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Effect of shoulder stability exercises on cervical proprioception in patients with mechanical cervical and shoulder pain

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Abstract
Background: Shoulder Impingement syndrome (SIS) is the second common musculoskeletal pain condition. Shoulder girdle muscle imbalance, tight posterior capsule have been implicated as contributing factors.
Objective: The purpose of this study was to investigate the effect of shoulder stability exercises (SSEs) on cervical proprioception (active joint angular reproduction, AJAR at 30º flexion and extension) in patients with mechanical cervical and shoulder pain.
Subjects and methods: Eleven patients (one group) had participated in this study, with age ranged from 27 to 42 years. Each patient was assessed for cervical proprioception (active joint angular reproduction, AJAR at 30º flexion and extension) using bubble inclinometer.
Results: There was statistically significant effect of SSEs on cervical proprioception (active joint angular reproduction, AJAR at 30^0, only for flexion (P=0.05), but not for extension (P=0.12) in patients with mechanical cervical and shoulder pain.
Conclusion: SSEs could affect cervical proprioception in patients with mechanical cervical and shoulder pain.

Keywords: shoulder impingement syndrome, therapeutic exercises, cervical proprioception

Introduction

Subacromial impingement syndrome (SAIS) is narrowing of the subacromial space (SAS) compressing rotator cuff (RTC), biceps tendon long head, and subacromial bursa against anterior under surface of the acromion and coracoacromial ligament during elevation of the arm. Its second stage occurs from repeated episodes of mechanical inflammation. Age range for this stage is 25 to 40 years [1].

SAIS is characterized by pain and functional restrictions mostly during overhead activities [2]. It is not necessarily a self-limiting one [3]. Prevalence of shoulder pain reported to range from 7% to 36% [4] with 44 to 65% of them is SIS [5]. SAIS can originate from chronic tendon overload, osteophytes, a hooked acromion, trauma, loss of strength, coordination, integrity of RTC [6] and the shoulder girdle muscles [7], hypomobility or instability of GHJ or scapula [8], and poor posture [9]. Neck pain is among the most common pain problems, with a reported prevalence ranging from 22% to 30% [10].

Functional impingement presents with normal X-ray findings, although pain and weakness are typically observed. Interestingly, this weakness is often pronounced in the scapular stabilizers, far from the point of pain. This type of pathology requires a different treatment approach: restoring muscle balance through specific exercises that work not just GHJ but the entire shoulder complex [11].

Correction of posterior shoulder tightness was associated with symptom resolution in patients with SAIS [12]. Rhythmic stabilization improves dynamic stabilization and proprioception [13]. PNF is most commonly used to restore ROM, decrease pain, increase strength and endurance, hasten motor learning, improve coordination, facilitate proximal stability, and begin functional progression [14]. Low row exercise activates the key scapular-stabilizing muscles [15].

The shoulder girdle is a possible contributing factor in cervical spine stability and treatment [16]. Cuomo *et al*. [17] reported that the reduction of proprioceptive information led to the reduction of activation level of the surrounding muscles that controlled the joints.

Up to 40% of patients with shoulder pain present with dysfunction in the cervicothoracic spine [18]. Pain experienced in the shoulder, upper, and lower arm can be as a result of a myriad of medical conditions, including mechanical pain from nearby musculoskeletal structures such as the shoulder or the cervical spine [19].

There are a number of explanations for the correlation between neck pain, upper limb dysfunction, and reduced upper extremity strength. The first is the structural connectivity of the cervical spine and shoulders. The bones and muscles of the cervical spine and the shoulders are connected to each other mechanically, thus a continuously applied mechanical load on the shoulders directly increases the load on the cervical region, which may cause joint and ligament pain. This can be seen in certain occupational groups who use their shoulders more often than most workers. The second explanation is damage to peripheral nerves. The brachial nerves are linked structures that pass from the cervical spine to the shoulders. If shoulder movements result in cervical tissue elongation and sliding, this may cause symptoms typically seen in neck pain suffers. Sustained and repetitive movements of the shoulder and elongation of the nerves may cause damage to the fine neural tissue leading to it becoming brittle and causing neck pain [20].

To the best of our knowledge, no studies to date assessed

the effectiveness of shoulder girdle stabilization on cervical proprioception. Although clear evidence exists for the efficacy of stabilization exercises in reducing neck pain, clear evidence for the other effects shown by several previous studies is lacking [21].

The purpose of this study was to investigate the effect of SSEs on cervical proprioception (active joint angular reproduction, AJAR at 30º flexion and extension) in patients with mechanical cervical and shoulder pain.

Patients and Methods

1. Patients

Upon approval of Cairo University's supreme council of postgraduate studies and research, this study was conducted at the outpatient clinic of Kasr Al-Aini Hospital. Cairo, Egypt. The study extended from December 2016 to October 2017. Sixteen subjects referred by orthopedic surgeons as unilateral SIS participated in this study. Their ages ranged from 27 to 42 years.

The inclusion criteria were: At least 3 out of the following; Positive "Neers' sign", "Hawkins' sign", and empty can test, Pain in the C5-C6 dermatome, Pain with palpation of RTC tendons, and Pain with resisted isometric abduction [22]. Exclusion criteria were: DM, Malignancy, infection, frozen shoulder, Macro-instability, RA, Advanced OA, Complete tear of RTC, or Labrum, Symptoms radiate below elbow joint, History of spinal or upper limb fractures, trauma, surgery, or peripheral nerve lesions, and Instability of patient's medical condition.

Procedures

a. Assessment procedures

Each subject was examined by the researcher for the inclusive and exclusive criteria.

In order to measure the proprioception of neck, the subject was instructed to stand with his/her feet shoulder length apart, and sit upright on the chair without leaning over the chair. Bubble inclinometer was fixed with a strap directly above the ear, looking straight ahead. The Bubble inclinometer was set at zero. And the patients were asked to bend his/her neck at an angle of 30 degrees to hold the pose for 3 seconds. And then the patients asked to remember the point of flexion. And after coming back to the neutral position, the patients were asked to go back to the previous position to keep the position for 3 seconds. The flexion angle measured and recorded. As in the method mentioned above, the patients were instructed to carry out the movements such as extension, and the measured values were recorded (Figure 1).

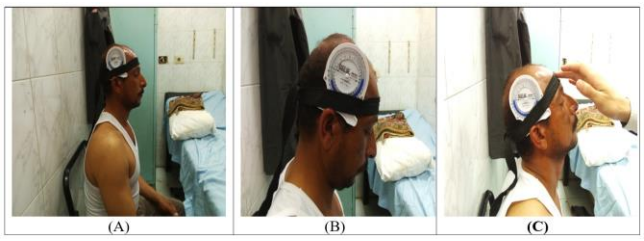

Fig 1: Measurement of cervical proprioception using bubble inclinometer; (A): start, (B): AJAR at 30^0 flexion, and (C): AJAR at 30^0 extension.

b. Treatment procedures

1. **Stretch of the posterior capsule (Sleeper stretch):** figure (2).

Fig 2: sleeper stretch, patient lies on affected side, shoulder abducted 70-900, elbow 900F, then passively internally rotates the shoulder, with other hand, as far as he can and hold 30secx4. [23]

2. **Shoulder stability exercises**

a. **Low row exercise** (figure 3), patients stand opposite to wall; elbow extended and push it with ulnar sides of fisted hands, retracting and depressing the scapulae, for 12reps/6sec hold.

b. **Rhythmic stabilization** (figure 3), from arms at sides, elbow flexed 90^0 and scapulae retracted with chin tucked, theraband stretched between hands and patients abduct bilaterally and hold at 20º, for 12 reps/ 6sec hold.

c. **D2 flexion PNF** (figure 3), patients do chin tuck and put one end of theraband under the foot opposite to the affected shoulder and the other end on the hand of affected shoulder, start with extended, adducted, internally rotated shoulder with affected extremity across body and end with flexed, abducted, and externally rotated position by saying "pull wrist up and reach." [24], with 30secs hold, 4 reps.

Fig 3: Shoulder stability exercises: (A): Low row, (B): Rhythmic stabilization, (C): PNF D2 flex.

Results

Descriptive statistics are presented as means and SD for all patients. The differences within group were analyzed using paired-samples t-test. Prior to final analysis, data were screened for normality assumption, homogeneity of variance, and presence of extreme scores. This exploration was done as a pre-requisite for parametric calculations of the analysis of difference. Testing for the homogeneity of variance revealed that there was no significant difference with p values of > 0.05. The box plots of the tested variable were done to detect outliers and showed no outliers. Normality test of data reflect the data was normally distributed. All statistical analyses were done using SPSS version 18 (IBM Inc., Chicago, IL) with the p-value set at ≤ 0.05.

Descriptive Statistics for Demographic and clinical data of the patients

The mean (±SD) for age, weight, height, BMI were (32±9.3) years, (77±14.8) kg, (162±5.8) cm, (29.7±6.47) kg/m2.

Analytical Statistics for cervical proprioception

The mean (±SD) of total pretest, posttest for cervical proprioception (AJAR at 30^{O}), respectively, were 4.1(±3.1), 3.1(±2.5) degrees for extension, and 4.3(±2.3), 3.3(±2.2) degrees for flexion; paired t-test (one tail) revealed non-significant difference between pre and posttest for extension (P= 0.12), but significant for flexion (P=0.05), see table 1, 2, fig. 4).

Table 1: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	CEPRE	4.0727	11	3.05781	.92196
	CEPOST	3.0636	11	2.52993	.76280
Pair 2	CFPRE	4.2818	11	2.30166	.69398
	CFPOST	3.3455	11	2.20969	.66625

Table 2: Cervical flexion and extension AJAR error data (pretest, posttest) Paired Samples Test

		Paired Differences					t	df	Sig. (1-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	CEPRE - CEPOST	1.00909	2.73914	.82588	-.83109-	2.84927	1.222	10	.120
Pair 2	CFPRE - CFPOST	.93636	1.76990	.53364	-.25267-	2.12540	1.755	10	.05*

(*): significant difference.

Discussion

The main purpose of this study was to investigate the effect of shoulder stability exercises on cervical proprioception (AJAR at 30^{0} flexion and extension) in patients with mechanical cervical and shoulder pain.

The study general hypothesis stated that there would be significant effect of shoulder stability exercises on cervical proprioception. The results of this study failed to totally reject this general hypothesis, as there were non-significant difference between pre and posttest for extension (p-value=0.26), but significant for flexion (p-value= 0.05), in patients with mechanical cervical and shoulder pain.

Based on results of present study, the current study showed that SSEs, for patients with mechanical cervical and shoulder pain, have significant effect on cervical proprioception (in particular for AJAR at 30^{0} flexion).

SSEs and cervical proprioception

It was hypothesized that there would be significant effect of shoulder stability exercises on cervical proprioception (AJAR at 30^{0} flexion and extension). Based on results of present study, these hypotheses were not totally rejected, as there was significant difference between pre and posttest in cervical proprioception for AJAR at 30^{0} flexion (p-value= 0.05), not for extension (p-value= 0.12).

These results indicate that shoulder stability exercises are significantly effective in improving cervical proprioception. These observed results support the link between elements of the upper quarter, which caused improvements in cervical proprioception found in our study.

The finding of the present study cannot be compared with other studies due to loss of literature in this area.

Conclusion

SSEs were significantly effective in improving cervical proprioception (only for AJAR at 30^{0} extension, not for flexion).

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