Author’s response to reviews

Title: Reliability and validity of a Novel Kinect-based Software Program for Measuring a Single Leg Squat.

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Author’s response to reviews:

Answer to the editor and to the reviewer #2
We thank the reviewers and the editor for the comments which have helped to improve the manuscript. We have corrected the typos as proposed by reviewer #2. Due to the comment from the editor, part of the introduction is rewritten to get a better flow. We have not added any new sections only used the current manuscript and partly rewritten and moved some of the sections. Our answers to the comments are marked in red in this document and all changes in the manuscript are marked with yellow. The whole of the manuscript is read and revised regarding grammatical errors.

Comments from the editor

1. Albeit an issue introduced due to amendments from reviewer comments, the addition of lines 9-20 on page 1 may require some additional smoothing into the introduction. The line of your argument becomes a little muddy as I read it, I see: (line 15) Visual assessment of knee-foot in asymptomatic adults = valid; (line 18) multi segmental approach (≤3 point scale) = reliable; (line 21) visual assessments complex, difficult to test and hard to reach acceptable validity/reliability. Reading the first few sentences suggests that a clinical rating is acceptable, but then you indicate the opposite. While I understand the context throughout the paragraph, I would suggest minor adaptation to bring clarity to your argument here.

Additionally, line 16 page 5 through line 4 page 6 could benefit from better integration. As it stands the rationale for the study proposed in the introduction should be stronger.

We appreciate the editors comment and we have rewritten this paragraph to achieve clarity. The change is marked with yellow on; page 4 line 13 to page 5 line 21.

One part of the previous paragraph is moved to the end of the introduction: Page 6, line 22 to page 7 line 4.
Some authors propose a simple approach, assessing only the relation between the foot and knee [10], whilst others propose a multi segmental approach, assessing the kinetic chain comprising the inter-relation between several body segments from the trunk to the foot [8, 9, 11]. In general, visual assessment is challenging as movements are complex and sometimes performed at high speed. Clinical examination is in addition subjective in its nature why it can be difficult for a test to reach acceptable levels of reliability and validity, thus hampering its clinical usage [12-14]. Reliability is commonly affected by the complexity of the rating scale, the definitions of the rating criteria, the velocity of the test, the between/within-subject variation, and the examiner’s training and clinical experience [6, 15, 16]. Even so, several studies report that visual assessment of the knee in relation to the foot is reliable and valid for asymptomatic adults [6, 10, 16, 17], whilst the multi segmental approach up until now has been questioned [16, 17]. A meta-analyses, however recently reported that a multi segmental approach, preferably with a ≤3 point rating scale, is indeed feasible and reliable [6]. The reason to assess more than one body segment is that additional information can be useful in the targeted rehabilitation [6, 16].

An increased dynamic knee valgus and its interlinked malalignment is proposed to be associated with overuse syndromes such as patella-femoral pain syndrome [18], iliotibial pain syndrome [19], femur-acetabular impingement [20], tibial stress fractures [21] and injuries such as anterior cruciate ligament injuries [22]. No cut-off point is yet established for when the degree of a medial displacement of the knee is to be considered a risk for these syndromes or injuries. Further, there exists no precise or true consensus on the clinical importance using the SLS test to measure medial displacement of the knee. A critical step in injury prevention is to determine the cause of injury to understand why an athlete is at a greater risk in a given situation and how an injury occurs [23]. As the cause of injury often is multifactorial, comprehensive models to understand injury causations have been developed which emphasis intrinsic-, and extrinsic risk factors together with a careful description of the injury [23, 24]. Intrinsic factors are among others described as modifiable physiological factors [7, 23, 25] such as the dynamic knee valgus, visually assessed with for example the SLS test, drop jump, vertical drop jump, lunge, one leg hop or a crossover hop [16, 17]. In addition to separate movement tests, a variety of screening systems are used in the clinic to observe and assess injured athletes or for proactive purposes among others the Functional Movement Screen (FMS) [1, 2, 26, 27].

Albeit a highly significant correlation between dynamic knee valgus and injury risk is reported, it still is not possible to predict future injuries based on the results from movement screening tests [43]. The need to improve and develop methods and the understanding for the complexity of injury prevention and thus movement screening, still remains an important and essential part of the effort to protect the athlete from injury [44]. Hence, there is a need for simpler, yet objective and quantitative, methods for capturing dynamic knee valgus. Such methods could be used to define relevant cut-offs, or angles associated with a greater risk of knee injury, when evaluating movement quality with a SLS.
Methods

2) I would suggest shifting amended lines 3-7 on page 13 prior to the test-retest reliability subheading.
We have moved this section as the editor proposes

3) Please indicate what software was used to run all statistical analyses.

This is now added at page 14, line 7-9.
STATA version 15.1 was used to run all statistical analyses and Microsoft Office Excel version 16 for Windows 10 was used to plot the Bland-Altman plots.

4) Page 13 Line 17 – “Since not all variables were normally distributed”, reads a little easier than “Since all variables were not-normally distributed”

Thank you for pointing this out. We have changed the wording accordingly.

Results

5) Page 15 Line 21 – Suggest: “Since two variables were not-normally distributed (left knee down and right knee up at 22 occasion one), Spearman correlation coefficients were calculated in addition to ICCs to assess relative reliability.” Rather than “Since two variables were not-normally distributed (left knee down and right knee up at 22 occasion one), Spearman correlation coefficients and in addition ICC were calculated for the relative reliability.”

Thank you for pointing this out. We have changed the wording accordingly.

6) With regards to the use of “SDC”, I believe Minimal Detectable Change is more commonly used, and given you cite MDC’s from other work it may be useful for you to change to this acronym, or indicate within the manuscript that they refer to the same thing to avoid any confusion in your readership.

We agree and have made following amendment in the method section on page 13 line 12-13.

Another term used for SDC is Minimal Detectable Change (MDC), which will be used synonymously within this text.

Discussion

7) I also suggest indicating that you acknowledge limitations of assessing ICC on the non-normally distributed measures and that the readers should interpret those particular results with caution. Though the findings are not promoting a good ICC here, acknowledgement of the issue is relevant for transparent reporting.

Yes, transparent reporting is of course of great importance. We have added this amendment on page 23 line 13-17.

Since two variables were non-normally distributed (left knee down and right knee up at occasion one), Spearman correlation coefficient were calculated in addition to ICC to assess relative reliability. To calculate and assess ICC on non-normally distributed data is a limitation and the ICC results in the present study must therefore be interpreted with some caution.
8) Amendments made on 18 – 20 on page 19 are unclear. Please re-write to clarify. Additionally, lines 2-6 page 20 should be written in past-tense. Perhaps more importantly, these lines / the ends of this amended paragraph is not well integrated within the paragraph itself, nor the discussion. The SEM and MDC values across studies are added here without any meaningful message to the reader.

We thank the editor for making us aware of the unclarity of this section. We have rewritten the whole section for better understanding, starting at page 18, line 15-22.

Unfortunately, the results from recent studies that used the Kinect camera and investigated the SLS and the double leg squat cannot be compared with the QinematicTM, since different post-processing techniques are used to measure lower extremity kinematics [34-37, 39]. While, most studies measure peak joint angles [34-37, 39], QinematicTM calculates the medial and the lateral displacements of the knee 30 times per second from the top of the squat to the bottom of the squat (down) and vice versa (up). Then, a net trajectory angle (NTA) is calculated which represents the angle between the estimated “line of best fit” through the changes in knee position and the vertical axes for each direction.

In addition, line 2-6 page 20 has been rewritten in past tense and moved to line 6-12, page 19. Previous test-retest studies [36, 37, 39] using Kinect data present relatively small and clinical acceptable SEM and MDC (equal to SDC) values. Mentiplay et al. [36] measured the knee abduction angle and calculated the SEM of a SLS to 4.38° and 3.62° for a vertical drop jump. Similar low values were found by Schmitz et al. [37] in which an MDC of 3.1° were found for knee adduction and 4.1° for knee flexion in a double leg squat. Wochatz et al. [39] found, however, somewhat higher variation for knee flexion/extension (SEM=6.8-8.3°) during a double leg squat.

9) Page 22, lines 2 and 3, please indicate which ‘above mentioned studies’ you are referring to.

Thank you for pointing this out. We have added the references and made some small changes on page 20 line 20-23.

In terms of reliability, recent studies highlight difficulties with the hardware as well as the software of the QinematicTM system when measuring knee angles in the frontal plane during concurrent internal and external rotations of femur and tibia during a SLS [36, 37, 39].

10) Within the amendments made in the revised document submitted I noted a number of grammatical errors, and some sentences that seemed unfinished or lacked clarity – please carefully read through the manuscript and attend to these.

We agree and we have read through the manuscript and changed accordingly.

11) For Additional Material 1, do you require any permissions to publish what seems to be a direct system report from QinematicTM? If so, do you have confirmation of this permission from QinematicTM?

Yes, we have confirmation from QinematicTM. An amendment of that have been stated under competing interest, page 28 line 3-4.

The company provided permission to reprint the “biomechanical report” in Additional file 1.
12) Please ensure formatting of citations (e.g. reference list) follow journal guidelines:

Yes, we have ensured that the formatting of citations follow the journal guidelines.

Reviewer #2

Abstract Background Line 7: Change "is" to "was". Done.

Page 5 Line 15: Delete "the" before understanding
Changed to – “to understand”.

Page 6 Line 2: it should be "recognized"
This is omitted due to rewriting the introduction.

Page 6 Line 5: it should be "argued"
This is omitted due to rewriting the introduction.

Page 6 Line 7: change to" pointed"
This is omitted due to rewriting the introduction.

Page 6 Line 8: change applicable to "apply"
This is omitted due to rewriting the introduction.

Page 13 Lines 17-18: Consider rewording to " Spearman correlation coefficients were calculated in addition to the ICCs
This is changed accordingly.

Table 2: Limits of Agreement should be changed to Mean Difference and (95% CI of the mean difference). What you have in your brackets is not the limits of agreement. The LOAs are calculated using the mean difference and the standard deviation of the differences.
This is changed accordingly.

Page 19 Line 23: "This is in order"
This is omitted due to rewriting of item 8 according to the editor.

Page 20 Lined 3, 4, & 5: Change various forms of measure to measured.
Changed accordingly.

Page 20 Line 14: Change presents to presented
Changed accordingly.

Page 22 Line 6: Change to "which enables capture of the whole movement
Changed accordingly.