The Effect of Neck Endurance Training as a Component of an Exercise Program for Chronic non-Specific Neck Pain

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ABSTRACT

Objective: *the purpose of this study was to determine the effect of an integrated exercise program of strength, endurance and flexibility in patient with chronic nonspecific neck pain.* ***Background:*** *Chronic non-specific neck pain is a common problem. The sustained muscle contraction required to hold the head in various positions and the fatigue because of muscular weakness are suspected of being causative factors in chronic neck pain. Therefore, neck pain is often associated with muscular deficiencies in neck and shoulder muscle, such as: weakness tightness and fatigue. There are studies supporting the efficacy of exercises targeting different aspects of muscle function, for example training aimed at improving muscle strength, flexibility or endurance. However, studies evaluating the effect of muscular endurance training for neck/shoulder muscles are sparse. There are no studies that compare the combined effect of strength and endurance exercises in cases of chronic non specific neck pain.* ***Design:*** *Twenty subjects (10 males and 10 females) diagnosed by their referring physician with chronic mechanical neck pain participated in this study. They were randomly assigned to either the experimental group performing strengthening exercises, endurance exercises and stretching or a control group performing strength and stretching only. Before and after 4 weeks of training performed every other day, cervical range of motion and neck pain and disability were recorded.* ***Results:*** *Both groups achieved improvement in range of motion and perceived neck pain. However the experimental group achieved a significant increase in flexion and side bending and pain more than the control group P<0.5.* ***Conclusion:*** *The integrated exercise program of strength, stretch and endurance described in this study for subject with chronic non-specific neck pain is mainly efficient for neck flexors and is associated with greater improvement of perceived pain. Strengthening exercise can either be combined with endurance or not in order to improve perceived pain and neck extension and rotation. Isometric strength and endurance are recommended to improve neck extension.*

INTRODUCTION

Chronic neck pain is a common problem[16]. In most cases, no underlying pathology can be established and the causes of the complaints remain unknown[10,30]. Because most neck pain has no specific, identifiable cause, it is diagnosed as mechanical neck pain[4] or non specific neck pain[20]. McKenzie[29] and Haughie et al.,[18] have proposed that nonspecific neck pain results from poor posture, arising through sustained, long-term, abnormal physiological loads that such postures impose on the neck[5,14] with a consequent reduction in neck muscle strength[21].

The sustained muscle contraction required to hold the head in various positions and the fatigue because of muscular weakness are suspected of being causative factors in chronic neck pain. Therefore, neck pain is often associated with muscular deficiencies in neck and shoulder muscle, such as: weakness with the greatest reduction in the extensor muscle group; tightness and fatigue[3,12,23,25,27]. The sustained Prospective studies have suggested that patients with chronic neck pain have weak muscles[32,33] and that strengthening exercises may decrease pain and increase neck range of motion and muscle performance[19]. In line with these findings there are studies supporting the efficacy of exercises targeting different aspects of muscle function, for example training aimed at improving muscle strength, flexibility or endurance[3,9,31,38].

However, studies evaluating the effect of muscular endurance training for neck/shoulder muscles are sparse. Hagberg et al.,[17] found reduced shoulder pain after ten weeks of isometric muscular endurance training for shoulder muscles. Falla et al.,[9] also reported a reduced average intensity of neck pain and reduced neck disability index score after 6 weeks of strength-endurance regime for patients with chronic neck pain. Patients with neck pain usually exhibit poor body alignment with a forward head posture, accompanied by upper quadrant muscle imbalance. The poor posture is characterized by tightness and increased activation of the suboccipital muscles, sternocleidomastoids, upper trapezius, levator scapulae and pectoral muscles and by weakness of the deep neck flexors and the lower stabilizers of the scapula (serratus anterior, rhomboids, middle trapezius, and lower trapezius)[15,21,22].

Therefore, stretching exercise for neck and shoulder muscles was used by many authors for chronic neck pain patient[20,26,31,39]. There are no studies that compare the combined effect of strength and endurance exercises in cases of chronic non specific neck pain. Therefore, the purpose of this study was to compare the effect of an integrated exercise program of strength, endurance and flexibility with an exercise program of strength and flexibility alone in patient with chronic nonspecific neck pain.

METHODS

Subjects

Twenty subjects (10 males and 10 females) diagnosed by their referring physician with chronic mechanical neck pain participated in this study. Prior to participation, all subjects signed an informed consent. Subject selection criteria included (1) History of chronic neck pain of at least 3 months duration, (2) age between 25 to 40 years. Subjects were excluded from the study if they had evidence of specific pathologic condition such as neurologic disease, fracture, herniated disc, systemic rheumatic disease infections, neoplasm, previous history of injury to the neck or upper back from T1-T6, abnormality of the spine, and any condition preventing physical loading such as severe instability, severe osteoporosis, pregnancy, severe depression and mental illness. As the subjects joined the study, each was randomly assigned to 1 of 2 groups: experimental group (N=10) or control group (N=10).

Outcome measures

Cervical range of motion: Before and after the 12 treatment sessions given every other day under direct supervision of the investigator over 4 weeks, active range of motion of neck flexion, neck extension, neck side bending and neck rotation were measured with Myrin goniometer. The Myrin goniometer (REHAB. LIC -17182 Solna Sweden.) Consists of an inclinometer for measurement of flexion-extension and lateral flexion and a compass for measurement of horizontal rotation. Myrin goniometer is reported to be both reliable and valid for neck ROM measurement with ICC >0.90[28].

The patient was seated with back rested in a relaxed position and the head fixed in the mid position. The therapist fixes the strap around the patient head with the Myrin goniometer at the side to measure flexion and extension, with the Myrin goniometer at the back of the patient head to measure lateral bending right-left or with the Myrin goniometer at the patient vertex to measure rotation right-left. The inclination needle was set at zero by turning the instrument to measure round the horizontal axis for flexion, extension and lateral bending while the compass needle was set at zero by turning the instrument to measure round the vertical axis for measuring rotation. The patient was asked to move his neck as far as possible, and the movement of the needle was observed during the whole movement to be sure that the movement is in the correct plane. The final position of the needle was recorded when the patient stop motion at the farthest range possible.

Neck Pain and Disability: Pain and disability were assessed by using Neck Pain and Disability Scale (NPAD). It consists of 20 items that measure the intensity of pain, its interference with vocational, recreational, social, and functional aspects of living, and the presence and the extent of the associated emotional factors. Patients respond to each item by marking along a 10-cm scale. Item scores range from 0 to 5, in quarter-point increments. The total score is the sum of the item score with zero indicating no dysfunction and 100 indicating maximal dysfunction[37]. The NPAD is a stable, valid and responsive measure for patients with neck pain and is useful in identifying treatment effects[13].

Treatment procedure

All treatments were delivered by the same physical therapist. A schedule of three times per week for 4 weeks was established. All subjects received Infrared radiation at the start of the session, followed by theraband neck strengthening exercises, active exercises for leg and trunk and self stretching exercises at the end of the session. In the sitting position, infrared was administered for 15 minutes with a distance from the patient neck that produces comfort[35].

Theraband neck strengthening exercises included neck flexors, extensors and lateral flexors isotonic exercises using theraband (green, blue and violet). Exercises was started by offering mild resistance through the application of green theraband then moderate resistance offered by the blue one and finally severe resistance was applied by the violet one.

The training regime consisted of pulling against elastic rubber band (thera band, Hygiene crorp-Alcranohio) to train the neck muscles. The exercises were performed in the sitting position in sets of 15 repetitions[40]. The rubber theraband was fixed on wall bar and around the patient head then the patient pull the theraband directly forward to train his neck flexors. To train the neck extensors, the patient was asked to pull the theraband directely backward. For neck lateral flexors, the patient pull the theraband to the left then to the right while he is sitting beside the wall bars in which the theraband was fixed.

Treatment was concluded with 10 repetitions of active exercises for leg and trunk including squatting and back extension from prone position, followed by self stretching of lateral flexors (upper part of the trapezius), rotators (scalene muscle) and pectoralis muscles. Each of these stretching was held for 30 sec each followed by 15 sec relaxation and repeated 3 times[20,39].

Prior to active exercises for leg and trunk and self stretching, the experimental group received endurance exercises consisting of head lifting from supine position, head lifting from prone position and head lifting from side lying. Each exercise was performed 60 times divides into three sets for 20 repetitions each, with 2 minutes rest in between sets. The experimental group received a maximum of 15 minutes additional treatment compared with the control group.

Data Analysis

Between-group comparisons on all descriptive and dependent variables were done at baseline using two tailed, independent sample t tests for age, height, weight, gender, range of motion and NPAD. Baseline to post-treatment comparisons was done with two tailed paired sample t tests for range of motion and NPAD score. 95% confidence intervals were set for group differences.

RESULTS

Both groups were similar in age, height, weight and sex (table 1). At the beginning of the study, there were no differences between groups on the dependent variables of active range of motion and NPAD. Following treatment, there were no significant differences in active range of motion measurements of neck extension and rotation between groups. The experimental group demonstrated more range of motion in neck flexion and lateral bending and less pain and disability at post treatment compared with the control group (table 2, figure 1). Both the experimental and control group improved significantly on all measured variables after the training period.

Table (1): Means ± SD, and t tests at baseline for age, weight, height and gender.

Variable	Control group (N=10)	Experimental group (N=10)	t value	P value
Age (years)	33.9±5.6	35.7±5.1	0.74	0.46*
Weight (kg)	71.2±8.3	72.1±10.01	0.21	0.83*
Height (cm)	166.2±7.5	166.5±6.6	0.09	0.92*
Gender	4 females 6 males	6 females 4 males	Chi=0.80	0.3*

* Not significant

Table (2): Mean ± SD, and t tests for neek ROM and NPAD score variables at baseline and following treatment in both groups.

Variable	Baseline	Post-treatment	t value	P value
Flexion (degrees) Control (N=10) Experimental (N=10) P value	41±3.1 40±4.08 0.548*	70±2.35 73±2.58 0.014**	29 40.41	0.000 0.000
Extension (degrees) Control (N=10) Experimental (N=10) P value	37±4.8 38±3.49 0.602*	63±4.83 64±3.94 0.3*	15 17.89	0.000 0.000
Rt rotation (degrees) Control (N=10) Experimental (N=10) P value	26±5.1 26±5.3 1.000*	65±3.33 67±2.58 0.151*	17.63 18.54	0.000 0.000
Lt rotation (degrees) Control (N=10) Experimental (N=10) P value	26±5.16 26±5.29 0.833*	65.5±2.83 67.5±2.63 0.12*	19.41 25.10	0.000 0.000
Rt lateral bending (degrees) Control (N=10) Experimental (N=10) P value	23.5±3.37 23±3.49 0.749*	37±3.49 43±2.58 0.000**	8.06 18.97	0.000 0.000
Lt lateral bending (degrees) Control (N=10) Experimental (N=10) P value	23±2.58 23.6±1.77 0.552*	39±3.16 43±2.58 0.006**	12.92 27.62	0.000 0.000
NPAD (score) Control (N=10) Experimental (N=10) P value	72.45±3.46 71±30 0.357*	28±2.03 22±1.66 0.000**	34.9 75.49	0.000 0.000

* Not significant ** Significant difference

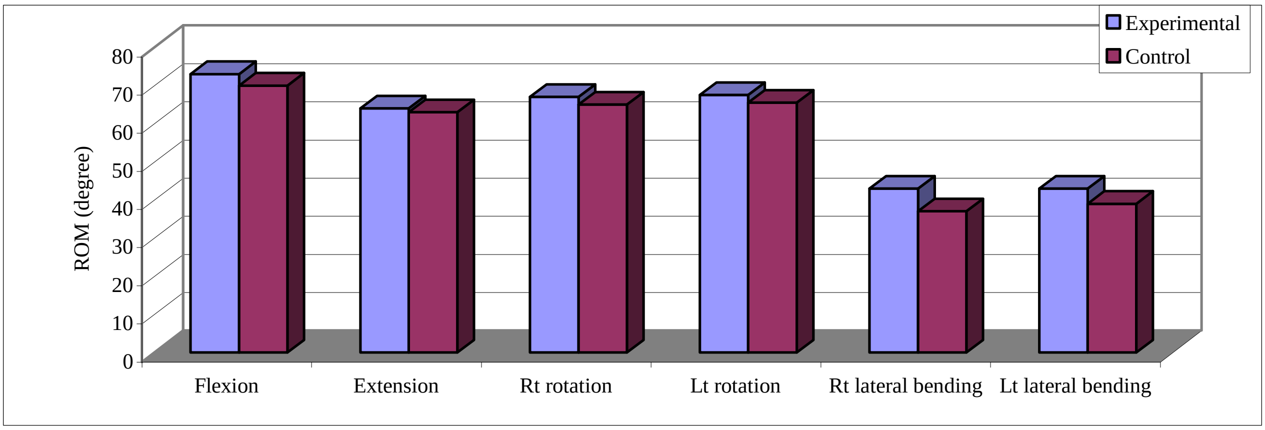

Fig. (1): Comparison of the mean value of neck range of motion in both group after treatment.

DISCUSSION

This study compared the effectiveness of endurance training as a component of an exercise program with an exercises program not including endurance in people with nonspecific chronic neck pain. We found improvement in neck ROM and NPAD score in both groups with the significant improvement shown in the experimental group who performed endurance training in combination with strength and stretching exercise. Although, the difference in extension and rotation range of motion was not statistically significant between groups, the experimental group had more range. It is of interest that the postulated objective of endurance exercises, that is the increase of local circulatory capacity, decreases pain and increase range of motion was achieved, as indicated by the relatively large increase in the range of motion of the cervical spine and decrease of Neck Pain and disability score.

Subject in the control group did not perform endurance training and improved the range of motion and decreased pain. Other studies trying to separate effects on muscle endurance and strength in rehabilitation training faced difficulty as it was found that strengthening exercises increase endurance and vice versa[1,11].

The exercise equipment for strength training was easy to handle which facilitate the establishment of a distinct load provided by the different color of theraband. The experimental group performed endurance exercises with small load (the weight of their head) and increased repetitions.

Ylinen et al.,[38] have shown significant reduction in neck pain as a result of stretching exercise. However, the effectiveness was significantly better when stretching exercises were combined with neck muscle endurance or strength training. This was in agreement with our study in which we address all muscular changes that were associated with chronic neck pain not only stretching exercises. Ahlgren et al.,[1] compared three types of exercises including strength, endurance and coordination for shoulder muscles and found reduction of pain in shoulder muscles for all groups and recommend using any of these exercises when the purpose is to reduce pain but he obtained these results after 10 weeks of training with three sessions per week. However, our result of significant pain reduction in both groups is obtained after only four weeks of an integrated exercises program indicating that the types of exercises have a role in reducing pain not only the intensity and frequency as mentioned by Ahlgren et al.,[1]. Other investigators on the other hand, found no pain reduction after group gymnastics once a week during ten weeks[8,34].

One of the important points is the selecting study population; patients with neck and shoulder pain are often combined into a single group. However, ailments in the shoulder joint are distinctly different and should be differentiated from neck pain. All the exercises introduced by Ahlgren et al.,[1] in the cases of trapezius myalgia suffering from a reduced range of motion in lateral flexion and/or rotation of the neck , and one of more tender points in the neck/shoulder muscles; were for shoulder muscles (rowing, triceps press, shoulder press, arm ergometers). This may be another cause of finding no difference between exercises in reducing pain. Type of exercise, frequency, and intensity of training are key factors in the effectiveness of training. Intensive muscle training at a fitness center which excludes specific neck exercises does not increase neck strength[6,7].

As mentioned by Riku et al.,[31] Higher "doses" of training were associated with improved neck pain and at least 8.75 metabolic equivalent (METs) per week of specific neck, shoulder and upper extremity training was effective. One MET represents the approximate rate of oxygen consumption of a seated individual at rest (35 ml of oxygen per kilogram of body weight per minute). In our study, the experimental group received 15 min additional treatment which may be one of the factors that might contribute to the significant change in range of motion and NPAD. It is recommended in a future study to consider the MET while designing an exercise program.

One of the limitation of this study is the lack of measurement of neck muscle strength and endurance which was recommended by Ylinen et al.,[41] as in patient with chronic neck pain may have low neck strength in flexion, extension, and rotation or in any combination of these and knowledge of the different parameters of neck strength is essential in planning individually tailored neck strength training program. However, we have addressed all groups of muscles in order to alleviate this problem as Jordan and Mehlsen[24] found lower maximal strength of the cervical extensor, Barton and Hayes[2] found that isometric flexion strength in patients with chronic neck pain was about 50% of that of healthy controls. Jordan et al.,[23] and Chiu and Lo[6] found significant reductions of isometric strength in both flexor and extensor muscles of the neck in patient with chronic neck pain compared to healthy controls and recently Ylinen et al.,[38] found weakness also in rotator muscles. In addition our concern is on the clinical manifestation of pain and function. However, the active ROM during extension and rotation were improved almost equally in both group.

Falla et al.,[9] designed an endurance strength program for neck flexors and reported a significant improvement in cervical pain, flexion force and fatigability of sternocleidomastoid muscle (SCM) and anterior scalene (AS) muscles following a 6 week endurance-strength training program for the cervical flexor muscles. This was in agreement with our result that strength and endurance decrease neck pain and improve flexion range of motion. In our result the addition of endurance training didn’t produce any added improvement to neck extension and rotation range of motion which means that neck extension and rotation can improve without endurance training and that neck flexors are those who need the addition of endurance to the exercises program. However, Falla et al.,[9] didn't addressed the weakness and the significant reduction in isometric endurance of neck extensors which was previously reported by Jordan et al.,[23] which means that the addition of endurance training to neck extensor could improve pain and hence range of motion. Perhaps we didn't find extra improvement in the experimental group because we hadn't addressed the isometric endurance exercise but our exercises is in the dynamic form.

Conclusion

The integrated exercise program of strength, stretch and endurance described in this study for subject with chronic non-specific neck pain is mainly efficient for neck flexors and is associated with greater improvement of perceived pain. Strengthening exercise can either be combined with endurance or not in order to improve perceived pain and neck flexion and rotation. Isometric strength and endurance are recommended to improve neck extension.

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الملخص العربي

تأثير تمرينات التحمل كجزء من برنامج تمرينات لحالات الم الرقبة المزمن الغير محدد السبب

الهدف من هذه الدراسة معرفة تأثير برنامج متكامل من التمرينات للتقوي والتحمل والمرونة في حالات ألم الرقبة المزمن غير المحدد السبب . الخلفية العلمية : آلام الرقبة المزمن الغير محدد السبب مشكلة شائعة . الانقباض العضلي الثابت المطلوب للحفاظ على وضع الرأس ف ي أوضاع مختلفة والإجهاد بسبب ضعف العضلات يتوقع أن يكونوا من العوامل المسببة في ألم الرقبة المزمن . ولهذا الم الرقبة يصاحبه ضعف في عضلات الرقبة و الكتف وكذلك قصر و إجهاد فـي العضلات . هناك دراسات تؤيد تأثير التمرينات الت ي تستهدف تحسين قوة وتحمل واستطالة العضلات . على الرغم من ذلك فان الدراسات التي تقيم تأثير تمرينات التحمل للرقبة والكتف قليلة وليس هناك دراسات تقارن تأثير تمرينات القوة والتحمل مجتمعة مع بعضها البعض ف ي حالات آلام الرقبة المزمن . تصميم الدراسة : عشرون شخص (10 إناث و 10 ذكور) يعانون من الم الرقبة المزمن اشتركوا فـي الدراسة وقد تم تخصيصهم عشوائيا أم ا للمجموعة التجريبية التي تقوم بتمارين التقوية والتحمل والاطالات أو المجموعة الحاكمة التي تقوم بتمارين التقوية والاطالات فقط . ولقد تم قياس المدى الحركي للرقبة وكذلك قياس ا لألم والإعاقات قبل وبعد فترة الدراسة و هي أربعة أسابيع من التمرينات أو جريت يوم بعد يوم . النتائج : كلتا المجموعتين تحسنت في المدى الحركي للرقبة و كذلك في مقياس الألم والإعاقة و لكن المجموعة التجريبية تحسنت أكثر في المدى الحركي للثنى و الإمالة الجانبية للرقبة وكذلك مقياس الألم والإعاقة . الاستنتاج : إن برنامج التمرينات المتكامل الذي يتضمن تمرينات القوة والتحمل والاستطالة الموصوف في هذه الدراسة للأشخاص الذين يعانون من الآم الرقبة المزمن فعال بشكل رئيسي لتحسين الآم الرقبة و مدى الحركة في الثني . ولكي يتحسن المدى الحركي في الفرد والدوران للرقبة يمكن استخدام أي نوع من التمرينات سواء كانت للقوة أو التحمل .