HIP REPLACEMENTS OF THE SECOND GENERATION

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The design of artificial replacements of a human skeleton is a complex problem. A perfect implant cannot be designed without a complete knowledge of the biological environment. The present state of research, development and clinical applications (of a hip joint and its replacements, for example) shows that the engineering concepts (focused on in vivo applications) lag behind the model – the biological environment. The artificial replacements of big joints have been developed for more than one century, and yet the engineering product which would, at the very minimum, resemble the live tissue has not been created. Although the present-day rigid implants are clinically applied, and their application is substantiated, their use is limited. Despite the fact that rigid metallic implants, for example, will continue to be applied a long time in the future, their application does not offer good prospects.

The application of the rigid metallic implants represents, from the developmental point of view, the 'Iron Age'. Material and biomaterial engineering, and the clinical practice as well, will more and more focus their attention on new materials and their hybridisation with a live connective tissue. That is the reason why this work is also aimed at the use of new materials with regulated mechanical properties.

Key words: *connective tissue, gradient of elastic properties, femoral diaphysis, stem*

1. Introduction

The rigid metallic artificial replacements (implant stems) up-to-now applied in the clinical practice are classified as the artificial **replacements of the 1st generation**. Their substantial shortcomings include the limited possibilities of regulating the material properties. It is the composite polymer materials that make it possible to actively direct (influence) the properties of materials of a non-biological origin, as, for example, the magnitude of moduli of elasticity in compression, moduli of elasticity in tension, strength of materials etc. The composite stems of implants whose material properties will be very similar to those of a bone tissue are included in the group of artificial replacements of the 2nd generation.

The artificial replacements of the 2nd generation *are such implants that have very similar material properties to the properties of a live tissue. These materials are biologically tolerated by a surrounding live tissue. After special treatment of stem surfaces, these materials create (or support) the initiation of strong physical bonds with molecules of a connective tissue. Between the implant and the live tissue,* **physical bond interfaces are created**.

The conditions of developing the physical bond interface of two completely different materials, i.e. a heterogeneous material (of a 'visiting', non-biological origin) and a biological material, are strongly encouraged by identical deformations of the surface fibres of an inanimate implant and the fibres of a connective tissue. While the moduli of elasticity of the

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