Author's response to reviews

Title: Effect of Head and Limb Orientation on Trunk Muscle Activation During Abdominal Hollowing in Chronic Low Back Pain

Authors:

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Author's response to reviews: see over
Response to Reviewers’ Comments

Reviewer #1: Dr. Page

1. Is the question posed by the authors well defined?
   Yes. it’s a very novel study.

Authors’ response: Thank-you

2. Are the methods appropriate and well described?
   Somewhat. I’m not aware of the validity/reliability of their assessment of patients with ATNR. Need to have more consistency with the use of ‘supine’ versus ‘neutral’. Suggest not using “ATNR” as a testing position, but rather “Cervical Rotation with Arm extension” as an example. There is also little reference to the transverse abdominus, which is an important muscle activated during abdominal hollowing. Suggest not using “Exercises” as a heading, and include description of AHM earlier in methods.

Authors’ response: As we had one certified physiotherapist it was not possible to conduct an inter-rater reliability measure. However the reviewer can be assured that the reviewer has had 20 years of experience in this area.

The term “cervical neutral” has either replaced “supine” or been added in brackets as a clearer description of the position throughout the paper as requested. Throughout the paper head and limb positions are emphasized. When reflex positions are mentioned, the authors always initially describe them as simulated reflex positions or positions used to mimic a particular reflex.

We have discussed the role of the transverse abdominus and IO electrode placement in the limitations section. We have also added information to the methods section. We acknowledge the importance of the combined role of the IO and TrA and have better described these roles in the methods and the discussion. We provided a comprehensive paragraph near the end of the discussion on this matter. We have copied it for your reading convenience.

However, the results must be considered within the limitations of the study. In this study, only surface EMG electrodes were used. At the site of IO, there will be recordings from TrA since it lies directly beneath this point. McGill et al. [59] reported that surface electrodes adequately represent the EMG amplitude of the deep abdominal muscles (i.e. TrA and IO) within a 15% RMS difference. Ng et al. [60] indicated that electrodes placed medial to the ASIS would receive competing signals from the EO and TrA with the IO. Based on these findings, the EMG signals obtained from this abdominal location are described in the present study as the IO, which would be assumed to include EMG information from both the TrA and IO. However this limitation should not affect the interpretation of the results in this study for three reasons. Anatomically it has been shown that the lower fibers of both IO and TrA have similar orientation and attachments.
Likewise it has been proposed that they have similar synergistic functions in ipsilateral rotation and sacroiliac joint closure [62]. Finally it has been shown that the hollowing maneuver is performed by the combined activity of IO and TrA [63]. Because of the similarity in function and anatomy, these two muscles have been recorded together with surface electrodes in a number of studies from this laboratory and their EMG activity have been differentiated from other neighbouring muscles such as the RA and EO [24-27].

Exercise subheading has been removed and the AHM description has been placed earlier as suggested.

3. Are the data sound?
Using ‘meaningful differences’, it appears so. Recommend possibly adding inferential statistics to support future meta-analysis.

Authors’ response: We are pleased that the reviewer recognises our data interpretation method as valid and clinically useful. Unfortunately, it is not possible to display both clinical likelihoods and null hypothesis significance tests as the philosophical differences between our Baysian approach to data interpretation is in contrast to the frequentist style to which the reviewer is referring (i.e. hypothesis testing). However, a p-value of less than 0.05 can be inferred from a 95% confidence limit: if the 95% confidence limit crosses the zero (e.g. mean=3, 95% confidence limits= -1 to +7), the effect can be considered statistically non-significant. However, if the 95% confidence limits DO NOT cross the zero (e.g. mean=3, 95% confidence limits= +2 to +4), the effect can be considered statistically significant. Information on statistical significance is available from the 95% confidence limits should a reader desire it.

There are some wonderful articles to read espousing the weaknesses of statistical significance testing from a wide range of different fields that we can direct the reviewers and editor to for further reading on this topic:


4. Does the manuscript adhere to the relevant standards for reporting and data deposition? Yes. (See #3 comment)

**Authors' response:** See our response to #3 comment.

5. Are the discussion and conclusions well balanced and adequately supported by the data?
   Somewhat. The discussion needs to be shortened a little and kept more relevant to the study.

**Authors' response:** We have modified the discussion to reduce its length as suggested.

6. Are limitations of the work clearly stated?
   Suggest more limitations discussed on the use of superficial EMG, only one examiner, and lack of V/R on assessment.

**Authors' response:** The suggested limitations have been provided in the limitations subsection of the discussion.

7. Do the authors clearly acknowledge any work upon which they are building, both published and unpublished?
   yes.

**Authors' response:** Thank-you

8. Do the title and abstract accurately convey what has been found?
   yes, but abstract should be revised based on comments above as well. Title is appropriate and should serve as the foundation for the entire paper.

**Authors' response:** Abstract has been revised based on the reviewer’s comments.

9. Is the writing acceptable? There are some grammatical errors and copyediting, but the writing overall is good.

**Authors' response:** We have reviewed the paper again and attempted to rectify any grammatical errors.
Reviewer #2
Reviewer: Mark Lidegaard

1. Minor essential revision:
I would like a definition of this term

**Authors' response:** We have provided the following definition.

Individuals with chronic low back pain (CLBP) have altered activations patterns of the anterior trunk musculature when performing the abdominal hollowing manoeuvre (attempt to pull umbilicus inward and upward towards the spine.).

2. Discretionary revision:
Possibility to use the abbreviation "HM"

**Authors' response:** We would prefer to minimize the number of acronyms as manuscripts become more difficult to read when there are too many acronyms.

3. Minor essential revision:
Following sentence needs a reference

**Authors' response:** Reference has been added as requested.

4. Minor essential revision
As said in the abstract it would be nice to give definition of this term

**Authors' response:** We have added a definition as requested.

“One treatment protocol for CLBP has been performing abdominal hollowing [3]. With this maneuver, the subject is asked to draw their umbilicus inward and upward toward their spine.”

5. Discretionary Revisions:
I would suggest to move this part of text to the end of the background, more specific the part where the objectives are mentioned

**Authors' response:** This sentence was specifically placed here as it is related to abdominal strengthening strategies. The second portion of the introduction deals with primitive reflexes and this sentence would not fit with that discussion.

6. Minor essential revision:
Following sentence needs a reference

**Authors' response:** References added as requested.

7. Discretionary Revisions:
Is this part essential for your line of argument? I would prefer to exclude this part

Authors’ response: The sentence/note about the disappearance or inhibition of PR is an important point that we would like to include. The prior and following sentences just provide background information so they have been deleted as requested.

8. Minor essential revision:
If the local ethics committee provided a approval number you should mention it

Authors’ response: Approval code number has been added as suggested.

9. Minor essential revision:
Why did you choose the frame? Furthermore it differs from the exclusion criteria pain free subjects (6 months)

Authors’ response: An exclusion criteria of longer than 6 month time frame was to ensure there was no mistake over the transition time frame of being sub-acute. There is some disagreement regarding the time frame so we chose the longer time frame to avoid disagreement instead of avoiding the chance people who were sub-acute could be included due to forgetting the exact date. We have added the following citation for using a 6 month exclusion criteria.


We have added the following reference for the 12 week inclusion criteria


10. See the comment above

Authors’ response: The authors’ response above incorporates our response to #9 and #10.

11. Minor essential revision:
Is there any exclusion criteria connected to the determination of PR?
Furthermore I feel that it’s unclear who of the subject that are determent to have PR

Authors’ response: The prior paragraph outlined the exclusion criteria used for PR subjects. We have added further information.
“Inclusion for the CLBP group was identified by a score of over 12 on the Rolland Morris Disability Questionnaire (RMDQ) [21] and suffering from low back pain for greater than 12 weeks (1). Subjects were excluded from the CLBP group if there was a presence of a severe postural abnormality, radicular symptoms, limited neck range of motion or pain, any neuromuscular or metabolic disorder, previous diagnosis based on radiographical evidence (specifically spondylolisthesis or spondylolysis), or if the subject was currently taking antidepressant or opiate medication. A certified physiotherapist assessed the presence of PR.”

12. Discretionary Revisions:
This entire section only repeats things that are already mentioned and does not give any supplementary information. Therefore it can possibly be left out.

**Authors’ response:** Deleted as suggested.

13. Discretionary Revisions:
I would propose to merge the information from this section with the information from the “Electromyography” section. In my opinion this would give a better reading experience.

**Authors’ response:** The first sentence has been moved to the EMG section as suggested. Based on this reviewer’s comments as well as the other reviewer this section was re-organized for easier flow of reading.

14. Minor essential revision:
Where a maximum number of times this procedure could be repeated? Regardless the answer should mention if it was limitless or the maximal number of repetitions.

**Authors’ response:** One additional try would be performed. We have modified the sentence as follows.

“If the investigator noticed any problems in the execution of either the double leg raise exercise or the hollowing maneuver the subject was asked to stop given a break of thirty seconds and asked to retry the exercise for one additional repetition.”

15. Major compulsory revision:
General remarks to “Electromyography” section. Where there performed any type of control of the data quality, fx. visually? Have been the rejection rate of the measurement?

**Authors’ response:** Yes the signals were visually inspected for saturation, low signal to noise ratios. These data were removed from analysis. We have now mentioned this fact in the text. Unfortunately we did not note the rejection rate however it was quite low as the signals were generally strong, and reliable.
16. Minor essential revision:
Following sentence needs a reference

**Authors’ response:** Done.

17. Minor essential revision:
Following sentence needs a reference

**Authors’ response:** Done.

18. Minor essential revision:
Following sentence needs a reference plus explanation for this procedure

**Authors’ response:** Done.

19. Minor essential revision:
Does these articles support their electrode placement on any type of guideline? If so mention it.

**Authors’ response:** We did not specifically base electrode position on an association’s guidelines but on the successful utilization from our laboratory and other laboratories internationally. We have used these placements for over 10 years in our laboratory.

20. Discretionary Revisions:
Missing word: Fx. “passed”

**Authors’ response:** Adding the term “pass” does not make sense with the word “directed” already present.

21. Discretionary Revisions:
Not important, leave out

**Authors’ response:** Deleted as suggested.

22. Minor essential revision:
This sentence is not written very clearly

**Authors’ response:** We have modified the sentence as follows.

A submaximal isometric contraction was performed for normalization since maximal contractions are known to be unreliable in a CLBP population [28].

23. Discretionary Revisions:
I believe that this reference should be mentioned the first time you talk about AH
Authors’ response: We have now included this reference with the first mention of abdominal hollowing in the background section.

24. Discretionary Revisions:
Not important, leave out

Authors’ response: Deleted as suggested.

25. Discretionary Revisions:
Wrong word: “Not”

Authors’ response: Changed as suggested.

26. Minor essential revision:
Refers to the wrong figure, according to the present labeling of the figures it should be 1.c instead.

Authors’ response: Correct figures are now in place.

27. Minor essential revision:
Poorly written sentence could be “…two positions were used for cervical…”. Plus refers to the wrong figure, see above.

Authors’ response: Sentence has been modified and correct figure labeling has been ensured as follows.

“Two positions used in this study were cervical rotation to either the left (Figure 1b) or right with the arm (side to which head is pointed) extended straight out and perpendicular to the torso and the leg (side to which head is pointed) extended.”

28. Discretionary Revisions:
This part only seems to be repeating the above. Can be left out

Authors’ response: The previous section described the ATNR reflex while this section describes the cervical rotation positions. As you may notice both involve cervical rotation but ATNR also includes the specific limb positioning.

29. Minor essential revision:
There is no figure 7

Authors’ response: Appropriate figure numbers have been inserted.

30. Discretionary Revisions:
This section could use some subheadings, as it would improve the reading experience. Furthermore this section is really long so it would improve the reading experience dramatically with a general reduction in the amount of text.
Authors’ response: Subheadings have been added as requested.

31. Discretionary Revisions:
Missing word: Fx. “group”

Authors’ response: “Group” added as requested.

32. Discretionary Revisions:
Missing word: Fx. “is”

Authors’ response: This sentence was deleted to decrease length of discussion.

33. Discretionary Revisions:
CLBP who? Possible missing word: Fx. “patients”

Authors’ response: Patients added as requested.

34. Minor essential revision:
I feel that is late in the paper to redefine/ differentiate one of the essential terms

Authors’ response: The paper has been restructured such that global and local abdominal hollowing discussions appear only in the discussion where they have been defined and not earlier.

35. Discretionary Revisions:
Missing word: Fx. “group”

Authors’ response: Added as requested.

36. Discretionary Revisions:
This part should be mentioned as one of the first parts in your discussion, as it is one of the most important

Authors’ response: The paragraph has been moved as suggested and now is the second paragraph in the discussion section.

37. Discretionary Revisions:
Missing word: Fx. “researchers”

Authors’ response: Added as requested.

38. Discretionary Revisions:
Peculiar word, I would advise to change it to something more

Authors’ response: The term “felt” now replaced with “reported”. 
39. Discretionary Revisions:
Missing word: Fx. “as”

Authors’ response: Added as suggested.

40. Discretionary Revisions:
Delete word

Authors’ response: Deleted.

41. Minor essential revision:
Why patients? Do you make a general statement or are you talking about your own population? Please clarify.

Authors’ response: We have modified the sentence to read “our CLBP subjects” to clarify for the reader that the sentence refers to the study population.

42. Major Compulsory Revisions:
This part has not been mentioned in the “methods” section, but it should have Been

Authors’ response: We have added this information to the methods section as suggested.

43. Minor essential revision:
Following sentence needs a reference

Authors’ response: Citations added as requested.

44. Minor essential revision:
Why patients? See comment on page 16

Authors’ response: Similar to page 16 we have modified the phrase to “our CLBP subjects” to ensure reader is aware that the phrase refers specifically to our subjects.

45. Discretionary Revisions:
Again, is this part essential for your line of argument? I would prefer to exclude this part.

Authors’ response: Excluded as suggested.

46. Minor essential revision:
Following section needs references
Authors’ response: References added as suggested.

47. Minor essential revision:
Following sentence needs a reference

Authors’ response: Done.

48. Minor essential revision:
Why not use the abbreviation, “PR”

Authors’ response: Changed to PR as suggested.

49. Minor essential revision:
I would propose to relocate this section, so it is found immediately following the part on page 14, where you first discuss your finding.

Authors’ response: Done.

50. Major Compulsory Revisions:
This section is vital and therefore needs to be elaborated

Authors’ response: We have added the following information as requested.

“There are three possible explanations for this result. There were a predominant number of participants with right-sided pain and thus increased contractions on the left side may have been predominant to help brace or stabilize the area. Only certain PR were assessed therefore there could have been other PR or neurological soft signs (i.e. frontal release signs, clumsiness, motor incoordination, difficulty with motor sequencing) present that were not accounted for. Finally the physiotherapist always stood on the right of the participant during instruction of the AHM, which may have affected the individual’s focus for ipsilateral motor recruitment.”

51. Discretionary Revisions:
In my opinion it would improve the reading experience if the numerous explanations/reasons were highlighted. It can be done in several ways, fx. 1), 2), 3) etc., i) ii) iii) etc.
This also applies for page 19

Authors’ response: Numbers have been inserted as suggested.

52. Minor essential revision:
I feel that is late in the paper to redefine/differentiate one of the essential terms

Authors’ response: As mentioned previously we have removed the prior discussions regarding local and global abdominal hollowing. This section is now the first appearance of this concept.
53. Discretionary Revisions:
Delete word

**Authors’ response:** Deleted.

54. Discretionary Revisions:
Poorly written sentence. Please clarify.

**Authors’ response:** We have rewritten the sentence as follows.

Clinically, the re-emergence or continuing presence of PR may influence muscle activation patterns of CLBP patients during the hollowing maneuver.

55. Minor essential revision:
I feel that this section would be more appropriate under the limitations section

**Authors’ response:** The other reviewer felt this section was not vital and thus most of it has been deleted except for a summary sentence that has now been placed at the beginning of the conclusions and clinical applications section. The sentence is as follows.

Further research is required to understand the mechanism of altering cervical and limb position on abdominal activity, and the influence of other PR or neurological soft signs on CLBP.

56. Discretionary Revisions:
The idea of showing the positions with reel pictures are actually really good, however I don’t think that these are the best pictures. Somehow it feel they are unfocused and if you choose to change these I would recommend that you remove the EMG electrodes.

**Authors’ response:** We respectfully feel that the electrodes provide additional information for the reader about their exact location. Perhaps the transfer of the photos to you resulted in some dispersion of the pixels but our version of the photos are of high fidelity. Thank-you for your concern.

57. Minor essential revision:
Labeling of the figures does not correspond with the pictures, see earlier Comment

**Author's response:** This discrepancy has been rectified.

58. Minor essential revision:
There are three issues that apply for both figures 2 & 3 1) It would be make
reading easier if the figures had some form of heading. 2) The abbreviations on the y-axis differ from both the text and figure 1. 3) In my opinion the positions on the y-axis is presented in reverse order, I would expect the top position to be one that has been mentioned first, I feel that this is more intuitive.

**Authors’ response:** Headings have been added to the figures as suggested. Abbreviations have been modified where possible to include full terms and any abbreviations have been defined. The positions on the y axis have been modified as suggested.

59. Discretionary Revisions:
Unclear sentence, could be clarified

**Authors’ response:** We have modified the sentence as follows.

“Each graph represents a muscle group with plots representing the magnitude of difference between ratios of different muscle groups for the two groups in the different postures.”
Response to Editorial Comments

1) Acknowledgements section has been added as requested.
2) Additional sections such as competing interests, authors’ contributions, information etc. have also been added as requested.