

Computer model analysis of cervical lateral function for symmetric and asymmetric/symptomatic subject groups

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Abstract

Research Purpose. To move toward an era of evidenced based medicine, it will be necessary to develop computer models that are more representative of the human body. This study used kinematic data obtained from two groups of subjects, one classified as having symmetric movement patterns and another with asymmetric patterns exhibiting neck pain, to drive a cervical computer model. The model then generated muscle profiles for each subject, these profiles were grouped and compared. It was hypothesized that the kinematic patterns for the symmetric subject group would yield differences in muscle activities (predicted by a computer model) as compare to the group that exhibited pain and asymmetry.

Relevance. Along with clinical assessments, further biomechanical study of the human body as it relates to clinical diagnosis and treatment is a necessity. One difficulty in the biomechanical assessments of humans is the large range of variability. A model can address this issue by providing estimations for mainstream populations. Another challenge is controlling specific parameters. Different predictive scenarios could be studied with a computer model to shed insight into how parameters affect the kinematics or the muscle forces associated with an activity. Thus, the use of a model during a biomechanical analysis can help refine studies.

Methods and Analysis. Two examiners screened subjects through the palpatory diagnostic test of cervical lateral flexion; by their concurrence, ten subjects were deemed symmetric and nine were asymmetric with a self marked score of 4 or higher on a Pain Scale. The classification of the symptomatic subjects was based on the concurrence between examiners and the pain score, etiology of the subject's pain was not incorporated into the classification process.

The examiners then performed a diagnostic test of passive cervical lateral flexion on these subjects and 3-D kinematic data were collected from a 5-camera Qualisys system. For data collection, three targets were placed on the head (forehead and each temple) and using a triad fixture, three were placed on the sternum.

Next, the three-dimensional movement patterns from each of the subjects were input into the cervical model (AnyBody Modeling System) and used to drive the

movement of the head/neck. By solving the muscle recruitment problem, the model provided percents of maximum muscle forces for those muscle groups used in the activity

Results. The model predicted the highest activity in the Longus Colli, Scalenus Posterior and Sternocleidomastoid muscle groups for both symmetric and pain subjects. The symmetric subjects consistently yielded higher levels of activity with the average of right and left sides at 41% for the Longus Colli, 41% for the Scalenus Posterior and 22% for the Sternocleidomastoid while the pain subjects demonstrated 32%, 31% and 19% respectively. In both groups the lowest activity was found in the Trapezius and Splenius Capitis with the average of right and left sides ranging from 0.5 to 3 %. Upon the completion of a t-test at a 95% confidence level, only the activity from the Trapezius was significantly different ($p=0.03$) between groups. However several other muscle groups demonstrated low p values, and with a larger sample may show significant differences in future studies: Sternocleidomastoid ($p=0.17$), Longus Colli ($p=0.21$), Scalenus Medius ($p=0.23$) and Scalenus Posterior ($p=0.29$).

Conclusions. The higher activity in symmetric subjects might be expected because as a group they had a larger range of primary motion. Higher muscle force values for a control group were also reported in a different study by Barton and Hayes (1996). In future work, larger sample sizes along with further classification of the asymmetric/symptomatic subjects (such as etiology) will be necessary.

Implications. A model increasingly more representative of the human cervical region can be used in combination with biomedical/clinical assessments to facilitate the move toward evidence-based strategies.

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