Cervical Discogenic Pain: A Suggested Physical Therapy Approach

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ABSTRACT

Neck pain is a common complaint that typically represents a spectrum of disorders affecting the cervical spine. ***Purpose:*** *The purpose of this study was to detect the degree of impairment of sensorimotor control function of cervical spine and to determine the effect of a specific designed proprioceptive rehabilitation program on postural stability, pain, functional disability and active cervical ROM in patients with cervical discogenic pain.* ***Subjects:*** *Forty patients with cervical discogenic pain from both sexes participated in this study (24 female and 16 male). Their age ranged from 30 to 50 years with mean age of (38.53±5.69). They were assigned into two equal groups. The study group "G I" received specific designed proprioceptive rehabilitation program plus conventional treatment. The control group "G II" received a conventional treatment. Patients in both groups were assessed before and after the treatment programs. Both groups received the treatment program three sessions per week for eight weeks.* ***Procedures:*** *Pain intensity was determined by visual analog scale (VAS). The functional disability was evaluated by neck pain and disability scale (NPDS). The postural stability was assessed by Biodex Stability System (BSS) and neck range of motion by goniometer.* ***Results:*** *Statistical analysis revealed that there was a significant improvement in both groups but in favour of "G I" which showed highly significant improvement.* ***Discussion and Conclusion:*** *specific designed proprioceptive rehabilitation program may stimulate cervicocephalic kinesthetic sense, and increase proprioceptive input to higher centers; consequently, this improves the function outcome in patients with cervical discogenic pain.*

Key words: *Neck Pain, Physical Therapy Treatment, Proprioceptin.*

INTRODUCTION

Neck pain is among the most common and costly health complaint throughout industrialized society. It is the result of fast, mechanical, full tension life, lack of exercise, bad posture neck strain, and sporting or occupational activities[6]. In many cases symptoms persist for a long time, associated with limited cervical spine mobility. Frequent concomitant symptoms are headache, vertigo, and vegetative symptoms (sweating, dizziness, nausea). This kind of pain usually affects a person's life in many ways. It can change someone's personality, ability to function and quality of life[3]. It presents greater problem, causing severe discomfort and inability to work[7].

Cervical discogenic pain may be the most common cause of neck pain. It is caused by changes in the structure of one or more of

the cervical intervertebral discs. Common symptoms of discogenic pain include pain in the neck when turning or tilting the head. Pain may be worsened when the neck is held in one position for prolonged periods, such as occurs with driving, reading, or working at a computer. There is often associated muscle tightness and spasms. Discogenic pain can also refer pain or odd sensations into the arm or shoulder[16]. Many physical therapy modalities have been used widely in treating neck pain, but the benefits of these treatments are often temporary and evidence of their effectiveness is minimal[8]. Treatment for chronic neck pain disorder vary from traditional means for pain management and manipulative therapy to group gymnastics and neck specific exercises. Although the efficacy of physiotherapy has been partly disappointed[23].

Proprioception is a key component of dynamic joint stability, because afferent input indirectly produces on and modulates the efferent response that allow the neuromuscular system to maintain a balance of stability and mobility. In essence, dynamic joint stability is the product of the proprioceptive system[29].

It was shown that the wounds or tiredness decreases the cervical proprioceptive system effectiveness to repositioning the head well or to control the oscillations[15]. Chronic neck pain patients have a functional alteration in the muscle spindle receptors. This function deficit could occur as a result of muscle pain. Proprioceptive modifications related to the muscular or different afferents, undoubtedly contribute at the same time to the inflammatory pains, wears processes and articular attacks[24]. Cervicocephalic kinesthesia was significantly poor in patients with neck pain, indicating an alteration in neck proprioception[13].

The cervical spine plays the most important role in the body's regulation of equilibrium sense[17]. Patients with neck pain may suffer from sensorimotor impairment. When proprioception is impaired, the timing of eccentric contraction of neck muscle is delayed and neck stability in performing activities is insufficient, this is thought to lead to excessive strain and microtrauma[9].

Dysfunction of the cervical receptors in neck disorders can alter afferent input and subsequently change the integration and timing of sensorimotor control[12]. Measurable changes in active cervical ROM, postural stability, cervical joint position sense, and reports of dizziness and unsteadiness by patients with neck disorders can be related to such alterations to sensorimotor control. Therefore the assessment and management of abnormal cervical somatosensory input and sensorimotor control in neck disorder patients is as important.

MATERIALS AND METHODS

Subject

Forty patients with cervical discogenic pain of both sexes (24 females and 16 males) participated in the study. The patients were referred from the out-clinic of the faculty of physical therapy, Cairo University. Those patient followed the following criteria: their ages ranged between 30 to 50 years old with the mean age of (38.53±5.69). All patients initially diagnosed as cervical disc lesion either one level or multilevel lesions, as diagnosed by the neurologist and confirmed by MRI imaging. All patients suffered from chronic neck pain persisted more than three months and the degree of pain is mild to moderate according to visual analogue scale.

They were medically stable. They had neck proprioception deficit. All subjects had no visual or auditory problems or associated deformities. Subjects were excluded if they had undergone cervical spine surgery or vertebral artery insufficiency.

The patient were assigned equally into two groups:

The study group "GI" included twenty patients with mean age of (39.1 ± 5.4) years and mean duration of illness (15.7 ± 4.89) months. the Study group received specific designed proprioceptive rehabilitation program in addition to a conventional treatment program. Both groups received the treatment program three session per week for eight weeks.

The control group "GII" included twenty patients with mean age of (37.95 ± 6.05) years and mean duration of illness (14.4 ± 5.28) months. Control group received a conventional treatment program, which included infrared (IR) application for 10-min, continues ultrasound therapy on neck paraspinal muscle of cervical vertebrae for five minutes, with frequency 1.5-2 w/cm^2 and TENS was applied on neck paraspinal muscle of cervical vertebrae for 10 minutes, finally shoulder and neck exercises.

Evaluation procedure

1- Biodex stability system. (Biodex Crop. Shirley, NY) was used for the assessment of the standing postural control of the patient before, and after 2 months of treatment. Each patient in both groups was evaluated on two different balance tests of the Biodex stability system; dynamic balance overall stability index (OASI) and dynamic limits of stability tests. The dynamic limits of stability (DLOS) include directional control (DC) and time to elapse the test. The Biodex Stability System had eight stability levels. These levels indicate the stiffness of the platform. Stability level 8 indicates a most stable platform surface, whereas stability level one indicates a very unstable surface[34].

The subject assumed the test positions which are standing on both feet with eyes open. All the tests were done with the at stability level eight (most stable level). Biodex stability system was used to measure the patient's postural stability by assessing the deviations from center[31]. Test duration was 20 seconds.

2- Visual Analogue Scale (VAS): Visual analogue scale was used to measure the degree of pain intensity of neck and upper limb by allowing the patient to choose a number between 1 to 10 which represents his pain intensity[36].

3- Neck pain and disability scale (NPDS) It is a questionnaire designed to determine degree of disability. It gives the investigator information as to how patient's neck pain has affected his ability to manage in everyday life[36]. It consists of twenty items every item ranges from 0 (none) to 5 (maximum) that are summed into a total score ranging from 0 to 100. This scale assesses the degree to which pain interferes with activities of daily living. Higher scores correlates with greater disability[1].

4- Range of movements (ROM) of neck by goniometer; cervical range of motion (CROM) included: flexion, extension, side bending, and rotation.

Therapeutic procedures

Proprioceptive rehabilitation program of the study group included the followings:

(1) Tonic vibrator reflex (TVR): It had high frequency vibration with frequency of 80-120 Hz s and an amplitude of 1.8 mm. Vibration will be applied while the patient in sitting position with feet supported on the ground. The vibrator will be applied on the lower dorsal neck, a few centimeters from the spine

(trapezius and splenius capitis tendons, at the level between the 5th and 7th vertebrae) the time of application was ten minutes.

(2) Cervical stabilization exercise: Cervical stabilization program through rhythmic stabilization technique, alternating isometric technique, hold relax technique of proprioceptive neuromuscular facilitation and traditional isometric exercises of neck muscles in all directions. It was preferable to apply them in the quadruped position which is done on the floor. Quadruped position allows for the facilitation of stabilization mechanisms[32].

(3) Craniocervical flexors training: Craniocervical flexor training involves performing and holding inner range positions of craniocervical flexion, this training has been shown to increase the activation of these muscles. Two exercises have been shown in research to be the most effective in recruiting the deep neck flexors[10].

- Exercise (l) Head Nod Exercise: The patient was instructed to lie on his back with knees bent without a pillow under his/hew head and neck. With the eyes looking down at a spot on the wall just above knees. Then follow the eyes with head making a gentle nod of your head like he was saying "yes".
- Exercise (2) Head Lift Exercise: The patient was instructed to lie on his back like the previous exercise. Head should be in a neutral position and then the head was lift off the floor or table (about 3-4 inches) slowly and then return.

(4) Specific Exercise Program for Balance:

a) Proprioceptive facilitation exercise through weight shift exercise and approximation of the upper and lower limbs to stimulate the joint mechanoreceptors from different position. The best position was quadriped position, patient was asked to shift weight in all direction, then free one extremity while weight bearing on others. A progression was made through unweighting one upper extremity to one lower extremity, to opposite upper and lower extremities, simultaneously to ipsilateral upper and lower extremities finally. Head exercises with open eyes: A progression was made performing the same exercises as step one but with eyes closed.

b) Balance training on Biodex Stability System (BSS)

The Biodex training provided a simple mean of sitting up a training session. It included two training routine dynamic postural stability and as well as dynamic limits of stability.

- Dynamic postural stability: In the initial stage of balance training during the suggested period of treatment (2 months), as each patient started training according to his ability, on the most stable state of platform tilt; stability level 6 was suitable for the majority of the patient as a starting training level Each patient was trained on each stability level for 4 sessions starting with the easier level tolerated; level 6 and progressed toward the most difficult level.
- Dynamic Limits of Stability Training Routine: The patient began training with the footplate centered and the cursor over the blinking central target. The patient was instructed to hold the cursor inside that central flashing box until it stopped blinking. Instruction was then given to the patient to shift his body weight, to move the cursor over the second randomly appearing flashing box and also to hold it inside that flashing box until it stopped flashing. Finally the patient was asked to move the cursor back to the central

flashing box, as quickly and with as little deviation as possible. The same process was repeated for each of eight targets[18].

Statistical analysis

The arithmetic mean and standard deviation of the mean, the student paired t-test (to determine level of significance in one group pre and post treatment), and unpaired t-test between two groups (to determine level of significance between two groups). Level of significance was assumed at 0.05 for all analysis.

RESULTS

The current study was designed to investigate the influence specific designed proprioceptive rehabilitation program on postural stability pain functional disability and active cervical ROM in patients with cervical discogenic pain.

The results of the present study before starting treatment revealed that there were no significant differences in all chronological variables (age, weight, length and duration of illness) between both groups (GI & GII). These results ensured matching between the patients in both groups. Therefore, it provided basis for comparison between results obtained. Mean value of age in G(I) = 39.1±5.4 and G(II) = 37.95±6.05 with. Mean value of Duration of illness in G(I) = 15.7±4.89 and G(II) = 14.4±5.28 General characteristics of subject between the two groups shown in table (1).

Table (1): General characteristics of subject between the two groups.

Variable	Study (GI)	Control (GII)	t	P
	Mean ±SD	Mean ±SD		
AGE	39.1±5.4	37.95±6.05	0.634	0.530
Duration of Illness	15.7±4.89	14.4±5.28	0.808	0.424
Weight	74.3±8.21	72.85±7.05	0.560	0.553

Comparing the mean of (OASI & DC) in both groups (GI&GII) to normal age-matched subjects revealed that there were statistically significant impairment of postural instability in patient with cervical discogenic pain.

The results of this study showed statistical significant improvement in (OASI & DC) between both groups as shown in table (2) and fig. (1).

Table (2): Effect of treatment procedures between the two groups on (OASI) & (DC).

Group	Study (I)				Control (II)			
	Mean ±SD		t-value	P-value	Mean ±SD		t-value	P-value
	Pre	Post			Pre	Post		
OASI	2.91±0.56	1.64±0.33	14.336	0.0001***	2.83±0.51	2.55±0.80	3.442	0.0027**
DC	22.25±4.04	58.86±4.66	57.344	0.0001***	23.55±2.74	26.75±6.97	2.82	0.0109*

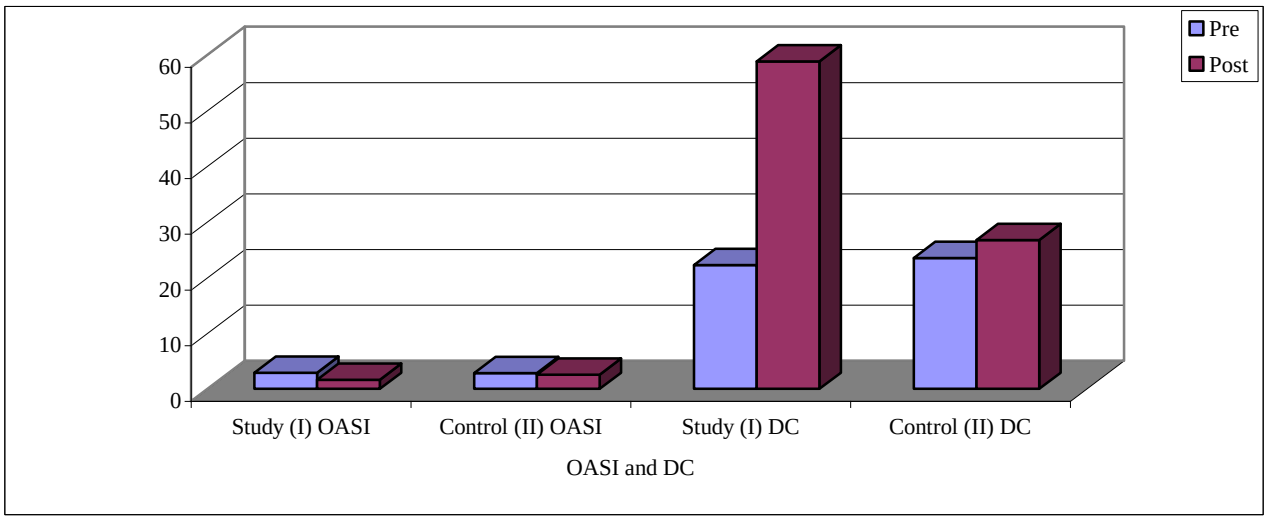

Fig. (1): Effect of treatment procedures between the two groups on (OASI) & (DC).

The results of this study showed statistical significant improvement in (VAS & NPDS) between both groups as shown in table (3) and fig. (2).

Table (3): Effect of treatment procedures between the two groups on VAS & NPDS.

Group	Study (I)				Control (II)			
	Mean ±SD		t-value	P-value	Mean ±SD		t-value	P-value
	Pre	Post			Pre	Post		
VAS	6.90±1.89	2.30±0.80	15.201	0.0001***	6.40±0.68	4.95±1.96	3.746	0.0014**
NPDS	63.65±4.43	16.30±5.32	45.225	0.0001***	61.80±3.72	30.35±7.51	19.798	0.0001***

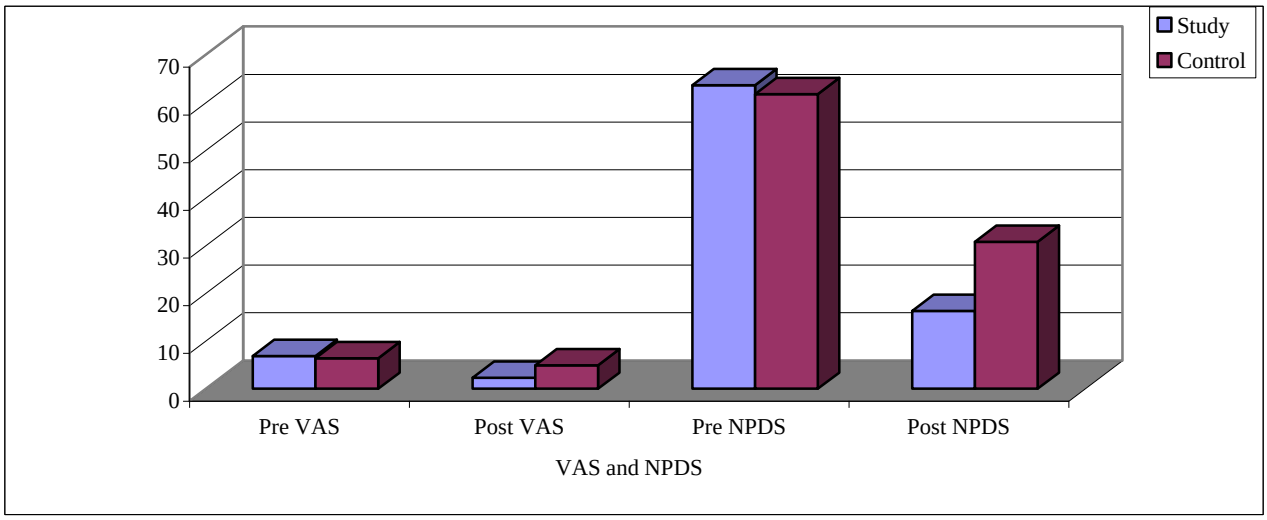

Fig. (2): Effect of treatment procedures between the two groups on VAS & NPDS.

Regarding cervical ROM, the results of this study showed statistical significant improvement in (CROM) between both groups as shown in table (4).

Table (4): Effect of treatment procedures between the two groups on CROM.

Group	Study (I)				Control (II)			
	Mean ±SD		t-value	P-value	Mean ±SD		t-value	P-value
	Pre	Post			Pre	Post		
Flexion	31.30±4.28	44.15±5.25	10.684	0.0001***	32.40±7.63	39.25±5.62	3.844	0.0011**
Extension	22.90±3.46	39.60±4.16	15.142	0.0001***	21.70±3.80	28.50±9.63	3.718	0.0015**
Side bend Rt	31.30±3.67	40.80±4.62	8.409	0.0001***	30.70±4.01	35.10±5.44	2.736	0.0131*
Side bend Lt	33.85±5.04	43.05±5.27	6.289	0.0001***	32.50±4.11	38.06±5.74	3.479	0.0025**
Rotation Rt	28.65±4.13	43.25±4.23	14.74	0.0001***	29.35±3.41	35.05±7.62	3.115	0.0057**
Rotation Lt	31.30±4.14	41.35±4.12	9.066	0.0001***	32.40±3.58	34.75±7.05	2.38	0.028*

DISCUSSION

Neck pain affects one third of the adult populations at some point in their lives, with approximately 14% exhibiting symptoms for three months or longer[20]. Acute pain provokes a disturbance of the cervical proprioception. Increased muscle spindle sensitivity may be mediated by the sympathetic nervous system acting on the intrafusal fibers of the muscle spindles as a feedback loop. The correlation between interneurons and motor neurons in the spinal cord may also contribute to increased muscle tension. Assuming increased muscle tension and sensitized muscle spindles, the latter condition may give rise to erroneous proprioceptive signaling, particularly if spindles in dissimilar neck muscles or on different sides of the neck are disproportionately sensitized. Erroneous cervical proprioceptive information converges in the central nervous system with vestibular and visual signals, which could affect the mental perception of body orientation and lead to a misinterpretation of relation to the surrounding. This suggests that changes in the quality of proprioceptive information from the cervical spine region may affect postural control as well as reduction of cervical pain[28].

Proprioceptors are responsible for providing afferent information regarding change in position and angular velocity of the spine to central nervous system (CNS), which controls tension of the neck muscles and react to those changes according to theses information. In the change in position exceeds the limits of the normal movement, then the muscle groups activated by this reflex system will be thus capable of counteracting the applied external force. This feed back for the control of muscle actions then serves to counteract excessive strain of the passive structures and guard against injuries[14,33].

It was found that there was a reduced perception of muscle tension in the neck muscles of patients experiencing chronic pain, indicating a reduced proprioceptive ability of the muscle spindles as a consequence of their altered activities[30]. All the structures of the cervical articulations have mechanoreceptors (more than at the lumbar and thoracic level) these mechanoreceptors implied in the proprioception are extremely probably modulate the activity of the muscles crossing these articulations in order to ensure its stability[11,22].

The results of this study revealed that the suggested program was effective in reducing pain, increasing CROM and improving functional disability. This may be attributed to the use of cervical stabilization exercise program increases the proper flow of fluids and nutrients across the intervertebral discs and spinal cord during regular loading and unloading of joint cartilage of facet joint [26]. This leads to decreasing spinal cord ischemia. This explanation agrees with the study of Twomey and Taylor[35]. The repetitive contraction of muscle increases muscle metabolism with its associated consequences of increased oxygen uptake [5].

Furthermore the neck stabilization exercises may stimulate the mechanorecptors in cervical ligaments and muscles, and reduce reflex guarding spasm of the neck muscles in addition to the slow stretch force that was applied (hold relax technique) that stimulates the golgi tendon organ to fire and produces autogenic inhibition of stretched muscle. This may allow neck ROM to be increased. The proprioceptive input from the neck is not only integrated in the control of stance, but also in the steering of locomotion. It was reported that it was possible to modify standing posture, as well as to induce walking, by applying neck muscle vibration[2].

Elevated stability indices of the dynamic balance test in the pre-treatment results of both groups, could be attributed to reduce somatosensation and difficulty in adapting sensory information to changing environment demand which might affect their abilities to maintain stability in different levels of the unsteady surface. Several studies have reported significant disturbances of vertical posture during standing and walking in patients with neck pain[22,25].

The ability to execute different postural tasks is reduced with increasing task complexity. Reduced balance in chronic neck pain has also been manifested as increased postural sway during standing in different postures[25].

Results of this study demonstrated a significant improvement in degree of postural stability measured by Biodex stability system in the study group who received specific designed proprioceptive rehabilitation program in addition to conventional treatment compared with the control group who were treated by conventional treatment only. So it could be mentioned that, better balance control reported from the post-treatment results were associated with a decrease in the mean values of stability index of dynamic balance test and total time needed to complete dynamic limits of stability test. On contrary, an increase in the mean value of overall directional control was reported as better balance control.

The results may be attributed to influence of specific designed proprioceptive rehabilitation program on improving proprioceptors function and reestablishing neuromuscular control and therefore improving functional stability[27]. These results agree with Bryan Ladkevin [4] who stated, alteration in proprioceptive sensibility in patients with neck pain due to functional alteration of tendinous and muscular proprioceptors disturbances. Also These results agree with those obtained from previous studies done by Heikkila and Wenngern [21] who stated that there is a higher joint position error during tasks involving head repositioning suffering from chronic neck pain which may be explained by disturbed proprioceptive input to the CNS which is responsible for movement[21].

The significant improvement of balance in the present study may be attributed to increasing the proprioceptive inputs through exercise program which provide unique sensory component to optimize motor control. This improves anticipatory reactions that activates postural adjustments of movement patterns particularly in the trunk and lower extremities which lead to steadiness of gait[19].

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الملخص العربي

برنامج علاج طبيعي مختار لآلام العنق الغضروفية

يهدف هذا البحث إلى دراسة تأثير برنامج علاج طبيعي مختار على ثبات القوام والألم والإعاقة الوظيفية والمدى الحركي للرقبة لمرضى ألام عنقية غضروفية . اشترك في هذا البحث أربعون مريضا (16من الذكور و 24من الإناث) الذين يعانوا من آلام العنق الغضروفية . تم تقسيمهم إلى مجموعتين متساويتين .المجموعة الأولى (مجموعة الدراسة) عولجت ببونامج تأهيلي مختار للمستقبلات الحسية العميقة بالإضافة إلى برنامج العلاج التقليدي ، بينما عولجت المجموعة الثانية (الهجموعة الضابطة) ببرنامج العلا ج الطبيعي التقليدي فقط وأستمر البرنامج العلاجي لمدة ثمانية أسابيع بواقع ثلاث مرات أسبوعيا . تم تقييم المرضى قبل وبعد العلاج عن طريق جهاز قياس الاتزان (البيودكس) لتقييم درجة ثبات القوام . كما تم قياس حدة الألم بالمدرج البصري للألم ، و استخدام مقياس الم الرقبة واعتلال القدرة لتحديد الإعاقة الناتجة من ألام الرقبة الغضروفي واستخدم الجنيوميتر لقياس المدى الحركي للرقبة. وقد أظهرت النتائج تحسن ذو دلالة إحصائية في كل من المجموعتين لصالح المجموعة الأولى . مما سبق فانه يفضل استخدام برنامج تأهيلي مختار للمستقبلات الحسية العميقة لعلاج هؤلاء المرضى .