Author's response to reviews

Title: Hallux Valgus and Plantar Pressure Loading: A Population of Men and Women

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Author's response to reviews: see over
Reviewer 1: Sheree Nix

Major compulsory revisions:

1. Abstract conclusion - is this concluding statement really justified, since the reported study did not investigate prospective risk of other lower extremity ailments?

   RESPONSE: The abstract conclusion has been edited to more conservatively describe the conclusions drawn from this study. This section now reads, “These results suggest that HV alters foot loading patterns and pressure profiles. Future work should investigate how these changes affect the risk of other foot and lower extremity ailments.”

2. Background Para 2 - query whether References #7 and #8 are the best citations to support these statements? The paper by Schoenhau & Cohen (1992) appears to be a theoretical paper, and other more recent studies with original data could support the point being made. It appears that the authors have not considered study quality when citing references in this paragraph, and I would suggest more emphasis be placed on the findings of the systematic review (Reference #6).

   RESPONSE: Thank you for this feedback. Paragraph 2 of the background has been reworked to acknowledge that reference 7 (Schoenhau) was a theoretical paper, to replace reference 8 with more recent data, and to speak to some of the findings of reference 6. The new paragraph reads:

   “The degree to which foot anatomy or biomechanics influence HV is poorly understood. In a 2012 systematic review and meta analysis, Nix et al reported that the first intermetatarsal angle and first metatarsal protrusions distance were significantly associated with hallux valgus, but also noted that a number of radiographic factors were not significantly associated with hallux valgus [6]. Arch height is noted as an area of interest in clinical models of hallux valgus [7], which often cite low arches as a contributing factor. However, past research has yielded inconsistent results [6]. While Nguyen et al found a significant association between a clinical assessment of pes planus and hallux valgus in men [2], Kilmartin et al reported no relation between arch height and hallux valgus when using an arch index [8]. Similarly, studies are inconsistent regarding whether a curved joint head was [9] or was not [10] associated with HV”.


RESPONSE: Thank you. The suggested reference has been added to the background paragraph on page 3.

4. Background Para 4: the authors state that previous plantar pressure research in HV has been limited by a “lack of generalizability”; it would be helpful to be more specific regarding the limitations of previous research and the "gap" that is being filled by their study. The novelty of this study in considering HV in combination with other foot deformities could be emphasized.

RESPONSE: We have rewritten the first sentence of this paragraph at the bottom of page 3 to read, “Prior studies are limited by conflicting results, small sample sizes, and consideration of hallux valgus in isolation of concurrent foot disorders. Addressing these limitations can impact clinical decision making...” in order to highlight the novelty of the manuscript and to better describe the gap that is being addressed with our data.

5. Although large, the population-based sample in this study included mostly older adults, and this should be made clear in the introduction and discussion.

RESPONSE: The third sentence of the fourth paragraph of the Introduction on page 3 has been rewritten to read “The purpose of this study is to describe plantar pressures and forces in a large epidemiologic, population-based study of older adults...”.


6. Study purpose - suggest adding "and other foot deformities" after "...between those with and without HV"

**RESPONSE:** This phrase has been added to the sentence which now appears on the top of page 4, as suggested.

7. Methods Para 2 - could the authors please explain briefly how the physical examination has been “validated”?

**RESPONSE:** Yes, the following text has been added to the Methods section (Para 2).

“The validity of the foot exam was previously evaluated in a sample of elderly residents by comparing podiatry clinic findings to the results from the trained study examiners. There was excellent agreement for HV as well as other foot disorders that were included in the foot examination. A comparison of multiple examiners yielded kappa values >0.85 (all p<0.01), and all domains demonstrated excellent interobserver and intraobserver reliability [20, 21].”

8. Methods Para 5 - “biomechanical data” is somewhat vague and could imply that other open- and closed- kinetic chain measures were obtained; suggest using the term “plantar pressure data”

**RESPONSE:** The word “Biomechanical” in the two section headings on page 5, and in paragraph 5 of the Methods has been replaced with “Plantar Pressure”.

9. Methods Para 8 (statistical analysis) - could the authors provide some justification for why both feet were included for analysis, rather than using right or left only for analysis? See Menz, H. B. (2005). Analysis of paired data in physical therapy research: time to stop double-dipping? J Orthop Sports Phys Ther, 35(8), 477-478.

**RESPONSE:** Thank you for this comment and reference. As Menz points out in the reference provided, the inherent problem in including both limbs (or in this case, both feet) of the same person violates the assumption of independent observations, as the left and right foot of the same person are highly correlated. In our study, we have chosen to include both feet in order to take full advantage of the data that we have. However, in analyzing these data, we account for the fact that we no longer have independent observations. Generalized estimating equations, which were used in our analysis, account for the correlation between the multiple observations per
person (i.e., left and right foot) and thus does not “double-dip” or overcount participants. This is a commonly used technique in studies with multiple observations per person.

10. Results Para 2 - suggest less emphasis should be placed on crude model findings for maximum force, as these values were not normalized to body weight (i.e. expressed as %BW), thus the statistical adjustment for body weight is necessary in order to interpret the data (i.e. some of the differences reported could have been due to differences in body weight of participants between groups)

RESPONSE: As suggested, the paragraph on page 7 has been reworked to de-emphasize the results of crude models. The results are explicitly mentioned where a similar result was found in the adjusted models, and merely alluded to in cases where such an agreement did not exist.

11. The discussion section follows a logical structure and the authors offer clear theoretical explanations for a number of the study findings. Some novel aspects of this study are mentioned in the discussion but could be more clearly emphasised: 1) the use of CPEI and MAI in addition to peak pressures and force, 2) the analysis of medial and lateral rearfoot regions in plantar pressure analysis.

RESPONSE: We thank the reviewer for these comments and have edited for clarity the Discussion portions related to the more novel findings. This also led us to wording clarifications in the Abstract, first paragraph of the Discussion, and in the Conclusion.

12. Discussion Para 2 - the authors acknowledge a study by Menz et al. (2006) that showed reduced hallux pressures in HV; however, it should also be acknowledged that other previous studies have found increased hallux loading in HV.

RESPONSE: Thank you. We have expanded the discussion of pressure under the hallux to include the following passage that now appears on page 9 under the heading, Hallux and Lesser Toes:

“While reduced pressure under the hallux in those with hallux valgus has been seen in previous studies [13, 17], this result has not been reported consistently [27]. Past studies have also observed no significant difference in loading of the hallux [15], as well as an increase in pressure under the hallux [14]. The conflicting findings noted by Martinez-Nova et al. [14]
could be due to the inclusion of only mild cases of hallux valgus and a comparatively smaller, younger cohort (mean age 54.7 years)."

13. Discussion Para 4 - two studies are cited that reported reduced loading under the first metatarsal area (References #11-12); however, both of these studies investigated groups of surgical patients. Other previous work has shown elevated pressures under the first metatarsal area, and these conflicting findings should be acknowledged.


**RESPONSE:** To better reflect the available literature, we have modified the first sentence of this paragraph in the Discussion (Forefoot section) to read: “Prior studies of surgical patients have also reported that HV is associated with lower loading at the 1st metatarsophalangeal joint (MTPJ) [11,12].”

We have also added an additional sentence to acknowledge the conflicting findings: “Studies in non-clinical groups by comparison have noted an increased load at the 1st MTPJ [15,16, 27].”

14. The authors have clearly discussed some study limitations; however, a further limitation that should be mentioned in the Discussion is regarding the plantar pressure masking of the hallux region in individuals with HV. Was the same mask used for all participants? Lateral deviation of the hallux in HV can mean that standardized masks are not able to accurately identify the hallux position.

**RESPONSE:** The following response has been added to the Limitations section:

“As a common mask was used to define foot regions for all pressure scans, it is possible that foot regions may not have correlated exactly with the anatomical location of the corresponding metatarsals in some cases. To more accurately define foot regions, it may be useful in future studies to align anatomical foot structure from spiral X-ray tomography with plantar pressure data as described by Hastings et al [36].”
Minor essential revisions:

15. Page 5 - third last line - suggest adding the word "the" between "under" and "middle"

   RESPONSE: “The” was added to the sentence that now appears on page 6: “The pressure under the middle third of the foot...”.

16. Suggest to check abbreviations for journal titles in References

   RESPONSE: Thank you. We have fixed the References section so as to ensure that the abbreviations used throughout the section to match those used on PubMed.

17. Reference #19 appears incomplete

   RESPONSE: The reference has been fixed. Thank you.
Reviewer 2: Edward Roddy

Major Compulsory Revisions

1) Background (pg 3) - hallux valgus is described as a structural deformity commonly referred to as a bunion. A bunion is more accurately described as the reactive soft tissue changes that occurs secondary to the increased prominence of the 1st MTP joint laterally as a consequence of the hallux valgus deformity.

**RESPONSE:** Thank you for this feedback. The first sentence of the Introduction on page 3 has been revised to read “Hallux valgus (HV), a structural foot deformity often resulting in a reactive soft tissue bunion, can cause foot pain and limited mobility [1].”

2) Methods (pg 4) - hallux valgus was defined by a greater than 15 degree abuction of the hallux by comparison to an illustration of the hallux valgus angle. A more detailed description of this technique is required. What is the validity and reliability of this method?

**RESPONSE:** We have added additional details of the procedure to describe the validity and reliability of the foot exam:

“The validity of the foot exam was previously evaluated in a sample of elderly residents by comparing podiatry clinic findings to the results from the trained study examiners. There was excellent agreement for HV as well as other foot disorders that were included in the foot examination. A comparison of multiple examiners yielded kappa values >0.85 (all p<0.01), and all domains demonstrated excellent interobserver and intraobserver reliability [20, 21].”

And to better describe the assessment of HV:

“While the participant was standing, the examiner compared the angle of the hallux to an illustration of a 15° angle printed on a laminated page, and recorded hallux valgus as present if the angle was larger than the illustration.”

3) Methods (pg 4) - how was hallux rigidus measured?

**RESPONSE:** Hallux rigidus was considered present if the hallux was frozen or rigid during attempted passive movement by the examiner while the participant was seated. This has been inserted into the text in the first paragraph on page 5. Thank you.
Minor Essential Revisions

1) Reference 19 is incomplete

   RESPONSE: The reference has been fixed.

2) Figure 3 is described as a CONSORT diagram. The CONSORT statement pertains to the reporting of randomised controlled trials. The figure should be renamed

   RESPONSE: The word “CONSORT” has been removed from the Figure 3 legend to avoid confusion.