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MODELING AND NUMERICAL ANALYSIS OF THE STRENGTH OF THE OSTEOSYNTHESIS PLATE USED TO STABILIZE LONG BONE FRACTURES

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Proper functioning of the human locomotor system is extremely important in everyday activities. In carrying out daily activities, people are exposed to a variety of stresses on their bodies and situations that can lead to injury and, in extreme cases, even to broken bones. Based on the statistics presented in the 2021 report 'Global, regional, and national burden of bone fractures in 204 countries and territories, 1990–2019: a systematic analysis from the Global Burden of Disease Study 2019', it is visible that there has been an increase in the number of femur fractures occurring between 1990 and 2019. The global number of all fracture types (for both gender) in 2019 was estimated to be 178 million, an increase of 33.4 per cent on 1990 data.

Medical devices used for fracture fixation include bone plates, intramedullary nails, pins, wires, screws, etc. Depending on the type and location of the fracture, different methods of internal stabilization are recommended. However, the most commonly used implants for internal stabilization of bone fractures are osteointegrated plates. They offer a number of advantages, such as high stability of plate fixation, restoration of anatomically compatible relationships between fractured bone fragments and the possibility of rapid rehabilitation after plate implantation. Plate designs are constantly being developed due to ongoing advances in the understanding of factors affecting fracture healing

The aim of presented article is to conduct a numerical analysis of the connection of the femur and the osteosynthesis plate used for the internal stabilization of fractures. Two versions of the osteosynthesis plate were modeled: a conventional L*ocking Compression Plate* (LCP) and a plate with an alternative geometry (spiral curved). Both plates were tested for stresses and displacements under given boundary conditions simulating the real biomechanical loads. The numerical study was performed for 4 models imitating different variants of femoral shaft fractures, i.e. simple fractures (transverse and oblique) and multifragmentary fractures (intact segmental and fragmentary segmental). The analysis of the bone – plate system shows that for the tested variants of bone fractures, the maximum stresses and displacements in the case of a plate with alternative geometry are lower than for a plate with a classic shape. Better results (from a mechanical point of view) may indicate that a modified plate may prove more effective in treating injuries and may have an impact on faster patient recovery. Nevertheless, further research is required to fully confirm this hypothesis.