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BIOMECHANICS OF THE UPER CERVICAL SPINE IN RESISTING ANTEIOR/POSTERIOR AND RIGHT LOADING

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Summary: Computational studies of the biomechanical response of the head and neck (HN) is important to predict patterns of injury resulting from loads applied to the head in different directions. Characterizing the isometric muscle strength capacity as well as the contact forces (CF) between the facets joints at the different level is important for understanding the differential vulnerability of the cervical spine to injury with externally applied loads. For that, the objective of this study is to use our validated HN finite element model to primarily predict the moment developed by the upper cervical spine muscles as well as the CFs between the facets joints in resisting 100N external force applied separately to the head in anterior (ANT), posterior (POST) and right directions in presence of 40N head weight. First thoracic vertebra was fixed while the head and cervical vertebrae were free to translate but not to rotate to compute the reaction moment at each bony structure representing the net muscles moments required to counterbalance the applied force and to maintain static stability of the segment.

Our predictions indicate that the net muscles moment at head was the highest in resisting the ANT and POST forces reaching 5.6N.m and 6.6N.m at 100N external force, respectively, following by the moment acting on C2 and then on C1. This trend was found to be different under the right loading case where the maximum net moment was computed at C1 (4.6N.m), at head and then at C2. On the other hand, total CFs were 26.5N, 37N and 12N, respectively at C0-C1, C1-C2 and C2-C3 levels under head weight. Under POST load, total CF increased at C0-C1 reaching 80N, diminishing at C1-C2 reaching 16.5N both under 100N POST and finally vanished at C2-C3 level after 20N. Under ANT load, the total CF increased at all levels and reaches 80N at C0-C1 and C2-C3 and 85.5N at C1-C2 level at 100N ANT load. This study elucidates biomechanical aspects of the upper CS which can be of great interest for understanding of the differential vulnerability of the segment to injury with externally applied loads in various directions.