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Variation in Texture Features of Quadriceps Tendon with Different Body Mass Indexes

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Abstract

In the present study, texture analysis and thickness were studied on the Quadriceps tendons (QT), to find the variation in image characterizing parameters and thickness among individuals having different Body Mass Index (BMI). Participants included in our study were all male, belonging to Saudi descent. Moreover, all had sedentary lifestyles and were not involved in physical activity or sports for the last six months. Nine volunteers were selected for the current study and were divided into three groups (weak, normal, and obese) according to their BMI. A total of 9 volunteers participated in the present study having a mean age ± SD, and BMI ± SD of 22.44 ± 0.53 kg/m2 and 23.53 ± 5.83 years, respectively. All volunteers having sedentary lifestyles and had the right side of their body as the dominant side. The results displayed that thickness increase with an increase in BMI, whereas, no particular or specific trend (increase or decrease) was found between the three different groups with different BMI for mean and variance values.

Keywords *- Quadriceps tendon, texture analysis, ultrasound.*

I. INTRODUCTION

Images obtained from Ultrasound (US) B-mode are commonly used for diagnostic purposes but can further be used as image analysis to supplement and improve the diagnostic process [1]. Generally, digitized B-mode US images are used for texture analysis. Earlier studies showed that texture analysis tends to be useful in treating and diagnosing numerous organs or tissues, such as the brain [2], heart [3], liver [4, 5] muscle [3], and the placenta [6]. Texture characterization studies on breast ultrasonography displayed significant results [7, 8].

B-mode ultrasound images can differ due to the variations of numerous reasons. Thus diagnosis only based on texture analysis is not recommended by the medical practitioner. Different texture parameter results can be achieved easily for the same tissues as B-mode images greatly vary under different scanner settings [9]. Hence the usefulness of texture analysis in tissue characterization can be examined and accurate only with the same ultrasound setting [10]. In the present study, texture analysis and thickness were studied on the Quadriceps tendons (QT), to find the variation in image characterizing parameters and thickness among individuals having different Body Mass Index (BMI).

II. MATERIAL AND METHODS

A. Study Design

The study was designed and conducted at the Biomedical Technology Department, College of Applied Medical Sciences, King Saud University, Riyadh, Saudi Arabia. The Ethical Review Committee approved the study of the College of Applied Medical Sciences. Helsinki Declaration guidelines were strictly followed for obtaining the images. In addition, it was also a prerequisite to fill the consent form from every individual before the start of experimental protocols.

B. Participation

Participants included in our study were all male, belonging to Saudi descent. Moreover, all had sedentary lifestyles and were not involved in physical activity or sports for the last six months.

Nine volunteers were selected for the current study and were divided into three groups (weak, normal, and obese) according to their BMI. Thus each group had three individuals. The present study aimed to find out the difference in texture parameters and thickness of the QT according to the BMI.

C. Acquisition of Body Mass Index and B-modes Images

The height of all the volunteers was calculated manually by using a fixed stadiometer. Inbody 720, Body Composition Analyser (made by Inbody Corporation Limited, Cerritos, CA, USA) was used to obtain each individual's BMI by entering the height obtained from the stadiometer.

All B-modes images of the QT were obtained using the Ultrasonix SonixTouch Q+ system (made by Analogic Corporation, Peabody, MA, USA), equipped with a linear transducer 5–14-MHz with a fixed setting of 10 MHz, for the dominant side of each volunteer. All the volunteers were laid in the supine position with 30 degrees' knee flexed. The thickness of the QT was measured from the center of the tendon, see figure 1.

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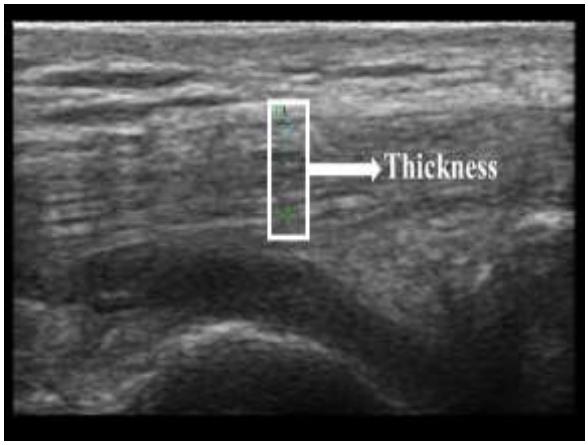


Figure 1: Quadriceps tendon thickness measurement from the midpoint.

D. Acquisition of Texture Parameters

To establish a relation for texture parameters between the three groups (weak, normal, and obese) software MAZDA versions 4.6 (Institute of Electronics, Technical University of Lodz, Poland) was used for each B-mode image. The mean and variance were found by selecting a Region of Interest (ROI) of 1200 pixels in each image, as shown in figure 2.

Figure 2: Selected region of interest of Quadriceps tendon.

III. RESULTS AND DISCUSSION

A total of 9 volunteers participated in the present study having a mean age ± SD, and BMI ± SD of 22.44 ± 0.53 kg/m^2 and 23.53 ± 5.83 years, respectively. All volunteers were having sedentary lifestyles and had the right side of their body as the dominant side.

Figure 3 displays the results of the QT thickness. It shows an increasing trend of QT thickness among the groups from weak to normal, and normal to obese.

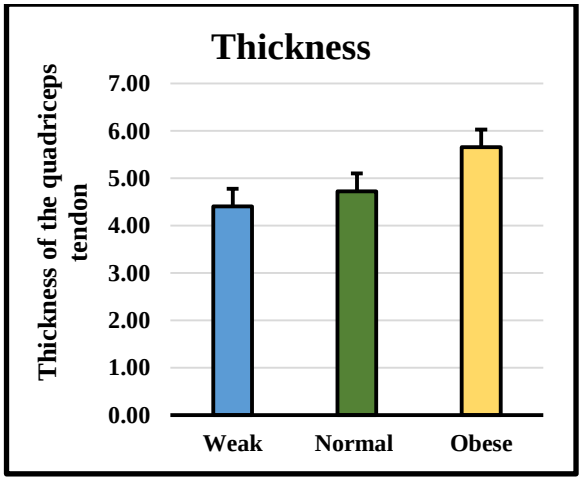
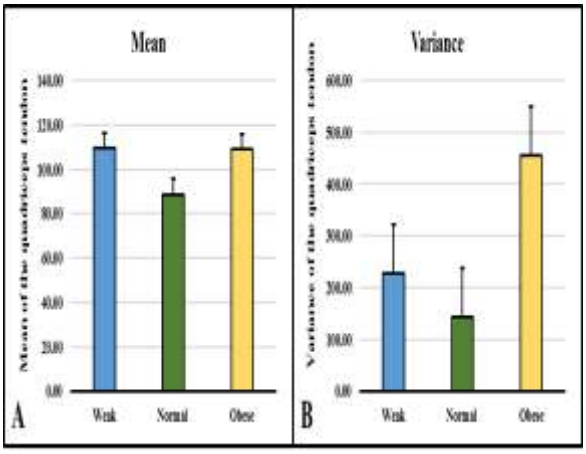


Figure 3: Thickness of the Quadriceps tendon for each group.

Figures 4 A & B shows the mean and variance values of all the groups (weak, average, and obese), respectively. The values of the mean for groups weak and obese are almost the same and higher in comparison to the normal group. The values of variance show a variation among the three groups (weak, normal, and obese). The normal group has the lowest variance value in contrast to



the obese group, which displays the highest variance value.

Figure 4: (A) Mean of the Quadriceps tendon for each group and (B) Variance of the Quadriceps tendon for each group.

Properties of tendon muscle can change with variation in BMI [11]. Often there is a gradual increase or decrease in properties of tendon muscle with an increase in BMI or vice versa [11]. In our study, thickness and texture analysis (mean and variance) was performed on QT B-modes images of three different groups (weak, normal, and obese) of BMI. The results displayed that thickness increase with an increase in BMI, whereas, no particular or specific trend (increase or decrease) was found between the three different groups with different BMI for mean and variance values. However, increasing the sample number in each group can further enhance the findings of our study.

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