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ABOUT MEDICAL IMPLANTS MADE IN NANOTECHNOLOGY

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DISCUSSION

In modern medical practice, there are often used methods of "overhaul" or total replacement of the damaged organ. In some cases, this will require highly sophisticated, artificial materials and structures, which, by their physical properties, are better than natural bodies and structures. The creation, testing and use of such materials have opened a new field of medicine. This trend has emerged in a place where the medical, biological and technical sciences are intertwined. One of such directions is the creation and use of medical implants.

Implants are specially designed structures that can replace damaged or completely damaged organs and survive in the human body.

They are made from biomaterials. Such materials must be specially selected to survive in the tissues and cells of the body.

Requirements for biomaterials:

- Biomaterials must be highly adapted to a living organism;
- Must have high mechanical properties (especially for each case, such as hardness, tension or stretching, elasticity, overall strength, durability)[1].

Implant materials can be natural or artificial. Among them are metal, ceramic, synthetic and natural polymers. Metal implant is now being used more extensively. By biochemical compatibility (absence of inflammatory reaction in tissues) metallic materials are divided into 3 groups:

"living" (Ti and its alloys, zirconium Zr, niobium Nb, tantalum Ta, platinum Pt), which does not have any adverse effect on the surrounding biological tissues;

"encapsulated" (Al, Fe, Mo, Ag, Au, Stainless Steel and CoCr alloy), which protects them from the formation of a capsule;

"Toxic" (Co, Ni, Cu, Vanadium B), which have a negative effect on the body.

Of these materials, the strongest characteristic is steel. However, steel does not respond the eligibility requirements. Implanted steel implants, including corrosion-resistant steel, cause inflammatory reactions in tissues when interacting with biological fluids. In some cases, they also have an overall and allergic reaction to the body.

Among the leading metal biomaterials, titanium and its alloys are the leading. This metal is used for various types of prostheses, such as plates and screws, which replace pelvic joints, knee and jaw bones or facilitate bone growth [2].

The following properties of titanium have made their use in medicine.

- High biological compatibility;
- Corrosion resistance;
- Lack of magnetic properties;
- Low thermal conductivity;
- Low specific weight (relative to steel).

The high corrosion resistance of titanium is explained by the formation of an oxide film on its surface that is rapidly bonded to the base metal. This film protects the metal from direct contact with the corrosion-active environment of the living organism. Currently, more technically pure titanium and titanium alloys are used for the preparation of implants: Ti-4AL-6M, Ti-55Al-2Sn and Ti-2.5Al-5Mo-5V and others.

However, due to its mechanical characteristics, titanium alloys are lower than steel. At the same time, many of the above alloys contain alloying elements (Ni, Al, B, etc.) that are toxic to living organisms. In experiments, it was found that one of the corrosion-resistant titanium alloys had a toxic effect on Ti-6Al-4V against bone cells. At the same time, the alloys, which are not preserved by the alloying elements

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mentioned above, do not adversely affect bone tissue cells. One of the ways to solve this problem without the use of alloying elements is to replace titanium alloys with pure nanostructured titanium. In nanostructured state (slab size, less than 100 nm). Mechanical characteristics of titanium (properties of strength, hardness, elasticity and elasticity) determine the properties of titanium alloys. Mechanical strength in nanostructured titanium implants is 2-3 times higher than the original, pure titanium implants [3].

Thus, it is possible to make implants from titanium nanostructures, which retain the required mechanical properties that do not require exfoliation and trauma.

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