GEOMETRICAL AND INERTIAL QUANTITIES OF THE TRUNK AND ITS TISSUE AND THEIR APPLICATIONS

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INTRODUCTION

The movement of a man depends on his morphological data. Geometrical and inertial data are the most important. Extremities' data are already known at good level. In contrary trunk needs still further investigations.

METHODS

In these investigations trunk's data for 15 male patients 20. 40 years old were obtained with the help of computerised tomography - Fig. 1. The trunk was divided onto three portions. Only one portion of a trunk was scanned for each group of five patients. The trunk was also divided onto five parts (Erdmann 1989): A real trunk, i.e. 1) thorax, 2) abdomen, 3) pelvis and B. Shoulder girdle, i.e., 4) right shoulder, and 5) left shoulder. Every part was than divided onto proximal and distal segments - Fig. 2.

The picture of every layer (8mm of height) was divided onto finite number of elements (columns and rows). Each element of known volume (0.1 ccm) which belonged to the particular tissue was given its density value. The density was obtained during separate investigations, where 50 trunk tissues taken from fresh cadavers were analysed (Erdmann and Gos 1990).

The layer included two groups of tissues: A. Unchangeable - bone as support tissue, tissues of feeding systeni (digestion, breathing, vessel), nervous tissue, and others, and B. Changeable - muscle tissue, fat tissue, and skin.

RESULTS

From the analysed trunks following geometrical and inertial quantities were obtained: 1) Linear - straight - and curve - linear, 2) Planar-area of surface of the whole layer and its main tissues, area of surface of trunk's portions projection on sagittal and frontal planes and radius of center of surface's area, area of surface of skin. 3) Volume and mass of trunk's segments and their main tissues - basic, lung, digestion, muscle, fat and skin, and also centers of volume and centers of mass - Fig. 3.5 (Erdmann 1991a and 1991b).

DISCUSSION

By dividing portions onto sub-portions there was the possibility of presenting them for new investigated subjects as geometrical figures (a set of frustums), so the calculation of their geometrical data was possible. The same was achieved for unchangeable tissues. For calculation of fat tissue regression equations were given based on skinfolds' measurements. Volume of muscle tissue for an investigated subject can be calculated by subtracting volume of unchangeable tissues, fat tissue, and skin from the whole volume of the portion.

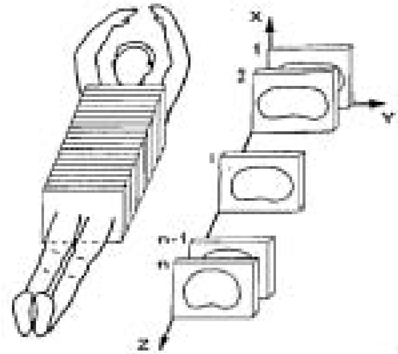

Fig. 1 Portions of trunk's division

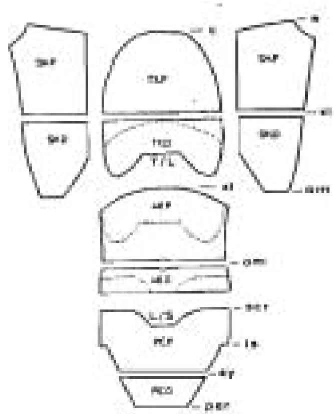

Fig. 2 Elements of the trunk: torax (TX), abdomen (AB), pelvis (PE), shoulder (SH). Proximal (P) and distal (D)

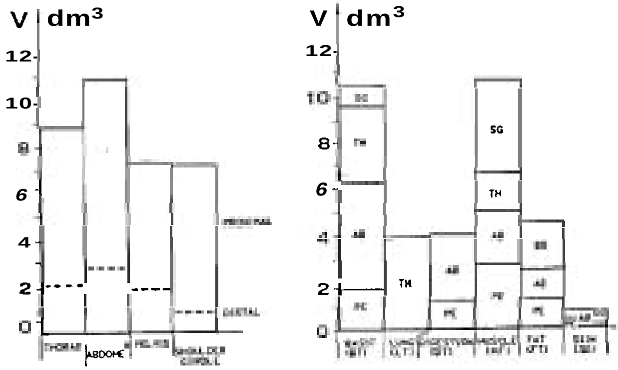

Fig. 3 Volume of the elements (left) and volume of the tissues (right)

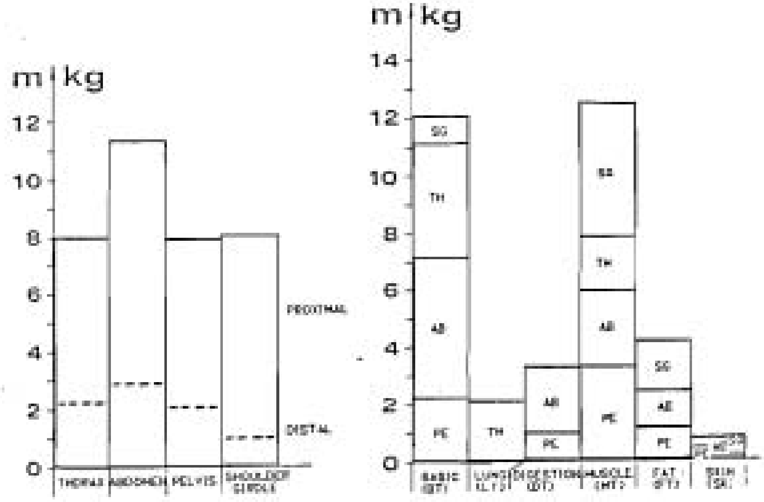

Fig. 4 Mass of the elements (left) and mass of the tissues (right)

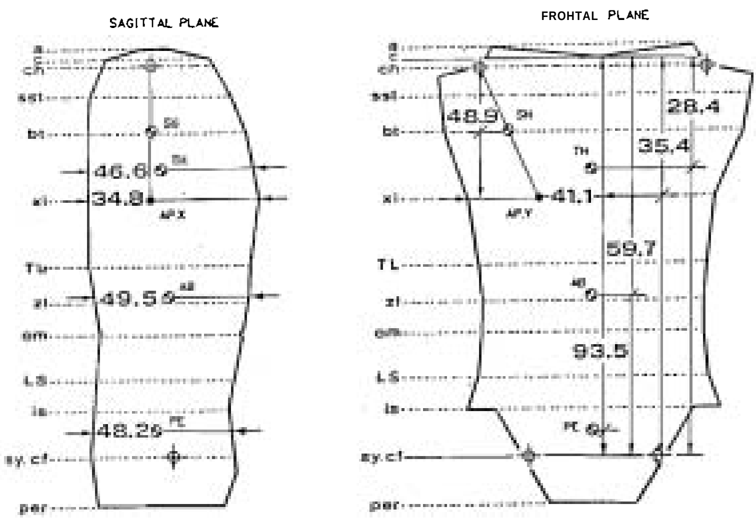

Fig. 5 Center of mass of each element of the trunk

APPLICATIONS

1) Anthropology. Calculation of volume and mass of tissues will allow for estimation of their development, and also for qualification of investigated subjects to proper population groups.

2) Biomechanics. More precise estimation of mass of trunk's parts and location of their centers of mass will allow more precise estimation of location of center of mass of the whole trunk, and then of the whole body. Area of surface and location of its center will help for analysis of a drag. Volume and location of its center will help for analysis of floating.

3) Hygiene of nourishment. Precise calculation of the voluine of the fat tissue will allow for better estimation of applied measures for diminishing fat tissue within the body.

4) Aeronautics and space. During long space flying, at the state of weightlessness and hypokinesis atrophy of muscle tissue exists. When the method of calculation of volume of muscle tissue will be applied it will give better inspection of this tissue and proper dosage of fitness exercises.

5) Pathology. Some diseases give atrophy of muscle tissue. This also exists when a patient lies in a bed for a long time. Here also a method of calculation of volume of muscles can help in estimation of their atrophy.

6) Theory of training. During measurement of muscle strength the data are also given as a coefficient: moment of force/weight of the body. It will be better to use the coefficient: moment of force/weight of muscle tissue that is tissue which generates the force.

7) Safety of transportation. During investigations of results of transportation accidents dummies are applied. They should have human data on geometry and inertia of the body.

8) Bioenergetics. A value of area of surface of the skin will help in estimation of heat exchange. Precise calculation of volume of muscles and data on the number of energetic elements within the muscle's unit can give tlie information on entire energy produced by muscles.

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