Reviewer’s report

Title: Reliability of doming and toe flexion testing to quantify foot muscle strength

Version: 0 Date: 02 May 2017

Reviewer: Luke Kelly

Reviewer's report:

Thank you for the opportunity to review this manuscript. The authors should be commended for their efforts to undertake this study, assessing the reliability of three, somewhat novel techniques of measuring foot muscle strength. The manuscript is well written and the findings are clear and well presented. However I have a few important points for the authors to consider, prior to publication of this research.

General considerations

1. A primary aim of the current study was to assess the reliability of novel measures of intrinsic foot muscle strength. The authors do a great job in the introduction of highlighting the issues associated with current measures of intrinsic foot muscle strength and the difficulty in isolating / separating the force produced by the intrinsic muscles versus the force produced by the extrinsic foot muscles. Although the measures presented in the current study are reflective of those applied in clinical practice by Physiotherapists, Podiatrists and other health practitioners, I remain unconvinced that these measures are any more or less valid than previously described techniques to measure intrinsic foot muscle strength. The authors have not provided any evidence (via electromyography, or otherwise) that the intrinsic foot muscles have been activated in isolation during these tasks. To my knowledge, the referenced papers of Jung et al (as well as others) have not addressed this issue either. I do acknowledge that the intrinsic foot muscles are definitely active and producing force during these tasks. However, it is highly likely that the long toe flexors are also contributing a substantial proportion of the measured force output. Furthermore, tibialis anterior and tibialis posterior are also likely to be active during the "doming" task.

Should the authors wish to make the claim that these techniques are measures of intrinsic foot muscle strength, they will need to provide validity data for their tests. For example, provide evidence that the intrinsic foot muscles are the only muscles contributing force during this task. This may be achieved with the use of electromyography.

The plantar intrinsic foot muscles, long digital flexors, tibialis anterior and tibialis posterior are all likely to contribute to active control of longitudinal arch function. As Such, it might be more appropriate to be a less selective in terms of attributing the force produced during these tests to
one particular muscle group. But rather to all of the muscles that are potentially involved in these manoeuvres. For example, the authors could refer to "foot doming strength", "hallux flexion strength" and "lesser toe flexion strength" rather than intrinsic foot muscle strength. This change, while making a considerable change in focus of the manuscript away from the intrinsic foot muscles, should not detract from the importance of the work. In my opinion, the focus on strengthening one small group of muscles, in isolation, to produce meaningful changes in foot and/or lower limb kinematics seems futile given the functional contributions by a large number of muscles to controlling foot / longitudinal arch biomechanics. This is not to neglect the importance of the intrinsic foot muscles, but rather to recognise the function of the entire system. Strength training programs that target multiple muscle groups during functional tasks would seem far more appropriate and beneficial, as this is more likely to be reflective of what happens during locomotion.

2. This comment is not directly issue related to this manuscript. However, the authors may wish to consider if the force produced during these training tasks is sufficient to strengthen these muscles, given the large magnitudes of force that they are required to produce during locomotion. The authors may also like to consider some type of modification to the technique to include lengthening contractions (eccentric) as well as shortening contractions, given that these muscles undergo active lengthening and shortening during stance phase.

Specific comments

1. Abstract Line 44 - "lesser toes" may be more appropriate than "lateral toes".

2. Introduction P3 Line 77 - please change "may contribute to" to "has been associated with"

3. Introduction P3 Line 83-84 - The final sentence "if the intrinsic muscles of the feet are ineffective" is very vague. Could the authors please be more specific, or remove the sentence.

4. Introduction P4 Line 98 & 99 - please change "was" to "is"

5. Introduction P4 Line 100 & 102 - please change "drawback" to "limitation"

6. Introduction P4 Line 106-111 - Please re-focus this paragraph to be less certain that are measuring intrinsic foot muscle strength in isolation.

7. Introduction P5 Line 116-117 - The authors may wish to provide further justification for why they believe their measures are likely to be more reliable than others. Is there something in the experimental set-up that is likely to increase the ability of participant to consistently replicate the task?
8. Methods P5 Line 125. Please add a statement regarding the declaration of Helsinki, if this was adhered to.

9. Methods P6 Line 142. The authors should be less definitive about the role of the intrinsic foot muscles in producing force in isolation during this test. They may wish to mention the long toe flexors, TA and TP here too.

10. Methods P6 Line 142. Can the authors be certain that the metatarsal heads were not raised of the surface of the Brannock device during the doming task? Inversion of the rear-foot, via tibialis anterior and tibialis posterior activation may also produce an upward directed force.

11. Methods P7 Line 1162-166. The toe flexion task descriptions do not seem as they as they are encouraging the participant to activate the intrinsic foot muscles in isolation. This idea is supported by the images in figures 3A and 3B where it is apparent that there is substantial amounts of distal IP joint flexion occurring in all toes. Distal IP joint flexion is most likely produced by the long digital flexors (FHL and FDL).

12. Discussion P10 Line 228 - Please alter reference to intrinsic foot muscle strength, as discussed earlier

13. Discussion - The authors may wish to discuss the potential contribution of different muscles to these tasks. The authors may also like to comment on the functional relevance of toe flexion and doming in terms of gait biomechanics in the discussion.

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