Author's response to reviews

Title: Are cervical multifidus muscles active during whiplash and startle? An initial experimental study.

Authors:

Gunter P Siegmund (gunter.siegmund@meaforensic.com)
Jean-Sebastien Blouin (jsblouin@interchange.ubc.ca)
Mark G Carpenter (mark.carpenter@ubc.ca)
John R Brault (john.brault@meaforensic.com)
J Timothy Inglis (tinglis@unixg.ubc.ca)

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Response to Reviewer’s Comments

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Title: Are cervical multifidus muscles active during whiplash and startle? An initial experimental study.

We wish first to thank Drs. Ivancic and Dickey for their constructive comments regarding our manuscript. Below is a point by point description of how we accommodated each of their comments.

Reviewer 1: Dr. Ivancic

1) As requested, the standard deviations for the four parameters describing the pulse kinematics have been added at page 6, lines 15-16.

Dr. Ivancic correctly points out that the pulse we used has a shorter duration than the pulse prescribed by RCAR. Our pulse also has a lower peak acceleration and a lower speed change than the RCAR pulse (the prescribed RCAR pulse has a peak acceleration between 9.5 and 10.5g, a duration of 88 to 94 ms, and a speed change of 14.8 to 16.2 km/h). We did not use the RCAR pulse because it was unnecessarily severe to study the phenomenon in question. Instead we used a less severe pulse (lower peak acceleration, shorter duration, and lower speed change), though we did keep the onset of the pulse similar to a more severe collision (speed change of 8 km/h) and we mention this on Page 12, line 4 of the Discussion. Since onset of the muscle response is likely linked more closely to the onset of the collision pulse than the end of the collision pulse, the duration of the pulse was less important to answering our question.

It is also worth pointing out that many whiplash injuries occur in pulses less severe than the RCAR pulse and it is these low severity crashes that produce long term injuries that are perhaps the most puzzling aspect of whiplash injuries.

2) The number of subjects with multifidus activation within 125 ms has been added to the discussion (page 9, lines 5-8).

3) We have added the suggested references to prior estimates of the multifidus loads and compared these prior estimates to our own (page 10, lines 8-11).

Dr. Ivancic correctly points out that we should compare our multifidus loads to the dynamic tolerance of the capsular ligament rather the quasi-static tolerance. The dynamic data has been added to the Discussion (page 10, line 15-25; and Table 2) to address this more appropriate comparison.

4) The first sentence of the Results has been altered as suggested (page 7, line 16-17).

5) The reference to Table 1 has been moved to the first sentence of the paragraph as suggested (page 7, line 24).

6) The sentence fragment beginning “Or short, reflex…” has been reworded (page 9, line 20).

7) The “<” in Reference 35 has been correct to a “,” (page 19, line 1).
Reviewer 2: Dr. Dickey

1) We have added a short description of our previous work in Introduction (page 2, lines 21-23) to highlight that multifidus activation has been previously reported in one subject during a simulated rear-end collision. We have also added a comment in the Discussion (page 8, lines 16-20) that indicates the single subject in the current study who responded to neither stimulus may represent a segment of the population whose multifidi do not react to these stimuli and that this subject should not be dismissed outright as atypical given the low number of subjects we tested.

2) Dr. Dickey correctly points out that we did not randomize the order of our stimuli between subjects. This limitation has been added to the Discussion (page 12, line 25 to page 13, line 2).

3) The nine accelerometer array used in this experiment consisted of nine uni-axial accelerometers arranged in a 3-2-2-2 array. This has been clarified in the Methods (page 5, lines 19-20).

4) As requested, the sentence including the phrase “grades positively” has been improved to remove ambiguity (page 12, line 14).

5) As requested by both reviewers, the sentence fragment beginning “Or short, reflex…” has been reworded (page 9, line 20).