

Age-related changes in geometric characteristics of the pediatric thoracic cage

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Abstract:

Currently, the thorax design of pediatric anthropomorphic test devices (ATDs) is based on limited anthropometry data measured from real children. In order to develop the next generation of pediatric ATDs and advanced mathematical models, a comprehensive data-driven approach is needed to generate age-specific thoracic geometric guidelines. The objective of this study was to quantify the detailed geometric characteristics of the pediatric thoracic cage by using medical imaging data. CT scans were obtained from three, six, and 18 year old male subjects (5 per age group). Anatomical landmarks on the thoracic cage, such as costochondral junction, tubercle, external surface of the shaft, etc., were digitized and a custom MATLAB code was created to compute the geometrical characteristics based on the Cartesian coordinates of these points. Examples of key computed parameters include rib length, rib angle, longitudinal twist of the ribs, and radius of curvature of the ribs. After normalizing rib length by subject height, the three year old subjects were observed to have slightly longer ribs for their stature. Rib angle was defined as the angle each rib makes in the sagittal plane with the vertical. The average rib angle at levels two through 10 showed a decreasing trend (i.e. became more vertical) with increasing age. The longitudinal twist was defined as the difference between the angle made by a vector placed on the cortical surface of the rib and the vertical. It was assessed at two regions: at 90% of its length (near costochondral junction) and 10% of its length (near the tubercle). A decreasing trend in average longitudinal twist was observed in ribs two to seven (ranged from 39.2-14.8, 39.3-12.5 and 57.0-8.1 degrees for three, six and 18 year olds, respectively). The magnitude of the average radius of curvature (ROC) was observed to increase with age. Also, an increasing trend in the average ROC was observed for ribs four through 12 in all age groups. Future analyses will include more pediatric age groups to determine age-specific trends in thoracic geometry.

I would prefer an oral presentation.

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