ISB 2013 BRAZIL
XXIV CONGRESS OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS
XV BRAZILIAN CONGRESS OF BIOMECHANICS

REABILITY OF ULTRASOUND IMAGING FOR THE MEASUREMENT OF ABDOMINAL MUSCLE ACTIVITY IN PATIENTS WITH CHRONIC NON-SPECIFIC LOW BACK PAIN: MORE IMAGE REGISTERS ARE BETTER?

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INTRODUCTION

Despite the great number of researches about low back pain, a specific cause is unknown[1] although changes in recruitment of the deep intrinsic muscles of spine have been reported constantly[2-6]. Ultrasound imaging has been introduced as an approach for indirectly measure the recruitment of the abdominal muscles by morphologic changes assessment[7].

Some studies have tested the reproducibility of US in people with low back pain and showed that USI measure are reproducible[8-10], however some questions still need be answered about control issues for repeated imaging; like the influence of the number of measures on the level of error. Thus, the objective of this study was evaluated if reproducibility of ultrasound measures to the transversus abdominis muscle between two days undergoes change when one or three records are done.

METHODS

Subjects positioning to obtain transversus abdominis muscle automatic activation was made like proposal previously[11]. Ultrasound records were made with a SIEMENS ultrasound (Issaquah, WA, USA) model Sonoline Sienna (frequency range 8–12 MHz), and a 13.5 MHz linear probe set to 10 MHz for recordings. Ultrasound image records were made during a test for transversus abdominis muscle automatic activation, which has been described in detail elsewhere[11]

During the test, study participants lay in supine position on a litter with arms crossed over the chest, the hips flexed to 50°, and knees flexed to 90° supported by slings around the knees and ankles. Subjects were oriented to perform isometric contraction of flexion and extension of knee monitored for a load cell to guarantee a force of contraction equivalent to 7.5% of body weight, which is equivalent to ≈ 20% of MVC. The images were registered at three times, at rest, during isometric flexion and extension task, in each one were registered 3 images. The directions order of the movement was systematized (rest, flexion and extension) and subjects received an auditory feedback about the level of force monitored in a computer by load cells. Images were frozen at the end of the patient's expiration. The same procedure was repeated in another day (24 hours after) to comparison of the results.

Before the beginning of the study, the researcher performed a period of training in the ultrasound machine for two months in healthy and low back pain subjects. Only one evaluator was responsible in make all USI registries and image measures.

The measure of images was made using custom designed imaging software. In this software, a perpendicular reference line was placed in the medial edge of the TrA and thereafter 10, 15 and 20 mm from this line. The reproducibility was calculated using values of single image, as an average of the three images. Analysis of the change of thickness in flexion and extension a mathematical formula $\frac{C-R}{R} \times 100 = (\%)$ was used to calculate change of thickness that is expressed as a proportion of thickness at rest, where C is value of muscle thickness at contraction and R is value of muscle thickness at rest.

The reliability analysis was calculated by intra-class correlation coefficient (3,1) with 95% confidence intervals using the software SPSS version 18.

(Figure 1)

RESULTS AND DISCUSSION

According *Fleiss*[12] description, the $ICC_{3,1}$ values can be describe like an almost perfect concordance for change of thickness in flexion and extension (0.88 and 0.82 respectively) for mean value of 3 images. For single record the $ICC_{3,1}$ results showed a substantial concordance for change of thickness in extension (0.8), and a moderate concordance for change of thickness in flexion (0.42).

The data normality analysis was performed using *Shapiro Wilk* test, showing normal distribution ($p<0,05$), then was performed a parametric analysis presenting no significant difference between values measurements with three and

single images for flexion (p=0,9) and extension analysis (p= 0.6).

Ultrasound is a tool that have been constantly used both to feedback during muscle training and as a measurement tool for treatment effectiveness, which have been facilitated for technological advance due fall in prices of the old equipment. To date, we do not know any study comparing reproducibility between single and more US images within different days in patients with low back disorder. Only one study verified reproducibility for duplicated measures, but in this one the values of duplicated measures were obtained using statistics adjustment based upon single measures. The results presented here are consistent with the available literature, showing ICC scores between good and excellent, same results are observed to thickness change measures opposing a recent finding.

Reliability of ultrasound measures has been demonstrated in different situations like in hollowing maneuver, walking and standing; but for each situation a type of bias is possible. We were concerned in use a type of task that allowed automatic activation of the transversus abdominis ensuring a same level of force (≈20% MCV) between tasks, in this way was verified that, reliability values of single image are close mean of three images.

Despite some different ICC values, these not had statistical significance (p>0,05) making US evaluation a fast and viable tool to be use. The results of this study shows that US is a good way to examine deep abdominal muscle function, however its important remember that for each new method of test and evaluator, a period of training for the examiner is necessary as well a study of reliability.

One potential limitation of this study was the sample size; maybe with a more expressive sample we could show ICC values more representative main in thickness change decrease SEM observed in these situations.

CONCLUSIONS

Ultrasound image are a reliable method for measure deep abdominal recruitment using 3 or 1 image registers for flexion, extension and during rest.

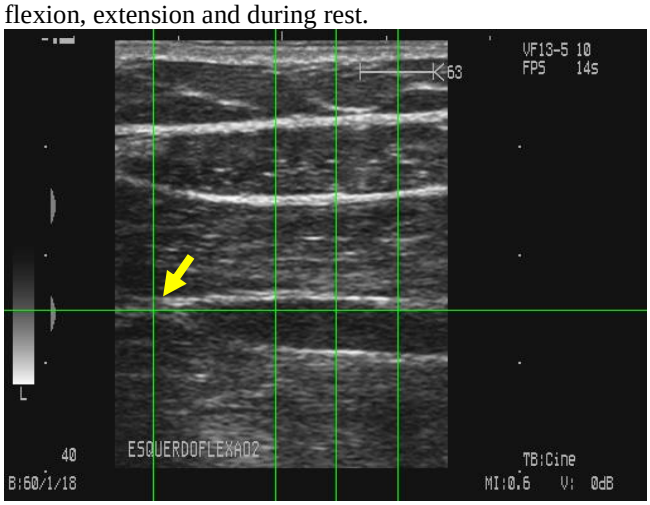

Figure 1: Abdominal layers with reference line (arrow) in the edge of transversus abdominis and a grid for measure of muscle thickness.

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