Author's response to reviews

Title: Reliability of capturing foot parameters using digital scanning and the neutral suspension casting technique

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Version: 2 Date: 24 December 2010

Author's response to reviews: see over
Re: Revision of manuscript, **Reliability of capturing foot parameters using 3D non-contact digitisation and the neutral suspension casting technique** (MS: 7690958364226012)

Dear Dr Munteanu,

We would like to thank both reviewers for their time to read the manuscript and the constructive comments. We have used track changes to display revised comments within the second version.

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Reviewer 1 Comments and responses

1. The reliability results of the plaster cast technique are not reported in the results or conclusion of the abstract.

Due to the shear amount of results and word limitations within the abstract only key findings were reported. ICC values for neutral suspension casting were added and SEM values deleted due to word restrictions. The results section in the abstract now reads:

ICC values for all foot parameters using digital scanning ranged between 0.81-0.99 for both intra and inter-rater reliability. For neutral suspension casting technique inter-rater reliability values ranged from 0.57-0.99 and intra-rater reliability values ranging from 0.36-0.99 for rater 1 and 0.49-0.99 for rater 2.

2. Page 3 – 1st paragraph. The wording ‘...obtain a reproduction of the foot’ is awkward and is used a few times in the introduction. Consider changing to obtain an accurate impression of the foot’

The wording of reproduction was amended to representation of the foot. This terminology is in accordance with a recent publication in the Journal of Foot and Ankle Research regarding 3D scanning. [1].


3. Page 4 – 4th paragraph. The results of previous studies have been listed without any critical appraisal or discussion, and therefore, it is unclear what issues/arguments the authors are raising in this section. In addition, why have the authors included some reliability outcome measures for some studies and not others?

The final paragraph on page 4 states the underpinning of the study. The authors feel due to word limitations the description of past literature is adequate.

4. Page 4 – 4th paragraph. All references in this paragraph are from multiple authors and are therefore not cited appropriately in-text. This issue is evident throughout the manuscript
5. Page 4 – 4th paragraph. Line 2 – what are ‘within-method’ techniques?

Within methods techniques is wording taken directly from the Laughton et al [2] article, Table 2. The authors wanted to maintain consistency by using terminology utilised in the article.


Methods section:

6. The methods section would be enhanced by pictures and or diagrams of the equipment/casting procedures.

Figure 1 has been added demonstrating the digital scanner.

7. Page 5 – Participants. Why did the authors decide to exclude participants with all of these conditions? This reduces the generalisability of the results to a large portion of patients who require casting/customised foot orthoses therapy

We did not generalise the study to a patient population as the study was to assess the reliability of the casting/scanning techniques. We did not want to look at specific populations as again we were assessing the reliability of the instrument.

8. Page 5 – 3rd paragraph. Since this paper is focused on the plaster cast and 3D digitisation methods, it is inadequate to have one sentence describing the plaster cast technique

We have added the additional sentences explaining the casting method.

“The technique required the participant to be placed in a supine position with hips and knees extended. One strip of plaster of Paris bandage (Gypsona®) was then applied to the rearfoot and one to the forefoot. The foot was then placed in subtalar joint neutral position, the midtarsal joint locked through placement of the thumb to the sulcus of the fourth and fifth digits”.

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9. Page 5 – 2nd paragraph. The 3D non-contact digitiser that used triangulation by pattern projection is not shown or illustrated in Figure 1

The wording figure 1 has been deleted from the text

10. Page 6 – 1st paragraph. The second sentence states that 6 plaster casts were taken of the left foot and then the following sentence states three casts were taken of each foot

The word ‘each’ deleted and replaced with the word ‘left’

11. Page 6 – 1st paragraph. Did any rater training take place to reach consensus on the casting/scanning technique? Was rater 1 blinded from rater 2 during the casting/scanning procedure? Was the foot re-positioned by each rater following each digital scan? Perhaps not if only 20 seconds separated each scan. This is an important issue that may affect the generalisability of the reliability findings. That is, does the inexperienced rater depend on the experienced rater to place the foot accurately for the scanning procedure?

The aim of the study was to evaluate an inexperienced clinician who has limited exposure to casting and no exposure to digital scanning. Single-blinding did occur. Foot re-position with the allocated time-frame of 20 seconds.

12. Page 6/7 – The description of cast length seems more like cast width

Description altered.

“Cast length was measured from the posterior heel to the forefoot bisection”.

13. Page 6/7 – The description and associated figure (1) for the foot parameter measurements could be made clearer by adding further detail to figure 1. For example, how was the calcaneus bisected? What is meant by ‘widths were taken at 10mm height on the cast/scan? How were measurements, such as the navicular tuberosity, determined on the 3D scan?

The authors have deleted the paragraph relating to the above description. We felt the paragraph was not necessary and would only confuse the reader.
14. Page 7 – Statistical analysis. Could the authors please clarify in the manuscript whether; (i) the data was screened for normality, and (ii) whether hypothesis testing was undertaken to determine whether systematic bias was statistically significant.

Thank you for the comment. We appreciate your comments but we have spoken to our statistician, and we are confident that our statistical tests are the current and appropriate. We fully understand this grey area and there are controversies relating to the most appropriate tests. We have indicated the type of tests we have used by the current evidence:

We have removed the Bland and Altman graphs from the revised manuscript as we felt they we could not report all graphs requested due to the shear amount of variables.

The smallest real difference (SRD) has now been added to the statistical analysis. SRD’s have been added as the ICC reveals little information regarding measurement error. Random error can be quantified by the SRD and SEM^{1,2}.


15. Page 8. ‘The results demonstrated a mean a age’. This should be re-worded as the participants’ anthropometric characteristics are not the result of the experiment.

Sub-title amended to Participant characteristics, ‘results demonstrated’ deleted and section detailing characteristics reworded:

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“The overall mean age (SD) of the participants was 35.4 (13.6) years, the mean weight was 69.3 (13.4) Kg, the mean BMI was 24.9 (5.1) Kg/m² and mean height was 1.67 (0.09) m”.

17. Page 8 – 3rd paragraph. What is meant by ‘...least supportive reliability findings’?

Least supportive deleted, lowest reliability finding added.

“With regard to neutral suspension casting technique, forefoot to rearfoot alignment and medial arch height produced the lowest reliability value of all parameters measured”.

18. The results section is disorganised. In the second paragraph, the reliability of some measurements are included while others are not. For the 3D digitisation method, the authors report the ICC range for all measurements and the SEM for each rater individually. However, for the plaster cast method, the ICC results for the forefoot to rearfoot alignment and medial arch height are reported, but not the SEM or the other foot measurement?

The authors feel the results are not disorganised however for consistency we have included the SEM values for intra rater reliability regarding plaster casting.

19. Page 9 – ‘The Virtual Orthotics™ digitiser utilised in our study allowed...’.

The manufactures name should be replaced with 3D digitiser to be consistent with other sections of the manuscript.

Virtual orthotics deleted and replaced by digital scanner.

20. Page 9 – final sentence. Without a diagram or further explanation, it is unclear what meant by ‘This resulted in the heel being further from the scanning bed than the forefoot that may have contributed to an increased measurement error’.

A diagram cannot be provided as this explanation was quoted directly from the Laughton et al [2] article.
21. Page 10 – The following sentence requires revision, as it sounds as though the testers foot was more inverted forefoot. ‘When casting with the neutral suspension technique our results indicated rater 1 (inexperienced rater) had on average a more inverted forefoot to rearfoot alignment’.

Added wording ‘cast produced by’ to clarify misinterpretation.

When casting with the neutral suspension technique our results indicated that casts produced by rater 1 (inexperienced rater) had on average a more inverted forefoot to rearfoot alignment, increased variation between casts and a higher SEM for forefoot to rearfoot alignment than rater 2.

22. Page 11 – The following sentence does not make sense to the reader: ‘Adhering to the foot morphology theory [14] prescription protocol begins with a cast of the foot in a non-weightbearing neutral position’

The sentence has been deleted from the article and is not included in the revised discussion.

23. Page 11 – 2nd paragraph. The following sentence in confusing and potentially contradictory to the previous sentence... ‘In the study only pes cavus feet were cast, whereas our methodology did not exclude specific foot types’

The sentence has been deleted from the article and is not included in the revised discussion.

24. Page 11/12/13 – A large portion of the discussion contains describes different theories of foot function (i.e. sagittal plane facilitation theory, tissue stress paradigm). However, it is unclear what the relevance this has to the reliability of the two casting techniques.

Reference to the above has been deleted from the article and is not included in the revised discussion.

25. A table caption is needed to explain the meaning of the numbers listed in columns 1, 2 and 3 (presumably average measurements?)
Table titles amended.

26. The lower limit of the ICC 95% CI for rater 1 is three decimal places

ICC value reduced to 2 DP.

27. Figures 2-5: Why are there only figures for four of the six foot parameter measurements investigated?

All reference to Bland and Altman plots have been deleted from the article.

28. Figures 2-5: What is the purpose of including the Bland and Altman plots. There are not referred to in the paper (i.e. there are no comments in the paper indicating what the plots illustrate in terms of the results)

All reference to Bland and Altman plots have been deleted from the article.

29. Why have the authors chosen to illustrate inter-tester data in the Bland and Altman plots rather than both inter- and intra-tester reliability.

All reference to Bland and Altman plots have been deleted from the article.
30. Upon reading this manuscript, it appeared that Virtual Orthotics supported this study as a commercial partner. As Phillip Hartshorne (Director of Virtual Orthotics) has been listed as a co-investigator of this study on the AUT University website (www.aut.ac.nz/research/research-institutes/hrcc/research-activities/podiatry), could the authors clarify whether there was potential for any Conflict of Interest in the preparation of this manuscript. Perhaps a short statement around this issue could be added to the Conflict of Interest Declaration.

Thank you for drawing this to our attention. Mr Phillip Harshorne’s name has been removed from the web site as he was not an investigator. Virtual Orthotics involvement in the study was fully disclosed.
Reviewer 2 comments and responses

1. My understanding is the more common terminology for the device the authors used is ‘digital scanning’ and the authors have called it ‘3d non-contact digitisation’, which is probably correct, but as a reader it was not until well into the manuscript did I get to understand that they were using a ‘digital scanner’. I misunderstood that the ‘3d non-contact digitisation’ was actually something different, which it wasn’t. Perhaps the authors need to better explain this early in the manuscript to avoid misunderstanding or confusion.

In the interests of avoiding reader misunderstanding all references to 3D non-contact digitisation have been replaced by digital scanning throughout the entire manuscript.

2. The only other minor point is the statement on page 12 of the manuscript that "It would also be of benefit to investigate a full cost analysis study to ascertain the clinical viability of the technique". I have actually done that study: Payne CB. Cost benefit comparison of plaster casts and optical scans of the foot for the manufacture of foot orthoses. Australas J Podiatr Med 2007;41(2):29-31

Reference to the article has been added into the discussion and reads as below.

“It would also be of benefit to reinvestigate a full cost benefit analysis based on the initial work completed by Payne [16], as the cost of digital technology has significantly decreased over the past 5 years”.

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