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Forces distribution during plantar stand among the myo-osteo-joint components of the foot. Simulations and analysis on a human anatomical network model

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The anatomical network analysis allows to explore the network of relationships among the anatomical parts of the human body. In our previous work the features of (2) a wide anatomical - biomechanical network were investigated.

The human foot represents a highly complex anatomical structure that carries motor-sensor functions and load distribution through a network of bones, muscles, joints and tendons. The main contacts with the ground during standing position match the metatarsal region for the forefoot and the calcaneus for the backfoot. Studies on the transmission of load in the forefoot area have shown that the latter cannot be considered as a metatarsal arch but rather as a continuous line in physiological condition of metatarsal motility (1, 3). Moreover, electromyographic studies (4, 5, 6) can only give information on the activation of the extrinsic muscles of the foot during walking, without providing any response about the distribution of the load, and the different role played by the numerous anatomical structures involved (7).

Here we present a weighted anatomical network of the foot, where every single node has a numerical value deriving from both the Young's modulus calculation and the number of connections with other nodes. The network consists of 116 nodes interconnected by 219 links and represents the biomechanical structure of the foot as activated by the plantar support.

By the collection of the data, the nodes cluster of the foot can be extrapolated and by detecting of the direct pressure on the plantar support, the virtual foot network can be reconstructed.

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Keywords

Anatomical network, foot, locomotor system