*Original Article*

Note: Paper has been condensed for ease of review

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# Reliability and validity of new evaluation methods using static surface electromyography in persons with neck pain

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**Objective:** The aim of this study was to evaluate the validity and reliability of using static surface electromyography (sEMG) on persons with neck pain and in healthy adults.
**Design:** Cross-sectional study.
**Methods:** Twenty-two female participants with neck pain and thirty healthy adults in the age group of 20-65 years were recruited in this study. To evaluate the validity and reliability of sEMG in subjects with neck pain, the subjects'characteristics were recorded and the Visual Analog Scale (VAS) and Neck Disability Index (NDI) were examined in addition to sEMG and algometer tests being carried out on the subjects. The site for using the sEMG and algometer was the upper trapezius. sEMG test-retest reliability was measured by intraclass correlation coefficients (ICCs). Independent t-tests were used to analyze the differences in the dependent variables between subjects with neck pain and healthy adults. The Pearson correlation coefficient was used to examine the linear relationship between measured variables.
**Results:** sEMG and algometer tests were reliable according to the test-retest reliability results in subjects with neck pain and healthy adults (ICC=0.815-0.979). The results of this study showed that there were significant differences in respect to age, VAS, sEMG and algometer tests between persons with neck pain and healthy adults ($p$<0.05). The VAS and NDI were statistically correlated with sEMG and algometer results ($p$<0.05).
**Conclusions:** In this study, we investigated the clinical usefulness of the static sEMG test in evaluating the pain scale of persons with neck pain with high reliability and validity.

**Key Words:** Diagnosis differential, Diagnostic techniques and procedures, Electrodiagnosis, Neck injuries

## Introduction

Seventy-one percent of the world's population has a high incidence of experiencing neck pain at least once in their lifetime. It has confirmed that 45.5% of a total of 512 workers in the office have compliants of neck pain, and in 50%-85% of those with neck pain, 47% have chronic symptoms in which the symptoms are not completely resolved [1]. Patients with pain often complain of subjective symptoms, such as muscle stiffness and tension along with pain, and the main clinical symptoms lead to an imbalance of the soft tissues around the neck and shoulders, and painful areas on the neck, shoulder, back, scapula, fatigue headaches, and restriciton of range of motion, but in severe cases, it is associated with functional disability of the neck, such as muscle weakness, muscle atrophy, and muscle tension, depending

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### Static surface electromyography

Static sEMG was performed with the Myovision EMG 4000 (Precision Biometrics/Myovision, San Carlos, CA, USA). Static sEMG is a wireless device consisting of two joysticks with five electrodes, each of which is designed to record muscle activity levels at the vertebral level where the results were obtained from three measurements per site (Figure 2) [12].

**Figure 2.** Static surface electromyography device and measurement sites (upper trapezius).

### Statistical analysis

Statistical analysis was performed using PASW Statistics ver. 18.0 (IBM Co., Armonk, NY, USA). Test-retest reliability was calculated by ICCs. An independent sample t-test was conducted to compare the measurement variables between the two groups. Pearson correlation coefficients were used to determine the linear relationship between measured variables. All statistical significance levels were below $p$=0.05.

## Results

### General characteristics of the subject

As for general characteristics of the subjects, there were 22 subjects with cervical pain and 30 healthy adults who had participated in this study. The average values for the patients was 33.59±10.29 years old for age, 161.60±4.49 cm for height, 55.77±9.38 kg for weight, and 5.65 for the VAS. The average values for the characteristics of healthy adults was 20.87±1.07 years old for age, 160.72±4.67 cm for height, and 56.93±9.19 kg for weight. There was no significant difference in height and weight among the subjects, but there was a significant difference in age ($p$<0.05) (Table 1).

### Reliability analysis

In the analysis of the test-retest reliability of the static sEMG and pressure gauge system in the subjects with neck

**Table 1.** General characteristics of subjects (N=52)

| Group | Age (y) | Height (cm) | Weight (kg) | Visual Analog Scale |
|---|---|---|---|---|
| Neck pain subjects (n=22) | 33.59 (10.29) | 161.60 (4.49) | 55.77 (9.38) | 5.65 |
| Healthy adults (n=30) | 20.87 (1.07) | 160.72 (4.67) | 56.93 (9.19) | - |
| t ($p$) | −5.775 (<0.001) | −0.685 (0.496) | 0.448 (0.656) | - |

Values are presented as mean (SD).

**Table 2.** Tests of Static sEMG and algometer values in subjects with neck pain and healthy adults-test-retest reliablility measurements (N=52)

| Division | Measuring site | Intraclass correlation coefficient | |
|---|---|---|---|
| | | Neck pain subjects (n=22) | Healthy adults (n=30) |
| Static sEMG | Left | 0.867 | 0.861 |
| | Right | 0.848 | 0.815 |
| Algometer | Left | 0.977 | 0.959 |
| | Right | 0.979 | 0.956 |

sEMG: surface electromyography.

Test-retest Reliability of 0.867 is excellent. This was performed with 10 year old MyoVision. New 2018 model significantly higher test-retest reliability.