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Some Models of Mechanical and Thermal Properties of Skin in the Context of Plastic Surgery

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The simplest model of the structure of the blood circulation of the skin is the angiosomal theory [1]. According to this model, the human body is divided into separate three-dimensional sections, fed by individual branches of the arteries. Further studies showed that angiosomes are not completely isolated, but are reported via anastomoses at the level of skeletal muscle [2]. Despite this, the significance of angiosomal theory remains in the field of plastic surgery [3].

Blood supply to the skin is very heterogeneous in time and space. For different areas of the body, it can differ by more than two times. Moreover, the blood flow is not constant, but is subject to fluctuations with a period that depends on various regulatory influences.

There are three approaches to modeling the mechanical properties of the skin: macro-, meso-, and micromechanical. The first of them is based on the representation of the skin as an abstract elastic material [5, 6]. The second is based on histological information, such as the depth and distribution of the elastic material of the skin [4, 7]. The third takes into account the detailed structure and behavior of collagen and elastin molecules [8].

The basic equation for modeling heat transfer in tissues is the biothermal equation [9].

Mechanical models of the skin are reduced to calculating the relationship of stress-strain. Then it becomes possible to select such deformations so that the stress is minimal. This will allow planning the surgical intervention in such a way as to facilitate the healing process of the stitched wound, since it is known that the edges of the scar undergo stretching [5]. We also believe that the combination of the above models will make it possible to predict skin growth under the influence of external tension when applying the method of tissue expansion.

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