3D PRINTING AS A "NATURE LIKE" METHOD OF OPTIMIZED ENDOPROSTHESES FABRICATION

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Introduction. At present time the mankind is experienced of difficulties of sustainable development caused the shortage of energetic and biological resources. The scientists see the solution in creating of **"**nature like" technosphere. In effect, additive technologies (AT) is a **"**nature like" method of «growing» not only any partial element and even complex issues, for example, endoprotheses of joints.

The aim of the work is to improve the tribomechanical properties of endoprotheses and overcome difficulties of AT manufacturing in respect to these implants making from thermoplastic disperse-reinforced UHWPE composites [1].

Methods and results.

Finite element method has been applied for the creating of CAD-models of joint with gradient of mechanical properties on depth z according to the method described in [2]. For obtaining of corresponding structure the porosity of material has been currently varied during 3D printing.

The modeling shows that such important parameter as maximal contact pressure $p_{\max}$ increases almost 2 times for negative gradient of Young modulus $E'(z) < 0$ in comparison with positive gradient of $E'(z) > 0$. For homogeneous material the maximal contact pressure is characterized by intermediate value. When E = const, it was established that $p_{\max}$ corresponds to constant Poisson's ratio of material $\nu'(z) = 0$; for positive gradient $\nu'(z) > 0$ this parameter decreases more than two times and for $\nu'(z) < 0$ – more than three times.

Some problems of realization of 3D printing of endoprotheses have been discussed, namely, relatively low accuracy of sizes and repeatability layers geometry; high roughness and necessity of additional treatment of contact surfaces; obtaining of specified microporosity; comparability of strength and elastic modulus of materials fabricated by AT and traditional technologies.

Conclusions. The combination of additive technologies, bionic principles and FEM modeling of materials opens up wide possibilities for creating of individually adapted and optimal designed implants. Using of thermoplastic biocompatible and extrudable composites allow us to obtain the gradient of the porosity and elastic properties of endoprostheses, which ensures to minimize contact stresses in this **"**nature like" tribojoint of complex geometry.

References

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