Author’s response to reviews

Title: Hop tests and psychological PROs provide a demanding and clinician-friendly RTS assessment of patients after ACL reconstruction, a registry study

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Author’s response to reviews:

Dear editor and reviewers,

Please also see attached file.

Thank you for taking the time to review and provide valuable comments on our manuscript. We appreciated the open review system provided by “Research Square”. We have updated the manuscript based on the reviewers’ comments. We feel that the quality and clarity of the manuscript has improved greatly. Please find our point-by-point response to the reviewer’s comments below. All edits are marked in red in the updated version of the manuscript.

Reviewer reports:
Brooke Patterson (Reviewer 1): We commend the authors on their study, on their ability to collect strength, function and PROs from 320 ACLR patients. To have these three key outcomes is a notable strength of the study, particularly the evaluation of psychological outcomes after ACLR and important message related to their inclusion in RTS assessment batteries. The key elements required for an observational cross-sectional study are reported, but the manuscript requires moderate revisions to be considered for publication. The key areas of attention relate to i) more detail in the introduction ii) increasing clarity of a-priori study aims iii) minor additional detail in the methods iv) linking the results of the study to the concluding statement v) improving clarity of figures, vi) linking results of current study to previous RTS battery pass rates. Please see specific comments below:

Thank you for your kind words and your thorough review of our manuscript. Please see response to specific comments below.
ABSTRACT
Background: Abbreviate RTS in second sentence when it first appears

Changed as suggested.

Background: First and third sentence: ACL abbreviation - should this be ACLR?

We actively chose to write ACL reconstruction as ACLR can be misinterpreted.

Psychological outcomes 1 year after "ACL" does not make sense so either change to ACLR or write ACL injury.

We have added “reconstruction”.

Background/Methods: Suggest changing muscle function to "physical function" to describe the strength and hop tests overall. Up to authors but preference would be to describe "muscle function" as the knee extensor and knee flexor strength testing, and hop tests as "hop-tests or 2 hops. This will also enable you to be very clear and more succinct when describing different results for these distinctly. And avoid the reader having to think back to what was the 2 MF and what was the 5 MF tests. You also refer to the 2 MF tests as 2 hop tests at times anyway, and this needs to be consistent throughout.

Good point, thank you. The use of MF or hop tests to define the 2 hop tests is just a mistake from us. We have now consistently changed to 2 MF (with exception for when it was relevant to define which tests were used, as it is in the second paragraph of the discussion). As for the definition of physical function versus muscle function, we have discussed it in our team, and we prefer to stay with the muscle function definition, as we believe it better reflects what we measure with strength and hop testing.

Results: Passing rates needs to be defined in methods. You have only used 230 of 350 words so would also see if you can include detail on the different test batteries. I.e. this could be done in results and just describe pass rate for the four different test batteries. 2 hops (XX%), 5 MF (XX%), 2 hops and 2 PROs (XX%), and 5 MF and 2 PROs (XX%).

Good point, thank you. We have added a short paragraph in the methods section of the abstract, clarifying passing rates, and a sentence in the results on the passing rates for all different test batteries.

Results: Discourage use of + in scientific writing to indicate and

All “+” have been replaced by “and”.

Results: "lowest passing rates" - give a number
We have added (13%).
Results: "There was a very strong correlation between passing 2 hop tests + 2 PROs and passing 5 MF tests as well as passing 5 MF tests + 2 PROs." This is a very confusing sentence, for the second part of the sentence, it is unclear if you are referring to a correlation between 5 MF tests and 2 PROs, or (2 hops + 2 PROs) and (5 MF tests). It would help if the statistical comparisons were defined in the Methods. OR Suggest breaking this sentence into two or providing r-values in brackets to break it up. Also, the first comparison - 2 hop tests + 2 PROs and passing 5 MF tests does not make sense - as the 2 hop tests are part of the 5 MF tests? Now I have read the results in the manuscript

Thank you, we have added results of the correlation analysis in brackets.

Conclusion: Try to repeat the results to provide context for your statement of "demanding"

I am still not sure on the term demanding, and the conclusion as a whole. Perhaps something along the lines of the following would highlight your results and tie into this message better. Otherwise, anyone could have made the statement hop tests with PROs provides a clinician friendly demanding test battery without doing the study.

47% passed the hop-tests, but when combined with the other 3 MF tests, and PROs, only XX% passed the entire battery. Therefore, clinicians should utilise a combination of PROs and different tests of physical function (i.e. strength and hop testing) to determine readiness for RTS.

Thank you for this suggestion. We have used parts of your suggestion, and combined it with our previous suggestion to revise the conclusion. “Demanding” has been removed. Please see conclusion section of the abstract.

INTRODUCTION:
The authors have constructed a concise introduction outlining the key elements of a RTS test battery. However, more detail is required.
Reference to clinical practice guidelines (Andrade BJSM 2019 review of six CPGs) recommend use of psychological measures (in two of the CPGs). But… few studies have evaluated psychological outcomes as part of RTS battery….

OF those that have… reference to previous RTS criteria test batteries or cohorts that have used physical function and PROs, and their associated "pass rates."
And why do we care apart from RTS outcomes? ?? what other consequences could failing physical and psychological criteria have for future outcomes (???symptoms, OA)

Thank you for the comment. We have used your suggested reference, together with other relevant references as well, and added two paragraphs in the introduction section. Please see introduction section of the manuscript

Line 51: "A proper assessment of MF after ACL injury and reconstruction should comprise measures of quadriceps and hamstring strength as well as measures of functional performance.[5]"
Please give an example of functional performance (e.g. hop tests) to provide context and lead into the tests of physical function in the current study.

We have added “such as hop tests” in brackets.

Line 54: Are references 6 and 7 specific to ACL injury? One reference about sports injury psychological response/assessment and one to two references specific to knee or ACL injury would be good here. Would suggest reading Truong BJSM 2020 scoping review (Psychological, social and contextual factors across recovery stages following a sport-related knee injury: a scoping review)

Thank you for the comment. Indeed, reference 6 and 7 are not specific for ACL injury, neither is Troung et al (they report 84% ACL though). After reading the paper, we chose to add it in the reference list.

Line 58-59: It is, however, unknown if adding an assessment of psychological outcome to MF tests will give a better base for decisions on RTS.

What is meant by a “better base”? Would a better phrase be "result in different pass rates?” Is this what your hypothesis is?

Thank you, we have rephrased to “in different passing rates, resulting a better foundation for decisions on RTS”, hoping to add some clarity.

Line 60-61 (Aims). In relation to above comment; what are you evaluating? ? Pass rates.

We have added “pass rates in”.

I would be more explicit with aim and hypothesis, in defining the "different RTS test batteries". I.e. was to evaluate the pass rate of a physical function RTS test battery with and without the inclusion of psychological outcome measures. Now having read the whole paper it is clear the two aims are to compare the pass rates, and to determine the correlation between the different batteries. Try to define this is in the aims. Without reading the methods, you may also need to justify that the KOOS QoL is a psychological outcome measure? And if you cannot do so then the aims may need to change slightly as well.

We have rephrased the purpose to “The aim of this study was to evaluate passing rates in different physical RTS test batteries, with and without the inclusion of psychological outcome measures 1 year after ACL reconstruction.”, taking your suggestion in to account.

METHODS:
General comment: Were the physical function tests and PROs administered by different assessors? If so, specifics around inter-rater reliability should be referenced in the methods.

The present study is based on data coming from a rehabilitation specific register. The PROs are self-administrated on-line, and not by physical individuals. The physical tests are conducted by different physical therapists thoroughly educated in the procedures of all tests, conducted according to a standardized protocol (please see Table 1 in manus). No published results on
inter-rater reliability is available. However, our unpublished data reveal that muscle function tests have a high inter-tester reliability. This was taken into account when conclusions were drawn.

Hop tests sections: Please provide more detail on the specifics of hop tests so the reader does not have to hunt through the reference. Is the vertical hop, vertical jump height based on contact time if hands were behind the back? Readers may not be familiar with the tests. E.g. side hop over 40cm line with aim to get as many repetitions as possible.

We have added brief information about the hop tests as follows: “For the vertical hop, the time from take-off to landing is converted into centimetres. For the hop for distance, the distance in centimetres between top of the toes at take-off to heel at landing is measured. For the 30 second side hop test, during one trial per leg, the patient is instructed to hop as many times as possible over 2 lines 40 centimetres apart. The number of hops is recorded.”

Test Batteries: Please provide rationale of why the different combinations of test batteries were chosen? Were these a-priori? Why not include the side hop test with the other hop tests if the rationale was based on clinician-friendly (i.e. access to isokinetic testing)

Thank you for your comment. We have provided a rationale for the choice of each of the tests in the batteries “For the 2 MF tests, the vertical hop and the hop for distance were chosen as Abrahams et al. [29] reported these tests as the most commonly used functional tests following ACL reconstruction. The battery of 5 MF tests was chosen as current consensus criteria for assessment of patients after ACL reconstruction include testing of both muscle strength and hop performance [8]. The PROs were chosen as the ACL-RSI has been reported with the highest methodological quality to assess patients with ACL reconstruction [30], and the QoL is a subscale of the KOOS which reflects the impact of the knee injury on patient’s life and commonly used to assess patients after primary ACL injury [31].”

PROs: Rationale for categorising KOOS-QoL as a psychological outcome measure is required? This seems to be referred to generally as psychological outcome at points throughout the manuscript.

Definition of passing: KOOS-QoL 62.5 seems very low for young adults. Did you consider using any other cut-offs from within the literature? I.e. Ingelsrud AJSM 2016 paper?

Please see previous comment on the rationale for the test batteries. As for the cut-offs, do you mean the paper from 2018? If so, Ingelsrud et al. do analyse the MIC in the subscale, and report absolute values (mean values) for their cohorts. However, they do not analyse, or state, what a good cut-off could be. This is instead exactly the aim of the Mueller paper from 2016: to find which value on the scale reflects a PASS. Therefore, we believe that the choice of the cut-off is appropriate.

RESULTS:
Line 143 - 162: Are the p-values all <0.001 for each statistical comparison? If not please state actual p-values for each comparison.
Yes, all reported p-values were under 0.001.

Figure 2: It is unclear what the Asterix are evaluating the relationship between from just looking at the figure. Especially as the Asterix are not placed directly on the bars. Would advise putting it next to the figures in the table below, and indicate in legend that * = significant relationship compared to 2 MF tests (if this is true / but I am unsure if my interpretation is correct).

We have added brackets highlighting which value’s comparison resulted into a significant p-value.

Figure 3: It is also unclear on Figure 3 what the * is evaluating. The definition is good in the legend. However, each one * appears to refer to two comparisons if my interpretation is correct? Again, would suggest putting it next to the numbers on the table below

We have added brackets highlighting which value’s comparison resulted into a significant p-value.

Correlation section: Be consistent with decimal places in text versus in Table 4.

Corrected, thank you.

DISCUSSION

Line 179-180: Interestingly, there was a very strong correlation[24] between the two different test batteries. I am not sure this is interesting given that 2 of the MF tests in one battery are incorporated into the battery with 5 MF tests? I agree with the point, if the two batteries (2 hops and 2 PROs result in reduced passing rate compared with 5MF) then clinicians should use the 2 hops and 2 PROs over 5 MF tests. What would be a better correlation to argue this point is if the 2 hops tests correlated with the 3 strength tests , therefore could say that hop tests are correlated and good substitute if no access to isokinetic testing.

Interesting point. However, the correlation analysis between the 2 hop tests and the 2 strength test is not needed, as we show that the 2 hop tests and the PROs correlate with the 5 MF tests. Based on this correlation we recommend clinicians who does not have isokinetic testing equipment to incorporate PROs to hop tests, as the integration of psychological response correlates with measuring merely muscle function.

Line 182: The results are comparable or even better than a comprehensive battery of 5 MF tests (strength and hop).

What does this mean? Comparable to what? What does better than mean?

We rephrased to “The passing rates are comparable or even lower than the passing rates of a comprehensive battery of 5 MF…”
Line 185: …which indicates that the use of only MF tests or only psychological outcomes is likely insufficient as RTS criteria.

This is an important point and should perhaps be linked back in to paragraph 4 (Line 202), it is the fact that your results demonstrate low psychological readiness and knee related QoL, but it is also that results demonstrate PROs aren't correlated to the MF tests. This further highlights the need to evaluate them both, and treat the appropriate deficits.

We agree on the fact that it is important but since we conclude the paragraph with “…supporting that it is important to include psychological PROs in RTS decision-making, alongside tests of MF”, we made no further amendments.

Line 192: are 29% and 13% listed in the wrong order? I.e. 13% passed with PROs

No, the order is correct.

Line 200: "…need to better prepare patients in order to make a safe RTS."

How does this compare to other cohorts evaluating pass rates at 1-year post-ACLR? Explore what need to better prepare patients means in 1 sentence. I.e. increase duration to achieve? Increase utilisation of evidence-based rehabilitation?

Good point. We considered your suggestion and added “(i.e. increase the utilization of evidence based evaluation to guide rehabilitation protocols).

Line 214: However, the use of both the KOOS QoL and the ACL-RSI led to more patients being identified as not “recovered” compared with using only MF tests. Indicate that refers to the results of the current study

We have added “in this study”.

Line 217: How might psychological profiles be related to other outcomes other than RTS? I.e. symptoms, function, future physical activity levels, weight gain?

This is an excellent point of discussion and indeed an interesting area. However, we feel that bringing up thoughts about how psychological profiles can be related to other outcomes could possibly shift focus from what is the aim of our study. We neither have nor consider outcomes other than the test batteries and its components. Therefore, we did not make any further amendment in the text, but save it for future studies.

CONCLUSION: Please refer to comments raised in the Abstract Conclusion.

Need to clearly link results of the study to the concluding statement. Otherwise, anyone could have made the statement hop tests with PROs provides a clinician friendly demanding test battery without doing the study.
Thoughts / suggestions below:

47% passed the hop-tests, but when combined with the other 3 MF tests, and PROs, only XX% passed the entire battery. The MF tests were not strongly correlated with PROs. Therefore, clinicians should utilise a combination of patient-reported psychological and QoL outcomes, as well as tests of physical function (i.e. strength and hop testing) to determine readiness for RTS. Hop testing was moderately correlated with strength testing, and can provide a clinician friendly substitute was isokinetic testing.

Please see answer to the conclusion in the abstract section. The conclusion in the manuscript has been changed to the same as in the abstract.

Angela Fearon, PhD, M(phy), BSc(Pthy) (Reviewer 2): This is a well written paper with a solid methods section. It provides an interesting insight into the issues of people returning to sport following ACL reconstruction.

I only have two comments that I think the authors could address to strengthen the paper.

Thank you for your review and the time spent on it.

I think it would be helpful to include in the limitations that you have not comprehensively assess the somatosensory system. Thus, while psychological factors may be the underlying reason for a person not being ready to return to sport - it maybe that their somatosensory system has not fully recovered.

Good point. We have added “In this study, the primary outcomes were results from muscle function tests and PROs. Cases where patients were unable to RTS due to unresolved impairments to the somatosensory system could therefore not be studied.”.

I also note that the rate of participants exercising at the higher level at 1 year post op was inverse to the preop level. It would be interesting to know if there was a correlation between level of participation and the battery of tests. While I accept that is was not the primary outcome, it would provide further evidence for your findings.

Thank you for your comment. We discussed the subject in our team. We found the rationale somewhat unclear behind correlating level of participation and success in the different batteries. In an earlier version of the manuscript we did a similar analysis: we checked the proportion of patients who succeeded in each test battery that even returned to sport. This analysis showed no significant differences, and we could not see any pattern. In addition: we had too few patients who succeeded in the 2+2 and the 5+2 battery and returned to sport, which would lead to underpowered analyses. We chose therefore not to include that data in the final version of the manuscript.
John Dixon, PhD (Reviewer 3): I thank the authors for submitting this manuscript. It is an excellent short paper which I enjoyed reading and which contains some very interesting data. The manuscript is written in a very clear and informative manner. I have only minor comments.

ABSTRACT:
This was nicely written and clear generally. The second sentence of the Methods has no verb and is just a list rather than a sentence - please add a verb for clarity.
Thank you for your nice words and your comments. The method section of the abstract has been revised with comments from reviewer nr 1, as well, and the missing verb has been added.

INTRODUCTION:
This is very brief but is written in a very clear and logical manner. It summarises the findings of previous studies that have examined the topic, and clarifies the gap in knowledge being addressed. As it is brief you could expand on some of the key literature.

It could be worth adding a hypothesis at the end - what did you hypothesise would be the outcome of the analysis? I don't think that is crucial but many readers would be interested.

Thank you for your kind words. We have written more based on the suggestions of reviewer number 1 and believe that now we have a more complete introduction.

METHODS:
Again this is very clear and logical overall.

P 6 L36 - could you set out the LSI acronym in full if it is the first time in the text.

This is now present in page 5, line 110.

RESULTS/
This is clear and nicely set out.

Table 3 - I suggest presenting the data with 1 decimal place for H, W, and BMI.

Thank you, this has been corrected.

DISCUSSION
This is set out very logically, and the inferences made are clear and robust, supported by the data.

This section starts with a summary of the main findings which was clear and very accessible to the lay reader.

P 10 para 3 has an interesting discussion of the psychological outcomes that was very clear.

The Limitations section is strong and the first couple of paragraphs there raise some pertinent issues for the area.
Conclusion - you could probably make stronger conclusions to end this paper. This seemed a very modest statement, almost as if little could be concluded from your data.

We have now changed the conclusion based on suggestions from reviewer 1, which we believe strengthened our conclusion.

Overall I thought this was an excellent paper.

Thank you for your kind words.