Author's response to reviews

Title: Relationship of moderate and low isometric lumbar extension through architectural and muscular activity variables: a cross sectional study

Authors:

Antonio I Cuesta-Vargas (acuesta@uma.es)
Manuel Gonzalez-Sanchez (mgsa@yahoo.it)

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Author's response to reviews: see over
GENERAL COMMENTS

This study tried to using the EMG and US image simultaneously for measuring the muscular contraction of erector spinae and to find their correlation. However, there are some revision were suggested as following. The writing need to be revised in English, also the contents need to be described in more precisely and detailed.

1. Introduction: The highly correlation between the EMG and US image for measuring muscular contraction other than erector spinae should be mentioned.
   - **Authors**: we have added the sentence “but the relationship between ultrasonographic and electromyographic variables is somewhat controversial. Some studies have shown a strong relationship between them, while others have found a low ratio [8-11].”

2. Introduction: The easiness for using EMG for measuring erector spinae seems decrease the need for this study.
   - **Authors**: We have understood that this facility has allowed it to be a widely used tool in research and with great potential in clinical practice. We have added a sentence in the introduction explaining this idea.

3. Methods: The reliability (repeatability) of using US image for measuring the muscular contraction of erector spinae should be mentioned.
   - **Authors**: The reliability of US image for erector spinae have been mentioned in the follow sentence “for the ES muscle, one study has shown that interobserver reliability ranged between 0.900 and 0.948, while intraobserver values varied from 0.938 and 0.962”.

REVIEWER 1
4. Methods: While using US image for measuring the muscular contraction of erector spinae, what variables were measured and how they were measured should be mentioned.

- **Authors**: we have modified the follow sentence to clarify what architectural variables were used to measure the muscle contraction: “Figure 2 shows an example of this a measure of this two muscle architectural variables (pennation angle and muscle thickness) from an ultrasound image”.

5. Methods: The signal processing of EMG data were not clearly defined.

- **Authors**: we have rewrite the paragraph to clarify the definition of the signal processing of EMG. The sentence added is “Electromyographic value was taken from the difference between the maximum and minimum registration. Prior to this calculation, all recorded signals were passed a low pass filter. The process of acquisition of values and treatment records was managed by the Datalink software 3.0”.

6. Methods: Why described the data using normalized rank (such as in Table 2) was not mentioned.

- **Authors**: we have added the normalized rank into table 2.

7. Methods: Why using the Spearman correlation method was not mentioned. Also, the multiple regression method was described in results but lack in methods.

- **Authors**: we have rewrite data analysis section to clarify the methods used to developed data analysis.

8. Methods: What kinds of variables for investigate the correlations between using Spearman correlation method was not mentioned.

- **Authors**: we have added the variables to investigate the correlation between using spearman correlation method.

9. Results: Why need to investigate the relationship between low and moderate contraction? Also why need to investigate the relationship between two sides.

- **Authors**: we have investigated the relationship between low and moderate contractions of the ES muscles because it’s a tonic muscle. The average intensity of contraction is usually moderate or light, necessary to maintain an upright posture and to assist the movement of
lateral flexion, rotation and lumbar extension. We have added a sentence explain this concept into introduction section.

10. Results: Figure 3& Figure 4 seems unnecessary.
   - **Authors:** we have cancelled figure 3 and 4.

11. Results: Table 2 lack unit for EMG data.
   - **Authors:** we have added EMG unit into table 2.

12. Results: Table 4 seems unnecessary and not mentioned in results.
   - **Authors:** we have cancelled Table 4.

13. Discussion: The reason for low correlation between EMG and US image during measuring muscular contraction of erector spinae should be proposed in focus.
   - **Authors:** we have modified the data because the results shown in the previous document were wrong. The real correlation between functional variables and US are high. We mentioned it along results and discussion sections.

Especially while past study has found the high correlation between EMG and US image during measuring muscular contraction of IO, EO and multifidus.

**REVIEWER 1**

**GENERAL COMMENTS**

Reviewer response
Summary

This paper examines the relationships between ultrasound measures of erector spinae architecture and levels of lower erector spinae muscle activation at different levels of torque production. There are a number of sentences that are poorly constructed making it difficult for the reader to interpret what is being said.

The introduction does not clearly provide rationale for the study and the aims at then end of the introduction are not clear. Some of the methods are not clearly
defined, particularly those used to collect and analyse EMG and the method used to ensure that all subjects had a similar lumbar posture in sitting. Some of the EMG results (left vs right) are not similar to that reported in the literature and it needs to be clarified that this is not due to methodological issues. The discussion does not provide explanations sufficient biomechanical or physiological for the results and why these results may differ from those reported by other groups.

- Authors: thank you very much for your comments. We are sure that they will help us for improve the quality of the paper presented.

Introduction (major revision)

1. The introduction does not clearly lead into the main aims of the study. Furthermore there is relatively little rationale for the importance of assessing relationships between muscle activation and ultrasound measures of erector spinae architecture. Your rationale could include the increased use and ease of ultrasound as a physiotherapy tool and why measurement of amount of activation is important. Brown and McGill (2009) explain this nicely in their introduction. You could also highlight why changes in muscle thickness and architecture are important in relation to forces generated by the erector spinae muscles. The aims written at the end of the introduction are not clear and confusing. These need to be clearly defined and written in a manner that is easy understood by the reader.

- Authors: we have added a sentence into the introduction section to clarify this argument. In addition, we have rewrote the aim of this study in manner that is easier to understand by the reader.

Design section

2. In the design section you need to clearly define the design. You introduce the design section with subject numbers. I would tend to start the design section with an overview of the design, including the independent (percentage of maximal extensor force) and dependent variables (level of muscle activation, ES thickness and fascicle angle). Your two sentences describing ethics could be simplified to something along the lines of, “Ethics approval was attained from… and all subjects gave informed consent”

- Authors: we have modified the sentence of the design, creating a section explaining it and another to explain the participants characteristics.

2.3 Maximal force generation
3. This is where you should include information about patient positioning. Line two is unclear. Perhaps it should be re-written, “One chain was fixated to the wall and the other to the measurement apparatus”. Sentence three section 2.3. This is confusing. What angle are you talking about? Is it trunk inclination or lumbar spine relative to zero? Figure 1 illustrates a vertical angle of zero degrees then a 45-degree angle. Did the subject move from 0 to 45 degrees trunk inclination?

- Authors: we have modified the first sentence and cancel the second one. We have modified figure 1 to clarify the position of the subject during isometric contractions.

4. How did you try and maintain a similar lumbar spine position for all patients? The amount of lumbar spine flexion can influence erector spinae fibre obliquity and thickness, and the amount of erector spinae muscle activity (McGill et al., 2000, Watanabe et al., 2004). If you were consistent in the positioning of the spine then this needs to be explained more clearly.

- Authors: we have added the follow sentence “Two straps placed one on another in the hip and thigh, to ensure maintenance of the neutral position of the lumbar spine during movement execution” to clarify how we ensured the maintain of the lumbar position for all patients.

5. Electromyography Registration (do you need the word registration?) (major revision).

- Authors: we have cancelled the word “registration”.

6. The first sentence is grammatically incorrect and needs rewording. Note that your sampling frequency will tend to be determined by your data collection software, not the amplifier (hardware). Line four this could be written more clearly. For example, you could reword this using a the following sentence: Two bipolar surface electrodes with an inter-electrode distance of one centimetre were place on the skin surface 3 cm lateral from the spinous process of L3-4. You also need to provide a reference for the location. Your explanation for computation of RMS and normalisation of EMG is not clear. Typically when normalising EMG the following equation would be used. RMS of the EMG signal during force exertion – resting RMS / RMS of the EMG signal during MVC – Resting RMS x 100 Resting RMS (representing no muscle activity) is usually calculated for data collected in a resting position (lying fully supported
supine or prone). Why did you choose to subtract EMG in the sitting position? Was the person completely relaxed in the sitting position? If not, the level of EMG may differ between subjects, thus affecting your normalised MVC.

- **Authors:** we have rewrote the sentence using the phrase suggested by the reviewer and we rewrote the sentence explaining the use of a low pass filter to improve the EMG signal. In addition we have added a sentence explaining that the normalization were used from MVC (100% values) and not from the rest.

Ultrasound registration (measurement) (minor essential revision)

7. Do you need to include the comment about inexperienced?
   - **We have added the follow sentence about the ultrasonographer experience.**

8. Was your ultrasonographer experienced? Did you measure intra-observer reliability? You use the term pennation angle, yet a number of studies (McGill et al., 2000 and Singh et al., 2011) refer to term fibre angle. Are pennation and fibre angle interchangeable?
   - **Authors:** we have experience using ultrasound for more than 5 years. We measured the intra-observer reliability but we decided not shows the values for don’t disturb the main of this study. Pennation angle and fibre angle are interchangeable.

2.5 Experimental protocol

9. Paragraph two line two: this sentence needs to be reworded. The second sentence in the paragraph has grammatical errors. How did you determine that the spine was in a neutral position? If there was lack of consistency of lumbar posture between subjects this could alter both ES EMG and muscle architecture measures.
   - **Authors:** we have rewrote the sentence resolving grammatical errors. In addition, we have explain how we guarantied the neutral position. The used sentence is “Before beginning the protocol, the correct subject position was confirmed using an electronic goniometer”.

Data analysis
10. Line 8. Please provide a reference for your interpretation of the correlation coefficients.

- Authors: we have added the reference for the interpretation of the correlation coefficients.

Results (Major revision)

11. Line 5: grammatical error

- Authors: we have modified the sentence, trying to resolve the grammatical errors.

12. Line 6, sentence five. This sentence is hard to understand and needs clarifying. It would be a good idea to briefly describe the patterns of EMG and changes in muscle architecture during the different levels of MVC. This would provide the reader with some insight into the influence of level of force/torque production on the EMG and ultrasound measures. A description of these patterns may also help explain reasons why there may be poor relationships between EMG and ultrasound measures. For example, if level of erector spinae muscle activation showed an increase with torque (as reported by Dolan, Mannion and Adams, 1994) and muscle thickness stayed the same irrespective of change in torque then one would expect poor correlations between EMG and ultrasound measures.

- Authors: We apologize for the results shown were wrong. We corrected them and added the phrase that facilitates the interpretation thereof.

13. You mention that there were moderate to strong correlations between variables of the same type. However, when observing data on the table there were relatively poor correlations EMG variables from right and left erector spine muscle. I find it an unusual finding that there are relatively poor correlations between EMG amplitude measures of the left and right erector spinae at each level of contraction. Other studies that have measured bilateral erector spinae activity during symmetrical tasks reported similar levels of activation between left and right sides (for example, Roy et al., 2003). Do you have an explanation for such poor correlations? One explanation could be that you task involved a rotation component.

- Authors: We ask again apologize. There was an error in the results presented. Indeed the correlation between variables of the same intensity is very high. Although it is curious that happen between variables of the same intensity, while the values of correlation between variables of different intensities are poor.
Discussion (Major revision)

14. Overall the discussion does not clearly discuss your findings and provide clear biomechanical or physiological explanations for these findings. You mention “functional variables”. Is this EMG? Using the word EMG or muscle activation may be more appropriate than “functional variable” Second paragraph In this sentence you state that you found no correlation between EMG and ultrasound measures, and your findings differed to those found by other authors.

- **Authors**: we have rewritten the discussion section, comparing the correct results with others studies.

15. You need to provide some explanations for why your findings are different. Third paragraph This is a summary of your findings compared to others who have examined different muscle groups (abdominal muscles)? You provide no clear explanation why there is a poor correlation. One explanation may be that surface EMG is collecting electrical activity from superficial muscle fibres whereas ultrasound measured whole muscle thickness. The John and Beith (2007) article highlights the limitations of using surface EMG. Another possibility explanation may be related to the effect of lumbar posture on EMG and US measurements. For example, if patients were in a more lordotic posture EMG and ultrasound variables would be quite different to if the lumbar spine was more flexed. How did you standardise lumbar posture to ensure that subjects were at a similar muscle length?

- **Authors**: we have rewritten discussion section from the correct results.

16. Line 14 of this paragraph needs rewording. Are you talking about muscle activation? What was EO correlated with?

- **Authors**: we have rewritten the discussion section from correct results.

Additional discussion

17. Your higher correlations between ultrasound variables at light and moderate effort may indicate that there was little change in thickness and angulation between 33% and 66% MVC. If this were the case you would need to explain why there is little change in muscle architecture between low and moderate levels of torque generation.
• **Authors:** We apologize. The values of variables offered were erroneous. We have made the necessary changes to correct this error.

Tables and figures

18. Figure 1. Include where the force gauge was located. Did the apparatus move in a 45 degree range?

• **Authors:** The figure has been changed to clarify the position of the gauge and the movement within the apparatus. Each participant was placed directly at 45° to the vertical and developed an isometric contraction.

19. Figure 2. Do you need the figure on to the left hand side?

• **Authors:** we have considered it necessary to show both images to understand better the method used to extract architectural variables.

20. Figures 3 and 4. Place measurement units on next to the titles of your x and y axis

• **Authors:** we have added a clarification on the tables. The values are normalized and we did the graphics from these values.

Level of interest: An article whose findings are important to those with closely related research interests
Quality of written English: Not suitable for publication unless extensively edited
Statistical review: Yes, but I do not feel adequately qualified to assess the statistics.

Declaration of competing interests: