Author’s response to reviews

Title: How to squat? Effect of various stance widths, foot placement angles and level of experience on knee, hip and trunk motion and loading

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Author’s response to reviews:

Dear Reviewers

First, we would like to thank to all of you for your excellent comments. They really helped to improve the manuscript. Please find below all the comments and changes.

Best regards,

Silvio Lorenzetti
Editor Comments:

BMC Sports Science, Medicine and Rehabilitation operates a policy of open peer review, which means that you will be able to see the names of the reviewers who provided the reports via the online peer review system. We encourage you to also view the reports there, via the action links on the left-hand side of the page, to see the names of the reviewers.

Reviewer reports:

Gavin Moir (Reviewer 1): Please include all comments for the authors in this box rather than uploading your report as an attachment. Please only upload as attachments annotated versions of manuscripts, graphs, supporting materials or other aspects of your report which cannot be included in a text format.

Please overwrite this text when adding your comments to the authors.

The authors sought to establish the effects of different postures, depth of descent, loads, and experience on the mechanics during the back squat exercise. This research has implications for practitioners interested in improving sporting performance and those concerned with rehabilitation. Overall the manuscript is well designed and well written but I have a number of issues that I would like the authors to address before the manuscript is accepted for publication.

Specific comments

Abstract, line 32: You note that '…tissue loading is crucial for positive adaptations and to avoid overload'. However, isn't overload of the tissue caused by loading the tissue and isn't this what the tissue adapts to? I would consider changing the term 'overload'.

>>The term overload has been changed to “injury”.

Abstract, line 37: Consider replacing the sentence "The motion was analysed using…” with 'A 3D motion capture system (100 Hz) and two force plates (2000 Hz) were used to record mediolateral knee displacement (ΔD*), range of motion (RoM) at the hip and knee joints, and joint moments at the hip, knee, and lower back.'

>>The sentence has been changed as suggested.
Abstract, line 48: Can you really discuss the 'targeted muscle' when you only calculated the net joint moments (which are indeterminate)? Consider changing this sentence.

>>The sentence has been changed to: "Suitable stance width and foot placement angles should be chosen according to the targeted joint moments."

Abstract, line 49: Change 'stand' to 'stance'. Also, consider changing the term 'overload' in this sentence as the tissue will adapt to the mechanical overload.

>>The sentence has been changed to: "In order to avoid injury, special care should be taken in extreme positions (narrow stance-42° and wide stance-0°) where large knee and hips joint moments were observed."

Introduction: There are currently 9 paragraphs in this section. Consider combining paragraphs to reduce the number.

>> The number of paragraphs has been reduced.

Introduction, line 97: I do not agree that the reference you have provided (Müller, 1999) really supports the assertion that the squat exercise has a high risk of injury. I am not aware of any research that would support the assertion that the squat has a high risk of injury. I think that you need to rewrite this sentence to reflect the fact that there are many variations of the squat some of which might result in mechanics that might be considered potentially injurious (i.e knee abduction etc.)

This is based on a survey including 6680 participants. However, I completely agree that strength training in general is a safe way to perform sport. The sentence has been reformulated and now reads the follows:

>> Besides the health benefits, and a general now injury risk of strength training compared to other sports, squatting has been identified as a strength exercise with a raised risk of injury for the lower limbs and the trunk compared to other strength exercises [5].

Introduction, line 117: Change 'Contradictory…' to 'In contrast…'

>>Changed as requested.
Introduction, line 145: Change '…knee, hip and trunk joint moments and motion…' to '…hip and knee range of motion and moments…'

>>Changed as requested.

Methods, line 151: Remove 'Overall' from the sentence.

>>Changed as requested.

Methods, line 209: Change '…knees and hips…' to '…hip and knee joints…'

>>Changed as requested.

Methods, lines 231-232: Is there any reason why the two terms on the right of Equations (2) and (3) are presented in a different order? Please be consistent.

The reason is that the normal vector is defined for each leg in the anatomical direction lateral. This missing information has been included: “where N⃗ is the normal vector of the sagittal plane of each leg pointing towards lateral:”

Methods, lines 250-251: Change the order from '…KJC, HJC..' to '…HJC, KJC…'

>>Changed as requested.

Results, lines 254-255: Consider changing the units to meters, as per the SI system (also for participant heights in lines 159 and 161).

>>Changed as requested.

Results, lines 303-304: Change '…sagittal moment in the back…' and '…back moment…' to 'lumbar spine moment'.

>>Changed as requested.
Results, line 308: Change '…step width…' to '…stance width…'

>>Changed as requested.

Discussion, line 311-313: You need to include references to the measure of spinal curvature and the use of different external loads in the restatement of your purpose.

>> the following has been added to the method section:" The lumbar curvature was calculated by fitting a circle around the skin markers in the lumbar part of the spine [37] a method that allows the quantification of the spinal dynamics during movements [11, 38-40]."

And furthermore in the discussion section:" . In order to assess the movement of the lumbar spine the curvature [11] was analysed. The here chosen extra load of 0% for novice and 50% for experienced squatters represents the lower end of weight used in a strength training [10] but it allows to analyse the unloaded squat movement and the effect of a moderate extra load.

Discussion, line 316: Change '…moments in the knee, hip and lower back…' to '…moments at the hip, knee, and lower back joints…'

>>Changed as requested.

Discussion, line 325: Rewrite the sentence ('…which tend to valgus positions in the knee…' is not grammatically correct).

This sentence has been rewritten and now reads the follows:" Excessive mediolateral movement of the knees is thought to signal a functional deficit. These deficits can include an enhanced hip adductor activity, malfunction / weakness of the musculature of the posterior chain complex or a reduced RoM of the ankle joint, which tends to valgus positions in the knee or [7, 22-26]."

Discussion, line 352: How could one perform a squat while avoiding knee displacement? Do you mean mediolateral displacement specifically? Please specify.

This has been clarified the follows:" Although “avoiding significant forward knee translation” and “no varus or valgus motion” is recommended by [18],…"
Discussion, line 355: You did not assess the mechanics of the movement performed by the novice group with any external load added to the barbell. Therefore, I'm not sure that you can make such a statement.

> > The sentence has been revised and now reads the follows:” Here, our results indicate that even novice squatters are able to perform squats with a low risk of injury due to knee displacement, if extreme positions are avoided. “

References: The references need to be checked for formatting (e.g. some references have the full title of the source while others have abbreviations).

> > This has been corrected according the style of the journal.

Table 2: Change 'Introductions' to 'Instructions'

> > Changes as requested.

Jim Richards (Reviewer 2):

P8 This could be rephrased

After a warm up phase of five minutes, the participants performed the squats in a randomized order. Each participant, novice (n) and experienced (e), performed a set of five squats in each of the nine different positions (Table 1) without additional weight.

To

After a warm up phase of five minutes, both groups performed a set of five squats in each of the nine different positions (Table 1), in a randomised order.

> > This has been changed as requested.

P11

"Two linear mixed models"

do you mean
"A two factor linear mixed method model was used to explore the two groups and the different foot placement angles and stance width"

>> This has been changed as suggested.

P11

A Bonferroni post-hoc test was conducted and adjusted by means of a Bonferroni correction in all aforementioned cases.

Do you mean

A Bonferroni post-hoc test was conducted to adjust the significance level for multiple comparisons.

>> This has been changed as requested.

Results

Were any significant interactions seen between group and foot position? If so please state, if not a simple statement saying no significant interactions were seen is required.

>> The following statement has been included in the result section:

There was no significant (p=0.614) interaction between group and foot position.

In statements of results please state the direction of the differences rather than just restating the data in tables.

>> A double presentation of the results has been avoided and the mentioned paragraph has been removed. The result section has been adapted where applicable.