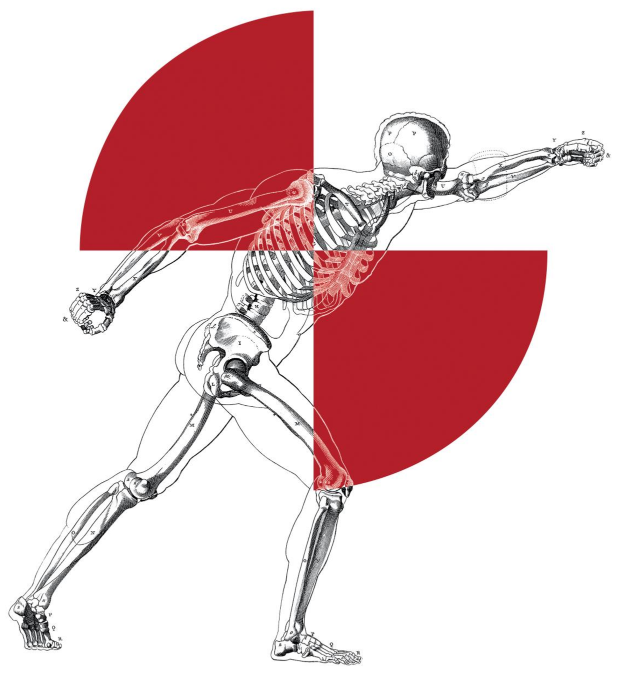

Hybrid III 6YO ATD Head and Neck Responses and Repeatability with Varied Neck Tension in Frontal Impacts

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INTRODUCTION

- Pediatric injury prevention in MVCs poses challenges due to the sparsity of pediatric biomechanical data for ATD design. Consequently, current pediatric ATDs are scaled according to adult biomechanical responses [1].
- This is especially important in head injuries, the most common injury sustained by children in MVCs [2].
- The HIII 6YO ATD, designed as a surrogate for a 6-year-old child, contains a molded neck and center cable, calibrated by applying a torque of 2.0 +/- 0.2 in-lb. Head and neck responses of the HIII 6YO may vary by prolonged testing and differences in initial neck cable tension.
- The objective of this study is to investigate the repeatability of the HIII 6YO upper neck response with varied neck tension.

MATERIALS & METHODS

- The HIII 6YO head and neck assembly was fixed to the mini sled and subjected to frontal impacts with a pneumatic ram (Figure 1).
- The nominal sled velocity was 14 km/h, in accordance with child ATD T1 acceleration in FMVSS 213 sled tests [3], and the peak y-moment occurred at roughly 100 ms (Figure 2).
- The results were quantified by a six-axis load on the upper neck and three accelerometers and three angular rate sensors in the ATD head.
- The data from each impact was filtered according to SAE J211 standards and processed in MATLAB, and the coefficient of variation (CV) values were calculated.

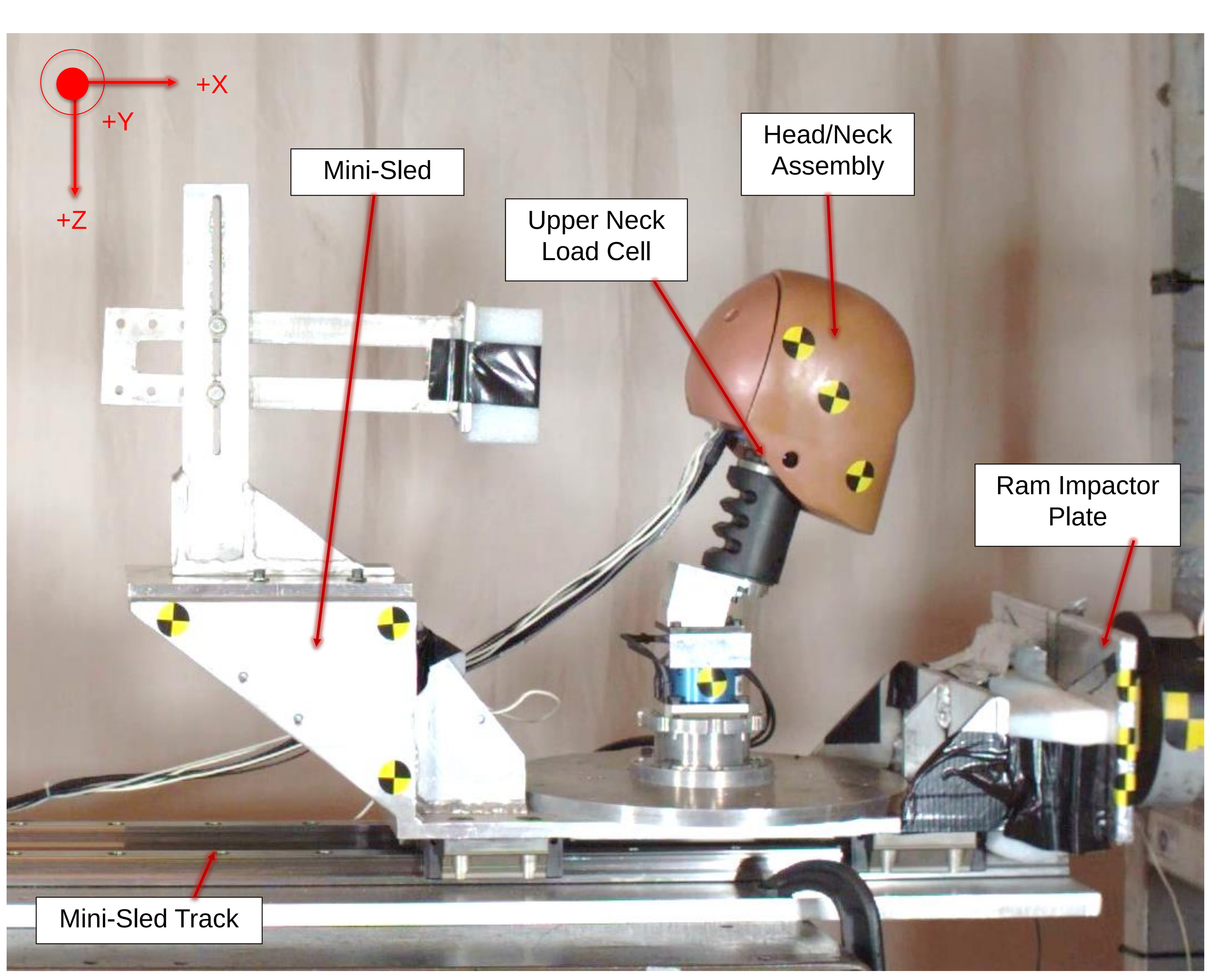

Figure 1. Mini-sled setup with J211 axes defined.

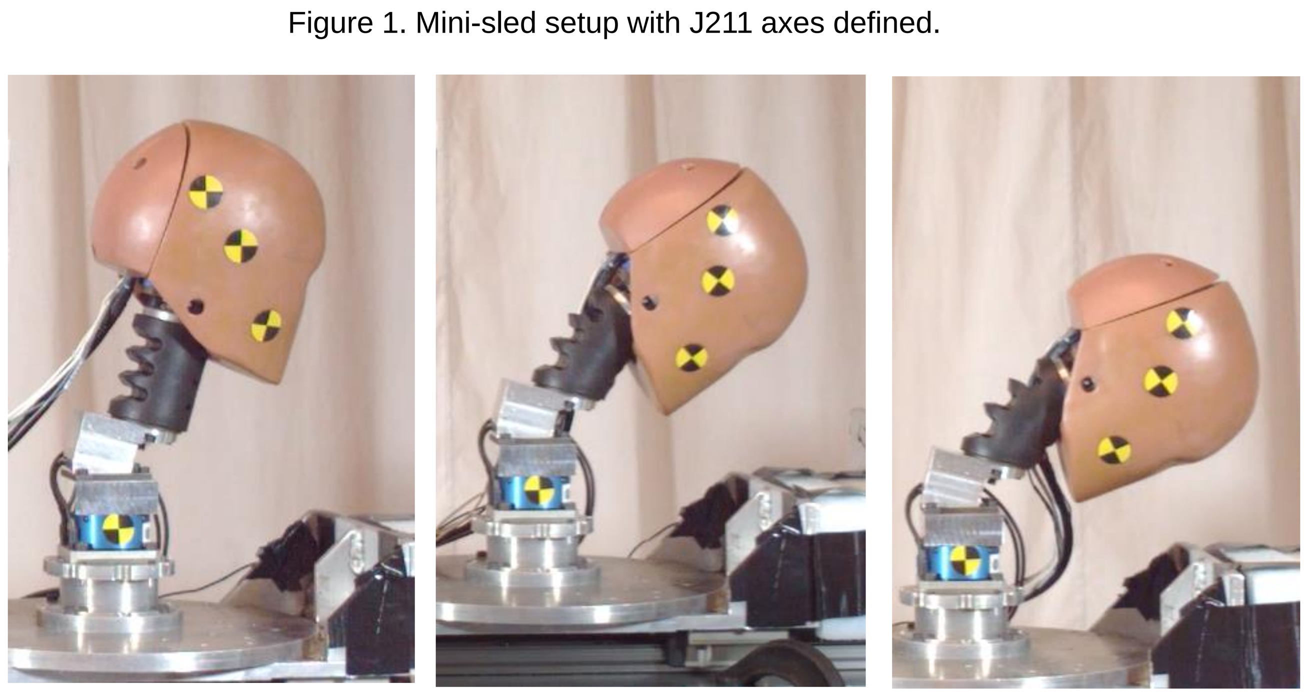

Figure 2. Images of testing response with a rigid T1 joint at 0, 60, and 120 ms.

RESULTS & DISCUSSION

- CV values for all upper neck parameters were repeatable within 5% for all neck tensions (Figure 3).

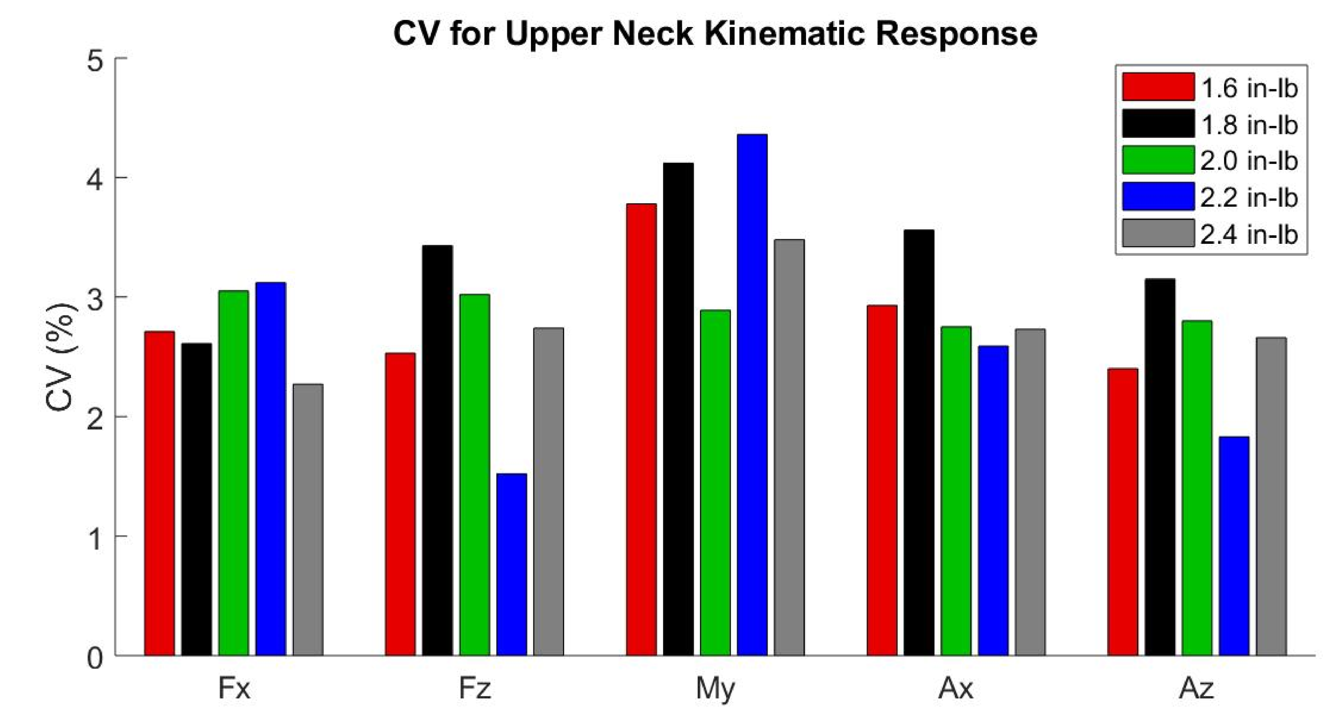

Figure 3. CV values for upper neck criteria for 1.6, 1.8, 2.0, 2.2, and 2.4 in-lbs.

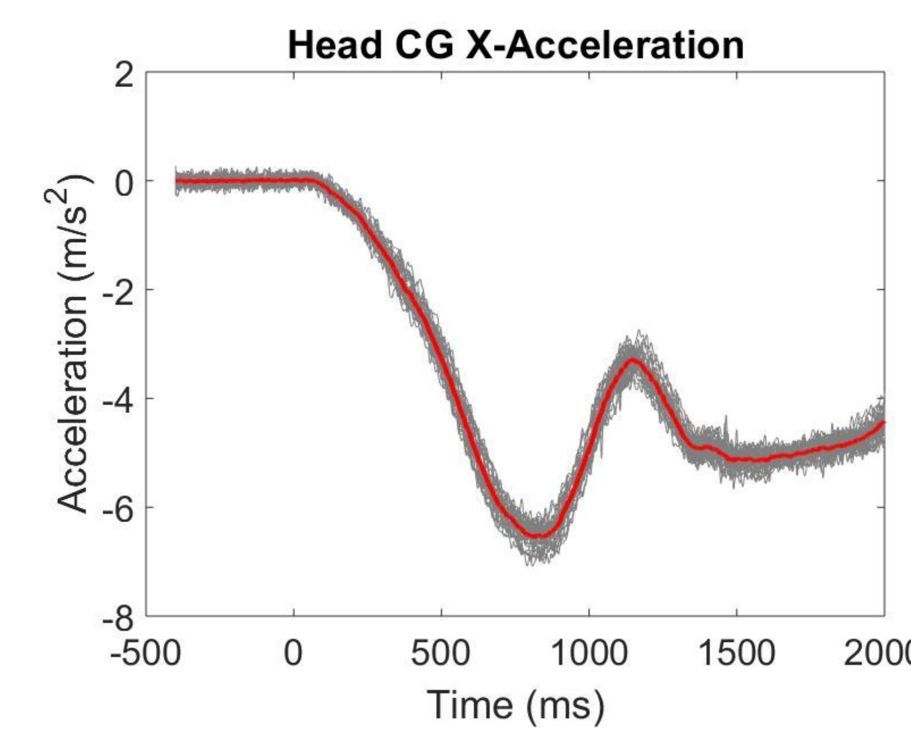

Figure 4. Head CG X-Acceleration time history for all trials at 2.0 in-lb.

- The head CG X-acceleration and upper neck Y-moment time history plots for all neck tension conditions (Figure 4) exemplify the differences in response across neck tensions. An asterisk in the mean value plots denotes a significant deviation from the 2.0 in-lb condition (Figure 6).

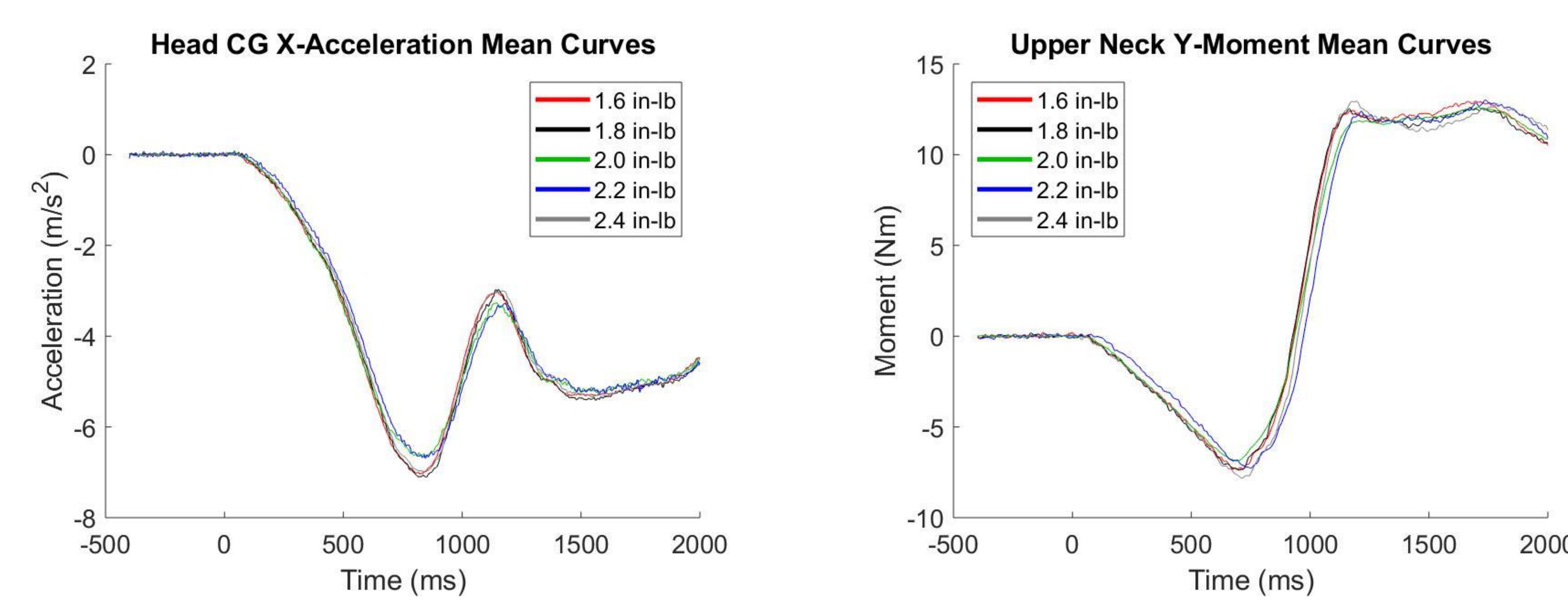

Figure 5. Head CG X-acceleration and upper neck Y-moment mean curve exemplar plots for 1.6, 1.8, 2.0, 2.2, and 2.4 in-lb.

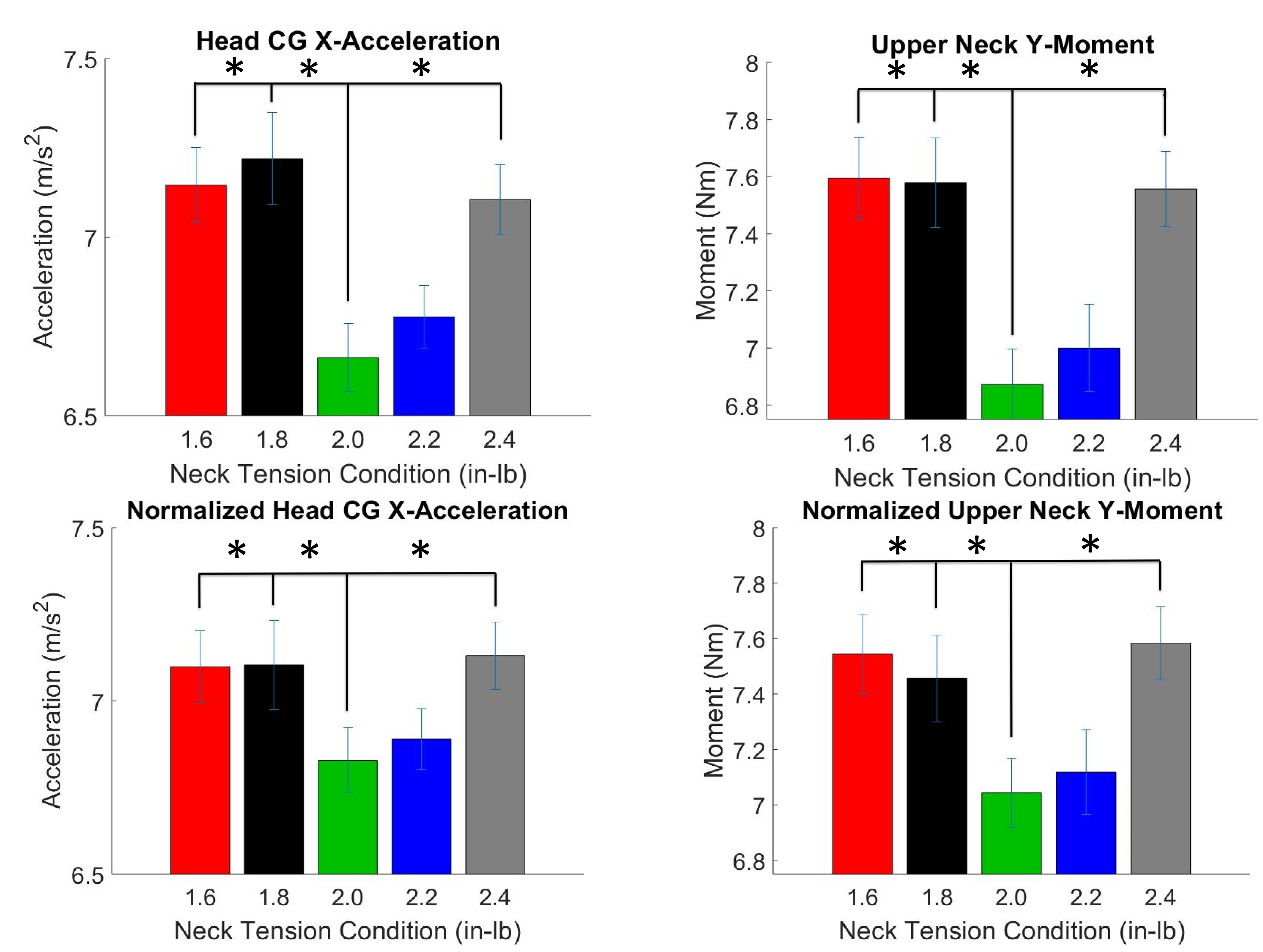

Figure 6. Head CG X-acceleration and upper neck Y-moment for 1.6, 1.8, 2.0, 2.2 and 2.4 in-lb.

CONCLUSIONS

- The HIII 6YO head and neck responses to a frontal impact were repeatable for each condition with neck cable tension at 1.6, 1.8, 2.0, 2.2, and 2.4 in-lb [4].
- After observing significant differences in sled velocity across neck tensions, the upper neck responses were normalized by sled velocity. The data showed significant deviation (significance level .05) from 2.0 in-lb response for 1.6 and 2.4 in-lb for all criteria, while the 1.8 in-lb did not deviate for upper neck Fx and 2.2 in-lb did not deviate for any.
- Future work will include TEMA localized displacement analysis to further characterize localize displacement to understand the trends in Figure 5.

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ACKNOWLEDGEMENTS

The authors thank the Center for Child Injury Prevention Studies (CChIPS), a research collaboration between the National Science Foundation (NSF) and industry, at The Children's Hospital of Philadelphia (CHOP) for sponsoring the project. The views presented are those of the authors and not necessarily the views of CHOP or CChIPS member companies. Thank you to the IBRC students, staff, and faculty for their support, especially David Star, Arri Willis, Zach Eshelman, and Scott Stuckey.