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Comment on: ‘Reliability of a commercially available and algorithm-based kinetic analysis software compared to manual-based software’

Letter to editor

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1 We read with interest the published study regarding the reliability and comparison between
2 manual- and algorithm-based kinetic analysis software by Carroll et al. (2019) entitled:
3 *'Reliability of a commercially available and algorithm-based kinetic analysis software*
4 *compared to manual-based software'* DOI: 10.1080/14763141.2017.1372514, and we
5 congratulate the authors for producing an informative and interesting study. However, we
6 would like to raise an issue regarding the interpretation of their results for the differences in
7 peak force (PF) between the two methods. We outline this issue in further detail in the
8 following paragraphs of this letter.

9 The authors compared isometric mid-thigh pull (IMTP) kinetics between two analysis
10 software methods: manual-based identification of contraction onset time (COT) using
11 LabView analysis software (LabView); and an algorithm-based analysis program (NMP
12 technologies Ltd). Unfortunately, the specific details regarding the COT identification for the
13 algorithm-based analysis software was not provided which we feel is a notable limitation.
14 Nevertheless, the authors reported that IMTP PF from the algorithm-based method was greater
15 than the manual-based method obtained via LabView ($p < 0.001$, $d = 0.05$, 3072 ± 800 N vs.
16 3033 ± 809 N), and the rate of force development values 0-50 ms ($p < 0.001$, $d = 0.11$, $1959 \pm$
17 1407 N vs. 2121 ± 1618 N) and 0-200 ms ($p < 0.001$, $d = 0.56$, 3519 ± 2650 N vs. 5045 ± 2832
18 N) were also greater for the algorithm-based method.

19 It is somewhat surprising that there was a significant ($p < 0.001$), although not meaningful
20 ($d = 0.05$) difference in PF between the two methods. The authors provide a potential
21 explanation for this difference and state the following: 'these differences were likely a result
22 of differences in COT identification between the two methods.' We respectfully disagree with
23 this explanation because COT identification will not affect absolute gross PF (inclusive of body

24 weight) during the IMTP, as shown in our previous work (Dos'Santos, Jones, Comfort, &
25 Thomas, 2017). If net PF was examined (i.e. PF – BW or PF – force at COT), we could
26 therefore understand how differences in COT could result in differences net PF between
27 methods. However, the authors clearly state the following: 'we did not remove body mass from
28 the force variables; therefore, the resulting values are absolute and not relative.' While we agree
29 that not removing body weight from force variables results in absolute gross forces, dividing
30 force variables by body mass would provide relative forces, not removing body mass (as they
31 state). Nevertheless, we suggest it is incorrect to attribute the differences in PF due to
32 differences in COT, based on their reported methods, and question whether they did in fact
33 examine net PF.

34 In addition, the authors do not state whether any of the force-time data were low-pass
35 filtered. We have previously shown that low-pass filtering can affect PF data, with lower low-
36 pass filtering cut-off frequencies resulting in lower PF values (Dos' Santos, Lake, Jones, &
37 Comfort, 2018). We question whether the authors have low-pass filtered their data, and if the
38 LabVIEW software low-pass filtered the data or if different COFs were used between the two
39 software. This could be a plausible explanation for the differences in PF values between
40 methods. We would also like to express an issue regarding the scatter plot shown in Figure 2.
41 There is a clear outlier in the data, and we find it difficult to comprehend how there can be an
42 approximate 500 N difference in PF for one trial between the two methods. The authors report
43 a strong, nearly perfect relationship ($R^2 = 0.9816$) in PF between the two methods; however,
44 this method is inappropriate for assessing agreement because the strength of linear association
45 is measured around a line of best fit, irrespective of whether the slope of the line differs from
46 unity (proportional bias) or whether its intercept differs from zero (fixed bias) (Ludbrook, 1997,
47 2002). Consequently, for method comparative designs it is integral to establish whether fixed
48 (i.e. greater or lower value by a constant amount across whole range of measurements) and

49 proportional bias (i.e. greater or lower value that is proportional to the level of the measured
50 variable) is present between the two methods (Ludbrook, 1997, 2002; Rankin & Stokes, 1998).
51 Additionally, using a linear regression statistical approach assumes that the gold standard
52 method is not prone to error (noise), when in fact both methods in the case of Carroll et al.
53 (2019) are susceptible to error (i.e. signal noise) (Ludbrook, 1997, 2002).

54 A more suitable method to illustrate the differences and assess the agreement between
55 methods would be using Bland-Altman plots and limits of agreement (LOA) (Bland & Altman,
56 1986; Ludbrook, 1997; Mundy & Clarke, 2019). Performing this would allow the researchers
57 to assess the systematic bias and random error, while the upper and lower limits of the LOA
58 could be interpreted to determine if they are of practical importance (Bland & Altman, 1986;
59 Mundy & Clarke, 2019). Furthermore, it is also suitable to determine if heteroscedasticity is
60 present by creating a scatter plot of the difference between the two measures versus the average
61 of the two methods (Mundy & Clarke, 2019). This will permit the researchers to examine if the
62 bias and variability is uniform throughout the whole range of the measurements. Additionally,
63 it has been suggested that because ordinary least-squares regression makes the assumption that
64 the gold standard method does not contain error (i.e. signal noise), that least-products
65 regression be used instead (Ludbrook, 1997; Mullineaux, Barnes, & Batterham, 1999). This
66 method assumes that both methods can contain error, considers this, and quantifies the
67 magnitude of fixed and proportional bias. Performing this process is integral to establish the
68 agreement in measurements between two different methods, and to ascertain if a specific
69 method produces constantly greater (or lower) values, or greater (or lower) values which are
70 proportional across the whole range of measurements. However, as with the LOA approach
71 (that does not consider proportional bias), if heteroscedasticity is present, data should be log-
72 transformed to remove this (Atkinson & Nevill, 1998; Mullineaux et al., 1999). If this works,

73 then least products regression (or LOA) can be used. However, if log-transformation does not
74 reduce heteroscedasticity then these methods cannot be used (Mullineaux et al., 1999).

75 Based on the above, we feel further clarification regarding the force-time data analysis
76 procedures is required to better understand why there was differences in PF between the
77 software. We would like to state that this letter is not intended to detract from the excellent
78 study by Carroll et al. (2019) but merely intended to help improve the study with some
79 additional but important information and clarify some aspects for the reader. This will enable
80 the reader to effectively interpret the findings and help improve best practice for IMTP testing.

81 **DISCLOSURE STATEMENT**

82 No potential conflict of interest was reported by the authors

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