International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 07 | July 2018 www.irjet.net p-ISSN: 2395-0072

EMG Analysis of Head posture at standing and sitting position

Kavita Kushwah[1], Rakesh Narvey[2]

[1]M.E. Student, Measurement and Control, Madhav Institute of Science and Technology, Gwalior, India
[2]Asst. Professor, Electrical Engineering Department, Madhav Institute of Science and Technology, Gwalior , India

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Abstract - *Human body posture defines the personality of a human and now a days it become a part of your life. In this paper the five head posture is taken and their EMG analysis is done in sitting and standing position. The upper trapezius muscle is considered for analysis. It is found that the muscle activity of upper trapezius muscle at both standing and sitting position is higher in 60 degree of head posture, whereas it is lower in case of 0 degree which is a neutral posture of head. It is investigated that the muscle activity of upper trapezius muscle is lower in neutral position of head.*

Key Words: EMG, Upper trapezius muscle, Head posture.

1. INTRODUCTION

The head forward flexion position (text neck) is becoming more common with the increasing popularity of hand-held gadgets. These gadgets are to be sure making our lives less demanding and easier but prolonged use of these gadgets giving us a neck pain, poor posture and load on the neck musculature. Smartphone user's sustain higher head flexion angle in sitting compared to standing (posture). They keep up the head flexion posture even with the presence of pain symptoms or uneasiness on the neck [1]. Head flexion angle varies significantly with the two posture conditions. As head tilted forward sternocleidomastoid (SCM), upper trapezius (UT) and lower trapezius (LT) muscles are activated among them SCR and UT muscles activity is increased with tilted head than LT. the UT is knows as a stabilizer of upper extremity or head.

The upper trapezius muscle can more activate with the forward flexion of head. With the very small variation of head forward position can raised the load put onto the musculoskeletal system by which activities of upper extremity increases. Upper trapezius muscle activates less in neutral position than head tilted position. It contributes more with head forward than healthy subjects [2][3]. When utilizing a hand-held devices or for study purpose, individuals typically flex their head to downwards to gaze at down object and keep up the head in a forward position for extensive stretches of time. These devices could likewise cause adverse consequences for a person's psychology. Hence, people should try to look at their phones with a neutral spine and to avoid spending more time over their object. [4]

The study by K. K. Hansraj [5] proposed that good posture happened when user's ears were align with shoulders and shoulders blades. However, normally, users tend to tilt their heads forward while using smartphones. During a neutral position, the load seen by the spine of the neck was around 10-12 lbs., however once the user's head was tilted forward for 15 degrees, it will increase to around 27 lbs., 40 lbs. for 30 degrees forward, 49 lbs., for 45 degrees forward, and around 60 lbs., for 60 degrees, respectively. The load seen by the spine of the neck raised dramatically because the angle raised. With this type of stress on neck spine (cervical spine), it may lead to an early wear, tear, degeneration, and possibly surgeries. People send a normal of two to four hours every day with their heads tilted over perusing and messaging on their keen telephones and gadgets.

Neck posture is defined as the alignment of cervical spine at a particular time. It is examined in different positions, with different postures, the most common being standing and sitting. The aim of this study is to observe the change of the muscle activity of the upper trapezius muscle in two postures using smart phones. To achieve the purpose of the study the muscle activity of the upper trapezius muscle that changes by positions of head will be compared and analysed using electromyography (EMG) analysis.

2. METHODOLOGY

a. Subjects

A total of eighteen male and female subjects voluntarily agreed to participate in the study. All of them were college students. To perform this study a required essential training for the desired position of the head was imparted to every subject one by one. Head positions were separated by 15 degrees. The five position of head for which the data was acquired are selected as 0 degree, 15 degree, 30 degree, 45 degree, and 60 degree. Subjects were asked to maintain each head posture for five seconds without rest period between each head position. Before the start of data collection, all subjects signed an informed consent form. This study is performed in Biomedical Lab of Electrical Engineering Department of Madhav Institute of Technology & Science, Gwalior, Madhya Pradesh.

For angle measurement, a universal goniometer of metal and a plastic ruler is used. Fulcrum of goniometer is place at the middle of the shoulder of the subject and stationary arm is

placed in horizontal plane. With the help of moving arm, 0 degree, 15 degree, 30 degree, 45 degree, and 60 degree angles are set with the protractor of the goniometer and a plastic ruler is attached with the moving arm and ear of the subject to measure accurate angle.

For standing position subjects were asked to stand in comfort posture. Each angle is measured through

Table -1: GENERAL CHARACTERSTICS OF SUBJECTS (N=18)

CHARACTERISTIC	*SUBJECT*
Gender	
Male	11
Female	8
Age (year)	25.666(1.188)
Height (cm)	166.327(8.426)
Weight (kg)	59.666(3.497)

goniometer as head posture changes with desired angle position.

For sitting position subjects were asked to sit on chair in a natural posture with their feet touching the ground and with the subject's hips and knees in 90 degrees of flexion [6]. EMG data is recorded at five head posture according to the angle measured in each time interval of 5 second. All five head positions in both standing and sitting position are shown in figure-1 and figure-2.

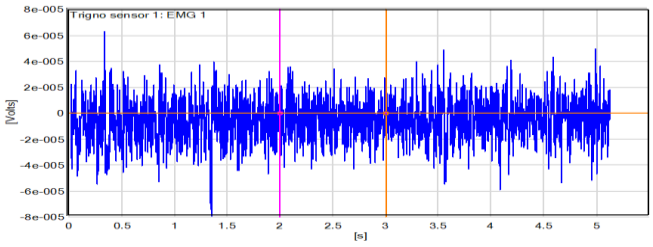
b. Data Collection

EMG Data can be collected by two methods invasive and non-invasive. For an invasive method, needle electrodes are used while for a non-invasive method surface electrodes are used. In this non-invasive study we used surface electrode for acquiring EMG signals at different head positions. The Data Acquisition contains the recording of Electromyographic (EMG) activity.

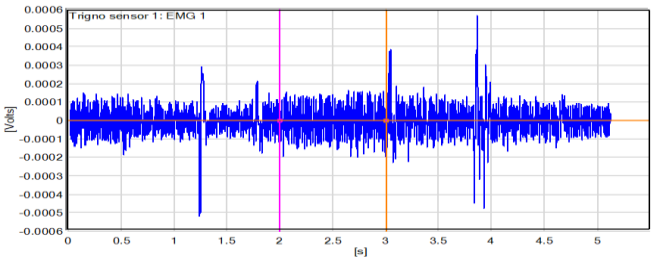
The data was recorded by using Trigno Wireless EMG System (delsys, USA) together with EMGworks Acquisition software and analysed by EMGwork analysis software. Then further statistical analysis was done in Microsoft excel. Trigno wireless EMG system has 16 EMG and 48 accelerometer analog channels. EMG signals are recorded with sampling rate of 1926 Hz/channel and gain is 1000 so that none of the useful information was lost during data acquisition. The muscle activity of upper trapezius muscle (UT) was recorded by two Surface electrodes and they were attached to the right upper trapezius (Rt-UT), left upper trapezius (Lt-UT) respectively. The surface electrodes are placed on concern muscles with the help of adhesive tape on the surface of electrodes. Electrodes arrangement is shown in figure-1 and figure-2 with both the positions. These EMG signals recorded using EMGworks acquisition software and RMS value was determined for measured muscle activity with 5 sec window length.

In EMG Analysis software recorded data is fetched and analyzed by calculating RMS value of each signal for window length of 5sec. The recorded EMG signals of left upper trapezius muscle in standing position of subject one are shown in figure-3.

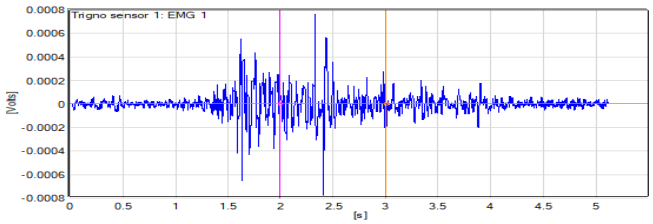
Independent variable of this study included two posture condition sitting and standing. The root mean square (RMS) of the signal is used to determine the muscle activity and was estimated. RMS values were normalized to the EMG data maximum voluntary contraction (MVC). In EMG Analysis software recorded data is fetched and analyzed by calculating RMS value of each signal for window length of 5sec. Features of EMG signals within the time domain are mostly used in medical and engineering researches. Time domain features are used in signal analysis. The main aim of the feature extraction is to emphasize the important information in the measured signal [7].



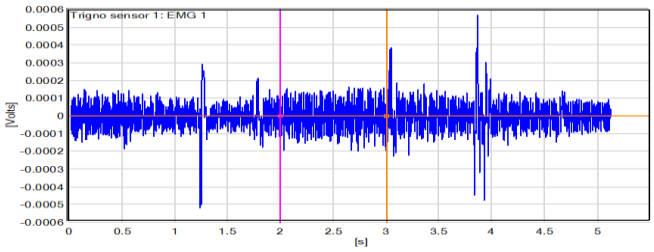
0 degree left TP sitting position



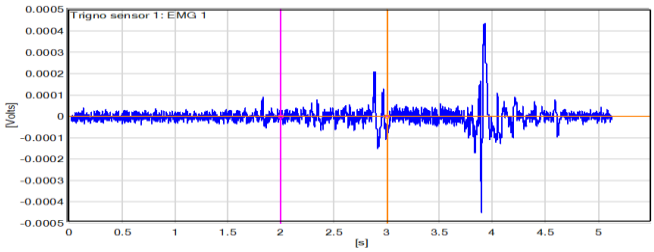
15 degree left TP sitting



30 degree left TP sitting



45 degree left TP sitting



60 degree left TP sitting

Fig -1: surface EMG signal of subject-1 at five different head postures in sitting condition

RMS value can be calculated by

$$RMS = \sqrt{\sum_i^N x_i^2} \quad (1)$$

Where x_i^2 is the EMG signal and N is the length of the EMG signal

c. Data Analysis

A test of normality was conducted for general characteristics of subjects and variables by the Shapiro-Wilk test using SPSS software ver. 12.0 (SPSS Inc., Chicago, IL, USA). Shapiro-wilk test for General characteristics of subject was normal but for variables it was not normal. Therefore muscles activity was investigate by using non-parametric test.

A non-parametric Friedman test was performed to examine the differences in muscle activity according to head posture at standing and sitting positions. Statistical significance was accepted for values of $p < 0.05$.

3. Result

Friedman test statistical method was used to test the differences between the muscle activity of EMG signals of five different head postures in both standing and sitting positions.

Null hypotheses: means that of all the electromyogram signals at completely different angles of sitting posture are equal.

Alternative hypotheses: means that of all the electromyogram signals at different angles of sitting posture don't seem to be equal.

a. Comparison of muscle activity according to changes in head posture at standing position

On comparing the muscle activity of right and left trapezius muscle for all five head posture in standing position. Analysis revealed that there is a significant difference between the five head posture. The p value of Friedman test was found 0.00 ($p<0.05$) in right trapezius muscle and in left trapezius muscle it was found 0.00($p<0.05$).

b. Comparison of muscle activity according to changes in head posture at sitting position

On comparing the muscle activity of right and left trapezius muscle for all five head posture in sitting position. Analysis revealed that there is a significant difference between the five head posture. The p value of Friedman test was found 0.00 ($p<0.05$) in right trapezius muscle and in left trapezius muscle it was found $p<0.05$.

Fig.4. and Fig.5. shows the RMS values of upper trapezius muscle of five head posture in standing and sitting position respectively.

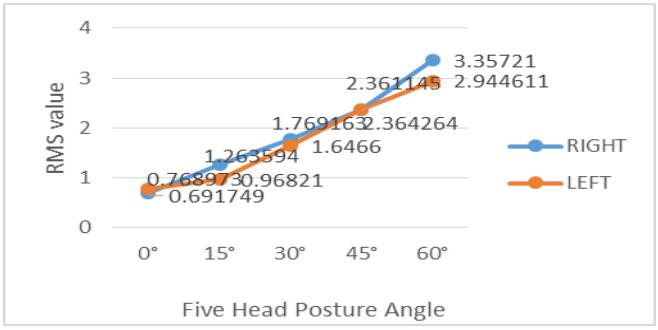


Chart -1: RMS values of trapezius muscle in standing position

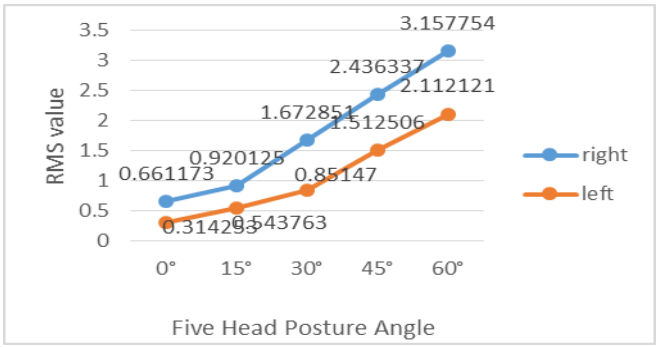


Chart -2: RMS values of trapezius muscle in sitting position

3. CONCLUSIONS

To evaluate muscle activity of upper trapezius muscle RMS value of EMG signal is calculated and then statistical analysis is done. In analysis of EMG signal of five head posture at standing and sitting positions, it is found that the muscle activity at 0 degree is lower and at 60 degree it is higher in both the positions. As the head flexed forward muscle activity is increased in standing and sitting positions.

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