Reviewer's report

Title: Changes in joint coupling and variability during walking following tibialis posterior muscle fatigue

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Reviewer: Ross Miller

Reviewer's report:

The study examined changes in coordination between the leg and foot during walking following a fatiguing exercise protocol that targeted tibialis posterior (TP). Conclusions are posed on the role of TP during gait and the data are compared to other similar studies that have examined coordination, variability, fatigue, and/or pathology.

I thought the study was interesting, and that the authors used a sound approach to investigate a topic that is difficult to address experimentally (fatigue or disability of a single muscle). I have several concerns and suggestions that are explained in greater detail in the comments below. In summary:

(1) How much certainty can be attached to the fatiguing protocol specifically targeting TP and not other functionally similar / nearby muscles?

(2) The vector coding technique and statistical analysis of the resulting directional data should be explained in more specific detail, and may need to be re-analyzed using circular statistics.

(3) The Conclusions section is weak and only restates the results.

MAJOR COMPULSORY REVISIONS

Introduction

(1) Page 3, 2nd paragraph: Could the authors explain in greater detail how a closed-chain exercise isolates TP more affectively than an open-chain exercise? What evidence was this conclusion based on? EMG?

Materials and methods

(2) It seems that the order of conditions was the same for all subjects. Ideally this order would be balanced to minimize the changes of a presentation bias, but this is admittedly difficult to achieve with a study like this. However, I think it should still be noted somewhere in the manuscript that a potential presentation bias is present in the results (unless the authors can refute this contention).

(3) Why were the two different termination criteria needed for the fatiguing protocol?

(4) Could the authors comment on how this protocol isolates the TP muscle while sparing other muscles that could feasibly participate in this motion? I assume this
was the goal of the protocol.

(5) I'm confused why the authors elected to “fold” the phase plane (angle-angle plot) into a single quadrant. Information on the coordination is lost by doing this. The full phase plane (from 0-360 degrees, proceeding counter-clockwise) contains four possible modes of coordination:

- Pure motion of the distal segment (q near 0 or 180)
- Pure motion of the proximal segment (q near 90 or 270)
- In-phase motion (q near 45 or 225); “synchronous”
- Anti-phase motion (q near 135 or 315); “asynchronous”

By collapsing the plane into a single quadrant, it seems to me that in-phase and anti-phase motion are treated as the same coordination pattern. Asynchronous motion is often suspected as an injury factor, for example between the subtalar and knee joints while running (e.g. Bates et al., 1979; Hamill et al., 1992). I would like to see more detail added on the exact method the authors used (equations would be very helpful) and a justification for why a phase plane on 0-90 degrees is suitable for the study.

(6) Due to the directional nature of the data coupling angle and variability data, means and standard deviations should be calculated using circular statistics (e.g. Chang et al., 2008; Miller et al., 2010). Was this done? Traditional means and standard deviations do not account for the directional nature or the discontinuity at 0/360 degrees, and can give a misleading picture of the data in some cases.

Results

(7) Were statistical analyses performed on the strength data? This would help strengthen the affirmation that the subjects were indeed fatigued.

Conclusions

(8) This paragraph basically just restates the major results, which is not really a conclusion. Can stronger summarizing, concluding statements be made here?

MINOR ESSENTIAL REVISIONS

Introduction

(1) Page 4, 1st paragraph: “However, inspection of the data also revealed that 24 out of 29 subjects demonstrated an increase in peak rearfoot following fatigue.” Is a word missing here? Peak rearfoot inversion angle, perhaps?

Materials and methods

(2) Subjects: Could the mean and SD of the subject heights be included as well? Breakdowns of male/female descriptive statistics would also be helpful.

(3) What sort of footwear did the subjects wear?

(4) Procedures, 1st paragraph: “More in depth explanations of the procedures and methods can be found in a previous publications [x]”. I think the reference
was mistakenly omitted here ([x] placeholder?).

(5) Data analysis: Were the segment angles calculated relative to the calibration trial?

(6) I presume that TP is not highly active during the swing phase, similar to the other plant flexors. Is this why only the stance phase was analyzed? I think an explanation for only using the stance phase should be added.

Results

(7) Joint coupling and variability sections: These sections are very general and not informative. It would help if the quantitative descriptions were added (e.g. means/SDs and p-values) along with the existing qualitative descriptions.

DISCRETIONARY REVISIONS

Introduction

(1) Page 4, 2nd paragraph: Several studies pre-date the Hamill et al. (1999) study in the context of joint/segment timing, coordination, and injury (e.g. James et al., 1978; Hamill et al., 1992). It would seem relevant to cite them here as well.

Discussion

(2) Page 12: The Hamill et al. (1999) and Miller et al. (2008) studies also used a different measure for coordination (continuous relative phase), which may not directly compare to the present vector coding method and could explain the different findings of the present study.

(3) Page 13: “Miller et al. [28] studied…runners currently experiencing ITBS,” is incorrect. The subjects in this study had resolved cases of ITBS, but were not injured at the time of data collection. In any case, this paragraph does not seem entirely relevant to the present study. The discrepancy between their results and the results of the present study was already touched upon in the Discussion.

Materials and methods

(2) Page 7, Data processing: I am not sure if it will be intuitive to readers why these three particular couplings were selected. Could a brief justification/explanation be added here?

Level of interest: An article of importance in its field

Quality of written English: Acceptable

Statistical review: No, the manuscript does not need to be seen by a statistician.

Declaration of competing interests:

I declare that I have no competing interests