Author’s response to reviews

Title: Horizontal jumping biomechanics among elite female handball players with and without anterior cruciate ligament reconstruction. An ISU based study

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Horizontal jumping biomechanics among elite female handball players with and without anterior cruciate ligament reconstruction. An ISU based study

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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.

First of all, the authors would like to thank the reviewer board for his/ her constructive comments. Thank you so much for considering the manuscript for publication.
Reviewer reports:

Sajad Bagherian (Reviewer 1): Line 22-27: why 6 injured athletes versus 15 controls? How authors calculate sample size and how to control these differences?

The reviewer is right. As we mentioned in the original manuscript, our intention was to recruit all elite professional handball players available in our region. We enclosed to elite professional profile of athletes because we wanted to know if jumping performance deficits could also persist among full trained high supervised handball athletes. Nevertheless, we performed a sample size calculation for a power size of 0.80 with a significant alpha error level set at 0.05. We used previously reported data by Schiltz et al (2009) for vertical jumps testing among basketball professionals with or without previous ACL injury and with previously reported data of horizontal jumps by Myklebust et al (2009) among previously ACL injured elite and recreational handball players for required absolute mean differences, within groups SD and control/case ratios necessary to obtain sample size with “PS power size biostatistics version 3.0.43 software”. We reported that we should 4 subjects in each group UTHD in order to correctly achieve the predetermined 0.80 power size. (with the performance related variable, in cm)

It’s interesting to note out that the work of Schiltz et al, was carried out among 15 subjects, probably due to the difficulty concerning subject recruitment among professional athletes.

In the other hand it could be noticeable, that when doing research with top elite athletes, the sample size is commonly reduced, due to the common restrictions of elite team staffs to perform such evaluations with their athletes. That’s why MBI statistics in order to assess the effect size of the influence the previous ACL reconstruction could have among these cohort, were performed and reported in this investigation.

Tables: in methodology, the authors mentioned that there were 15 uninjured controls but in tables 1 and 2 the number of the control group reported 13 and 14?

We sorry for the mistake made. There were actually 15 uninjured controls. We corrected the data from Tables 1 and 2 in the draft accordingly.

Mario Lamontagne, Ph.D. (Reviewer 2): clinical application of the study. This case-study report has major issues in the study design having only 6 ACL-D participants compared to 15 uninjured participants. Among the 6 ACL-D participants, two have bilateral ACL-R. The statistical power of this study is somewhat weak.

We thank the reviewer’s effort in improving the quality of the manuscript.
Regarding the point related to the inclusion of both limbs on the statistical analysis, we preliminarily assessed the 2 way anova in order to elucidate if group by limb interaction would be present. We checked the absence of a significant interaction effect between fixed factors. Thus, we considered that being handball a highly physical demanding sport in which high level participants are exposed to large mechanical force requirements, and that the mean time since original ACL reconstruction among cases was about 6 years, we could assume that the ACL reconstructed athletes had fully restored and functioning limbs at the time of testing. Furthermore, all the previously ACL reconstructed subjects were playing at the Spanish top national handball division regardless the surgical procedure or rehabilitation program followed after original ACL rupture occurred. In the same way we ruled out the assumption that contralateral jumping patterns alterations could exist on the healthy leg of cases (in the authors´ opinion, this thesis as not verified to date among elite full recovered and competing athletes).

Finally some controversy exists in the literature regarding the biomechanical evidence of a dominance effect among single unilateral vertical jumping tasks in healthy and/or previously ACL reconstructed individuals. Some authors argue that the rehabilitation (Impellizzeri, Rampinini, Maffiuletti, & Marcora, 2007) or training effects (Golomer & Fery, 2001) could attenuate asymmetries between extremities identified among healthy individuals, whereas others report no dominance effect (Van der Harst, Gokeler, & Hof, 2007).

In order to lighten the results section, we refer to comparison between dominant limb of controls and ACL reconstructed limb of case)I to compare previously ACL reconstructed extremities, with non injured, non contaminated and fully performing dominant legs of sport matched, elite handball control subjects.

The study does not advance the information in rehabilitation sciences or biomechanics.

The methodology of using only one IMU to identify the overall motion of the athletes provides little information about the joint mechanics, however it gives some information about handball specific information. The methods to estimate jumping force from only one IMU is not strongly reliable. The authors would have a great advantage to present the validity and reliability of their instrumentation. The intent was to better understand the rehabilitation program which it was not described and no strong discussion of the effect of the rehabilitation program on the jumping performance.

The author must revise the manuscript by including the instrument validation and thereafter enrolled more participants in order to increase the statistical power.
As we referenced in the draft we previously developed a cross-validation study between the force plate and the MIMU recordings thorough a vertical jumping battery including both the countermovement and the drop vertical jumps (Setuain et al. 2015). In the referred study, the MIMU sensor demonstrated to exhibit a robust correlation level with respect to the force plate across the entire analyzed jumping battery; the VBDJ, VUDJ and VUCMJ. In this sense, significant (P< 0.001) and extremely large correlations were found when raw data of both IU sensor and force plate derived normalized force-time curves were compared. Furthermore significant (P < 0.001) and moderate to very large correlation levels were also found between both instruments when isolated resultant forces’ peak values of defined IA and FA phases of each maneuver were analyzed (Table I). We provide to the reviewer the table below;

Lastly, Bland & Altman graphical representation were used in order to display the agreement of both IU sensor and force plate for measuring Resultant Ground Reaction Force (RGRF) across the IA and FA phases of each jump analyzed. They showed that the vast majority of points were enclosed within the mean ±1.96 SD. The mean difference (estimated bias) was calculated and plotted in the representations. The significant (p<0.05) correlations encountered in the mean of between pairs differences (Y-) axis and the mean of the measured data from both IU and force plate (X- axis), revealed a non random distribution of the data points within the confidence intervals which indicates the existence of a systematic bias. Thus, the assumption that no relation existed between the measurement differences (errors) and their mean could not be accepted. It was demonstrated, in consequence, that greater the force, greater the disagreement between IU and force plate recordings.

Table I. IU and Force plate related data correlation and variability report.

<table>
<thead>
<tr>
<th>IU-Force plate Pearson´s Correlation product</th>
<th>VBDJ</th>
<th>VUDJ</th>
<th>VUCMJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Data r value (Whole curve) (95%CI)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.93 (0.81-0.97)</td>
<td>0.96 (0.89-0.99)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IA pre-defined instant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>r value</td>
<td>0.48 (0.01-0.78)</td>
<td>0.44 (0.015-0.76)</td>
<td>0.48 (0.01-0.78)</td>
</tr>
<tr>
<td>p value</td>
<td>&lt;0.001*</td>
<td>&lt;0.005*</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>r value (95%CI)</th>
<th>p value</th>
<th>p value</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IA phase mean</td>
<td>10.74</td>
<td>19.74</td>
<td>4.79</td>
<td></td>
</tr>
<tr>
<td>range (max-min)</td>
<td>1.43</td>
<td>25.48</td>
<td>3.84-39.25</td>
<td>3.97-32.09</td>
</tr>
<tr>
<td>IU mean</td>
<td>14.25</td>
<td>10.10</td>
<td>4.71</td>
<td></td>
</tr>
<tr>
<td>range (max-min)</td>
<td>6.73-26.02</td>
<td>3.85-33.15</td>
<td>1.58-8.61</td>
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</tr>
<tr>
<td>FA phase mean</td>
<td>16.04</td>
<td>17.05</td>
<td>10.45</td>
<td></td>
</tr>
<tr>
<td>range (max-min)</td>
<td>3.15-40.9</td>
<td>2.76-33.50</td>
<td>4.29-29.91</td>
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<tr>
<td>IU mean</td>
<td>12.14</td>
<td>13.14</td>
<td>10.84</td>
<td></td>
</tr>
<tr>
<td>range (max-min)</td>
<td>2.89-25.75</td>
<td>6.40-34.21</td>
<td>2.55-42.93</td>
<td></td>
</tr>
</tbody>
</table>

*Denotes statistical significance P <0.005.

Figure. Bland and Altman Representations for both IU and Force plate registered data. Vertical Bilateral Drop Jump (A). Vertical Unilateral Drop Jump (B). Vertical Unilateral Counter Movement Jump (C)

Antonino Bianco, PhD (Reviewer 3):

Dear Authors
I am reading your manuscript for the first time (I was not involved during the first-round revision).

Your R1 manuscript entitled "Horizontal jumping biomechanics among elite female handball players with and without anterior cruciate ligament reconstruction. An ISU based study" is of interest in principle, but there are still few minors to be solved.

The introduction and the methods section are well designed and exhaustive. The only comment I have is concerning the statistical software adopted (please include this info).

Thanks to the reviewer for his constructive comments. SPSS® statistical software (V. 20.0, Chicago, IL, USA) was used for the abovementioned statistical calculations. Following reviewer’s suggestions, we included the required info in the original text as follows...

“SPSS® statistical software (V. 20.0, Chicago, IL, USA) was used for the abovementioned statistical calculations.”

One more additional concern should be the fact that the sample is small and whatever statistical approach you want to adopt for sure the observations have low to moderate statistical power, so in my personal opinion Authors cannot generalise and/or speculate too much on the application of the ISU.

We agree the reviewer at this point. Hence, we summarized this key points as limitations in the discussion section of the original draft as follows

“Some potential limitations could be observed in the present study. Given the uniqueness of the analyzed population, which was limited to an exclusive cohort of female professional handball athletes, the results should be interpreted with caution and in relation to this sport level, discipline and sex. Additionally, there was a lack of standardization of the postoperative rehabilitation protocols and the graft type used for the ligament repair among the ACL-R athletes. The heterogeneity of the rehabilitation process may have biased the long-term outcome in terms of physical activity level and sport-specific performance. However, previous studies have reported that no differences exist between reconstructions using different graft types in relation to long-term function of the knee [29]. Furthermore, the use of a single ISU placed at the trunk level limited the information collected regarding the knee joint biomechanics. Consequently, the behavior of the center of mass during the different hopping tasks was determined through direct mechanics-based human body analysis and thus considered the whole body as a single system of mass and inertia. Thus, net moments of force calculations for specific joints were outside the scope of the present study.”
On the other side, the study design is interesting for the info provided, and the level of technical knowledge reported within the manuscript is high. In my personal opinion, it is interesting to read one more time that jumping biomechanics alterations seemed to persist after injury, even at the professional level (in which it can be supposed that the rehabilitation process is made properly).

Also, the discussion is well written and the study limitations are clearly highlighted, but according to that, I suggest one more time the Authors to be less overpromising overall.

We partially agree with the reviewer point. Hence, we added a “tuning down” sentence in the conclusion paragraph as follows:

“However, due to the uniqueness of the analyzed cohort the present results must be considered with caution and restricted to the intrinsic characteristics of these top level female handball players.”