
Elderly populations have a higher risk of rib fractures and other associated thoracic injuries than younger adults, and the changes in body morphology that occur with age are a potential cause of this increased risk. Rib centroidal path geometry for 20,627 ribs was extracted from computed tomography (CT) scans of 1042 live adult subjects, then fitted to a six-parameter mathematical model that accurately characterizes rib size and shape, and a three-parameter model of rib orientation within the body. Multivariable regression characterized the independent effect of age, height, weight, and sex on the rib shape and orientation across the adult population, and statistically significant effects were seen from all demographic factors (P < 0.0001). This study reports a novel aging effect whereby both the rib end-to-end separation and rib aspect ratio are seen to increase with age, producing elongated and flatter overall rib shapes in elderly populations, with age alone explaining up to 20 percent of population variability in the aspect ratio of mid-level ribs. Age was not strongly associated with overall rib arc length, indicating that age effects were related to shape change rather than overall bone length. The rib shape effect was found to be more strongly and directly associated with age than previously documented age-related changes in rib angulation. Other demographic results showed height and sex being most strongly associated with rib size, and weight most strongly associated with rib pump-handle angle. Results from the study provide a statistical model for building rib shapes typical of any given demographic by age, height, weight, and sex, and can be used to help build population-specific computational models of the thoracic rib cage. Furthermore, results also quantify normal population ranges for rib shape parameters which can be used to improve the assessment and treatment of rib skeletal deformity and disease.