Egyptian Journal of Physical Therapy
[EJPT]

Original Article

Efficacy of Sensorimotor Integration on pain in Patients with Cervical Myofascial Pain Syndrome

Asmaa A. Mahmoud[1, *], Abdelrahman A. Chabara[2], Salwa F. Abdelmageed[2], Sara M. Samir[2].

[1] Department of Physical Therapy, Helwan University, Egypt.
[2] Department of Physical Therapy for for Musculoskeletal Disorders & its Surgery, Faculty of Physical Therapy, Cairo University.
* Department of Physical Therapy, Helwan University, Egypt.
Email:asmaa198.abdelrhman@gmail.com, Telephone: 01121622578.

Abstract:
Purpose: This study was conducted to investigate the efficiency of sensorimotor control [SMC] training on pain intensity for patients with cervical myofascial pain syndrome [MPS]. **Methods:** Forty patients with chronic MPS were recruited for the study. Their age ranged from 18 to 40 years old. They were referred by an orthopedist with the presence of cervical MPS due to latent myofascial trigger points. They were allocated into two equal groups; Group A received the evidence-based PT program alone while Group B received SMC training program combined with the evidence-based PT program. All patients received 12 sessions of supervised intervention, three times a week for four weeks. Pain intensity was evaluated using the visual analogue scale. **Results:** There were significant differences in Group B as compared to Group A p-value≤ 0.05. **Conclusion:** The SMC training combined with the evidence- based PT program is more effective than the evidence-based PT program alone in reducing pain intensity for patients with cervical MPS.

Key words: cervical myofascial pain syndrome, sensorimotor control, evidence based physical therapy, pain intensity.
Academic Editor: Asmaa A. Mahmoud.
Received: March 2024, **Revised**: April 2025, **Accepted**: May 2025, **Published**: June 2025
Citation: To be added by editorial staff during production.

1. Introduction:

The musculoskeletal condition known as myofascial pain syndrome [MPS] is associated by motor, sensory, and autonomic symptoms. It is linked to a wide range of pain disorders, such as tendinitis, disk abnormalities, radiculopathies, joint dysfunction, and many more **[1].** It is compatible with the pain feeling and is defined by the presence of hyperirritable areas in palpably tense straps of skeletal muscle fibers called myofascial trigger points [MTrPs] **[2]**. Other prominent symptoms include the development of tense bands, weakening of the muscles, discomfort that is combined with limitation of ROM **[3].**

Clinically, trigger points are categorized as either latent or active **[4].** In addition to causing sudden pain, an active MTrP frequently results in overall motor dysfunction, which manifests as stiffness and limited range of motion. Motor dysfunction without pain is frequently the result of a latent myofascial trigger point. To provoke pain related to latent MTrPs, one must apply strong steady pressure or apply a mechanical stimulus **[5].** With MTrPs in the muscles, myofascial pain syndrome is a musculoskeletal state with a morbidity prevalence rate extending from 85% to 95% **[6]**

According to an investigation, 93.75% of patients with chronic non-specific cervical pain who also had MPS had MTrPs in their upper trapezius muscles **[3],** Compared to certain theories of incorporation, muscle spindle emissions, spinal section sensitization, scarring, and fibrosis in the muscles, in MTrPs, an excess leaking of acetylcholine at the neuromuscular connection causes continual contracture ties that develop into a palpably painful nodule **[6]** MPS can be caused by a multiplicity of agents, such as recurrent micro-injuries, aberrant pressures from overemployment or mechanical overwork of particular muscles and muscle group, long-standing keep of improper addicted postures, and mental pressure **[1].**

The management of multiple pressure injuries involves addressing mechanical imbalances and preventing and removing trigger point development **[7].** Short-term exercise improved bodily function and reduced pain **[8].**

One of the main reasons of incapacity, exhaustion, low income, mood swings, diminished quality of life, and restrictions on everyday activities is myofascial pain **[9].**

The goals of MPS treatment include pain relief, restoration of full ROM sufficient muscular strength, and proper posture **[10].** Exercise that combines different forms of strengthening, stretching, and endurance is inexpensive, non-pharmacological, and non-invasive. Since exercise usually has rare or no adverse effects in patients with myofascial ache, it may be employed as the initial therapy option for pain alleviation, enhancement in range of movement and function, and reduction of muscle spasm in many musculoskeletal problems **[11].**

Currently, there is extremely low-quality proof showing that train helps persons with myofascial pain experience minor -to- medium reductions in pain intensity during short term follow-up. Exercises that combine stretching and strengthening appear to have more beneficial effects [**12**]. In patients with myofascial pain syndrome, isometric reinforcement practice had been demonstrated to reduce pain intensity as assessed by the visual analogue scale **[13].** Exercises that improve blood flow to resistant areas while strengthening and increasing aerobic capacity most likely cause localized blood pressure increases. This may improve the increased resistance of the vascular bed that indicates the MTrPs **[14].** It is believed that changed cervical afferent input or impaired cervical movement and position sense cause sensorimotor control dysfunction, which manifests as poor postural stability and head and eye organization controller that coexists with neck ache **[15].** Moreover, several researchers reported proprioceptive abnormalities in MTrPs patients, such as tinnitus or balance issues **[16]**

This study investigated the efficiency of sensorimotor control training on pain intensity for patients with cervical MPS.

2.Patients and Methods

2.1. participants:

This research was conducted at Helwan university to evaluate the impacts of SMC training on pain intensity for patients with cervical MPS. The research was approved and permitted by the ethics committee of the faculty of physical therapy, Cairo University [P.T.REC/012/003771] on 17/5/2022. This study employed a two-armed pre- test post- test randomized controlled trial design. The overall sample size was 32 patients and sample size calculation were performed using G. power3.1.7.4 for Windows, t-test research, an alpha level of 0.05, confidence interval of 90%, an effect size of 0.6, and a two-sided alternative hypothesis. We would need to enroll about 38 patients [nineteen in each group] if we assume a 15% dropout rate. The study recruited 38 patients with cervical MPS of both genders, who were divided evenly and at random into 2 groups.

Inclusion Criteria:

Patients between the ages of 18 and 40 were eligible to participate in this study. Individuals without cognitive conditions that would prevent them from participating fully. Orthopedist referrals verified the existence of cervical MPS. Individuals with latent MTrPs. A trigger point can be found through palpation, with or without a referral of pain [**17**]. The patient must recognize symptoms during the palpation of the bruised dot; at minimum three of the next must be exist: muscle tautness or cramp, restricted range of movement of the related joint, pain that deteriorates with tension, palpation of a hard strip and/or nodule connected with a sensitive dot, and the local tremor reaction is a crucial medical finding that reinforces the existence of a elicit point [fast, concentrating contraction of muscle fibers caused by biting or strumming the rigid strip vertical to the muscle fibers].

Exclusion criteria:

Patients with radiculopathy or other neurological disorders, vestibular, visual, or neurological dysfunction, signs of significant trauma to the spine, unexplained weight loss, widespread neurologic changes, and recent treatments for cervical ache, such as rehabilitation therapy, in the previous eight weeks, were ruled out from this study. Patients allocated into two groups.

Group A: received evidence-based PT program alone.

Group B: received SMC training program combined with evidence-based PT program.

Each patient underwent twelve sessions of supervised intervention, for four weeks, three times a week **[18].**

Participants randomization:

The patients were randomly assigned using a simple random procedure, selecting one of two wrapped cards that represented the two experimental groups, in order to prevent selection bias.

2.2. Methods:

Assessment and Treatment Instrumentations

1. Visual analogue scale: to measure the grade of pain intensity.
2. Hot packs Moist hot: a towel, made in CHAINA.
3. Ultrasound Waves Device: was applied using [Enraf–NoniusSonopuls390-1].

A. Assessment Procedures

Measurement of Pain Intensity

Ask the patient use the VAS to mark their level of pain on a continuous 10-cm line by placing a horizontal mark ranging from no pain at all to the maximum amount of pain they might experience. [**19**]. The VAS was used to assess the grade of pain. It is valid, reliable and appropriate for use in the clinical practice [**20**].

B. Treatment Procedures

12-session supervised intervention program was provided to all patients, three times a week for four weeks [**18**].

A. The Evidence Based Physical Therapy Program

The first group of patients got a 20-minute period of time hot pack [HP] treatment, an 8-minute US [1W/cm2, continuous wave, 1 MHz], For a total of eight minutes, US was given bilaterally to the neck and upper back. [**21**].

12 sessions of stretching and strengthening exercises Stretching [neck extension, flexion, left/right lateral flexion, left/right rotation, and pectoralis] and strengthening [isometric exercise, the posterior portion of the deltoid, and postural exercise] exercises to the cervical and back muscles in a seated position [**21**].

After applying a hot pack and US, a physiotherapist performed exercises in a treatment unit, with ten repetitions of each. [**21**].

Stretches for the levator scapulae, sternocleidomastoid, posterior neck musculature, and upper trapezius and scalene muscles should be passive static exercises. Every stretching exercise was held for 20 seconds in a somewhat uncomfortable posture and then performed three times. [**22**].

Postural correction exercise [23,24].

1. Correcting the posture of the spine Sitting: Using a lumbo-pelvic motion to initiate an active, upright sitting position 10 repetitions × 10 second holds.
2. Adjusting scapular alignment and spinal posture Sitting: Maintaining spinal posture and actively positioning the scapular in a neutral stance for 10 second holds and 10 repetitions.

3. Occipital lift combined with scapular and spinal correction When seated, actively extend the back of the neck while keeping the posture of the spine and scapula. 10 repetitions × 10 second holds.

B. The Sensorimotor Training Program

Sensorimotor Exercises [23,24].

1.Cervical joint position sense:

Using a laser pointer joined to a lightweight circlet, the participants trained to move their heads to points in various targets while keeping their eyes open at first. In this exercise, the head is moved back to a neutral position or a pre-established range point. To advance through the workout, the patient was asked to close his/ her eyes and switch up your movement ranges and orientations for 5 repetitions × 3 sets.

2.Cervical movement sense.

With a laser pointer attached to a lightweight circlet for performance feedback, the applicants trained in drawing vertical and horizontal lines on a wall diagram, with accuracy and speed coming in second. Exercises are advanced by speeding up and tracing increasingly complex patterns, including alphabet patterns [5 repetitions × 3 sets], zigzag, or figure of eight.

3.Oculomotor Control Exercises [23,24].

a. Develop eye follow. The participants move their heads still as they follow a target that moves up, down, and side to side. 3 sets of 5 repetitions.

b. Practice gaze stability drills. The participants maintain eye contact with the target while making active motions. The target's speed can be increased, the applicant can move, and the visual contextual and focal dot can shift as examples of progressions. 3 sets of 5 repetitions.

c. Practice activities for eye-head coordination. To focus on an object, the participants move their eyes and head in a similar path. Moving their eyes and heads in opposite directions and moving the circumstantial eyes first are examples of progressions. 3 sets of 5 repetitions.

Balance exercises [23,24].

Static balance is the first skill taught during training, followed by dynamic balance and difficult gait. Training was advanced by shutting the eyes, switching to a softer surface for support, doing voluntary motions simultaneously, or extending the duration of the exercise, reputation time [30 s holds × 10 repetitions].

Statistical Analysis:

All of the patient's information, including, body mass index [BMI], height, weight, age and gender, were collected for both groups. Additionally, assessments of pain severity were reported both before and after treatment. Every test had a significant level of p-value≤ 0.05. Data statistical analysis was performed using the statistical program for social sciences [SPSS]version 26 for Windows [Armonk, NY: IBM Corp].

3.Results:

All patients in both groups had mean values for age, height, weight, and BMI. Using the MANOVA test to compare these values showed no significant differences in age [p=0.81], height [p=0.89], weight [p=0.51], or BMI [p= 0.73]. Using the Chi-square test to compare the gender distribution of all patients in both groups, no significant differences were found[p=0.75], [**Table 1**].

Table 1: Demographic data for all patients in both groups.

Demographic		Mean±SD		P-value	Sig.
		Group A	Group B		
Age[years]		31.15 ± 4.71	30.7 ± 6.97	0.81	NS
Weight [kg]		73.3 ± 10.51	71.3 ± 8.48	0.51	NS
Height [cm]		171.9 ± 8.61	171.55 ± 7.35	0.89	NS
BMI [kg/m2]		24.7 ± 2.35	24.37 ± 3.73	0.73	NS
Gender	Males [%]	9 [45]	7 [35]	0.75	NS
	Females [%]	11 [55]	13 [65]		

SD: Standard deviation, P-value: probability value.

Using a repeated measures MANOVA test to compare the mean values of groups A and B before and after therapy, significant differences were found for pain intensity [p=0.0001].

Using a one-way MANOVA test to compare the pre-treatment mean values between the two groups, no significant differences in pain intensity were found [p= 0.78].

Using a one-way MANOVA test to compare the post-treatment mean values between the two groups, it was shown that there were significant differences in pain intensity favouring Group B [p= 0.001], [**Table 2, Figure 1**].

Table 2: One-way MANOVA test for comparison of post-treatment mean values between both groups.

Post	Mean ± SD		P-value	Sig.
	Group A	Group B		
Pain intensity	3.04 ± 0.54	2.39 ± 0.63	0.001*	S

SD = Standard deviation, P-value = Probability, Sig. = Significance, S= Significant.

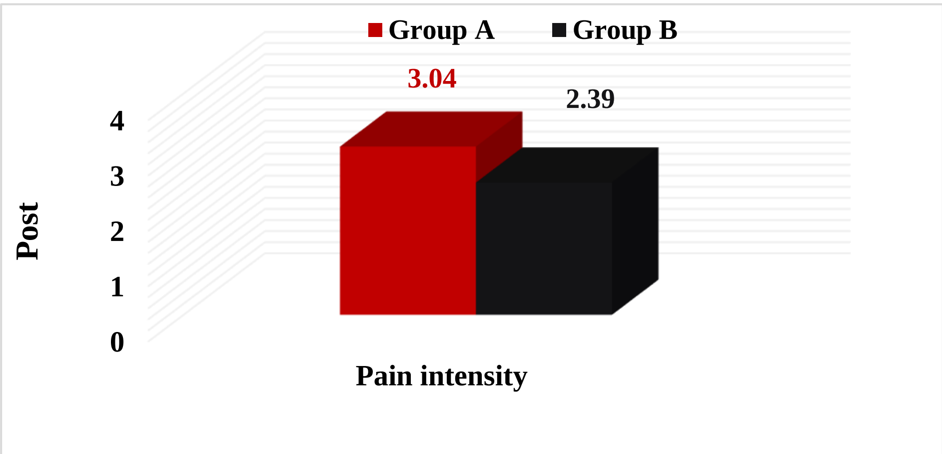

Figure 1: Post-treatment means values of pain intensity for all patients in both groups.

4. Discussion:

The current study was carried out to investigate the efficiency of SMC training on pain intensity for patients with cervical MPS. It was hypothesized that there are no significant differences between SMC training program combined with evidence-based PT program versus PT program alone on pain intensity for patients with cervical MPS. The results of this study reject this hypothesis as there were significant differences between SMC training program combined with evidence-based PT program versus PT program alone in post-treatment pain intensity in favour of the SMC training program combined with evidence-based PT program in post-treatment pain intensity [p= 0.001].

The findings of this study are in line with Mazidi et al [**25**] who demonstrated how well a SMT program worked with pain and improved the patient activities. In addition, the findings in accordance with Yalfani et al [**26**] found that pain was considerably reduced in males with patellofemoral pain syndrome [PFPS] who participated in SMT program. In addition, the findings are supported by Ahmadi et al [**27**] found that patients with PFPS reported much less pain after completing SMT.

Furthermore, the findings are agreed with Derakhshani et al [**28**] examined the impact on pain in patients with scapular downward rotation syndrome and found that passive interventions on the scapula and neck may be more effective in controlling pain intensity than conservative training on these areas alone. Vittersø et al [**29**] reviewed a wide range of modifications in SMT and found that treating conditions involving various pathologies, musculoskeletal, headache or orofacial, neurological pain, and whiplash associated illness has been shown to reduce discomfort.

Regarding the scientific explanation of the effects of SMT in controlling pain intensity, Harris [**30**] suggested that differences in the cortical representation of the affected body part caused inconsistencies between motor intention and sensory feedback, which might give rise to pain even in the absence of tissue injury and the treatment should be based on this concept. It was found that important links exist between the cervical spine's receptors and the vestibular and visual systems, as well as several parts of the central nervous system. The integration, timing, and tuning of SMC can be changed by afferent input changed by cervical receptor dysfunction in neck ache. Therefore, it is recommended that patients with neck discomfort have their aberrant cervical somatosensory input and sensorimotor control assessed and managed [**23**].

The deep fascia connects a group of muscles known as the posterior myofascial chain or superficial back line, which extends from the foot to the fascial sheath surrounding the eye. Myofascial neck and shoulder discomfort, tension headaches, non-otogenic otalgia, temporomandibular pain, and visual dysfunctions are thought to be caused by dysfunctions of the fasciae of the head and neck [**31**].

Aspects of sensorimotor impairments have been demonstrated to improve with traditional physical therapies. However, this might not be the best effective strategy. Therefore, treating any side effects on the vestibular and visual systems may be beneficial and result in a notable reduction in sensorimotor problems linked to neck pain [**15**].

The findings of this study differ from Sadaat et al. [**18**]. who compared SMC training combined with traditional exercise against traditional exercise alone in a double-blinded RCT for 53 patients with chronic non-specific neck pain. The results showed that there were improvements in both groups regarding pain intensity reduction but without any significant differences between them. Add to this, Min and Kim [**32**] found that the visual feedback better proprioception in the cervical spine when provided for patients with chronic neck pain, it results in no significant differences in pain intensity than the absence of it.

It recommended to have more well-designed RCTs regarding the effectiveness of SMC training and its effects on pain intensity for patients with cervical MPS.

5. Conclusions:

Sensorimotor control training combined with the evidence-based PT program and the evidence-based PT program alone is effective in reducing pain intensity for patients with cervical MPS with a greater effect for the SMC training combined with the evidence-based PT program.

Funding information:

No funds were available for this study.

Declaration of competing interest:

The authors declare that they have no conflicting interests.

Acknowledgment:

The authors would like to thank the participants in this study.

References:

1) Borg-Stein J, Simons DG. Focused review: myofascial pain. Arch Phys Med Rehabil. 2002;83(3 Suppl 1): S40-7, S48-9.

2) Vargas-Schaffer G, Nowakowsky M, Eghtesadi M, Cogan J. Ultrasound-Guided Trigger Point Injection for Serratus Anterior Muscle Pain Syndrome: Description of Technique and Case Series. A A Pract. 2015 15;5(6):99-102.

3) Cerezo-Téllez E, Torres-Lacomba M, Mayoral-Del Moral O, Sánchez-Sánchez B, Dommerholt J, Gutiérrez-Ortega C. Prevalence of Myofascial Pain Syndrome in Chronic Non-Specific Neck Pain: A Population-Based Cross-Sectional Descriptive Study. Pain Med. 2016;17(12):2369-2377.

4) Alvarez DJ, Rockwell PG. Trigger points: diagnosis and management. Am Fam Physician. 2002 15;65(4):653-660.

5) Lucas KR. The impact of latent trigger points on regional muscle function. Curr Pain Headache Rep. 2008 ;12(5):344-349.

6) Zhuang X, Tan S, Huang Q. Understanding of myofascial trigger points. Acupunct Med. 2014;127(24):4271-4277.

7) Gerwin RD. A review of myofascial pain and fibromyalgia--factors that promote their persistence. Acupunct Med. 2005;23(3):121-134.

8) Dong R, Wu Y, Xu S, Zhang L, Ying J, Jin H, Wang P, Xiao L, Tong P. Is aquatic exercise more effective than land-based exercise for knee osteoarthritis? Medicine (Baltimore). 2018 ;97(52): e13823.

9) Eftekharsadat B, Babaei-Ghazani A, Habibzadeh A, Kolahi B. Efficacy of action potential simulation and interferential therapy in the rehabilitation of patients with knee osteoarthritis. Ther Adv Musculoskelet Dis. 2015 ;7(3):67-75.

10) Azatcam G, Atalay NS, Akkaya N, Sahin F, Aksoy S, Zincir O, Topuz O. Comparison of effectiveness of Transcutaneous Electrical Nerve Stimulation and Kinesio Taping added to exercises in patients with myofascial pain syndrome. J Back Musculoskelet Rehabil. 2017;30(2):291-298.

11) Moraes Ada R, Sanches ML, Ribeiro EC, Guimarães AS. Therapeutic exercises for the control of temporomandibular disorders. Dental Press J Orthod. 2013;18(5):134-139.

12) Mata Diz JB, de Souza JR, Leopoldino AA, Oliveira VC. Exercise, especially combined stretching and strengthening exercise, reduces myofascial pain: a systematic review. J Physiother. 2017;63(1):17-22.

13) Buttagat V, Taepa N, Suwannived N, Rattanachan N. Effects of scapular stabilization exercise on pain related parameters in patients with scapulocostal syndrome: A randomized controlled trial. J Bodyw Mov Ther. 2016;20(1):115-122.

14) Turo D, Otto P, Shah JP, Heimur J, Gebreab T, Zaazhoa M, Armstrong K, Gerber LH, Sikdar S. Ultrasonic characterization of the upper trapezius muscle in patients with chronic neck pain. Ultrason Imaging. 2013;35(2):173-187.

15) Kristjansson E, Treleaven J. Sensorimotor function and dizziness in neck pain: implications for assessment and management. J Orthop Sports Phys Ther. 2009;39(5):364-377.

16) Ge HY, Zhang Y, Boudreau S, Yue SW, Arendt-Nielsen L. Induction of muscle cramps by nociceptive stimulation of latent myofascial trigger points. Exp Brain Res. 2008;187(4):623-9.

17) Kumbhare D, Shaw S, Grosman-Rimon L, Noseworthy MD. Quantitative Ultrasound Assessment of Myofascial Pain Syndrome Affecting the Trapezius: A Reliability Study. J Ultrasound Med. 2017 ;36(12):2559-2568.

18) Saadat M, Salehi R, Negahban H, Shaterzadeh MJ, Mehravar M, Hessam M. Traditional physical therapy exercises combined with sensorimotor training: The effects on clinical outcomes for chronic neck pain in a double-blind, randomized controlled trial. J Bodyw Mov Ther. 2019 ;23(4):901-907.

19) Price DD, Bush FM, Long S, Harkins SW. A comparison of pain measurement characteristics of mechanical visual analogue and simple numerical rating scales. Pain. 1994;56(2):217-226.

20) Begum MR, Hossain MA. Validity and reliability of visual analogue scale (VAS) for pain measurement. J. Med. Case Rep. 2019;2(11).

21) Acar B, Yılmaz OT. Effects of different physiotherapy applications on pain and mobility of connective tissue in patients with myofascial pain syndrome. J Back Musculoskelet Rehabil. 2012;25(4):261-267.

22) Wilke J, Vogt L, Niederer D, Hübscher M, Rothmayr J, Ivkovic D, Rickert M, Banzer W. Short-term effects of acupuncture and stretching on myofascial trigger point pain of the neck: a blinded, placebo-controlled RCT. Complement Ther Med. 2014 ;22(5):835-841.

23) Treleaven J. Sensorimotor disturbances in neck disorders affecting postural stability, head and eye movement control. Man Ther. 2008;13(1):2-11.

24) Rodine R. Whiplash, Headache, and Neck Pain: research-based directions for physical therapies. J. Can. Chiropr. Assoc. 2008 ;52(3):193-194.

25) Mazidi M, Sakinepoor A, Letafatkar A. Effect of Sensorimotor Training on Proprioception, Posture and Pain in Subjects with Chronic Non-specific Neck Pain. Rehabilitation. 2021 ;7(4):61-71.

26) Yalfani A, Ahmadi M, Gandomi F. The effects of 12-weeks of sensorimotor exercise on pain, strength, pelvic drop, and dynamic knee valgus in males with patellofemoral pain syndrome. Physical Treatments-Specific Phys. Ther. 2020 ;10(3):159-168.

27) Ahmadi M, Yalfani A, Gandomi F. Effect of Twelve weeks of sensorimotor training on pain, improvement proprioception, muscle strength, and postural control in men with patellofemoral pain syndrome: A randomized single-blind clinical trial. J Rehabil Med. 2021;10(1):1-3.

28) Derakhshani A, Letafatkar A, Abbasi A. Comparison of the effects of sensorimotor training programs on pain, electromyography and kinematics in patients with scapular downward rotation syndrome. Phys. Ther. Sport. 2018; 34:66-75.

29) Vittersø AD, Halicka M, Buckingham G, Proulx MJ, Bultitude JH. The sensorimotor theory of pathological pain revisited. Neurosci Biobehav Rev. 2022; 139:104735.

30) Harris AJ. Cortical origin of pathological pain. Lancet. 1999;354(9188):1464-1466.

31) Prabu Raja G, Shyamasunder Bhat N, Marie Cruz A, Prabhu A, Fernandes S, Naaz N. The anatomical myofascial continuum between the neck and eyes. Clin. Anat. 2022 ;35(3):340-346.

32) Min IG, Kim SY. Effects of cervical sensorimotor control training on pain, function and psychosocial status in patients with chronic neck pain. Phys. Ther. Korea. 2021 20;28(1):36-46.