study is that blind and US-guided injections were performed by different physicians who have been experienced in that injection technique for many years. Second, the clinical results were evaluated by a single-blinded investigator. However, this study had limitations due to the fact that it lacked long-term results.

The positive effects of subacromial corticosteroid injections performed both under US and landmark guidance on shoulder ROM, pain, disability, and functions are similar. Hence, we can conclude that using the injection technique in which the physicians are more experienced can obtain safer and more successful results.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Dr. Sadi Konuk Training and Research Hospital (number: 2018/178. Date: May 14, 2018).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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