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PREDICTION OF THE RIB CAGE VOLUME AND THORAX DENSITY FROM ANTHROPOMETRIC DATA.

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INTRODUCTION

Rib cage volume and thorax density are useful both for clinical issues (Sverzellati et al. 2013) and for multi-segmentol body modeling. In the latter case meon density is generolly ossumed, using dota from Dempster et al (Dempster 1955), which could be over-evaluoted due to the lock of considerotion of lung density. Bi-plonor X-Roy system (Dubousset et al. 20l0) combined with 30 reconstruction ollows to get both the rib cage and the externol body shope. The oim of this study is to estimote the rib cage volume compared to the thorax volume and to propose a refined thorax density estimation.

METHODS

55 osymptomotic volunteers were considered (*35 moles. 20 femoles*); meon age: 38.3 y.o. [20-85] and meon body mass index (BMI): 22.9 kg/m^2 [15.4-29.5]. Head to feet low dose bi-plonor X-Rays were ocquired using the EOS system (EOS Imaging, Paris, France) follow ed by performing the 30 reconstruc tions of the spine, rib cage and externol body shope (Humbert et al. 2009; Aubert et al. 2014; Nérat et al. 2015) (Figure I). Bone, Rib cage and thorax volumes (TV) were computed (from Tlb Tl2 levels). Lung volume was estimated os the inner rib cage volume (RCV) minus the heart volume computed from the literature (Badouna et al. 2012). Multi-linear regression was consideredb search for correlation between RCV and regressors such os TV, BMI. Age and Gender. Gender was setb I for Male subject and 0 for Female subject. Criteria b determine the ideal number of regressors were: the leave-one-out-error (LOOE), the R-squared stotistics (R^2), the p-value {pval) and the standard error of estimate (SEE). Moreover, global thorax density was calculated using literature reported densities of each component {bone, lung, heart and soft tissues), and their respective colculoted volumes.

RESULTS

Mean RCV was 7793 cm^3 (SD: 1 675) and mean reconstructed TV was 18020 cm^3 (SD: 4528). The most relevant predictive equotion was:

$$RCV\ (cm^3) = 0.336 \cdot TV\ (cm^3) + 151.4 \cdot Gender + 1609.2.$$

Prediction of the RCV was significant with p < 0.05 and R^2 = 0.88. SEE and LOOE were respectively 7.33 and 7.83 of the mean RCV. Mean density was 0.80 g/cm^3 (SD 0.007).

DISCUSSION

This study brings a new evoluotion of the rib cage volume from onthropometric porometers. This could serve os a reference when studying rib cage variability for pothologicol population.

Il olso ollows providing a refined value of global thorax density, which is lower thon the one proposed by Dempster et al. (0.92 g/cm^3, and could be more relevant for multibody humon models.

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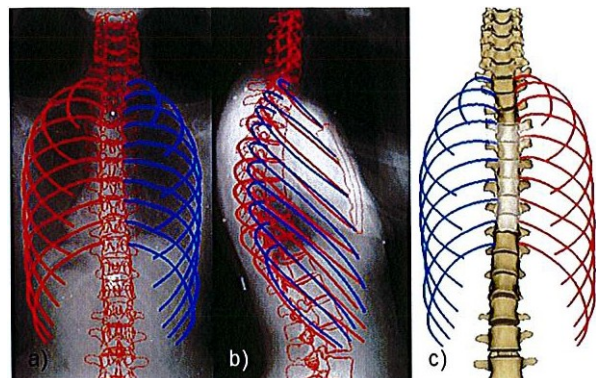- *Sverzellati, N. et al, PloS* one, *8: e68546, 2013.*

Figure 1: *a) & b) Bi-planar radiographies with reconstructed spine and rib* cage. *c) 30 reconstruction of the* spine *and rib* cage.