STRESS ANALYSIS OF THE HIP JOINT ENDOPROSTHESIS WITH SHAPE DEFLECTIONS

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The paper deals with the problems of ceramic head of hip joint endoprosthesis destructions, and with assessing the impact of shape deflections of conical surfaces on the probability of this failure. Concerned are shape deflections from the ideal conical surfaces of the stem and the head of the endoprosthesis, which – when the head is put on the stem and the endoprosthesis loaded – form a contact configuration. The shape deflections may be modelled at the macro-level – this concerns model shape inaccuracies such as deflection from the nominal degree of taper, ovality, and their combination, or, possibly, at the micro-level – when the stochastic distribution of unevenness on the contact areas is respected. The problem of stress in ceramic heads was solved using the algorithm of the finite element method for spatial contact tasks, and the Weibull probability model was used for solving the problem of head cohesion failure probability. In the paper are presented and analysed the results of solution of the micro-level shape deflections, obtained from measurements made on the cones of stems and heads.

Key words: *computational modelling, hip joint endoprosthesis, micro-unevenness modelling, stress and failure probability analyses, Weibull weakest link theory*

1. Introduction

The hip joint is one of the most frequently pathologically afflicted joints of the human body. The causes are various: congenital defects, disease in childhood, overloading or degenerative processes at an advanced age. From time immemorial, orthopaedists and surgeons searched for ways how and by what to substitute the hip joint, in order to return to man the possibility of movement. As early as hundred ten years ago, Glück suggested the first complete alloplasty – an artificial hip joint head and acetabulum made of ivory and fixed by a mixture of colophony, pumice and plaster. Today's total hip joint endoprosthesis dates back to 1969, when Weber developed a unit-built type of endoprosthesis consisting of the following three components [1]: the acetabulum fixed in the pelvic bone, the head put on or making an integral part of the stem inserted into the femoral cavity. The stem is made of stainless steel, the head is either metallic or ceramic, the acetabulum is either metallic or ceramic or made of low-pressure high-molecular polyethylene. The euphoria elicited twenty years ago by the successful application of total hip joint endoprostheses among orthopaedists and patients with implanted endoprosthesis, has recently been superseded by a realistic view of endoprostheses. It appeared that their service life is not unlimited and oscillates between

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