PROPORTIONALLY CORRECT 3D MODELS OF INFANTS, CHILDREN AND ADOLESCENTS FOR PRECISE BURN SIZE MEASUREMENT (187)

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**Introduction:** The estimation of a pediatric patient’s total burned surface area (TBSA) is challenging due to varying size and body proportions during growth. To address these anthropometric differences, the rule of nines and Lund Browder charts have been extended by three to five age groups. These standard methods however are subject to high inter-rater variance and typically lead to substantial overestimation of the affected area [1].

To enable precise three dimensional (3D) body surface area measurements, we generated 12 proportionally correct 3D models based on anthropometric measurements collected from 2529 patients aged 0-17 years. These models were integrated into BurnCase 3D [2] for measuring the TBSA of pediatric patients.

**Methods:** A total of 2529 pediatric patients, treated between 2010 and 2014 in the children’s hospital Linz, aged 0-17 years, were included into this anthropometric study. For each subject 24 quantitative body measurements were taken. As we aim for proportionally correct models, each measurement was divided by body height to obtain body proportions. A correlation analysis of all body proportions revealed five proportion clusters. Based on intra-cluster correlation and its relevance for body surface area, one representative proportion per cluster was selected. For each representative a visual analysis was performed to obtain body proportions. A correlation analysis of all body proportions revealed five proportion clusters. Based on intra-cluster correlation and its relevance for body surface area, one representative proportion per cluster was selected. For each representative a visual analysis was performed to obtain age partitions with high proportion stability. For each age partition the median body measures were extracted to generate a 3D model using a self-implemented optimization plugin written for the human character modelling software MakeHuman™ [3]. Finally the 3D models were imported into BurnCase 3D, where each model is rescaled to match the real patients height and weight while preserving the model’s proportions.

**Results:** We obtained five groups of body proportions with high intra-group correlation (reported in brackets). Group “head” included the head-circumference, -width, -length and -height (0.90), group “circumference” included circumferences for upper-arm, lower-arm, chest, waist, hips, thigh, shank (0.71), group “lengths” included lengths for upper-arm, lower-arm, thigh, shank, foot and leg (0.5), group “breadth” included breadths for shoulder, chest, waist, hip (0.40). The proportion “sitting height” correlated negatively with the group “lengths” and formed a group on its own.

The curves of each group representatives (head-circ., chest-circ., leg-length, waist-breadth, sitting-height) revealed six age groups with stable proportions. For each age group (see Figure 1), the median body-measurements were used to generate a 3D model in MakeHuman™.

**Conclusions:** To our knowledge this is the first approach to generate proportionally correct pediatric models for TBSA estimation. We show that body proportions can be clustered without negative intra-group correlation. The revealed age partitions with stable proportions call for further research whether age groups commonly used for rule of nines and Lund Browder charts should be modified.
References:

2. www.burncase.at, last visit March 11th 2015.

Figure 1: Male 3D models for different age groups [years]. The proportion changes (head height, leg length) are clearly visible in the generated models.