Author’s response to reviews

Title: Age-related differences in foot mobility in individuals with patellofemoral pain

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Author’s response to reviews:

Reviewer #1

Thank you for submitting this interesting paper. Overall I consider it to read well and to demonstrate focus and clarity throughout. I have a few specific comments for consideration:

The method is an interesting one in that it uses participants from 2 studies that are geographically and temporally separated. Table 1 provides details of the inclusion and exclusion criteria. In relation to this table and the methods section please consider:

- Defining the time periods during which the two studies - Brisbane and Melbourne - were conducted.

Author response: We have since defined the time periods during which the two studies were conducted. Please see page 4, lines 67 and 70.

“The randomised controlled trial cohort (n=179) was recruited in Brisbane (May 2004 to May 2006), for a study evaluating the effectiveness of foot orthoses for PFP [8]. From this cohort, 110 participants with complete foot mobility datasets were included in the current study. We included an additional 84 participants with PFP from an observational cohort study in Melbourne (July 2012 to March 2015) [9].”
Clarifying how the Anterior Knee Pain Scale was used in both groups. There is a difference in the text included in table 1 that relates to pain during activities that may lead to some confusion about the role of the AKPS and increased clarity would be helpful.

Author response: The AKPS was not used to define eligibility in either study. Rather, we used it in the current study as a way of characterising the cohort, as this is a condition-specific measure commonly used in PFP studies. This is distinct from the pain Visual Analogue Scale (VAS) that was used as an inclusion criterion in both cohorts. The nature of PFP is such that pain is typically worst during specific PFJ-loading (or aggravating) activities. As such, we would anticipate that the difference between the pain-specific eligibility criteria is minimal.

• In addition,

Please provide more references to illustrate the ongoing appropriateness of the approach to diagnosing PFP.

Author response: We have added reference to the recent consensus statement on PFP, which includes recommendations on PFP diagnostic guidelines. Please see page 5, lines 80 to 81.

“Volunteers were included in either study if they had insidious onset anterior or retro-patellar knee pain, with a severity of at least 30 mm on a 100 mm visual analogue scale (VAS), or pain provoked by at least two activities that load the PF joint (e.g. prolonged sitting or kneeling, squatting, running, hopping, stair ambulation or rising from sitting). This is consistent with published recommendations regarding diagnostic criteria for PFP [10].”

- If possible, provide information on the number of participants recruited from each source e.g. from community advertising and health professional referrals.

Author response: While we agree with the reviewer that this data would be useful to characterise the cohort, unfortunately this data is not available. Anecdotally, the majority of participants in both studies were recruited through community advertising, but we are unable to quantify this.

- Clarify if equal body weight distribution between the two feet was achieved by asking the subject to monitor this themselves or via any other means.

Author response: We have since clarified the above by stating “Briefly, weight-bearing (WB) measures were taken with participants in relaxed standing on a custom-made foot measurement platform [13], with participants asked to maintain equal body weight on each foot while measures were taken (self-monitored).” Please see pages 6, line 105 to 107.
- Include a brief sentence to detail the nature of the visual inspection that confirmed the appropriateness of the clusters identified.

Author response: “Visual inspection confirmed that the age clusters formed were clinically appropriate (i.e. aligned with decades).” Please see page 7, line 130.

- There is also scope for some development of the limitations in the discussion to refer to the potential impact of the geographical and temporal differences in data collection between the two groups.

Author response: We have since added to this point in the Discussion by stating, “Despite using two cohorts with a disparity in age range, this may in fact provide us with a more representative age demographic of individuals who experience PFP.” Please see page 12, lines 217 to 218. The same investigator took all foot measures in both cohorts. These measures have demonstrated high intra- and inter-rater reliability between raters of varying experience (2-30 years experience; McPoil et al 2009, JFAR, 2(1):6). Thus, we do not feel that time (temporal) differences in data collection would have confounded our findings, and have not addressed this in the Discussion.

- Similarly, after acknowledging that the platform is not available to purchase commercially, it may be useful to state the role this plays and detail how the lack of availability of the platform could be overcome.

Author response: This has been addressed as requested, by adding the following sentences: “Simple digital callipers can be used to measure midfoot width at 50% foot length in weight bearing and non-weight bearing. However, measurement of midfoot height requires a flat, firm base to be in contact with the sole of the foot during measurement. This necessitates specific equipment, particularly for the non-weight bearing measure. Until such a device is commercially available, clinicians can use the Foot Posture Index to quantify foot posture and mobility. Cornwall and McPoil [19] demonstrated that people classified as more ‘pronated’ on the FPI (higher score) had greater midfoot height mobility, midfoot width mobility and foot mobility magnitude compared to people classified as ‘supinated’ (lower score).” Please see page 11, lines 203 to 210.
Reviewer #2

The authors have produced a good quality report with information that will be useful to the relevant professional communities. There are some aspects where small amendments might improve clarity and provide a clearer base for future work. The following points should be addressed:

- Lines 49-51: “range of motion [5], with three-dimensional motion analysis demonstrating that older 50 individuals have less midfoot and forefoot mobility during walking compared to younger 51 people [6, 7]”

- Ref 6 the participants were age and gender matched? Can the authors truly interpret those findings in this manner?

Author response: We thank the reviewer for pointing out this error. We have since removed reference 6 and replaced it with a more appropriate one - Judge JO, Davis RB, 3rd, Ounpuu S. Step length reductions in advanced age: the role of ankle and hip kinetics. J Gerontol A Biol Sci Med Sci. 1996;51: M303-12.

- Ref 7 the age difference between the old and young groups was approximately 50 - is this a fair comparison to the cohort in this study?

Author response: The use of this reference is not to compare the study by Arnold et al. with our cohort. We are introducing the concept that as humans age, foot mobility during gait is less than in younger adults.

Please see page 4, lines 51 to 52 to view the above amendments.

- Lines 94-95

“A single assessor (NJC) used reliable methods to quantify midfoot mobility, which have been detailed previously [11]” This method relies on relaxed sitting versus weight bearing stance but in the manuscript the authors also refer to dynamic gait analysis (kinematics), which is likely to be considerably different (muscle function, for example). Do the authors wish to bring confusion or clarity to the readers? By simply leaving the report as it stands some readers will fail to comprehend the subtle difference between true kinematics and pseudo-dynamics (sometimes confusingly referred to as "dynamic posture" assessment). Perhaps the authors should include a paragraph in the discussion regarding this issue so that readers comprehend clearly the difference between kinematic motion analysis and measures of dynamic posture (which are not interchangeable)? The alternative is to remove references to dynamic function (kinematics), which I think will be detrimental. Please add a section to the discussion.
• Lines 188-89

“Firstly, despite the foot assessment platform being able to evaluate foot mobility, which may (be) useful in predicting dynamic foot function (18)…”

Whereas the authors (Franettovitch et al) for ref 18 state: "The results of this study support the use of arch height and arch height ratio measurements taken statically in the clinical assessment of the foot and may assist the clinician in estimating foot posture during dynamic activity in patients with lower-limb injuries.” It is clear that they estimate "foot posture" during dynamic activity (ie, foot shape NOT foot function).

Again, I would request that the authors insert a paragraph within their discussion to highlight and clarify the crucial difference between dynamic foot posture analysis (pseudo kinematics) and 3D kinematic analysis (true kinematics). If the results cannot be described precisely with the terms DISPLACEMENT, VELOCITY and/or ACCELERATION, then it in not motion analysis.

Author response: As requested, we have added a paragraph to the Discussion to clarify this for the reader. “Secondly, it is important to note that the foot mobility measures we have used are ‘quasi-dynamic’, in that they document changes in foot posture from relaxed sitting to full weightbearing. Although such measures provide useful insights into how the foot responds to loading and may have some value in estimating foot posture during gait [31], they cannot be considered to be equivalent to true kinematic measures obtained with motion analysis systems.” Please see pages 11 and 12, lines 211 to 215.

• Terminology such as "foot mobility measurement” brings considerable ambiguity to the literature because it can be misinterpreted as representative of dynamic analysis. The authors themselves appear to have fallen foul of this problem in Lines 188-189 of the manuscript.

Author response: We thank the reviewer for highlighting the ambiguity in this term throughout the literature. However, we feel that we do not add to this ambiguity given that we specify in the Methods that foot mobility measures were taken during static weightbearing and non-weightbearing, and not during three-dimensional (3D) motion capture. Furthermore, we have since replaced the word “mimics” with “parallels”, which we feel assists in distinguishing between 3D motion capture and static measures of foot posture. Please see page 10, line 181.

• Lines 160-162

“Several studies have shown that ankle dorsiflexion- plantarflexion and subtalar joint inversion-eversion range of motion are 12-30% lower in older individuals [5]”
This is unhelpful. Either, re-word it along the lines that "Menz concluded from his review that...", or, itemise and reference the studies of relevance, at least the most supportive ones.

Author response: We have since amended this sentence to read “Menz [5] concluded from his review that ankle dorsiflexion-plantarflexion and subtalar joint inversion-eversion range of motion are 12–30% lower in older individuals, and Lee et al. [15] found that range of motion in the sagittal plane of the forefoot was lower in older compared to younger healthy women.” Please see page 10, line 175.

• Conclusion

- The authors have conducted a sound study and written a good report.

- There is one major issue that requires clarification, the confusion regarding foot mobility assessment (essentially not dissimilar to range of motion assessment), dynamic foot posture assessment, and kinematic analysis. The authors can address this easily within their discussion.

- In addition there are a few minor points for consideration - I believe these will enhance the report.

Author response: We have responded to each of the queries raised by the Reviewer and trust that they are satisfactory.