

DIFFERENCES IN CERVICAL MULTIFIDUS MUSCLE THICKNESS DURING ISOMETRIC CONTRACTION OF SHOULDER MUSCLES: A COMPARISON BETWEEN PATIENTS WITH CHRONIC NECK PAIN AND HEALTHY CONTROLS

Leila Rahnama, PT, PhD,^a Asghar Rezasoltani, PhD,^b Mino Khalkhali Zavieh, PhD,^c Farhang NooriKochi, MD,^d and Alireza Akbarzadeh Baghban, PhD^e

ABSTRACT

Objective: The purposes of this study were to (1) measure the thickness of cervical multifidus muscle (CMM) in different maximal voluntary contraction percentages of isometric contraction of shoulder muscles, (2) evaluate the differences of the CMM thickness in different directions of the shoulder movement, and (3) compare the changes in the CMM thickness of participants with neck pain and also of healthy individuals.

Methods: Twenty healthy men (age, 27.45 ± 4.37 years; height, 177 ± 4.66 cm; weight, 72.85 ± 6.46 kg) and 20 men with chronic mechanical neck pain (age, 28.90 ± 5.53 years; height, 176 ± 5.98 cm; weight, 73.15 ± 7.82 kg) participated in the study. Both the right and left CMM thicknesses were measured using an ultrasound device while participants performed isometric contraction of shoulder muscles in 6 movement directions.

Results: In both groups, an increment of CMM thickness followed as the increase of isometric force ($P < .01$). The increase of muscle thickness of healthy participants was substantially more than the chronic mechanical neck pain participants ($P = .03$). Although no significant difference of CMM thickness was seen among the effects of the 6 force directions ($P > .05$), there was a significant difference of activity noted between the left and right sides ($P = .047$).

Conclusion: The results of the present study indicate that isometric contraction of shoulder muscles caused an increase in the CMM thickness regardless of force direction. This increase was seen in both groups of healthy participants and patients with neck pain. However, less thickness changes were observed in participants with neck pain, which may be interpreted as reduced CMM activity in such people. (*J Manipulative Physiol Ther* 2015;38:210-217)

Key Indexing Terms: *Ultrasonography; Neck Muscle; Neck Pain; Isometric Contraction; Muscle Size; Shoulder*

Participants with chronic neck pain have altered neck muscle activities compared with healthy participants.¹⁻⁴ Proprioceptive deficit, sensorimotor disturbances,⁵ reduced neck muscle strength, and endurance^{6,7} are general

manifestations of chronic neck pain. Recently, atrophic changes and reduced deep cervical muscles size and thickness have been reported in these participants.^{8,9} Because deep dorsal neck muscles including the cervical multifidus muscle

^a Assistant Professor of Physiotherapy, Department of Physiotherapy, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.

^b Professor of Physiotherapy, Faculty of Rehabilitation, Physiotherapy Research Center, Shahid Behesht University of Medical Sciences, Tehran, Iran.

^c Assistant Professor of Physiotherapy, Faculty of Rehabilitation, Department of Physiotherapy, Shahid Behesht University of Medical Sciences, Tehran, Iran.

^d Radiologist, Specialist Doctor, Department of Radiology, Medical Imaging Research Center, Shiraz University of Medical sciences, Shiraz, Iran.

^e Associate Professor of Biostatistics, Faculty of Rehabilitation, Department of Basic Sciences, Shahid Behesht University of Medical Sciences, Tehran, Iran.

Submit requests for reprints to: Leila Rahnama, PT, PhD, Assistant Professor of Physiotherapy, Department of Physiotherapy, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran. (e-mail: lrahnama@gmail.com, lrahnama@uswr.ac.ir).

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(CMM) have been shown to play a role in providing neck stability and preventing strains to cervical structures,^{10,11} strengthening them is of prime concern while treating patients. Several studies have shown that physical exercises might facilitate increase in muscle strength and improve muscle activity.^{4,12-15} However, these studies focused on general training of neck muscles rather than exercises for a selected muscle like CMM.^{15,16} Therefore, there is still a need to further expand knowledge concerning activities for each neck muscle.

Some studies have targeted areas of the neck. Lee et al¹⁷ reported changes in CMM thickness as an effect of isometric head extension at different levels of the cervical spine in healthy participants. Peolsson et al¹⁸ measured the different activity patterns of cervical muscles, especially for the CMM, during a loaded arm lifting task between healthy participants and patients with long-standing neck pain. What these studies did not investigate, however, is the behavior of the CMM contraction and how it responds to different amounts of force exerted by the shoulder muscles and also the different movement directions of the upper extremities.

Various methods are used to investigate neck muscles functions, such as magnetic resonance imaging and ultrasound imaging.¹⁸⁻²⁰ Among these, ultrasound imaging is recognized as a reliable and valid method of muscle function evaluation in real time.^{9,21-23} In recent research studies, the interest in ultrasonography measurement of muscle dimensions has greatly increased. For instance, some studies reported dimensions of the CMM at rest or during an isometric head extension as an index for muscle activity using ultrasound.^{8,17,24} However, it is unknown whether the CMM dimensions change during a task involving the upper extremities of patients with chronic neck pain. Further studies are required to reveal this little known aspect of neck muscles functions.

We hypothesized that the CMM thickness will change during an isometric contraction of the shoulder muscles in different movement directions in healthy participants more than that of participants with neck pain. Therefore, the purposes of this study were to (1) measure the thickness of CMM in different maximal voluntary contraction (MVC) percentages of isometric contraction of shoulder muscles, (2) evaluate the differences of the CMM thickness in different directions of the shoulder movement, and (3) compare the changes in the CMM thickness of participants with neck pain and also of healthy individuals.

METHODS

Participants

Twenty participants with chronic mechanical neck pain (CMNP) and 20 healthy individuals voluntarily participated in the study. Participants were recruited from bank office workers. A total of 300 questionnaires containing the study

Inclusion criteria for subjects with chronic neck pain:

- 1) Experiencing pain for at least 3 months in the last year.
- 2) Having a pain score of 3 or more on the visual analogue scale.
- 3) No regular gym and sporting activity.
- 4) Being right hand dominant .

Inclusion criteria for healthy subjects:

- 1) No history of neck pain.
- 2) No regular gym and sporting activity.
- 3) Being right hand dominant.

Exclusion criteria:

- 1) History of cervical discopathy.
- 2) Radicular pain to the shoulder.
- 3) Any surgery on the neck.
- 4) Traumatic neck injury.
- 5) Any congenital disorders.

Fig 1. Inclusion and exclusion criteria for participants of the study.

criteria were distributed among them. Then, the researcher collected the questionnaires and announced those who met the eligibility criteria and stated that they agree to participate in the study. Participants were all male and at least 18 years old with no regular gym activity. The general eligibility criteria include having no any history of trauma or surgery on the spine, any congenital or inflammatory diseases, or shoulder and arm pain. The inclusion and exclusion criteria for participants are listed in [Figure 1](#). Participants in both groups were comparable in terms of age, weight, height, and body mass index (BMI). The procedure was explained to the participants, and they signed the informed consent forms prior to the study. This study was approved by the Research Ethics Board of the Faculty of Rehabilitation, Shahid Beheshti University of Medical Sciences.

Ultrasonography Measurements

Ultrasonographic imaging of the CMM was conducted by an ultrasonography device (Accuvix V20 prestige; Samsung, Medison, Korea) with a 8-MHz, 4 .5-cm linear array transducer. An experienced physical therapist identified the spinous process of C4 by palpation. Further clarification was carried out with the help of ultrasonography. We evaluated the CMM at the level of C4, as it has been reported to have a greater cross-sectional area (CSA) than C3 and the same CSA as C5 and C6.⁸ Lee et al²³ also investigated the thickness of CMM at the level of C4.

At that point, the examiner placed the transducer transversely at the level of the C4 spinous process, moving it slowly to the right or left side and slightly upward and downward so as to identify the echogenic vertebral lamina clearly. At this level, the CMM was located laterally to the spinous process, rotator muscle, and laminar junction;

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