Author's response to reviews

Title: Changes in the flexion-relaxation response induced by hip extensor and erector spinae muscle fatigue.

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Author's response to reviews: see over
Dear Editor in chief,

Please find included a revised version of the manuscript entitled: “Changes in the flexion-relaxation response induced by hip extensor and erector spinae muscle fatigue” that we would like to submit to BMC musculoskeletal disorders. The manuscript has been revised according to all reviewers, comments and suggestions. A figure of the experimental set-up is now included, the methods section has been improved for clarity and the references have been cleaned-up. We have also included a point by point response to all comments made by reviewer 1 and 2. We would also like to thank the reviewers for there precise and thoughtful comments.

This manuscript has not been published previously and will not be submitted elsewhere until a decision is made regarding its acceptability for publication in BMC musculoskeletal disorders. All authors acknowledge having read the paper and approved the content presented in this manuscript.

Yours Sincerely,

Martin Descarreaux
RESPONSE TO REVIEWERS

Changes in the flexion-relaxation response induced by hip extensor and erector spinae muscle fatigue.

Reviewer 1

Major Compulsory Revisions

Comment 1
Page 5: could you please tell me why the movement period had to last 5 seconds. Isn't it too long? Does it reflect a natural bending time? You should add a sentence in the text about that.

Response:
There are three main reasons why the full flexion period was set to 5 seconds. The first reason was to ensure that the data from the current experiment could be used to make comparison with a previous study done in our laboratory (Descarreaux et al. 2008). By using a very similar protocol, we thought it would better our general research program question: which muscles contribute to functional trunk stability? The first study showed that erector spinae muscle fatigue could modify FRP parameters but did not answer the question about potential changes in trunk-pelvis movement parameters.

The second reason is that speed needed to be controlled since Sarti et al. (2001) showed that an increase in speed of movement produced a delay in the appearance of the electrical silence of the erector spinae muscles in the range of flexion. In their study the authors compared two different movement periods (3 seconds and 8 seconds) and showed a significant difference in FRP parameters caused by change in speed of movement. In our study it was decided to use a 5 second period because it was in the range of movement durations that have been tested in the past.

Finally, all our protocols are designed to be eventually used on clinical population and previous study done at our laboratory indicated us that movement duration lower than 5 seconds were harder to standardized in clinical population (ex: low back pain subjects).

Although it may not reflect activities of daily living, we believe that movement duration of 5 seconds is part of a wide range of activities performed frequently by adults in the context of work, physical and social activities.

A sentence was added to the manuscript to briefly justify this choice.
Comment 2
One of the main comment I have is about your fatigue test: page 6 you wrote that you induced a hip and back extensor muscle fatigue. However, your MVC required hip (and not back!?) extensor contraction efforts... Can you tell me more about that... Why did not you use the Sorensen test for example? Besides, inserting a figure would make the test better understandable for the readers.

Response:
Again, our first study using a similar protocol but using the Sorensen protocol suggested that the presence of fatigue of the ES muscles modified the FRP parameters. It was at that time hypothesized that superficial back muscle fatigue may induce a shift in load-sharing towards passive stabilizing structures. However, subsequent studies performed in our laboratory also showed that depending on the strategy put forward by the subject, extensor muscle fatigue simultaneously with paraspinal muscle fatigue when a Sorensen type protocol was used to trigger fatigue. In order to limit inter-subject variability, the hip extension task and apparatus was developed. By pushing a board upwards with both legs at the same time, our expectation was to create fatigue primarily in hip extensor muscles and secondly in erector spinae muscle.

We totally agree that this unconventional task may not be easy to envision for the reader and we, as suggested by the reviewer, added a figure illustrating the task and experimental set-up.

Comment 3
I am not sure you used the SENIAM recommendations to choose electrode locations... If you use them, you should tell that; otherwise, justify your choices. Besides, the location of the electrode over the ES should be more detailed (width lateral from the proc spin,...).

Response:
The erector spinae electrodes were positioned at L2-L3 for technical reasons (electrical noise from the light-emitting diodes of the motion analysis system and wire positioning of EMG and kinematics system). The SENIAM recommendations have been followed for the gluteus maximus and the biceps femoris.

Appropriate changes were made throughout the revised manuscript concerning the location of the electrode over the ES. We also changed the term hamstrings for biceps femoris in the methods section of the manuscript.

Comment 4
Results section: P9: you stated that the rate of decline in MedF/Timùe indicate that muscular fatigue was induced. However, based on the standard deviation, we observe that a significant rate of decline was not present in all subjects (regarding gluteus maximus and hamstrings)... Therefore the fatigue occurence based on your EMG parameters is not so evident...
Response:
The comment made by reviewer 1 is very relevant since not all subjects presented fatigue of all recorded muscles. In fact, whereas all subjects showed fatigue of erector spinae muscles after the fatiguing task, 5 participants did not present hamstring fatigue and 3 participants (not the same participants) did not present hamstring fatigue. These results are concordant with a previous study (Champagne 2008) where it was observed that hip extensor muscles tended to fatigue simultaneously with the paraspinal muscles but in different patterns depending on pelvic position and test instruction. In a task where erector spinae are recruited hip extensor muscle (hamstring or gluteus muscles) may alternatively participate to the extension effort.

Clarification about the fatigue state was provided in both the results and discussion sections of the manuscript.

Comment 5
P10: the two first sentences about RMS values increase are not clear to me. Besides, you should refer to Figure 2-3.

Response:
The first two sentences referred to increased EMG activity during “loading trials”. As suggested by the reviewer, clarifications about RMS values were added to the manuscript.

Minor Essential Revisions

Comment 1
The "cessation of the flexion-relaxation response" is not very clear to me in the paper. Is it the period/time of reduced or silent myoelectric activity?

Response:
The cessation of FRP corresponds to the end of the myoelectric silence. The term cessation has been better defined in the background section of the manuscript.

Comment 2
Figure 1: you should add on the figure and in the legend the letters "a", "b",... "h" to make the figure clear.

Response:
We are not sure we understand the reviewers comments because the letters a,b c, and d were present in both the figure and the figure legend?

Comment 3
Results section, P9: F-R phenomenon: 2nd sentence: you should end the sentence by "after the fatiguing protocol".

Response: Appropriate changes were made to the revised version of the manuscript.
Comment 4
Results section, P9: F-R phenomenon: 3rd sentence: you should start the sentence by "During loading conditions".

Response: Appropriate changes were made to the revised version of the manuscript.

Comment 5
Limitations: you should change the last sentence of your conclusion into your limitations section.

Response: Appropriate changes were made to the revised version of the manuscript.

Comment 6
Conclusions section: I am not convinced you can conclude with your study that muscle fatigue of the hip extensor and ES muscles may "potentially put previously-injured structures...".

Response: The abstract and conclusion have been modified in accordance to the reviewer’s comment.

Comment 7
References section: use systematically full journal article name or abbreviated names according to the instructions of the current journal.

Response: The reference and citation were completely redone using the BMC musculoskeletal disorders endnote template.

Comment 8
References section: check you references to avoid "((14))" or "9::10", ...(cfr your reference number 3, 8,...)

Response: Appropriate changes were made throughout the references. See previous comment.

Comment 9
Table 1: legend: add "degree" after "angles" as well as the significance of SE (is it standard error, standard deviation?). Furthermore, it is not clear what 1 and 2 means? 1 = no fatigue and 1= fatigue? If it is the case, add that information in the legend.

Response: All suggested changes have been considered in the revised version of the manuscript.
**Discretionary Revisions**

**Comment 1**  
Background chapter: I think the first two sentences should be integrated (to avoid repetition).

**Response:** Appropriate changes were made throughout the revised manuscript.

**Comment 2**  
Background chapter: last sentence of page 3: change "suggest" into "suggested".

**Response:** Appropriate changes were made throughout the revised manuscript.

**Comment 3**  
Page 5 and 6: you wrote numbers in brackets [] as if they corresponded to references; that could be confusing.

**Response:** Appropriate changes were made to the revised manuscript.

**Comment 4**  
Results section, P9: I do not understand why you refer to Figure 2 there.

**Response:** There may have been confusion in the figure numbering. Figure 2 and 3 (now 3 and 4) illustrate the Lumbar/hip ratio during all conditions. The reference to figure 2 (now 3) refers to the L/H ratio during the flexion phase of the movement.

**Comment 5**  
Figure legend 2 and 3: write "no load-fatigue" instead of "no load fatigue".

**Response:** Appropriate changes were made to the revised manuscript.

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**Reviewer 2**

**Minor Essential Revisions**

**Comment 1**  
I would recommend Minor Essential Revisions (such as missing labels on figures, or the wrong use of a term, which the author can be trusted to correct). Specifically on page 12 the following paragraph needs to be corrected as indicated:

Repeated trunk flexion and extension as well as lifting tasks has have been previously targeted as potential causes of work related low back pain [24, 25]. Therefore, repeated trunk movement or sustained static posture leading to muscle fatigue of back or hip extensor muscles may alter usual spinal loading and stability usual mechanisms putting, therefore putting, the lumbar spine at risk of injury or reinjury.

**Response:** The paragraph has been modified according to the reviewer comments.