

Feasibility and efficacy of the Vojta therapy in subacromial impingement syndrome: a randomized controlled trial

María Lidia Juárez-Albuixech¹, Olga Redondo-González², Inmaculada Tello-Díaz-Maroto³, Jorge Lucas Torres de la Guía⁴, Jorge Hugo Villafañe^{5,*}, Carmen Jiménez-Antona⁶

¹Servicio de Rehabilitación. Hospital Universitario doctor Peset. Valencia, Spain

²Preventive Medicine and Public Health Service, University Hospital of Guadalajara, Guadalajara, Spain

³Autónoma University, Madrid, Spain

⁴Quintanar de la Orden Health Centre, Toledo, Spain

⁵IRCCS Fondazione Don Carlo Gnocchi, Milan, Italy

⁶Rey Juan Carlos University, Madrid, Spain

Subacromial impingement syndrome (IS) is a common disorder associated with functional impairment and disability of the shoulder. The aim of this study was to evaluate the efficacy of Vojta therapy (VT) techniques compared with standard therapy (ST) in patients with subacromial IS. A randomized controlled trial was performed, with 60 patients with IS (mean age, 61 ± 12 years) randomized into two groups: ST (n = 30) and ST plus Vojta therapy (SVT, n = 30). Both received 15 treatment sessions over 4 weeks. Outcome measures included pain intensity, functionality, joint range of motion (RoM), strength, and quality of life measurements. The efficacy of both treatments was analysed, both com-

paratively and separately, immediately after completion of treatment and after 3 months. After the intervention, both groups showed statistically significant differences in visual analogue scale ($P=0.001$), RoM ($P<0.01$), and strength ($P<0.001$), which were also seen 3 months after the intervention. SVT is more efficient in both the short and medium term in reducing pain, improving functionality, increasing articular RoM and strength, and offering a better quality of life in IS patients.

Keywords: Subacromial impingement syndrome, Pain, Vojta therapy, Musculoskeletal disorder

INTRODUCTION

Subacromial impingement syndrome (IS) consists of an irritation of the rotator cuff tendons where they pass through the coracoacromial arch during shoulder elevation. This causes a narrowing acromiohumeral distance, which is thought to be the cause of subacromial IS-related pain in the anterolateral and upper shoulder, frequently reducing its functionality, mainly with regard to abduction, rotation, and flexion of over 60° (Ishii et al., 2021; Michener et al., 2004).

Patient ages (range, 42–58 years) are typical for IS (Kuhn, 2009). The prevalence of shoulder pain is reported to range between 7% and 27% in the general population and can be even higher in athletic populations with frequent overhead arm activity, where it

can range from 36% to 66%. Shoulder pain has an incidence of 9–25 cases per 103 population/yr (Villafane et al., 2019). Indeed, IS is the most frequent alteration of the shoulder's articular complex of diverse aetiology (Calis et al., 2011). Due to the pain, 40% to 50% of those affected seek medical attention; the pain persists 12 months after the first medical consultation in half of these cases (van der Windt et al., 1996), causing a lack of productivity and a considerable drain on healthcare resources (Bongers, 2001).

Initial treatment of IS is conservative in most cases (Varela et al., 2013). If the initial treatment fails, arthroscopy may be recommended for decompression (Guyette et al., 2002). The standard treatment (ST) applied in the physiotherapy unit (UF) is prescribed by a rehabilitation specialist, consisting of one or more of the following procedures: transcutaneous electrical nerve stimulation

*Corresponding author: Jorge Hugo Villafañe  <https://orcid.org/0000-0002-3239-7626>
IRCCS Fondazione Don Carlo Gnocchi, Piazzale Morandi 6, Milan 20121, Italy
Email: mail@villafane.it

Received: June 5, 2021 / Accepted: July 9, 2021

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

(TENS), ultrasound therapy, kinesiotherapy, and cryotherapy (Tav-eggia et al., 2016).

Reflex locomotion or Vojta therapy (VT) consists of administering pressure to defined zones of the body with the patient in the prone, supine, or side-lying position to activate global and innate locomotive patterns or complexes, namely the creeping reflex and the rolling reflex. Both complexes provoke coordinated, rhythmic activation of the skeletal musculature throughout the entire body (Juarez-Albuixech et al., 2020). This enables a change from pathological patterns to alternative physiological patterns that are painless, efficient, and functional, by means of generating significant global effects, including the axial extension of the spine, correct positioning of the shoulder girdle, and activation of the abdominal musculature (Phillips, 2014), all of which are altered by shoulder pathologies. We hypothesise that VT is a safe and efficient conservative alternative. This new possibility, which would be accessible to any physiotherapeutic facility, could have a considerable economic and social impact, considering that it sustains and even improves patient functionality over time. Our objective was to examine the effectiveness of a VT and standard approach relative to a standard intervention in patients with subacromial IS.

MATERIALS AND METHODS

Study design

This is an analytical experimental study conducted as a random-

ized clinical trial with two parallel intervention levels: a control group and an experimental group. All patients were diagnosed with IS. All participants read and signed an informed consent form prior to study enrolment. The study protocol was approved by the local Ethical Committee of the Mancha Central Hospital and conducted in accordance with the Helsinki declaration. This project was retrospectively registered in *ClinicalTrials.gov* with the number NCT04102397 in September 25, 2019. The assignment process for either the standard or experimental therapy, as well as the subjects who did not participate in the final study are shown in Fig. 1.

Participants

Sixty-five potentially eligible patients were recruited from IS associations from February 2015 through December 2016. Inclusion criteria for this study were: Patients aged between 18 and 85 years and diagnosed previously with IS, who fulfil at least three of the following criteria: (a) pain in active abduction (70°–120°), considered impingement +; (b) pain on palpation of any of the following osteotendinous insertions: infraspinatus, teres minor, supraspinatus, subscapularis, and biceps; (c) pain in any of the following isometric contractions: abduction (first 10°), internal rotation (in the anatomical position and with 90° elbow flexion), and shoulder flexion; (d) positive on the Neer and Hawkins tests (Phillips, 2014); or (e) night-time shoulder pain. Patients were excluded from enrolment if they had signs of a full-thickness rotator cuff tear; acute inflammation or cervical radicular pain; calcification of

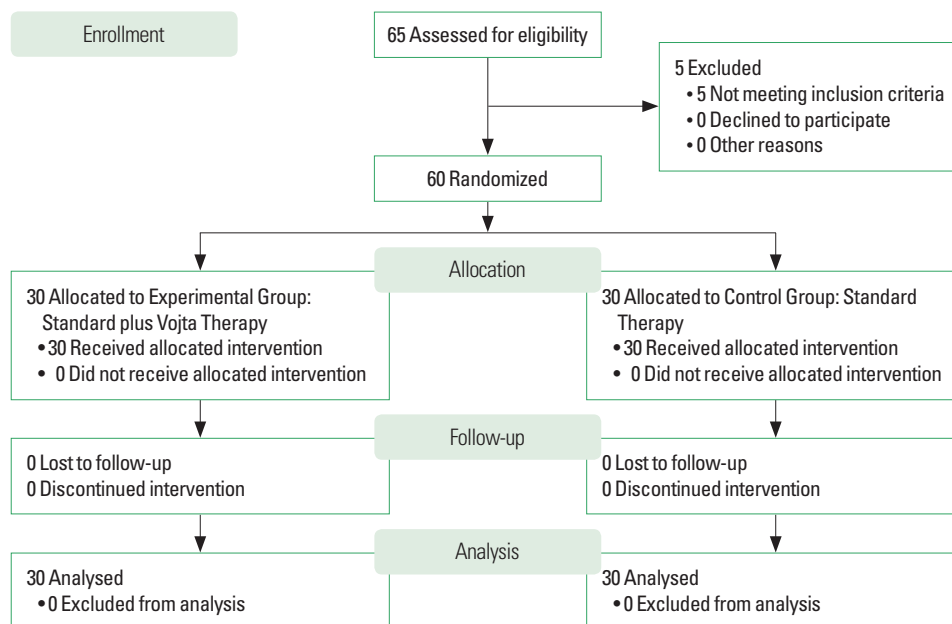


Fig. 1. Consort flow chart.

the cuff tendons; glenohumeral instability; previous shoulder surgery; limited passive joint balance; pain due to suspected visceral or infectious process; shoulder pain of neurological origin; bilateral involvement; physiotherapeutic treatment in the past 6 months; aged < 18; or physical and/or psychological dependence.

Randomization and blinding

The randomization sequence was generated using the programme EPIDAT ver. 4.2 (Xunta de Galicia, Galicia, Spain). The sequence consisted of random permutation blocks, each with four to six elements of length, to avoid imbalances in the groups in case of attrition. The sequence was concealed in sealed, serialised, opaque envelopes (Schulz et al., 1995). The necessary sample size was calculated taking into account the number of samples required for the main result indicator (level of pain). We expected to find an improvement of at least 2 points with the implementation of VT. We therefore assumed a variability of 2.5 points (standard deviation) on the pain scale, a value previously estimated in patients suffering shoulder pain in the same healthcare area. In order to detect this difference with a power of 80% (β error = 20%) and a 95% confidence interval (CI) (α error = 5%), it was necessary to recruit 25 patients per group.

Interventions

The patients that fulfilled all inclusion criteria and gave their informed consent to participate were assigned either to the control group or to the experimental group at random and with equal probability. Interventions in both groups were applied by the same physical therapist with 3-year experience in manual therapy and the management of musculoskeletal pain disorders. Both groups were provided with the same instructions regarding effectiveness of the treatment.

- (a) Control group: standard therapy (ST) (~50 min/session):
 - TENS (20 min, phase duration = 0.10 μ sec, frequency = 50 Hz). The intensity applied depended on the patient's tolerance for the treatment (Fig. 2A). Ultrasound (5 min, frequency = 1 MHz, intensity = 1 W/cm²) (Fig. 2B).
 - Kinesiotherapy. In stages: at first assisted (with isometric exercises), then free, and finally, with resistance, usually using elastic bands (Fig. 2C).
 - Cryotherapy (5 min).
- (b) Experimental group: standard plus VT (SVT) (VT, ~20 min/session): application of the reflex creeping complex, activating several stimulus points on the facial and the nuchal sides (Fig. 3A), and then activation of the reflex rolling complex



Fig. 2. Control group. (A) Application of transcutaneous electrical nerve stimulation current. Placement of four electrodes on the skin of the areas identified as the most painful (normally under the acromion and above the supraspinatus. Application of cathodes at the most painful points, and of the anodes near them. (B) Application of pulsating ultrasound. (C) Rehabilitation through kinesiotherapy.



Fig. 3. Experimental group. (A) Crawling reflex. Stimulation of the acromial area and the buttock on the nuchal side. (B) Rolling reflex, supine position. Stimulation of the pectoral area with head-guided resistance. (C) Rolling reflex, lateral position. Areas of stimulation: medial edge of the scapula and anterior superior iliac spine from the top side.

in both the supine position and with the patient lying on their side (Fig. 3B, C), alternating between nuchal and facial stimulation and guiding from the head.

Outcome measures

Changes in the following variables; pain (main result indicator), RoM, strength, functionality; and quality of life (QoL), were analysed using validated measurement scales. Pain intensity was assessed using a visual analogue scale (VAS=0: no pain, and VAS=10: maximum pain) (Hjermstad et al., 2011). The Disabilities of the Arm, Shoulder, and Hand (DASH) Questionnaire was used, which is the most commonly used questionnaire to globally evaluate the functionality of the upper limbs from the patient's perspective. It has excellent reproducibility, high sensibility, good internal consistency, and a high sensitivity to changes (Hervas et al., 2006). The Constant-Murley Scale (CMS) was also used, which is an evaluation system of shoulder functionality more commonly used in Europe and the United States. It assesses pain, functionality, strength, and joint RoM (Constant et al., 2008). QoL was assessed using the 12-item Short Form (SF-12) Health Survey. A shortened version of the 36-item Short Form, this survey has a high internal consistency, validity, and reliability. It is the most widely used health measurement in the medical field. Using 12 categories, it evaluates eight positive and negative dimensions of physical and mental health, and, by extension, of QoL (Schulz et al., 1995). These questionnaires were given to each patient three times: after signing the informed consent form, at the end of the 15 therapy sessions, and 12 weeks after the start of the therapy. An assessor blinded to the patients' allocated group obtained measurements at baseline, immediately after the 15-session treatment period, and at 3 months after the treatment.

Statistical analysis

Data were analysed using IBM SPSS Statistics ver. 22.0 (IBM Co., Armonk, NY, USA), with an intention-to-treat analysis using the last-value-forward method. The results are expressed as means, standard deviations, and/or 95% CIs. The Kolmogorov–Smirnov test showed a normal distribution of the data. Separate 2×3 mixed model analysis of variances, with the group (experimental, control) as the between-subjects factor and time (baseline, postintervention at 4 weeks, and 3-month follow-up) as within-subject factors, were conducted to examine the effects of the intervention on VAS, DASH, and CMS as the dependent variables. The main hypothesis of interest was the group×time interaction. *post hoc* comparisons were conducted with Bonferroni correction. Between-

groups effect sizes were calculated using Cohen *d* coefficient. We considered an effect size greater than 0.8 large, around 0.5 moderate, and less than 0.2 small (Citrome and Magnusson, 2014). The statistical analysis was conducted at a 95% CI and $P < 0.05$ was considered statistically significant.

RESULTS

Patient demographic and clinical data

Sixty-five consecutive patients were screened and 60 patients (61 ± 12 years, 70% women) were eligible and agreed to participate. Fig. 1 shows the recruitment and retention of patients throughout the trial. Baseline characteristics of the patients in each group are presented in Table 1. No significant differences were found between the characteristics of the two treatment groups.

Pain intensity

The time factor ($F = 146.312$; $P < 0.001$) and the group×time interaction ($F = 61.142$; $P < 0.001$) were significant for pain intensity measured by VAS. *post hoc* analysis indicated that patients with IS receiving the experimental therapy had a significant reduction in pain in the postintervention period (experimental group: mean, 3.9; 95% CI, 3.2–4.6; control group: mean, 1.0; 95% CI, 0.3–1.7, $P = 0.003$; significant difference between groups 1.5; 95% CI, 0.4–2.5; $P = 0.006$), as well as at 3-month follow-up (experimental group: mean, 5.3; 95% CI, 3.4–6.1, $P < 0.001$; control group: mean, 1.1; 95% CI, 0.4–1.8; $P = 0.001$; difference between groups 2.8; 95% CI, 1.7–3.8; $P < 0.001$) period (Table 2). Between-groups effect sizes were large ($d = 1.1$) after the intervention and ($d = 1.4$) at 3-month follow-up.

Table 1. Characteristics of patients at baseline

Characteristic	Exp (N=30)	Con (N=30)	P-value
Age (yr)	58.5±13	63.5±10.5	0.105
Weight (kg)	78.1±16.2	78.6±14.3	0.119
Height (cm)	160.6±9.6	161±8.9	0.186
Body mass index (kg/m ²)	30.0±6.1	30.6±5.0	0.263
Progression time (mo)	18.6±37.3	11.1±11.3	0.340
Gender			
Female	19 (63.3)	23 (76.7)	0.260
Male	11 (36.7)	7 (23.3)	
Level of education			
Primary	25 (83.3)	27 (90)	0.220
Secondary	4 (13.3)	3 (10)	
Advanced	1 (3.3)	-	

(Continued to the next page)

Table 1. Continued

Characteristic	Exp (N=30)	Con (N=30)	P-value
Employment status			0.609
On leave	1 (3.7)	-	
Active	8 (25.9)	6 (20.7)	
Retired	8 (25.9)	6 (20.7)	
Homemaker	11 (37.1)	16 (51.7)	
Unemployed	2 (7.4)	2 (6.9)	
Type of work			0.519
UL mobility	23 (76.7)	25 (83.3)	
UL sedentary	7 (23.3)	5 (16.7)	
Affected limb			0.301
Left	16 (53.3)	12 (40)	
Right	14 (46.7)	18 (60)	
Dominant limb			0.196
Yes	12 (40)	17 (56.7)	
No	18 (60)	13 (43.3)	
Analgesics			0.999
Yes	15 (50)	16 (53.3)	
No	15 (50)	14 (46.7)	
Previous treatments			0.467
None	17 (56.7)	15 (50)	
Physiotherapy	5 (16.7)	6 (20)	
Drugs	4 (13.3)	7 (23.3)	
Drugs and physio	4 (13.3)	2 (6.7)	
Sedentary habits			0.999
Yes	4 (13.3)	3 (10)	
No	26 (86.7)	27 (90)	
No. of CV risk factors			0.237
0	19 (63.3)	16 (53.3)	
1	7 (23.3)	10 (33.3)	
2	4 (13.3)	2 (6.7)	
3	-	2 (6.7)	
Tobacco use			
Yes	4 (13.3)	2 (6.7)	
No	26 (86.7)	28 (93.3)	
Hypothyroidism			0.492
Yes	2 (6.7)	-	
No	28 (93.3)	30 (100)	
Mood disorders			0.999
Yes	3 (10)	4 (13.3)	
No	27 (90)	26 (86.7)	
Neuromuscular disorders			0.353
Yes	1 (3.3)	4 (13.3)	
No	29 (96.7)	26 (86.7)	
Osteoarticular diseases			0.542
Yes	24 (80)	22 (73.3)	
No	6 (20)	8 (26.7)	

Values are presented as mean ± standard deviation or number (%).
Exp, experimental group; Con, control group; UL, upper limb; CV, cardiovascular.

Table 2. Pain intensity and disability

Outcome	Group				Difference within groups				Difference between groups			
	Pre		Post		FU		FU minus Pre		Post		FU	
	Exp (n=30)	Con (n=30)	Exp (n=30)	Con (n=30)	Exp (n=30)	Con (n=30)	Exp (n=30)	Con (n=30)	Exp minus Con (n=60)	Con minus Exp (n=60)	Exp minus Con (n=60)	Con minus Exp (n=60)
VAS	7.7±1.0	6.2±1.4	3.8±1.9	5.3±2.0	2.4±1.6	5.1±2.2	-3.9*±0.2	-1.0*±0.3	-5.3*±0.3	-1.1*±0.3	1.5 [†] (0.4-2.5)	2.8 [†] (1.7-3.8)
DASH	57.0±14.7	50.0±15.1	33.1±15.0	49.5±19.9	27.6±14.8	49.5±21.2	-23.9*±2.7	-0.5±2.8	-29.4*±3.2	-0.5±3.1	16.5 [†] (6.2-26.7)	21.9 [†] (11.3-32.5)
CMS affected	25.1±7.5	34.3±9.7	56.1±14.4	39.2±13.6	63.9±12.8	42.7±15.1	31.0*±2.1	4.9±2.1	38.9*±2.3	8.4±2.3	16.9 [†] (9.6-24.3)	21.2 [†] (13.9-28.6)
CMS unaffected	71.0±14.8	72.0±12.5	74.9±13.8	73.1±11.5	76.3±12.4	71.4±12.8	3.9±1.1	1.1±1.1	5.3±1.6	-0.6±1.6	1.9(-4.9 to 8.7)	4.9(-1.8 to 11.7)

Values are presented as mean ± standard deviation or mean (95% confidence interval) difference between groups.
Exp, experimental group; Con, control group; Pre-post, pre and post treatment; FU, follow-up; VAS, visual analogue scale; DASH, disabilities of the arm, shoulder, and hand; CMS, Constant-Murley Scale.
*P<0.05, significant difference within-group. [†]P<0.05, significant difference between-group.

Disability

The outcome for DASH, RoM, and strength of the affected limb (CMS) demonstrated a significant time factor ($F = 22.937$ and 115.838 , both $P < 0.001$) and a significant group \times time interaction ($F = 21.265$ and 52.624 ; both $P < 0.003$), respectively. The *post hoc* testing revealed significant increases in DASH and CMS postintervention compared with the baseline data (all, $P < 0.002$), and at 3-month follow-up (all, $P < 0.001$), in patients receiving the SVT protocol. There were significant differences between the groups ($P = 0.02$) at postintervention and the 3-month follow-up ($P < 0.001$) (Table 2).

Quality of life

In terms of QoL, ST led to improvements in two dimensions immediately after treatment: role-physical ($P = 0.01$) and vitality ($P = 0.004$). These improvements persisted 3 months after the con-

clusion of treatment ($P = 0.04$ and $P = 0.01$, respectively). Patients who received SVT also noted the following changes upon completion of therapy: improved physical functioning ($P = 0.01$); a reduction of bodily pain ($P < 0.0001$); better general health ($P = 0.04$), and improved mental health ($P = 0.008$). When compared to baseline values, the results showed that the changes in physical functioning ($P = 0.006$), bodily pain ($P = 0.002$), and mental health ($P = 0.002$) were maintained after the 3-month follow-up period (Table 3).

DISCUSSION

These results indicate that upon completion of either the standard or experimental therapy, as well as after the 3-month follow-up period for either treatment, patients noted improvements in pain, RoM, and strength. However, the results are clearly superior when VT is added to the treatment. Furthermore, improvements in functionality and QoL were only observed in patients receiving VT along with the ST.

Specifically, upon completion of SVT and after the 3-month follow-up, the decrease in pain experienced by patients as measured using the VAS scale was 3.0 and 4.2 points greater, respectively, than that experienced by patients in the control group. The literature contains several studies that have observed reductions in bodily pain at the end of ST according to the VAS scale. The efficacy of different modalities (ultrasound therapy, laser treatments, and therapeutic exercises) (Calis et al., 2011) for treating the pain caused by IS have been assessed, and although the majority of studies have focused on the effects of therapeutic exercises (Holmgren et al., 2012; Lewis, 2012; Litchfield, 2013), all treatment methods have been shown to lead to improvements. In our study, the efficacy of the experimental treatment was not only maintained, but also increased after 3 months.

Indeed, our results from the DASH test show that functionality only improved after SVT, an improvement that was 3.5 points greater after the 3-month follow-up period. Likewise, at the end of the treatment period, changes in the role-physical subdomain of the SF-12 Survey were only observed in the SVT group, with these effects increasing by 17 points at the end of the 3-month follow-up. Other authors have made reference to improvements in functionality according to the DASH scale after applying strengthening exercises (Lewis, 2012); however, these studies contain no short- or long-term follow-up analyses.

We also found that deficits in RoM and strength (as measured using the Constant-Murley Scale) improved in both groups, an

Table 3. Comparison of the evolution of joint pain, functionality, strength, and range of motion between the two groups under treatment (standard and experimental) after therapy completion and a 3-month follow-up*

Variable	Standard	t	P-value
VAS basal-final Standard	-0.97	7.714	<0.0001
VAS basal-final Standard+Vojta	-3.95		
VAS basal-3 months Standard	-1.10	10.393	<0.0001
VAS basal-3 months Standard+Vojta	-5.34		
VAS final-3 months Standard	-0.14	3.477	0.001
VAS final-3 months Standard+Vojta	-1.43		
DASH basal-final Standard	-0.30	6.489	<0.0001
DASH basal-final Standard+Vojta	-24.58		
DASH basal-3 months Standard	-0.52	6.476	<0.0001
DASH basal-3 months Standard+Vojta	-29.41		
DASH final-3 months Standard	-0.61	1.773	0.084
DASH final-3 months Standard+Vojta	-5.30		
CMS affected basal-final Standard	4.83	-8.781	<0.0001
CMS affected basal-final Standard+Vojta	30.87		
CMS affected basal-3 months Standard	8.41	-8.245	<0.0001
CMS affected basal-3 months Standard+Vojta	38.85		
CMS affected final-3 months Standard	3.55	-0.089	0.930
CMS affected final-3 months Standard+Vojta	7.84		
CMS unaffected basal-final Standard	0.99	-2.280	0.029
CMS unaffected basal-final Standard+Vojta	3.70		
CMS unaffected basal-3 months Standard	-0.62	-2.104	0.043
CMS unaffected basal-3 months Standard+Vojta	5.36		
CMS unaffected final-3 months Standard	-1.65	-0.672	0.506
CMS unaffected final-3 months Standard+Vojta	1.37		

VAS, visual analogue scale; DASH, disabilities of the arm, shoulder, and hand; CMS, Constant-Murley Scale.

*Hypothesis testing carried out with Student t-test for independent samples.

improvement that was 26 points greater when VT was added to ST. Three months after the completion of treatment, these improvements were even greater—30 points—for the SVT group. Several authors have estimated a significant improvement of 15 points when patients perform exercises aimed specifically at the scapula and rotator cuff stabilisers compared to nonspecific exercises (Holmgren et al., 2012). Others have likewise observed improvements in this scale after the application of certain exercises (Lewis, 2012; Litchfield, 2013). Using the SF-12 Survey, we have demonstrated that the symptoms of IS have a negative impact on a patient's QoL, physical capacity, relationship with their surroundings, and emotional state. Again, we found that there were significant changes in most of these dimensions in the experimental group, both at the end of treatment and after the 3-month follow-up. In the control group, changes were noted in fewer parameters. The characteristics of the patients who participated in our study coincide with those described in the literature (Calis et al., 2011; Garcia et al., 2016; Hanratty et al., 2012; Holmgren et al., 2012; Lewis, 2012; Litchfield, 2013; Michener et al., 2004; Tate et al., 2010; van der Windt et al., 1996). In addition, in our study population, 52% had undergone surgery to the abdominal wall, which may have contributed to alterations in the shoulder in the medium- to long-term due to insufficiencies of the abdominal musculature. Unfortunately, it is difficult to compare our results with those of other studies on VT, which have only evaluated its efficacy in treating other pathologies in adult populations. For example, Juehring and Barber combined VT and Neuromuscular Dynamic Stabilisation therapies in chronic migraine patients, observing positive effects on the pressure regulation of the circulatory system and pain reduction (Juehring and Barber, 2011), and Henze (2005) applied VT in the treatment of multiple sclerosis, achieving improvements in gait speed and stride length. Pavlú et al. (2000) applied this type of therapy in healthy adults in order to check its kinesiological effect by means of surface electromyography, finding changes in activation of the trunk and the four extremities (Pavlú et al., 2000). This finding coincides with the type of improvements we observed in the upper limbs of our experimental group, both on the affected and healthy side, due to the global effect of Vojta activation. Indeed, several authors have described this global activation pattern, noting improvements in respiratory frequency and total body mobility (Epple et al., 2020). Our results corroborate this activation through VT and the ability of this treatment to modify patient QoL in a way that is maintained over time.

The most common modalities of physiotherapy used in the treatment of IS include electroanalgesics, TENS, ultrasound, cryo-

therapy, kinesiotherapy, and exercise programmes. TENS is one of the least invasive techniques for treating pain and is the most used in our healthcare centre. Like other authors, we have argued for the positive effects achieved with TENS in reducing pain and increasing mobility (Zaniewska et al., 2012). With regard to ultrasound, most studies show that it is no more effective than a placebo in treating shoulder pain (Faber et al., 2006; Michener et al., 2004). As for kinesiotherapy, the exercises produce positive short- and long-term results in pain reduction and increased functionality, albeit with varying results (Kuhn, 2009; Michener et al., 2004; Varela et al., 2013).

The limitations of our study stem from its design, which did not include a nontreatment control group or a placebo group. Since the population sample was intentional, the data is not applicable to populations assigned to healthcare areas other than that used in our study. The lack of follow-up beyond 3 months is another limitation. It must also be noted that IS encompasses different pathologies with diverse anatomopathological origins; in fact, there is no consensus on the actual diagnosis of IS (Guyette et al., 2002; Michener et al., 2004). This may lead to distinct disease progressions upon treatment, which could distort the type and magnitude of response from patients with different profiles.

In conclusion, considering the number of athletes affected by subacromial IS, the growing number of athletes over 40 years old, the lack of curative treatments, and the side effects of many pharmacological pain treatments, more research in this field is necessary. In addition, the study of methods involving noninvasive interventions to achieve symptom relief is also crucial. In this study, we have evaluated for the first time the use of VT applied to IS. This procedure has been shown to be a safe and efficient conservative alternative, as it contributes to improving patient QoL with significant results that are superior to those of standard therapies, not only in the reduction of bodily pain, but also in the recovery of functionality, RoM, and strength. This new possibility, which would be accessible to any physiotherapeutic facility, could have a considerable economic and social impact, considering that it sustains and even improves patient functionality over time.

CONFLICT OF INTEREST

No potential conflict of interest to this article was reported.

ACKNOWLEDGMENTS

The authors received no financial support for this article.

REFERENCES

- Bongers PM. The cost of shoulder pain at work. *BMJ* 2001;322:64-65.
- Calis HT, Berberoglu N, Calis M. Are ultrasound, laser and exercise superior to each other in the treatment of subacromial impingement syndrome? A randomized clinical trial. *Eur J Phys Rehabil Med* 2011;47:375-380.
- Citrome L, Magnusson K. Paging Dr Cohen, Paging Dr Cohen... An effect size interpretation is required STAT!: visualising effect size and an interview with Kristoffer Magnusson. *Int J Clin Pract* 2014;68:533-534.
- Constant CR, Gerber C, Emery RJ, Sojbjerg JO, Gohlke F, Boileau P. A review of the Constant score: modifications and guidelines for its use. *J Shoulder Elbow Surg* 2008;17:355-361.
- Epple C, Maurer-Burkhard B, Lichti MC, Steiner T. Vojta therapy improves postural control in very early stroke rehabilitation: a randomised controlled pilot trial. *Neurol Res Pract* 2020;2:23.
- Faber E, Kuiper JL, Burdorf A, Miedema HS, Verhaar JA. Treatment of impingement syndrome: a systematic review of the effects on functional limitations and return to work. *J Occup Rehabil* 2006;16:7-25.
- García I, Lobo C, Lopez E, Servan JL, Tenias JM. Comparative effectiveness of ultrasonophoresis and iontophoresis in impingement syndrome: a double-blind, randomized, placebo controlled trial. *Clin Rehabil* 2016;30:347-358.
- Guyette TM, Bae H, Warren RF, Craig E, Wickiewicz TL. Results of arthroscopic subacromial decompression in patients with subacromial impingement and glenohumeral degenerative joint disease. *J Shoulder Elbow Surg* 2002;11:299-304.
- Hanratty CE, McVeigh JG, Kerr DP, Basford JR, Finch MB, Pendleton A, Sim J. The effectiveness of physiotherapy exercises in subacromial impingement syndrome: a systematic review and meta-analysis. *Semin Arthritis Rheum* 2012;42:297-316.
- Henze T. Managing specific symptoms in people with multiple sclerosis. *Int MS J* 2005;12:60-68.
- Hervas MT, Navarro Collado MJ, Peiro S, Rodrigo Perez JL, Lopez Mateu P, Martinez Tello I. Spanish version of the DASH questionnaire. Cross-cultural adaptation, reliability, validity and responsiveness. *Med Clin (Barc)* 2006;127:441-447.
- Hjermstad MJ, Fayers PM, Haugen DF, Caraceni A, Hanks GW, Loge JH, Fainsinger R, Aass N, Kaasa S; European Palliative Care Research Collaborative (EPCRC). Studies comparing Numerical Rating Scales, Verbal Rating Scales, and Visual Analogue Scales for assessment of pain intensity in adults: a systematic literature review. *J Pain Symptom Manage* 2011;41:1073-1093.
- Holmgren T, Björnsson Hallgren H, Oberg B, Adolfsson L, Johansson K. Effect of specific exercise strategy on need for surgery in patients with subacromial impingement syndrome: randomised controlled study. *BMJ* 2012;344:e787.
- Ishii D, Kenmoku T, Tazawa R, Nakawaki M, Nagura N, Muneshige K, Saito K, Takaso M. Limitation of the external glenohumeral joint rotation is associated with subacromial impingement syndrome, especially pain. *JSES Int* 2021;5:430-438.
- Juarez-Albuixech ML, Redondo-Gonzalez O, Tello I, Collado-Vazquez S, Jimenez-Antona C. Vojta Therapy versus transcutaneous electrical nerve stimulation for lumbosciatica syndrome: a quasi-experimental pilot study. *J Bodyw Mov Ther* 2020;24:39-46.
- Juehring DD, Barber MR. A case study utilizing Vojta/Dynamic Neuromuscular Stabilization therapy to control symptoms of a chronic migraine sufferer. *J Bodyw Mov Ther* 2011;15:538-541.
- Kuhn JE. Exercise in the treatment of rotator cuff impingement: a systematic review and a synthesized evidence-based rehabilitation protocol. *J Shoulder Elbow Surg* 2009;18:138-160.
- Lewis JS. A specific exercise program for patients with subacromial impingement syndrome can improve function and reduce the need for surgery. *J Physiother* 2012;58:127.
- Litchfield R. Progressive strengthening exercises for subacromial impingement syndrome. *Clin J Sport Med* 2013;23:86-87.
- Michener LA, Walsworth MK, Burnet EN. Effectiveness of rehabilitation for patients with subacromial impingement syndrome: a systematic review. *J Hand Ther* 2004;17:152-164.
- Pavlu D, Vele F, Havlickova L. Electromyographic and kinesiological analysis of Vojta's therapeutic principle. *Rehabil Fyz Lek* 2000;7:67-75.
- Phillips N. Tests for diagnosing subacromial impingement syndrome and rotator cuff disease. *Shoulder Elbow* 2014;6:215-221.
- Schulz KF, Chalmers I, Hayes RJ, Altman DG. Empirical evidence of bias. Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *JAMA* 1995;273:408-412.
- Tate AR, McClure PW, Young IA, Salvatori R, Michener LA. Comprehensive impairment-based exercise and manual therapy intervention for patients with subacromial impingement syndrome: a case series. *J Orthop Sports Phys Ther* 2010;40:474-493.
- Taveggia G, Borboni A, Salvi L, Mule C, Fogliari S, Villafane JH, Casale R. Efficacy of robot-assisted rehabilitation for the functional recovery of the upper limb in post-stroke patients: a randomized controlled study. *Eur J Phys Rehabil Med* 2016;52:767-773.
- van der Windt DA, Koes BW, Boeke AJ, Deville W, De Jong BA, Bouter LM. Shoulder disorders in general practice: prognostic indicators of outcome. *Br J Gen Pract* 1996;46:519-523.
- Varela E, Valero R, Kucukdeveci AA, Oral A, Ilieva E, Berteau M, Christodoulou N, UEMS-PRM Section Professional Practice Committee. Shoulder pain management. The role of physical and rehabilitation medi-

- cine physicians. The European perspective based on the best evidence. A paper by the UEMS-PRM Section Professional Practice Committee. *Eur J Phys Rehabil Med* 2013;49:743-751.
- Villafane JH, Lopez-Royo MP, Herrero P, Valdes K, Cantero-Tellez R, Pedersini P, Negrini S. Prevalence of myofascial trigger points in poststroke patients with painful shoulders: a cross-sectional study. *PM R* 2019;11:1077-1082.
- Zaniewska R, Okurowska-Zawada B, Kulak W, Domian K. Analysis of quality of life in patients with low back pain after receiving transcutaneous electrical nerve stimulation (TENS). *Med Pr* 2012;63:295-302.