Preliminary Study: The Impact of Moderate Exercises on Biomechanical Response of the Humans Muscles

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INTRODUCTION

Moderate exercise motions include standing, bowing, prostration, and sitting. The joints that are involved in the movements are the shoulders, wrists, elbows, metacarphophalangeals (MP), proximal interphalangeals, distal interphalangeals, temporomandibular, vertebral column, hip, knee, ankle, subtalar, metatarsophalangeal, and antanto-axial [1]. These motions result in moderate physical exercises, particularly to most of muscles in the human body.

A muscle can perform many mechanical functions and activities by developing force and power, and over time produces work output. If the muscle active fibers are stretched, the muscle can dissipate mechanical energy. The energy is stored when tendons of the muscle, as elastic elements, are stretched. When its tendon and other inseries elastic elements are stretched, energy is stored. The force–length–velocity property of muscle can stabilize movement with its impedance-like function before reflexes become functioning. [2]

METHODOLOGY

Subjects

The subjects are five normal healthy male Muslims between the ages of 18 and 30 years of standard weight with

Body Mass Index (BMI) readings of 18.5 to 24.9 kg/m^2. They had no known musculoskeletal or neurological dysfunction. Subjects were given an overview and informed of the purpose of the study and gave their written consents before participating in this study. All the required postures and maneuvers of the moderate exercises to be carried out were shown to them using a standard set of pictures and instructions.

Instrumentation

A Panasonic (NV-GS35) video camera with a shutter speed of 1/50 - 1/8000 sec was used to record the movements as subjects performed the maneuvers. The recording of this event was synchronized with the EMG system, Myomonitor IV Wireless Transmission.

This electromyography (EMG) system sent the data over a wireless local area network (WLAN) to the host computer for real-time display and storage. Bandwidth of this EMG was between 20-450 Hz at 4000 Hz sampling rate.

A single differential surface electrode models were used to acquire the EMG recording of the muscle activity. The signal data was observed continuously on a laptop and stored digitally in raw form. By using Delsys EMGworks Analysis software version 3.5.1.0, the raw data were analyzed.

Experimental Setup

Surface electromyographic recordings of selected muscles on the lower limb (biceps femoris, rectus femoris and gastrocnemius) were made. The surface electrode was placed on the back of muscle: on the fourth lumbar (L4) and fifth lumbar (L5). Preparation of the skin before the EMG electrodes placement involved shaving the skin at the location of the measured muscles, light abrasion, and clean ing with alcohol swabs. Exclusion of unwanted electrical signals from sources other than the muscle being investigated was made by positioning the electrodes in bipolar configuration with 0.01 m distance inter electrode [3]. This is a recommended distance and has been found to be compatible with the architecture of most muscles in the human body [3]. According to Basmajian *et. al*., electrodes must be placed at individual muscle and it can reduce the cross talk from the nearby muscles [4].

The surface electrodes were attached to the skin on the middle of the muscle belly by referring to the European recommendations for surface electromyography (SENIAM) [5].

All the subjects were required to assume the position with correct postures as shown in Table 1. Subjects were also asked to perform the moderate exercises indicated in the table.

These three sets of maneuvers were repeated three times. For examples, from Table 2, No.1, subjects assumed standing posture, then prostration, then standing again, followed by another prostration. This was considered a set of maneuvers. Basically, each posture took about 10 seconds. Each set of maneuvers took approximately 40 seconds to complete.

Electromyography analysis

The analyses of raw EMG signals were performed by using the Delsys EMGworks Analysis software version 3.5.1.0. By using Subset operation, a new Data Series from a portion of an existing data series were created. This could be done by visualization with a recorded video that synchronized with the EMG system. Three sets of maneuvers being analyzed were stand-prostrate-stand-prostrate, standbow-stand-bow, and sit-prostrate-sit-prostrate. The root mean square (RMS) was calculated for each set of raw EMG signals using 0.05 second without overlap of window. Then the values of all RMS were averaged to find a value of mean RMS.

These calculations were repeated for each of the four different muscles in five male subjects. In this preliminary study, the data displayed the mean RMS and standard deviation for 3 sets of maneuvers in four muscles as in Table 3.

In Figure 1, a sample RMS graph of 0.05 second window length of 5 subjects during performance of sitprostration-sit-prostration maneuver is shown. The sequence of movement in the pictures is parallel to the EMG signal of five subjects. By visualization, 3 peaks of RMS EMG signal are obvious in each of the five graphs for muscle activity in L4 and L5 muscles. The movements from the sitting position to the prostration position erected the spinae muscle when the upper limb was abducted slightly outward. The signal showed a slightly higher value in this sequence. Next, when the subjects got back to the sitting position, the spinae muscle contracted and also showed a high signal value. The same physiological response happened when a subject got back to the prostration position. Almost all the subjects showed the same pattern of muscle activity.

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