Reviewer’s report

Title: Relationship between imaging of architectural and electromyography muscular activity during isometric lumbar extension.

Version: 1 Date: 7 March 2013

Reviewer: Grant Mawston

Reviewer’s report:

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 the 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.

1. Is the question posed by the authors well defined?

Introduction (major revision)
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.

2. Are the methods appropriate and well described?

3. Are the data sound?

4. Does the manuscript adhere to the relevant standards for reporting and data deposition?
Design section

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”

2.3 Maximal force generation

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? 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.

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

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:

\[
\text{RMS of the EMG signal during force exertion} - \text{resting RMS} / \text{RMS of the EMG signal during MVC} - \text{Resting RMS} \times 100
\]

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.

Ultrasound registration (measurement) (minor essential revision)

Do you need to include the comment about inexperienced? 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?

2.5 Experimental protocol
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.

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

Results (Major revision)
Line 5: grammatical error
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.

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.

Discussion (Major revision)
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. 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 where as 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?

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

Additional discussion
Your higher correlations between ultra sound 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.

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

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

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

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:
I declare that I have no competing interest