



Review Article

Acupuncture Treatment for Shoulder Impingement Syndrome: A Review of Randomized Controlled Trials



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ABSTRACT

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To evaluate the effectiveness of acupuncture treatment for shoulder impingement syndrome (SIS) a literature review was conducted of randomized controlled trials (RCTs) where acupuncture was used as an intervention for patients diagnosed with SIS. Relevant clinical studies ($N = 181$) were retrieved from several databases based on the inclusion/exclusion criteria, and the interventions and results were analyzed. Six RCTs were selected to review based on the inclusion and exclusion criteria. In all 6 studies, the acupuncture treatment group showed significant positive changes in indicators evaluating pain, disability, and quality of life. A significant decrease in the evaluation indicators (Shoulder Pain and Disability Index, numeric rating scale, Visual Analogue Scale, Constant Murley Shoulder Assessment Score, patient's global assessment, and doctor's global assessment) and a significant increase in the questionnaire scores (UCLA, AL-score, EuroQol 5 Dimension Self-Report Questionnaire, and disabilities of the arm, shoulder, and hand) were observed. In addition, 1 study showed similar improvements in pain and quality of life measures in the acupuncture group and corticosteroid injection group. No major side effects were reported. Acupuncture may be an effective and safe treatment for SIS however, further RCTs are required.

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Introduction

Shoulder impingement syndrome (SIS) is a condition/disease which causes shoulder pain due to mechanical pressure involving the supraspinatus muscle, the long head of the biceps, and the subacromial bursa in the subacromial space [1-3].

The most common intra-joint conditions/diseases which cause pain in the shoulder joint are rotator cuff ruptures and rotator cuff conditions/diseases, including SIS. Pain in the shoulder joint has a prevalence rate of 6.6 to 25 per 1,000 patients worldwide [1] and is the 3rd most common musculoskeletal disorder in orthopedic care, 48% of which is caused by SIS worldwide [2].

In Korean society, the treatment of this condition/disease is important for improving public health. In Korea, the number of

shoulder lesions, including SIS is increasing and consequently the cost of medical care is increasing annually. In 2019, there were 2,362,145 reported cases of SIS in Korea [4].

In Western medicine there are conservative and surgical treatment options for patients with symptomatic SIS. Conservative treatments include physical therapy, platelet-rich plasma infusion, nonsteroidal anti-inflammatory drugs, corticosteroid injection, ultrasound therapy, heat therapy, electrotherapy, manual therapy, immobilization, and kinesiology taping. Surgical treatments include arthroscopic subacromial decompression, acromioplasty, and bursectomy. Western conservative and surgical treatments are reported to be effective for short-term pain relief, but are limited in the long-term therapeutic benefits for the treatment of SIS [5-7].

In Korean medicine, treatment options are conservative and

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include acupuncture, herbal medicine, electroacupuncture, moxibustion, cupping, chuna, physical therapy, exercises, pharmacoacupuncture, acupotomy, thread embedding acupuncture, and pharmacoacupuncture patch. Among these treatments, acupuncture is increasingly used for shoulder pain. However, to date, there have been no reviews of randomized controlled trials (RCTs) on SIS involving acupuncture treatment. Some studies that have reported on the treatment of shoulder pain in general however, there is a lack of research on specific problems such as SIS. Research on acupuncture treatment of SIS published in the Korean medicine journals is currently limited to 7 case reports and 1 research trend. Therefore, a review of RCTs involving acupuncture treatment of SIS was conducted using Korean and international databases to review safety and effectiveness.

Materials and Methods

Selection and exclusion criteria

The inclusion criteria: (1) studies on patients who had been diagnosed with SIS based on clinical assessments with or without radiological evidence (e.g., x-ray, ultrasound, magnetic resonance imaging); (2) RCTs of acupuncture regardless of the methods of stimulation (acupuncture, electroacupuncture, laser acupuncture, acupotomy, pharmacoacupuncture, thread embedding acupuncture) or types of needles, stimulating points (e.g., tender points, trigger points, acu-points on meridian), duration, or number of treatments; and (3) co-interventions (e.g., exercise, physiotherapy) were included in the review only if given to both the treatment and the control group.

The exclusion criteria: (1) duplicate studies; (2) studies that were not RCTs; (3) studies without full text available; (4) studies published in non-academic journals; (5) studies that did not perform acupuncture in the treatment group; (6) studies not related to acupuncture or SIS; (7) studies comparing between different methods of acupuncture (e.g., comparison between electroacupuncture and acupuncture, comparison between balanced electroacupuncture and conventional electroacupuncture, comparison between sinew acupuncture and filiform acupuncture); (8) studies which used acupuncture "as an intervention" in both the treatment and control group (e.g., a study of manipulation and acupuncture compared with acupuncture); and (9) studies in which interventions other than acupuncture and corresponding interventions are not the same (e.g., a study where manipulation techniques applied to the treatment, and control group were different).

There were no restrictions in language, date of publication, or locations of the study and no restrictions on age, sex, or ethnic origin of patients.

Databases and search methods

Cochrane Library, Embase, PubMed, China Academic Journal (CAJ), Korean Studies Information Service System (KISS), Research Information Sharing Service (RISS), and Oriental Medicine Advanced Searching Integrated System (OASIS) were used to search for studies published from 1990.01. 01 to 2020.12.20.

Searched terms including [{"shoulder impingement syndrome" OR "subacromial pain" OR "subacromial impingement syndrome"} AND {"acupuncture" OR "needle therapy"}] were used to search the Cochrane Library, Embase, PubMed, CAJ, KISS, RISS, OASIS databases.

Results

Study selection

The search resulted in retrieval of 25 studies from the Cochrane database, 71 studies in Embase, 38 studies in PubMed, 30 studies in CAJ, 4 studies in KISS, 6 studies in RISS, and 7 studies in OASIS.

A total of 181 studies were retrieved. Of these, 98 were duplicates. Of the 83 remaining studies, 38 were selected based on the title and abstract. Of these 38 studies, 23 were not RCTs and 4 studies did not have full text available and were therefore excluded. Subsequently, several studies were excluded from the remaining 11 studies identified: 1 study comparing acupuncture and electroacupuncture, 1 study comparing balanced electroacupuncture and conventional electroacupuncture, 1 study comparing acupuncture with thrust manipulation and acupuncture alone, 1 study comparing sinew acupuncture and filiform acupuncture, and 1 study where different manipulation techniques were applied to the treatment group and the control group. There were 6 studies included after considering the patients and the abstracts (Fig. 1).

The overview of selected studies

The 6 selected RCT studies were retrieved from Embase, PubMed, and CAJ, published between 2005 and 2020, and reported in English. The RCTs were conducted in Sweden ($n = 2$), Spain ($n = 3$), and Turkey ($n = 1$).

There was a total of 818 participants with SIS across the 6 RCTs included in the review. The study with the most participants had 425 individuals. Most of the studies included 50-100 individuals. The smallest study had 50 participants.

In all 6 studies the criteria for selection and exclusion were applied. The primary diagnostic criteria were pain confined to the proximal surface of the upper extremity at arm elevation, persistent symptoms for more than 2 months, positive Neer's test, positive Hawkin's Kennedy test, and a painful arc between 60° and 120° at active abduction.

Vas et al [8] included individuals with unilateral subacromial syndromes which had lasted more than 3 months. The study by Kibar et al [9] included shoulder pain lasting more than 3 months, pain over a VAS score of 4, and patients with SIS diagnosed with the Neer's test and Hawkin's Kennedy test that corresponded to Stage 1 or Stage 2 SIS on a magnetic resonance imaging scan. Garrido et al [10] included patients with unilateral injury with clinical symptoms of SIS which had lasted for more than 3 months. Studies by Johansson et al [11] and Johansson et al [12] included patients between the ages of 30 and 65 years who met the main SIS diagnostic criteria. The study by Arias-Buría et al [13] included those patients with 1 non-traumatic shoulder in pain, with a pain history of more than 3 months, and pain severity more than a numeric rating scale (NRS) score 4.

The baseline general characteristics of control and treatment groups of all the studies were similar and did not show any statistical differences (Table 1).

Interventions of the selected studies

Among the 6 selected studies, 2 used acupuncture, 1 used laser acupuncture, and 3 used acupuncture with other treatments as the intervention in the treatment group (Table 2). Treatment was usually performed once or twice a week [8,10-13]. Treatment typically lasted 4 to 5 weeks, with a range of 3 to 5 weeks. The types of acupuncture needles used were mainly stainless steel and sterile

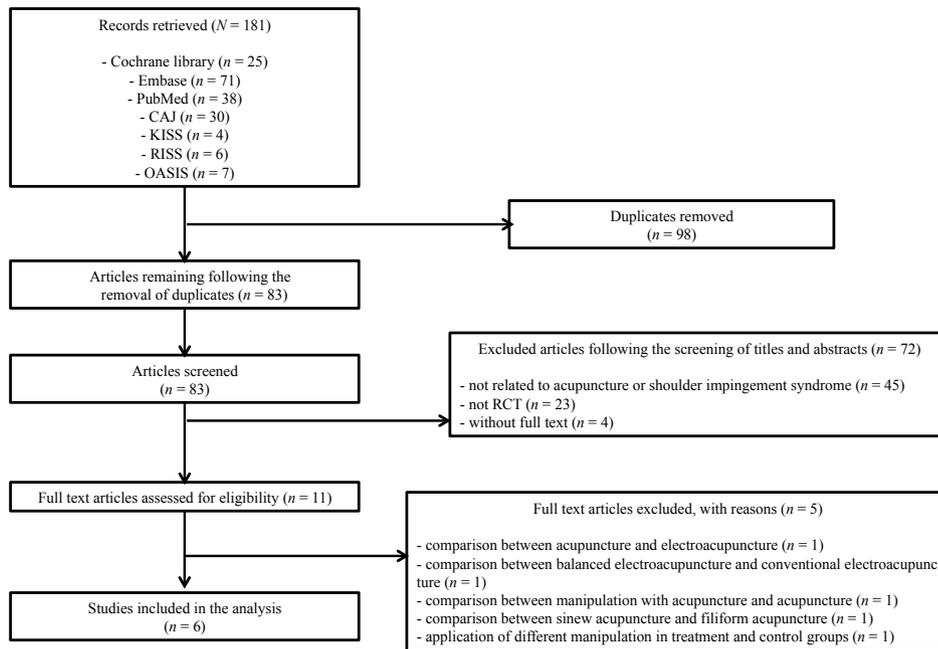


Fig. 1. Flow chart of the screening process.

Table 1. General Characteristics of Selected Studies.

Author (y)	Type	Country	Sample size	Criteria	Age, mean (± SD)	NRS/VAS, mean (± SD)	SPADI, mean (± SD)
Vas (2008) [8]	RCT	Spain	TG 205 CG 220	44-68 y NRS 3-10	TG 54.9 (10.8) CG 56.4 (11.8)	TG 8.5 (4.7) CG 8.4 (4.4)	-
Kibar (2017) [9]	RCT	Turkey	TG 36 CG 37	31-75 y VAS 0-7 SPADI 38-112	TG 64.5 CG 63	TG 2.36 (2.20) CG 2.84 (2.39)	TG 77.66 (21.98) CG 81.65 (16.76)
Rueda Garrido (2016) [10]	RCT	Spain	TG 35 CG 33	20-51 y VAS 43-83	TG 36.86 (13.94) CG 29.73 (9.76)	TG 64 (18.3) CG 63.03 (19.8)	-
Johansson (2011) [11]	RCT	Sweden	TG 42 CG 49	41-60 y VAS 31-81	TG 51 (9) CG 50 (9)	TG 57 (21) CG 56 (25)	-
Johansson (2005) [12]	RCT	Sweden	TG 44 CG 41	42-57 y	TG 49 (7) CG 49 (8)	-	-
Arias-Buría (2015) [13]	RCT	Spain	TG 25 CG 25	42-54 y NRS 5-9	TG 49 (5) CG 48 (6)	TG 7.2 (1.6) CG 6.6 (1.5)	-

CG, control group; NRS, numeral rating scale; RCT, Randomized controlled trial; SPADI, shoulder pain and disability index; TG, treatment group; VAS, visual analog scale.

hegu acupuncture needles, however Kibar et al [9] used galium-aluminum-arsenide needles. The area of the acupuncture treatment varied from study to study (Table 3). The needle retention time was usually 20 minutes but it ranged from 5 minutes to 30 minutes. The depth of the needle varied from study to study, ranging between 1.0 cm to 5.0 cm. Two studies used a needle depth of 0.3 to 1 cun (the unit of measurement [11,12]; Table 3). The most frequently

used acupoints were LI 14, LI 15, TE 14 [9-12], followed by LI 4 [9,11,12], LI 16 [9,10], S 38 [8,10], LU 1 [11,12], GB 21, LI 11, TE 15, and SI 10 [9] (Table 4). The most frequently used meridian was the LI (Table 5). The Arias-Buría study [13] used trigger points in the supraspinatus, infraspinatus, deltoid, teres minor, and teres major muscles.

Table 2. Interventions and Results of Selected Studies.

Author (y)	Intervention	Control	Outcome measurement	Result	Adverse effects
Vas (2008) [8]	Acupuncture (+ physiotherapy)	Mock TENS + physiotherapy	1. Reduction in CMS 2. Reduction in NRS	1.TG > CG ($p < 0.001$) 2.TG > CG ($p < 0.001$)	Not severe events
Kibar (2017) [9]	Laser acupuncture	Sham-laser acupuncture	1. Reduction in SPADI 2. Reduction in VAS 3. Reduction in PGA, DGA	1.TG > CG ($p < 0.001$) 2.TG > CG ($p < 0.001$) 3.TG > CG ($p < 0.001$)	Not reported
Rueda Garrido (2016) [10]	Acupuncture	Sham-acupuncture	1. Reduction in VAS 2. Increase in Kruskal-Wallis test	1.TG > CG ($p < 0.05$) 2.TG > CG ($p < 0.05$)	Not severe events
Johansson (2011) [11]	Acupuncture (+ exercise)	Corticosteroid injection + exercise	1. Reduction in VAS 2. Increase in AL-score, EQ-5D	1. No difference 2. No difference	Not severe events
Johansson (2005) [12]	Acupuncture	Ultrasound	1. Reduction in CMS 2. Increase in Kruskal-Wallis test 3. Increase in AL-score	1.TG > CG ($p = 0.045$) 2.TG > CG ($p = 0.045$) 3.TG > CG ($p = 0.045$)	No
Arias-Buría (2015) [13]	Acupuncture (+ exercise)	Exercise	1. Reduction in NRS 2. Increase in DASH questionnaire	1. No difference 2.TG > CG ($p < 0.01$)	Not severe events

AL-score, Adolphsson-Lyholm shoulder assessment score; CMS, constant Murley shoulder assessment score; DASH, disabilities of the arm, shoulder, and hand; DGA, doctor's global assessment; EQ-5D, The euroqol-five dimension self-report questionnaire; NRS, numeral rating scale; PGA, patient's global assessment; SPADI, shoulder pain and disability index; TENS, transcutaneous electrical nerve stimulation; VAS, visual analog scale.

Table 3. Implementation of Acupuncture Intervention.

Author (y)	Period	Frequency	Acupoints	Acupuncture needle	Size of needles	Depth of insertion	Needle remaining time
Vas (2008) [8]	4 wk	1 trial/wk	S 38	Sterile filiform	30 gauge \times 75 mm	4.5-5.0 cm	20 min
Kibar (2017) [9]	3 wk	3 trial/wk	GB 21, LI 4, LI 11, LI 14, LI 15, LI 16, SI 9, SI 10, SI 11, TE 14, TE 15	Gallium-aluminum-arsenide (GaAlAs), infrared laser, wavelength 850 nm, Voltage 100 mV	spot area 0.07 cm ²	4 joules/cm ²	40 s
Rueda Garrido (2016) [10]	4 wk	1 session/wk	LI 14, LI 15, LI 16, SI 9, TE 14, S38	Sterile needle	0.25 \times 40 mm	2-3 cm	20 min
Johansson (2011) [11]	5 wk	2 trial/wk	LI 4, LI 14, LI 15, LU 1, TE 14	Hegu sterile needle	0.30 \times 30 mm	0.3-1 cun	30 min
Johansson (2005) [12]	5 wk	2 trial/wk	LI 4, LI 14, LI 15, LU 1, TE 14	Hegu sterile needle	0.30 \times 30 mm	0.3-1 cun	30 min
Arias-Buría (2015) [13]	5 wk	1 trial/wk	Trps	Stainless steel needle	0.32 \times 40 mm	1-1.5 cm, 3-3.5 cm	5-10 min

GB, gallbladder meridian; LI, large intestine meridian; LU, lung meridian; S, stomach meridian; SI, small intestine meridian; TE, triple energizer meridian.

Assessment indicators

Visual Analogue Scale (VAS) scores (0 to 10) were used to assess levels of pain, where higher scores represent a greater level of pain. It is a method of measuring the length of the patient's current condition after marking the current position on a 10cm horizontal line connecting 'no pain' and 'extreme pain'. In the study by Kibar et al [9], there was a significant decrease in VAS score in the laser

acupuncture treatment group compared with the control group. In the study by Garrido et al [10], there was a significant decrease in VAS score in the acupuncture treatment group compared with the control group. In the study by Johansson et al [11], there was a significant decrease in VAS score in both the treatment group (acupuncture with exercise) and the control group (corticosteroid injections with exercise; Table 6).

Shoulder Pain and Disability Index (SPADI) indicators were

Table 4. Frequency of Acupoints in the Studies.

Frequency	Acupoints
4	LI 14, LI 15, TE 14
3	LI 4
2	LI 16, S 38, LU 1
1	GB 21, LI 11, TE 15, SI 10

LI, large intestine meridian; TE, triple energizer meridian; S, stomach meridian; LU, lung meridian; GB, gallbladder meridian; SI, small intestine meridian.

Table 5. Frequency of Meridians Used in the Studies.

Frequency	Meridians	Acupoints
14	Large intestine meridian	LI 4, LI 11, LI 14, LI 15, LI 16
5	Triple energizer meridian	TE 14, TE 15
2	Stomach meridian, Lung meridian	S 38, LU 1
1	Gallbladder meridian, Small intestine meridian	GB 21, SI 10

LI, large intestine meridian; TE, triple energizer meridian; S, stomach meridian; LU, lung meridian; GB, gallbladder meridian; SI, small intestine meridian.

Table 6. The Outcome of VAS in the Studies.

Author (y)	Treatment	Control	p
Kibar (2017) [9]	LA 0.56 ± 0.93	Sham LA 3.62 ± 1.93	< 0.001
Rueda Garrido (2016) [10]	Acu 19.85 ± 15.1	Sham acu 43.18 ± 23.2	< 0.05
Johansson (2011) [11]	Acu + exercise 82 ± 6	Corticosteroid injection + exercise 80 ± 5	< 0.001

LA, laser acupuncture; Acu, acupuncture; VAS, visual analog scale.

used. It is a questionnaire consisting of a total of 13 assessment items consisting of 5 pain subscale questions and 8 function/disability subscale questions, which shows the degree of shoulder pain and dysfunction. In the study by Kibar et al [9], there was a significant reduction in SPADI compared in the laser acupuncture group to the control group (Table 7).

NRS scores were used to assess levels of pain, which quantifies the current level of pain when the pain-free is zero and unbearable extreme pain is ten. In the study by Vas et al [13], there was a significant decrease in NRS in the acupuncture treatment group compared with the control group. In the study by Arias-Buría et al [13], there was a significant reduction in NRS in both the acupuncture with exercise group and the exercise-along group

Table 7. The Outcome of SPADI in the Studies.

Author (y)	Treatment	Control	p
Kibar (2017) [9]	LA 14 ± 5.78	Sham LA 34.5 ± 9.55	< 0.001

LA, laser acupuncture; SPADI, shoulder pain and disability index.

Table 8. The Outcome of NRS in the Studies.

Author (y)	Treatment	Control	p
Vas (2008) [8]	Acu + physiotherapy 1.6 ± 2.6	Mock TENS + physiotherapy 3.8 ± 3.1	< 0.001
Arias-Buría (2015) [13]	Acu + exercise 1.5 ± 1.4	Exercise 1.6 ± 1.5	< 0.01

Acu, acupuncture; NRS, numeral rating scale; TENS, transcutaneous electrical nerve stimulation.

Table 9. The Outcome of CMS in the Studies.

Author (y)	Treatment	Control	p
Vas (2008) [8]	Acu + physiotherapy 30.6 ± 6.9	Mock TENS + physiotherapy 22.7 ± 9.1	< 0.001
Johansson (2005) [12]	Acu 79 ± 9	Ultrasound 76 ± 11	0.045

Acu, acupuncture; CMS, Constant Murley Shoulder Assessment Score; TENS, transcutaneous electrical nerve stimulation.

(Table 8).

Constant Murley Shoulder Assessment Score (CMS) indicators were used to define the level of pain and the ability to carry out the normal daily activities of the patient by 100-points scale composed of a number of individual parameters. In the study by Vas et al [8] and Johansson et al [12], there was a significant reduction in CMS in the acupuncture group compared with the control group (Table 9).

Patient's global assessment (PGA) and doctor's global assessment (DGA) indicators were used. PGA is one of the patient-reported outcomes, whose content is associated with pain, functional limitation, psychological distress and comorbidities. DGA is a 5- or 6-point scoring system used to assess disease severity. In the study by Kibar et al [9], there was a significant decrease in PGA and DGA in the laser acupuncture group compared with the control group.

Kruskal-Wallis test (UCLA Questionnaire) was used as an indicator. It is one of shoulder assessment scale and the maximum score is 35 points. This questionnaire contains questions such as whether the pain is constant or intermittent, whether the pain requires painkillers, whether the pain relates to rest or activities, level of activity, muscle force, and satisfaction with results. In the studies by Rueda Garrido et al [10] and Johansson et al [12], there

was a significant increase in UCLA questionnaire scores in the acupuncture group compared with the control group.

Adolfsson-Lyholm Shoulder Assessment Score (AL-score) and the EuroQol 5 Dimension Self-Report Questionnaire (EQ-5D) were used as the indicators. AL-score is one of shoulder assessment scale and is a pure patient self-assessment. The maximum score is 100 points. This test contains questions such as whether the pain is at rest or during the activity, whether the pain disturbs sleep, level of activity, glenohumeral joint instability and disability. EQ-5D was used to evaluate health-related quality of life. This instrument has two parts: the EQ-5D descriptive system resulting in a health state between -1.0 (worst health) and 1.0 (full health) and the EuroQol Visual Analogue Scale (EQ-VAS). The later is a 20-cm vertical line from 0, 'worst imaginable health state', to 100, the 'best imaginable health state', and the patients mark their current state. The study by Johansson et al [11] showed significant increases in the AL-score and EQ-5D in both the acupuncture with exercise treatment group and corticosteroid injections with exercise control group. Johansson et al [12] showed a significant increase in the AL-score in the acupuncture group compared with the control group.

Disabilities of the arm, shoulder, and hand (DASH) Questionnaire was used to evaluate shoulder related disability. It consists of 30 items assessing: degree of difficulty during the preceding week in performing physical activities because of problems in the upper extremity (21 items), severity of each pain symptom, activity-related pain, tingling, weakness, and stiffness (5 items), and the problem's effect on social activities, work, and sleep, and its psychological effect (4 items). Each item is answered on a 5-point scale ranging from 1 (no symptom) to 5 (very severe symptom). Responses are summed and converted to a 0 to 100 scale where higher scores reflect greater related disability. In the study by Arias-Buría et al [13], there was a significant increase in DASH questionnaire scores in treatment group compared with control group.

Adverse events

One out of 6 studies did not mention side effects [9], 2 studies reported no side effects [10,12], and 3 studies reported minor side effects [8,11,13]. In the study by Vas et al [8], 3% in the acupuncture group and 5% in the control group had gastralgia following treatment. Johansson et al [11] reported pain, bruising, and days of worsening of symptoms, which are common reactions following acupuncture treatment. The number of patients complaining of side effects was not reported in this study [11]. In the study by Arias-Buría et al [13], 5 patients assigned to the exercise plus acupuncture (25%) experienced muscle soreness after the 1st dry needling session which resolved spontaneously within 24 to 36 hours.

Discussion

This study aimed to evaluate the clinical effects of acupuncture treatment on SIS by examining RCTs worldwide. SIS refers to a syndrome of the shoulder caused by repeated pressure on the supraspinatus, subacromial bursa, and long head of the biceps under the subacromial space [2,14,15]. SIS is the most frequent cause of pain in the anterior part of the shoulder joint. The number of patients with shoulder lesions including SIS, and the cost of medical care have been increasing every year in South Korea. SIS is common among swimmers and athletes who throw balls. If the anterior part of the acromion protrudes or slopes down excessively, it is likely to cause SIS. The diagnosis of SIS is based on past medical history and physical examination. It is necessary to ensure

that the patients keep their arms raised overhead, and physical examinations such as the Neer's test and the Hawkins Kennedy test can be conducted [15].

If SIS worsens, it can cause the rotator cuff to rupture, restrict passive ROM, and even lead to atrophy of the supraspinatus and infraspinatus muscles which can become potentially exacerbated if left unattended without proper treatment.

The treatment of SIS includes conservative and surgical treatments. Conservative treatments include physical therapy, nonsteroidal anti-inflammatory drugs, corticosteroid injections, ultrasound, heat, electrotherapy, manual therapy, immobilization, kinesiology taping, and dry needling. Surgical treatment is performed if the symptoms do not improve after conservative treatment, or if the symptoms prevent an individual from returning to their original work after 4-6 months of systematic rehabilitation [2,7]. However, studies have shown that arthroscopic subacromial decompression surgery is not more effective than physiotherapy [7]. Similarly, scapular decompression does not seem to benefit pain, function, or quality of life in adults with subacromial pain syndrome and may even cause serious harm in rare cases [16]. Exercise has been shown to be more effective than treatment with platelet-rich plasma [5]. In addition, corticosteroid injections are effective for short-term pain relief and recovery of range of movement [6], but long-term effects have not been proven. Therefore, it is necessary to investigate other SIS treatment.

SIS is recognized by Korean medicine as belonging to "Gyeonbi-tong." This refers to shoulder and arm pain. Common symptoms of "Gyeonbi-tong" in Korean medicine include pain in the shoulder, impaired function of the shoulder due to pain, heat in the affected area, coldness, hypoesthesia, and tenderness, as well as referred pain to the cervical, scapular, or upper extremity [17]. The causes of the Gyeonbi-tong, as reviewed by Heo [18] include wind, cold, and dampness in the Dongui Bogam. Kim [17] classified the causes as "inner cause" versus "outer cause." The inner cause is induced by phlegm which obstructs the meridians and blocks the blood flow, or it is described as a symptom which occurs due to pathogenic effects of the lungs and heart on both the arms. The outer cause refers to the wind, cold, and dampness invading the shoulders and arms, causing circulatory problems in the meridians, or by external affairs invading the meridians due to bruises and sprains. SIS may be attributed to the accumulation of phlegm and blockage of blood and qi flow in Korean medicine, given that it is a lesion caused by friction and pressure in the space of the shoulder joint and rotator cuff muscles. Therefore, treatments to remove phlegm within the shoulder joint and promote blood flow and qi circulation should be implemented [19].

Acupuncture is increasingly used as a non-drug therapy to treat shoulder pain. Acupuncture relieves pain by promoting energy (qi) or blood circulation, blocking pain signals through chronic pain-carrying nerves and other pain nerves, and by releasing pain-relieving chemicals [20].

There have been some RCTs which have examined the effectiveness of acupuncture for SIS and therefore, a review of these RCTs was appropriate. A total of 181 studies were retrieved from 7 international databases. A total of 6 studies were selected for analysis based on the inclusion and exclusion criteria of this review.

In the selected studies, diagnosis of SIS was based on pain in the shoulder during abduction, pain in the lateral proximal part of the upper arm, a positive Neer's test, positive signs of Hawkins-Kennedy impingement, and signs of a painful arc between 60° and 120°. The Johansson et al studies [11,12] determined that the symptoms listed above lasted for more than 2 months. Vas, Kibar, and Rueda Garrido et al [8-10] reported that these symptoms

lasted more than 3 months. The reason for the different durations of symptoms may be related to the SIS diagnostic criteria used.

Regarding the treatment group interventions in the 6 studies, 2 used acupuncture alone, 1 used laser acupuncture, and 3 used acupuncture with other treatments. Vas et al [8] used physiotherapy intervention with acupuncture, and Johansson et al [11] and Arias-Buría et al [13] used exercise intervention with acupuncture. Since there were no restrictions on the interventions amongst the controls, exercise, mock transcutaneous electrical nerve stimulation, physiotherapy, and corticosteroid injections were included.

The results of acupuncture treatment for SIS showed a statistically significant decrease in the SPADI, NRS, VAS, CMS, PGA, and DGA evaluation indicators, and a statistically significant increase in the UCLA questionnaire, AL-score, EQ-5D, and DASH questionnaire scores. These changes indicated that acupuncture was effective at improving shoulder pain and shoulder movement, as well as increasing the quality of life in patients with SIS. Additionally, 1 study of 91 patients showed acupuncture has a similar therapeutic effect to corticosteroid injection [11]. In the study by Johansson et al [11], although both treatment groups reported significant improvements over time for pain and shoulder function ($p < 0.001$), there was no significant difference between two groups in pain and shoulder function measured by AL-score, and in health-related quality of life measured by EQ-5D. However, more clinical studies are needed on the physiological changes caused by acupuncture.

In the selected studies, acupuncture was mainly applied to the anterolateral, posterior lateral subacromial, lateral brachium, and scapular areas, and to the muscles, the supraspinatus, infraspinatus, deltoid, teres minor, and teres major muscles. It was also applied to the lateral part of the calf as a remote acupuncture point for needling.

One of the 6 studies used trigger point acupuncture (TrP) for treatment [13]. TrP locations included the supraspinatus, infraspinatus, deltoid, teres minor, and teres major muscles. In the Navarro-Santana et al [21] systematic review and meta-analysis on the effectiveness of TrP dry needling on musculoskeletal non-traumatic shoulder pain, there was moderate-quality evidence of TrP dry needling reducing shoulder pain intensity short term, although the effect was small. There was also low-quality evidence that TrP dry needling may improve related disabilities with a large effect compared with a comparison group [21]. Therefore, TrP may be effective for SIS. However, further research into the long-term effects of TrP is needed.

The most frequently used acupoints were LI 14, LI 15, TE 14 [9-12], followed by LI 4 [9,11,12], followed by LI 16 [9,10], S 38 [8,10], and LU 1 [11,12], and GB 21, LI 11, TE 15, and SI 10 [9]. The most frequently used meridian was the LI.

In a previous study [22], analysis of the treatment rate for each meridian type in patients with shoulder and arm pain determined that the Yang Myeong meridian (large intestine meridian) had a significant effect on the degree of daily discomfort and reduced symptoms of shoulder pain compared with other meridians ($p < 0.05$).

In addition, meridians control pain in the areas where meridians flow. Since the main areas of pain in SIS (anterolateral part of the shoulder and lateral proximal part of the upper arm) are similar to the areas where the large intestine meridian flows, it is believed that this is the reason for the large intestine meridian to have been used most frequently for the treatment of SIS.

Side effects were not mentioned in 1 study [9], were not reported in 2 studies [10,12], and minor side effects were reported in the other 3 studies [8,11,13]. One study reported worsening

symptoms of pain over several days, which is a common reaction to acupuncture [11].

The limitation of this study was that the number of RCT studies selected was small, and the quality of the literature was not evaluated. However, the results of this study suggest that acupuncture is a safe treatment and has a significant positive effect upon symptoms of SIS. In the future, studies are needed to confirm the effectiveness of acupuncture for patients with SIS and to shed light on the mechanisms of the acupuncture treatment.

Conclusion

1. Acupuncture treatment may be effective for SIS in terms of improving shoulder pain and shoulder movement, as well as increasing the quality of life.

2. Acupuncture may be a safe treatment for SIS, given that studies reviewed did not report any significant side effects caused by acupuncture.

3. One study has showed that acupuncture had a similar therapeutic effect to corticosteroid injection in SIS patients in terms of reducing pain and improving quality of life.

4. Due to several limitations in this review, more clinical studies are needed to determine the effectiveness of acupuncture treatment for SIS.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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