The interaction of the dentofacial system with other systems of the human within the framework of the conception of virtual physiological human

Y.I. Nyashin\textsuperscript{a}, V.A. Lokhov\textsuperscript{a}, V.M. Tverier\textsuperscript{a}, M. Mesnard\textsuperscript{b}

\textsuperscript{a} Department of Theoretical Mechanics, Perm National Research Polytechnic University, 29 Komsomolsky Prospect, 614990, Perm, Russia; nyashin@inbox.ru
\textsuperscript{b} Laboratoire de Mecanique Physique, CNRS UMR 5469 Universite Bordeaux 1, 351 Cours de la Liberation, 33405 TALENCE cedex Bordeaux, France; mesnard@u-bordeaux1.fr

Abstract

The conception of virtual physiological human (VPH) is considered. According to that, the human organism is regarded as a complex multiunit system. Particularly, the dentofacial system is considered as a part of the virtual physiological human framework. In turn, the dentofacial system is a combined multilevel system composed of different multilevel subsystems (from macrolevel to nanolevel). There exist the schemes where the biomechanical reasons of the appearance of the dentofacial system disturbances are composed in various periods of the human’s life from birth to death. These disturbances originate as a result of the biomechanical interaction of the dentofacial system with other systems, closely connected with that system (cardiovascular system, nervous system, locomotor system, etc.), as well as with environment.

The special attention is given to the biomechanics of the temporomandibular joint (TMJ). Very important and complicated part of the temporomandibular joint is the articular disk representing two-phase solid-liquid system: solid skeleton with pores filled by interstitial liquid. The mathematical modelling of TMJ disk is related to theory of poroelasticity (M. Biot, 1940). The application of this theory demands the conducting of experiments (in many cases in vitro for pigs). It allows determining the constitutive parameters which are included in the Bio's constitutive relations.

Anomalies (in particular, malocclusion) of the dental system can induce pathological deformation and displacement of the TMJ disk and possible anomalies of the internal carotid artery (located close to TMJ) which can provoke the anomalies in the brain blood circulation and strong headaches.

Therefore, treatment of the dental system disturbances can diminish biomechanical pressure on the TMJ disk and improve the brain blood circulation (in particular, to diminish the possibility of the insult to the brain).

Keywords: Virtual physiological human, dentofacial system, temporomandibular joint, insult to the brain