Development of a Biofidelic Upper Cervical Spine Model for Use in an Omnidirectional Surrogate Neck

Romani, S.M.B., Cripton, P.A.

Orthopaedic and Injury Biomechanics Group, School of Biomedical Engineering, University of British Columbia, Vancouver, BC CAN

OBJECTIVE

Develop an omnidirectional biofidelic upper cervical spine surrogate (CO-C2) by replicating the geometry and mechanical properties of key anatomical structures for the eventual development of a full ATD neck.

INTRODUCTION

- Anthropomorphic test devices (ATDs) are used for the design of safety equipment that we rely on in our day to day lives.
- ATD necks are designed only for a specific loading scenario and their response is typically biofidelic only in that application.

CONSTRUCTION - VERTEBRAE

- C0: Portion on the base of the skull that interfaces with C1
- C1: atlas
- C2: axis

TEST METHOD

- Pure moment applied in quasi static loading with custom spine machine flexion-extension, lateral bending and axial rotation

RESULTS

- Range of motion is presented in the darker colour and neutral zone in the superimposed lighter colour. The results of this study are in red

CONCLUSIONS

- Range of motion and neutral zone are within the reported ranges from cadaveric literature
- CorA scores all range from fair to excellent
- Lower scores in axial rotation and flexion-extension were due primarily to low phase shift scores. In axial rotation this indicates uneven distribution between left and right axial rotation, in flexion-extension, poor distribution between flexion and extension
- Helical axis of motion in axial rotation is aligned with the dens which is in line with what we expect as C1 points about this point. In flexion extension, helical axis is situated slightly more anterior to the occipital condyles about which CO pivots

ACKNOWLEDGEMENTS AND REFERENCES

We gratefully acknowledge Ms. Lani Redi and Dr. Brian Karon for assistance with ethics and obtaining the patients’ cervical spine CT scans.