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INVESTIGATING THE EFFECT OF NEUROMUSCULAR FACILITATION AND STABILIZATION EXERCISES ON PAIN, ALGOPHOBIA, KINESIOPHOBIA AND NECK RANGE OF MOTION IN PATIENTS WITH CHRONIC NON-SPECIFIC NECK PAIN

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ABSTRACT

Introduction: the present study aims to determine the effectiveness of specific neck muscle stabilization exercises relative to neuromuscular facilitation exercises on pain, algophobia , kinesiophobia , neck range of motion in patients with chronic neck pain.
Research Method: in this clinical trial, 44 patients suffering from chronic neck pain were examined in the year 2016. Forty-Four patients were divided into two groups of 22. Members of one group did stabilization exercises and members of the other group did neuromuscular facilitation exercises. The Tampa Scale for kinesiophobia was used for measuring algophobia and kinesiophobia, the Visual Analogue Scale was used for measuring pain and patients' neck range of motion was evaluated using a flexometer before the treatment and 4, 8 and 12 weeks after the treatment. The treatment program of the both groups contained 48 training sessions over the course of eight weeks 6 sessions a week. The following tests were used for comparing the intergroup and intragroup results obtained before, during and after the treatment: analysis of variance independent t-test and paired t-test.
Findings: the results show that the mean of pain has been significantly reduced in the two groups ($P<0.05$). Patients' neck range of motion in the group whose members did stabilization exercises has increased relative to the members of the other group who did neuromuscular facilitation ($P<0.05$). In addition, the level of algophobia and kinesiophobia has been significantly decreased in the both groups ($P<0.05$).
Conclusion: the present study showed that both types of exercises reduced the pain, fear of pain and fear of movement and increased neck range of motion of patients with chronic neck pain. However, the effect of stabilization exercises has been way more significant than the effect of neuromuscular facilitation exercises.

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Introduction

There is strong evidence that shows that fear of pain and fear of mechanism damage acts as a basis for enhancement of pain and the disability caused by it (1). Vlaeyen believed that any kind of damage or harm to the spine is painful for an individual and in most cases, patients use different methods for coping with the pain without fearing it. However, in some cases, patients

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act differently and they become stuck in a defective cycle; which not only doesn't result in recovery, but because of this fear, patients' pain will become continuous, chronic and turns into a pain that disables the patient (1). Once patients fear pain, reoccurrence of pain, harm or damage, they will avoid moving, doing routine and daily activities, job activities and any other factor that they think plays a role in feeling the pain once more (2) and the moment they start avoiding these physical activities, their musculoskeletal, cardiovascular, respiratory systems and the mental and psychological states will be affected in time. As a result, these patients will be at the risk of being diagnosed with depression because of their weakness and the damage in the aforementioned systems and ultimately, the patients wouldn't be able to do their job and daily activities (3). Because of these factors, the pain patients feel will be continuous and chronic and neck pain will turn into a disabling and chronic illness which imposes high costs on the individual as well as the society (2, 3).

Neck pain is a distinctive illness and it is important to examine the mental aspects of pain, especially fear of movement and the avoidant approaches resulting from the pain felt by patients. Neck pain is one of the most common musculoskeletal diseases and one of the main factors affecting personal, job and social performance of patients all around the world (4).

Like backache, neck pain tends to be chronic and often causes long-term disability. Currently, it has become perfectly clear that psychological factors are important determinatives of the risk of long-term disability (5). Among these factors, we can refer to the fear of pain and movement as predictors of long-term disability in patients suffering from backache which have attracted a great deal of attention (6 , 7). However, no study has reviewed these factors in patients suffering from neck pain. There are a few researches that have specifically studied the avoidant approach caused by pain (8).

One of the most common and valuable tools is TSK which is currently being used for reviewing as one of the biological – psychological – social aspects of backache, neck pain and especially different aspects associated with the avoidant approaches subsequent to it (8). Cleland et al. (9) in 2008 studied the psychometric properties of TSK in 78 patients suffering from mechanical neck pain or without referral to the upper limb. The repeatability of this scale was good and average, respectively; and it has high levels of internal consistency.

Numerous studies have reported that patients suffering from chronic neck pain have weaker muscles than healthy individuals. Neck stabilizer muscles play a crucial role in the movements of a body, maintaining a good posture and also in stabilization cervical spine. In fact, stability of the cervical spines is done by a set of muscles called the deep neck flexors including muscles such as longus colli and longus capitis. Previous studies and recent researches have all mentioned the special role of longus colli in maintaining cervical lordosis. Studies have also referred to the reduction in the deep neck flexors' endurance in patients with chronic neck pain (10).

Therefore, the present study aims to determine the effectiveness of specific neck muscle stabilization exercises relative to neuromuscular facilitation exercises on pain, algophobia , kinesiophobia , neck range of motion in patients with chronic neck pain.

Research method

This study is single-blind randomized clinical trial in which 44 patients suffering from chronic neck pain visiting the research center of the department of physiotherapy in University of Social Welfare and Rehabilitation Sciences were studied in 2016. The information collected from this study entered Iran Center for Clinical Trials Registration. Patients were randomly divided into two groups of 22. The first group of these patients was treated with specific neck stabilization exercises and the second group was treated with neuromuscular facilitation exercises. Patients were not informed about the theory and they were told that the purpose of the study was to review the difference between the effects of two different types of neck muscles exercises.

Sample volume for each group was estimated based on an experimental study with 95% confidence and 90% test power. Demographic information of patients were recorded using a short questionnaire. Information such as the starting date of neck pain,, intensity of pain and age , weight , height , BMI were recorded (table 1).

The criteria for the individuals to take part in the study were: being of the age 22 to 35 for both men and women and suffering from a neck pain for which no specific cause has been mentioned by the doctor and continues for 12 weeks or longer.

Patients answered to the following items as questions and in case of presence of any of these items, the participant would exit the study: disc protrusion or prolapse along with neurological symptoms; spinal surgery; presence of structural damages in the neck; rheumatic, inflammatory and autoimmune diseases; compression fractures induced by osteoporosis and spinal stenosis; rheumatoid arthritis; severe mental illness or pregnancy-related illnesses; physiotherapy, chiropractic, osteopathy,

massage, therapeutic exercises, etc. for neck or shoulders over the course of the past three months; hearing and vision problems which have not been modified with hearing and vision equipment.

Furthermore, patients who do not complete their treatment sessions, use other treatment methods during the conduction of the study or patients whose symptoms (pain and disability) had become intensified by doing the exercises also exited the study.

Qualified patients first signed a consent and then entered the study. The present study has been approved by the Morality Committee of Zahedan University of Medical Sciences. The rights of all of the subjects were observed and protected at all times during the course of the study.

In order to measure pain, the Visual Analogue Scale (VAS) was used which is a sensitive pain scale and this scale had reliability and validity. This scale is a graded ruler with a length of 10cm which is used so that patients would assess their pain on this rule from 0 (no pain) to 10 (severest pain imaginable) (11).

Kinesiophobia and algophobia in patients were measured using the Persian version of the Tampa Scale for Kinesiophobia. This scale has 17 items with 4-option Likert scale which varies from completely disagree to completely agree. The total score of the questionnaire is between 17 and 68. Higher scores are indicative of the high levels of kinesiophobia. According to the results of previous studies on patients suffering from backache, a score higher than 37 is defined as kinesiophobia (12). In the initial stages of the research, the researcher measured the validity of the questionnaire and the results of the ICC and Cronbach's alpha were significant. According to the Pearson test, there is a significant relationship between HADS, TSK and intensity of pain (on the day of the study and the next week) ($P<0.001$). Moreover, there was a relationship between TSK and SF12 ($P<0.001$) (13).

In order to measure the neck flexion range of motion, the patients were asked to lie on their backs, without putting their heads on the bed, put their shoulders on the edge of the bed and their arms on the sides of their bodies and the flexometer was attached to the ears of the patients. The testees were asked to flex their heads, to bring their chins closer to their chests and the flexometer would show their range of motion. In order to measure the range of motion in terms of openness of the neck, these were done the other way. In order to measure the lateral flexion range of motion, the patients were asked to sit on an armchair in a way that their backs would be completely straight, they would hold the arms of the chair and their arms would be hooked around the chair. Then, the flexometer would be fixed behind their heads. In this state, the graded page and marker were adjusted on zero. The testees bent their heads to the left (right) and then to the right (left) after the degree shown by the marker was read (14).

The treatment program of the two groups was as follows: in the first four weeks, the treatment only focused on the muscular problems of the patient so that there would be no trigger point. If there was any shortness of muscle, the active and the passive stretching techniques would be used and ultimately, the weak muscles would be strengthened. At the end of the fourth week, the patients were reassessed and they filled out the questionnaires again. After this stage, patients were put in one of the treatment groups (15).

The group with the stabilization exercises: seven neck stabilizer exercises were used in this study based on the existing treatment approaches (16). The first exercise was done so that the lower scapular stabilizers would be activated. The second, third and fourth exercises were given to the patient in the prone position so that flexor and extensor muscles would be flexed at the same time with the minimum load. The fifth exercise was given to the patients so that the deep neck flexor muscles would be used and strengthened. The purpose of doing the Cranio-Cervical Flexion (CCF) was to improve the function and the tonic capacity and to maintain the posture of the deep neck flexor muscles (17). For the stabilization exercises, the Pressure Biofeedback device was used for assessing the function of deep flexor muscles. After ensuring that the patient does the aforementioned exercises correctly, the sixth and seventh exercises would be given to the patients with the purpose of improving the coordination between the neck flexor and the extensor muscles. The following exercises were done: the first four exercises were done in the fifth and sixth weeks of the treatment program with the minimum CCF exercise (biofeedback pressure 20 mm Hg). In the seventh and eighth weeks of the treatment program, exercises were done with moderate CCF exercise (biofeedback pressure 24 mm Hg). At the end of the eighth week, patients would be assessed again. In the ninth and tenth weeks of the treatment program, all of the exercises were done with the maximum CCF (biofeedback pressure 28 mm Hg) and the sixth and seventh exercises were given to the patients at the 11th and 12th weeks of the program. At the end of the 12th week, the patients were assessed one more time.

The exercising program for the stabilizer group contained 8 weeks of exercise, 6 times a week, twice a day with 10 repetitions in each time. Each exercise took 10 seconds and there was a 10 second rest between the repetitions.

The exercising program of the neuromuscular facilitation group: the patients were asked to lie on their backs in such a way that their head and neck would not be on the bed. Then, the motion pattern of each of the upper organs would be observed in such a way that they were asked to bend, put their chin close to their chest and internal rotate their shoulder joint and their upper limb and simultaneously bending their head and neck forward and turning them to the same side. After this, the second pattern would take place where the patients were asked to open their arms, keeping their chin away from their chest and internally turning their shoulder and upper limb along with bending their head and neck backward and turning to the other side (both to the right and left). While doing the upper organ exercises, the motion patterns of the patients were observed and the patients were asked to follow the movement of their hand to the same side with their eyes (18). The number of movements in each pattern was 10 times for each of the organs. In the fifth and sixth weeks, each motion pattern was repeated 10 times and in the seventh and eighth weeks, they were repeated twelve times, 14 times in the 9th and 10th weeks, 16 times in the 11th and 12th weeks and the final assessment was done at the end of the twelve week (18) .

The exercising program of the neuromuscular facilitation group contained 8 weeks of exercise, 6 times a week, twice a day with 10 repetitions in each time. Each exercise took 10 seconds and there was a 10-second rest between the repetitions.

Research data were analyzed using the SPSS-16 software. The analysis of variance was used for repeated data, for comparing the two treatment methods, comparing the times of the two methods and to review the mutual effects of time and treatment method on one another. The paired t-test was used for comparing the times two by two and in order to compare the two treatment methods in each of the times of measurement, the independent t-test was used with the Benferroni correction. 0.05 was considered as the significance level of the tests.

Findings

Intergroup comparisons: in each of the groups under study, according to VAS, the mean pain was significantly reduced at each of the two consecutive times ($P<0.001$). In addition, in each of the treatment methods, the mean range of motion was reduced at each two consecutive times ($P<0.001$). Moreover, in each of the groups, the mean of kinesiophobia and mean algophobia were reduced ($P<0.001$).

Intragroup comparisons: there was a significant difference between the two groups in terms of range of motion ($P=0.048$); in such a way that this difference was significant after 8 weeks ($P=0.001$) and also after 12 weeks ($P<0.001$). Further, the measurement times and methods had an effect on one another ($P<0.001$); in such a way that the improvement of the range of motion was more rapid in the group receiving stabilizer exercises than in the neuromuscular facilitation exercises, especially after the passing of eight weeks.

No significant difference was seen between the two groups in terms of the pain measured by VAS at none of the times specified in the research ($P=0.482$). However, the effects treatment methods and different times had on each other were significant ($P=0.025$); in such a way that the reduction of the range of motion was slightly more rapid in the group receiving stabilizer exercises than in the neuromuscular facilitation exercises, especially after the passing of four weeks.

No significant difference was observed between the two groups in terms of TSK ($P<0.001$); in such a way that this difference only appeared after 8 weeks ($P<0.001$) and also after 12 weeks ($P<0.001$). Furthermore, the measurement times and methods had an effect on one another ($P<0.001$); in such a way that the reduction of TSK was more rapid in the group receiving stabilizer exercises between the fourth week and the eighth week.

Table 1. mean ± standard deviation of the measured quantitative variables in the groups receiving neuromuscular facilitation and stabilization exercises

	stabilization exercises group	neuromuscular facilitation exercises group	P value
Age (year)	26.2±2.42	26.09±2.84	P=0.96
Height (cm)	162.26±5.63	161.68±7.51	P=0.76
Weight (kg)	61.68±9.47	60.09±10.54	P=0.56

Body mass index	23.42±2.80	22.87±2.43	P=0.49
Intensity of pain at the time of their visit	6.90±1.47	6.1±54.22	P=0.37

Table 2. mean ± standard deviation of the measured variables in patients with chronic neck pain in the stabilization exercise group

Name of the variable	Time of the visit	4 weeks after the visit	8 weeks after the visit	12 weeks after the visit
Ext range of motion	20±3	22±6	24±7	27±6
Flex range of motion	47±4	58±5	68±7	73±3
Lat flex range of motion (right)	2±21	2±24.5	29±3	35±3
Lat flex range of motion (left)	1±20.7	1±23.8	3±28.2	2±34.7
Pain	6.4±1.8	5.4±1.2	8.2±0.8	0.9±0.7
TSK	53.80±6.75	68.47±5.93	30.16±5.16	76.49±21.2

Table 3. mean ± standard deviation of the measured variables in patients with chronic neck pain in the neuromuscular facilitation exercise group

Name of the variable	Time of the visit	4 weeks after the visit	8 weeks after the visit	12 weeks after the visit
Ext range of motion	21±2	22±2	23±4	25±4
Flex range of motion	45±4	51±5	59±6	62±6
Lat flex range of motion (right)	21±3	24±4	26±4	27±5
Lat flex range of motion (left)	21.4±4	22.2±5.5	25.8±2	26.4±5
Pain	6.6±1.7	4.88±1.67	3.00±1.00	1.28±0.94
TSK	51.08±6.41	46.68±6.01	52.35±4.44	27.56±3.35

Discussion

In the present study, neck pain, kinesiophobia and algophobia were decreased after both types of treatment (neuromuscular facilitation exercises and stabilization exercises) used in this research and neck range of motion was decreased after both types of treatments. Moreover, reduction of the pain intensity, reduction of the fear of pain and movement and enhancement of the range motion in the group receiving stabilization exercises were more significant than the group receiving neuromuscular facilitation exercises.

Cervical muscles of patients with neck pain are weaker than healthy individuals (19). Also, small one-joint or two-joint muscles of the spine atrophy or weaken in unstable parts of the spine (20). The main purpose of the neck muscles stabilization exercises is to maximize the function, to limit the improvement of destructive changes and to prevent further damage (Philadelphia). Stabilization exercises strengthen the specific muscles of the neck and limit or minimize muscular movements towards more joint mobility (20). Panjabi has referred to this principle that reduction of the activity of local muscles of the spine leads to occurrence of symptoms of instability and argued that these exercises reduce spinal pain; but he doesn't propose any specific reason that would be based on a randomized controlled trial (21). On the other hand, despite the lack of evidence on the effectiveness of neuromuscular facilitation exercises on the treatment of neck pains, these exercises are broadly used for treating chronic neck pain (18). In the study conducted by Asghar RezaSoltani et al., the effects of PNF exercises and traditional exercises (isometric) on the level of pain and strength of smooth and bending neck muscles in patients suffering from chronic neck pain were compared to each other. They concluded that neuromuscular facilitation exercises are more effective methods for reducing pain and for the recovery of the strength of muscles in patients with chronic pain than traditional neck pain (18). In their study, Akbari et al. also proved that doing neck stabilization exercises and dynamic neck exercises increase the strength of surface and deep neck muscles, increase its range of motion and reduces pain and disability. However, stabilization exercises were more effective when it comes to reducing pain and disability and increasing strength than the dynamic exercises (22). In the study of Chiu, neck muscles of patients suffering from chronic neck pain were strengthened and after 6 weeks of treatment, chronic pain and disability of patients were reduced and the strength of their muscles was improved (23). Askari Ashtiani et

al also proved that doing neck stabilization exercises and maximal isometric exercises increase the cross sectional area of deep neck muscles, reduces pain and disability. However, stabilization exercises were more effective when it comes to reducing pain and disability and increasing cross sectional area than the maximal isometric exercises (24) . We have also shown that stabilization exercises can reduce the pain, fear of pain and movement and increase range of motion of patients with chronic neck pain and in most cases, the variables under study are more effective than neuromuscular facilitation exercises. Aker also systematically reviewed the efficiency of conservative treatments for treating mechanical neck disorders. Many of the mechanical neck disorders treatment methods have not received the support they need by clinical trials (25). In a systematic review, Kay evaluated the efficiency of exercises in reducing pain and fear of pain and in improving disability and function in patients with mechanical neck disorders and showed that specific exercises might be effective in treating chronic and severe mechanical neck disorders (26). Bronfort, in a study, concluded that strength training exercises, along with manual treatment or separately, are more effective in improving pain and fear of pan in patients suffering from chronic neck pain than manual treatments alone (27).

According to the previous studies, stable activity of anti-gravity muscles of the neck is affected when people suffer from neck pain. Tonic fibers of these muscles support postural pain relief. These fibers are influenced by lack of usage, reflex inhibition and pain. The nature of this functional disorders is quite important in determining the type of exercise for recovering stability or playing a supportive role. Presence of a relationship between functional disorder of local muscles and neck pain has been confirmed. Functional disorder of deep neck flexor muscles, especially longus colli, has been specified in association with reflex inhibition and pain and reduction of the level of deep flexor muscles (21). The present study has also shown that doing stabilization exercises have been effective for improving the performance of individuals, reduction of pain, reduction of algophobia and increase of neck range of motion.

Stabilizer muscles of the neck are important for the head and neck to be in a proper position. It is obvious that these muscles are also effective for making dynamic activities stable (21). In case of presence of any pain and also fear of pain, these muscles can atrophy and not work properly. By doing stabilization exercises, fear of pain will be reduced and static and dynamic stability of the neck will be recovered. It is likely that when stability is improved in the neck area, mover muscles will better at creating power and subsequent to this, pain will be reduced and because of this reduction, the range of motion will also be increased.

Due to various reasons, we believe that stabilization exercises have a greater impact on the improvement of neck pain, reduction of fear of pain and movement and on the enhancement of range of motion. Firstly, although all muscles are involved in controlling movements and stabilization of the spine; deep muscles play a crucial role in controlling intervertebral movements. Secondly, the body muscle controlling strategy changes in patients with neck pain and activities of deep muscles are disturbed and these muscle will be at risk of atrophy. Finally, not treating the changes in the deep muscle system causes the pain, fear of pain and fear of movement to come back in patients with chronic neck pain (28).

Conclusion

This study has shown that neuromuscular facilitation and stabilization exercises in patients with chronic cervical spine (neck) pain reduce pain, fear of pain and movement and increase range of motion. However, stabilization exercises are way more effective than neuromuscular facilitation exercises. Therefore, given the existing evidence and the results obtained from this study and other studies, it is recommended to use stabilization exercises for patients with chronic neck pain; because these exercises play an important role on the psychological aspects of pain in patients with chronic neck pain.

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References

1. Vlaeyen JW, Kole-Snijders AM, Boeren RG,. Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. Pain. 1995;62:363-72.
2. Leeuw M, Goossens ME, Linton SJ, et al. The fear-avoidance model of musculoskeletal pain: current state of scientific evidence. Behave Med 2007;30:77-94.

3. Verbunt JA, Seelen HA, Vlaeyen JW, et al. Disuse and deconditioning in chronic low back pain: concepts and hypotheses on contributing mechanisms. Eur J Pain. 2003;7(1):9-21.
4. Burton AK, Tillotson KM, Main CJ, Hollis S. Psychosocial predictors of outcome in acute and subchronic low back trouble. Spine. 1995; 20:722-8.
5. Hogg-Johnson S, van der Velde G, Carroll LJ, et al. The burden and determinants of neck pain in the general population: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. Spine 2008;33(4 Suppl):S39-51.
6. Côté P, van der Velde G, Cassidy JD, et al. The burden and determinants of neck pain in workers: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. Spine. 2008;33(4 Suppl):S60-74.
7. Davatchi F, Jamshidi AR, Tehrani Banihashemi A, et al. WHO-ILAR COPCORD Study (Stage1,Urban Study) in Iran. J Rheumatol 2008;35:1384–9.
8. Ghaffari M, Alipour A, Farshad AA, et al. Incidence and recurrence of disabling low back pain and neck-shoulder pain. Spine 2007;31:2500-06.
9. Cleland JA , Fritz JM , Childs JD . Psychometric properties of the Fear-avoidance beliefs questionnaire and Tampa Scale of Kinesiophobia in patients with neck pain . Am J Phys Med Rehabilitation 2008 ; 87 : 109-117
10. Fountain FP, Minear WL, Allison RD. Function of longus colli and longissimus cervicis muscles in man . Arch Phys Med Rehabil. 1999 Oct; 67(10):665-669
11. Melzack R . The short-form McGill Pain Questionnaire. Pain . 1987 Aug;30(2):191-197.
12. Woby SR , Roach NK , Urmston M , et al . Psychometric properties of the TSK : A shortened version of the Tampa Scale for Kinesiophobia . PAIN 2005 : 117 : 137-144
13. Askari Ashtiani AR , Ebrahimi-Takamjani I , Torkaman G , Amiri M , Mousavi SJ Reliability and Validity of the Persian Versions of the Fear Avoidance Beliefs Questionnaire and Tampa Scale kinesiophobia in patients with neck pain . Spine2014 : 39 (18) ; E 1095 – E1102
14. Letafatkar A , Alizadeh MH , Taghavi M , Hadadnezhad M , Norouzi HR . The effect of one period of exercise program on non athletes neck ROM and chronic neck pain . Research in rehabilitation Science . 2011 : 7 (1) ; 39-47 (In Persian)
15. Askari Ashtiani AR , Ebrahimi-Takamjani I , Torkaman G , Amiri M . Effects of Stabilization exercises and Maximal isometric exercises on pain , TSK and disability in non-specific neck pain . J Physical Treatment 2013 :3 (2) ; 16-22 (In Persian)
16. Sweeney T . Neck school : cervicothoracic stabilization training . Occup Med . 1999 Jan – Mar ; 7(1):43-45
17. Jull G, Trott P, Potter H, Zito G, Niere K, Shirley D, et al . A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache . Spine 2002 Sep 1;27(17):1835-1843
18. Rezasoltani A, Khaleghifar M, Tavakoli A, Ahmadipour A. The Comparison of Neuromuscular Facilitation Exercises and Traditional Exercise Therapy Programs in the Treating of Patients with Chronic Non-Specific Pain.J Rafsanjan uni med. 2010 ;8(1) ; 59-66 (In Persian)
19. Ylinen J , Salo P , Nykanen M , Kautiainen H , Hakkinen A . Decreased isometric neck strength in women with chronic pain and the repeatability of neck strength measurements . Arch Phys Med Rehabil . 2004 aug : 85 (8) : 1303-1308
20. Randlov A, Qstergaard M, Manniche C, Kryger P, et al . Intensive dynamic training for females with chronic neck/shoulder pain . A randomize control trial . Clin Rehabil . 1998; 12(3); 200-210
21. Panjabi MM . The Stabilization system of the spine . Part 1 . Function , dysfunction , adaptation , and enhancement . J Spinal Disord . 1992 Dec;5(4) : 383-389
22. Akbari A, Ghiasi F, Barahoei M, Arab-kangan M. The Comparison of effectiveness of muscles specific stabilization training and dynamic Exercises on Chronic neck pain and disability . J gorgan uni med sci , 2010; 11(4);29-38 (In Persian)
23. Chiu TT, Lam TH, Hrdley AJ . A randomized controlled trial on the efficacy of exercise for patients with chronic neck pain . Spine (Phola Pa 1976) . 2005 jan 1;30(1):E1-7
24. Askari Ashtiani AR , Ebrahimi-Takamjani I , Mohammadi M . The effects of Stabialization Exercises and Maximal isometric Exercises on Cross-sectional Area of deep cervical flexor muscles in patients with chronic non-specific neck pain . Physical Treatment J . 2014 ; 3 (4) : 52-58 (IN Persian)
25. Aker PD, Gross AR, Goldsmith CH, Peloso P. Conservative management of mechanical neck disorders . A systematic overview and meta-analysis . BMJ . 1996 Nov 23 ; 313 (7068) : 1291-1296
26. Kay TM, Gross A, Goldsmith C, Hoving J, Bronfort G. Exercises for mechanical neck disorders . Cochrane Database disorders . Cochrane Database Syst Rew. 2005 jul 20;(3) : CD004250
27. Bronfort G, Evans R, Nelson B, Aker PD, Goldsmith CH, Vemon H. A randomized clinical trial of exercise and spinal manipulation for patients with chronic neck pain . Spine (Phila Pa). 2001 Apr 1;26(7):788-797
28. Richardson CA, Jull GA. Muscle control-pain control . What exercises would you prescribe? Man Ther . 1995 Nov;1(1): 2-10