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Sport-related concussion adopt a more conservative approach to straight path walking and turning during tandem gait

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Ref.: Ms. No. JCTRes-D-21-00042
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Dear Dr Murray,

Reviewers have now commented on your paper. You will see that they are advising that you revise your manuscript. If you are prepared to undertake the work required, I would be pleased to reconsider my decision.

For your guidance, reviewers' comments are appended below.

If you decide to revise the work, please submit a list of changes or a rebuttal against each point which is being raised when you submit the revised manuscript. Also, please ensure that the track changes function is switched on when implementing the revisions. This enables the reviewers to rapidly verify all changes made.

Your revision is due by Jul 02, 2021.

To submit a revision, go to https://www.editorialmanager.com/jctres/ and log in as an Author. You will see a menu item call Submission Needing Revision. You will find your submission

record there.

Yours sincerely

Michal Heger
Editor-in-Chief
Journal of Clinical and Translational Research

Reviewers' comments:

Reviewer #1: Overview:

In this paper authors assess force-plate measures during tandem gait, NPC, and VOMS scores following acute SRC (24-48 hours post injury) compared with healthy controls. The cohort is small but the methods are sound. Results suggest that postural instability and slowness during tandem gait weakly correlate with abnormal VOMS after SRC.

Discussion:

Page 3, line 25: This statement is not supported by the referenced paper. This paper reports only on normal athletes. There are a number of references to directly support VOMS as a predictor of protracted recovery to include as an alternative. Perhaps you intended to reference the Corwin et al J. Pediatrics paper from 2015?
'
Methods:

Page 4, line 13: Specifies that the control group as an average age of 12. Is this current or a typo?

Please better define exclusion criteria on page 4, line 33, specifically "neurologic pathology." Were athletes with a history of ADHD or Migraine excluded? Hx of childhood strabismus? These are common diagnosis among athletes influencing both concussion testing and recovery so relevant to consider in your analysis. If excluded for these conditions this is important for readers to know as this may limit generalizability of the results.

Page 6, line 13 please clarify the instructions provided to subjects at the time of testing. Subjects performing the tandem gait test are generally timed and requested to complete as quickly as possible. Please clarify "complete in a timely manner."

Page 6, line 25, Please provide additional details regarding your "custom fixation device." How does this device change the execution of the VOMS? Is the VOMS still executed as published? If so, what is the value of referencing your custom device? Can you provide a reference for this device with more details?

Discussion:

Page 10, line 14 please define "conservative straight path walking" and provide support. Results demonstrate slower completion of the tandem gait task based on time and slower AP velocity (previously demonstrated) and increased excursions in the ML plane during FP and the turn. Please explain how this data adequately supports a statement suggesting a different

underlying motor strategy between concussion and control cohorts.

Page 11, line 31 the discussion on hip strategy his highly speculative and not supported by the data presented here. If you keep in the discussion consider clearly specifying that this is speculative.

Page 11, line 52 please clarify the statement that SRC appear to increase their time to complete the turn. This is not supported by the data in figure 1.

Page 12, line 6. I agree with this line of reasoning ie + VOMS suggests that integration of eye and eye movements are provocative and this may influence performance during the TG turn maneuver. Your cohort is small but this may be further supported looking at VOMS tasks requiring eye movements only vs integration of eye and head movement (VOR and VMS).

Limitations:

Page 12, line 23. Although this statement is not without merit I would suggest avoiding a final sentence which calls into question a large portion of your presented data. I discussion on reliability of self-report measures may be appropriate or you may consider including this as a study limitation. Your study methods depend on a self-report measure, VOMS, as a stand-alone "vestibular test," with no objective data here assessing the vestibular system in this cohort.

Other relevant limitations should include the very small sample size, potential selection bias or limited generalizability depending on your inclusion criteria for pre-existing neurologic diagnosis, and a significant difference in cohort age (if the 12yo controls are in fact not a typo).

Authors' response

Response to Reviewers: JCTRes-D-21-00042 R1

Dear Reviewers – thank you for the time and consideration for our manuscript. We appreciate the through comments and clarifications. We have attempted to provide clarifications and changes to the manuscript per your specific comments. You can find each change to the manuscript within the amended text and within this response document in red text.

Reviewer #1: Overview:

In this paper authors assess force-plate measures during tandem gait, NPC, and VOMS scores following acute SRC (24-48 hours post injury) compared with healthy controls. The cohort is small but the methods are sound. Results suggest that postural instability and slowness during tandem gait weakly correlate with abnormal VOMS after SRC.

Discussion:

Page 3, line 25: This statement is not supported by the referenced paper. This paper reports only on normal athletes. There are a number of references to directly support VOMS as a predictor of protracted recovery to include as an alternative. Perhaps you intended to reference the Corwin et al J. Pediatrics paper from 2015?

Thank you for catching this error – this has been adjusted to the Corwin et al 2015 article and the prior citation has been removed. Please see reference #21 and Page 3, L8.

Methods:

Page 4, line 13: Specifies that the control group as an average age of 12. Is this current or a typo?

Thank you for catching this error – the control group average age was 21, not 12 as written. This has been adjusted within the text and now reads:

"..and 30 (Female: 20, average age: 21±1 years, average leg length (left and right): 83cm, weight: 70kg) closely matched controls" Page 4, L4.

Please better define exclusion criteria on page 4, line 33, specifically "neurologic pathology." Were athletes with a history of ADHD or Migraine excluded? Hx of childhood strabismus? These are common diagnosis among athletes influencing both concussion testing and recovery so relevant to consider in your analysis. If excluded for these conditions this is important for readers to know as this may limit generalizability of the results.

Thank you for this clarification and the reviewer is completely correct. This has been adjusted per the suggestions and now reads:

"…or neurologic pathology (excluding the existing concussion) which included a history of attention deficit hyperactivity disorder, learning disabilities, strabismus or other comparable disorders; chronic injuries…" Page 3, L12-14.

Page 6, line 13 please clarify the instructions provided to subjects at the time of testing. Subjects performing the tandem gait test are generally timed and requested to complete as quickly as possible. Please clarify "complete in a timely manner."

Subjects were instructed to complete the task in a timely manner in attempt to complete it as quickly as possible. This has been amended in the text and it now reads:

"…for the participants but they were encouraged to complete the in a timely manner with an attempt to complete it as quickly as possible while still maintaining the heel-to-toe walking pattern." Page 5, L6-7.

Page 6, line 25, Please provide additional details regarding your "custom fixation device." How does this device change the execution of the VOMS? Is the VOMS still executed as published? If so, what is the value of referencing your custom device? Can you provide a reference for this device with more details?

Thank you for this comment and clarification. The custom fixation device does not alter the way the VOMS is administered but it does standardized the distance the eyes must travel during the exam along with providing a near-point ruler. Our lab custom created this device which follow the explicit instructions for how far the fixation points should be placed from Mucha et al 2014. From our published abstract (Pavilionis et al 2020 – Ref #23), the use of the custom fixation device reduces overall symptoms due to the consistent distance the eye must travel following sport-related concussion. In addition, it is no different at baseline using traditional methods (upcoming published abstract – Pavilionis et al 2021. Virtual reality application for the Vestibular/Ocular Motor Screen: a comparison with a novel prototype. Medicine and Science in Sports and Exercise. Volume 53:5 Supplement). We have added more specific details on this device in the methods and it now reads:

"The custom fixation device consisted of an adjustable, vertical pole affixed to a tripod stand with a leg of the stand that extended to 36 inches. At the upper end of the vertical pole, a second pole was affixed via a pivot clamp. The length of this pole was 36 inches with 2 white 14 point markers affixed to either end. One end of this part of the prototype contained a secondary pole that had a slide rule device that can be extended out to the end of the nose when aimed at the face to allow for the measurement for NPC. Our preliminary data suggests no differences between the standard VOMS method of administration and using this device at baseline, however, it does reduce the total symptoms provoked following SRC due to standardizing the total distance the eyes must travel during administration." Page 5, L12-20.

Discussion:

Page 10, line 14 please define "conservative straight path walking" and provide support. Results demonstrate slower completion of the tandem gait task based on time and slower AP velocity (previously demonstrated) and increased excursions in the ML plane during FP and the turn. Please explain how this data adequately supports a statement suggesting a different underlying motor strategy between concussion and control cohorts.

Thank you for this clarifying question as it brings up an important point. The statement "a more conservative straight path walking strategy" is typically a result of a slower pace (using spatiotemporal gait measures) and/or the presence of instability as evidence by increased sway in a specific plane of motion. In this instance, during the first pass straight walking individuals with SRC had slower completion time, reduced AP velocity and greater ML sway.

These three pieces of data support the notion of a more conservative approach to tandem gait. This has been clarified within the text and now reads:

"The findings of this study are that individuals with SRC adopt a more conservative straight path walking strategy during TG. This speculation is supported by a longer completion time, slower AP velocity and greater postural instability in the ML direction during the first pass when compared to healthy controls. The increased sway is indicative of worse dynamic balance control which directly influences the ability to ambulate in a forward direction thus forcing the individual with a concussion to carefully control forward progression to limit a fall." Page 9, L7-11.

Page 11, line 31 the discussion on hip strategy his highly speculative and not supported by the data presented here. If you keep in the discussion consider clearly specifying that this is speculative.

Thank you for this comment. The authors do feel the data supports this claim, however, we agree that this is speculative. This has been stated within the text and now reads:

"…support and increases ML sway yet this is speculative." Page 10, L20.

Page 11, line 52 please clarify the statement that SRC appear to increase their time to complete the turn. This is not supported by the data in figure 1.

Thank you for this comment. This statement has been removed as it is not supported by the present study data. The text now reads:

"However due to the concussions symptoms and possible dynamic postural impairment, SRC have increased sway in the ML direction. This is supported by the weak positive relationship between the turns and the VOMS score (see Table 2)." Page 10, L24-25 to Page 11, L1-2.

Page 12, line 6. I agree with this line of reasoning ie + VOMS suggests that integration of eye and eye movements are provocative and this may influence performance during the TG turn maneuver. Your cohort is small but this may be further supported looking at VOMS tasks requiring eye movements only vs integration of eye and head movement (VOR and VMS).

Thank you for this comment. We have attempt to allude to this for further investigation. The text now reads:

"Further research is needed specifically examining how eye movements or integration of eye and head movements influence the postural stability during prior to and during the turn." Page 11, L7-9.

Limitations:

Page 12, line 23. Although this statement is not without merit I would suggest avoiding a final sentence which calls into question a large portion of your presented data. I discussion on reliability of self-report measures may be appropriate or you may consider including this as a study limitation. Your study methods depend on a self-report measure, VOMS, as a stand-alone "vestibular test," with no objective data here assessing the vestibular system in this cohort.

Other relevant limitations should include the very small sample size, potential selection bias or limited generalizability depending on your inclusion criteria for pre-existing neurologic diagnosis, and a significant difference in cohort age (if the 12yo controls are in fact not a typo).

Excellent comment and the authors agree with these prior statements. The 12yo controls were in fact 21yo and this was amended prior in the text and response to reviewer. The text has been amended and now reads:

"This research is not without limitations. Not all participants in this study post-SRC demonstrated a clinically meaningful VOMS score (≥2 provoked symptoms). These individuals, while few in number (n=5), could have more stable postural control given the lack of provoked symptoms. While it is important to note that the VOMS is reliable as a self-report measure, it is not a true stand-alone vestibular test given its lack of objective data. Future research should compare incorporate eye tracking and/or objective measures of vestibular function such as a modified head-shaking test. Additional limitations for this study are the small sample size and the potential selection bias given the NCAA Division I athletes and inclusion criteria. These aspects will limit generalizability of the findings of this study."

2nd Editorial decision
14-Jun-2021

Ref.: Ms. No. JCTRes-D-21-00042R1
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Dear authors,

I am pleased to inform you that your manuscript has been accepted for publication in the Journal of Clinical and Translational Research.

You will receive the proofs of your article shortly, which we kindly ask you to thoroughly review for any errors.

Thank you for submitting your work to JCTR.

Kindest regards,

Michal Heger
Editor-in-Chief
Journal of Clinical and Translational Research

Comments from the editors and reviewers: