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ПЕЧАТЬ ОРГАНОВ НА 3D ПРИНТЕРЕ

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ORGAN PRINTING ON A 3D PRINTER

Аннотация. Данная статья посвящена производству и выращиванию органов на 3д принтере. В статье представлена информация о значении 3д принтера в медицине, о достижениях в медицине, связанных с биопринтингом. Основная цель статьи – собрать информацию в целом о биопринтинге и обозначить преимущества данного способа получения органов.

Ключевые слова: биопринтинг, органы, трансплантация, имплантация, мимикрия, части тела.

Abstract. This article is devoted to the production and cultivation of organs on a 3D printer. The article presents information about the importance of 3D printer in medicine, about achievements in medicine related to bioprinting. The main purpose of the article is to collect information on bioprinting in general and to identify the advantages of this method of organ production.

Key words: bioprinting, organs, transplantation, implantation, mimicry, body parts.

The 21st century is a century of technology, a man can no longer imagine his life without the help of computers, various devices and, of course, machines.

Unfortunately, doctors have not yet created medicines for some diseases; people have not reached the stage of evolution where they could recover their body parts or organs after loss or illness. But fortunately, scientists and bioinformatics have developed special printers that can help people create the organs and tissues that traumatized and sick people need.

Organ printing on a 3D printer or bioprinting is a promising technology for growing healthy and live organs instead of damaged or missing ones. In addition to a 3D printer, bioprinting requires a model of an organ, patient's cellular material, and an environment where the organ is preserved before implantation.

Printed organs are better than prostheses and transplanted body parts. They are like "native" and are not rejected by the immune system, as they are created from the patient's DNA. This greatly reduces the time needed to obtain the right organ and saves the lives of patients who need an immediate transplant.

Organ stamping has already been tested on animals and with good results. The mice that were used to transplant the "printed" ovaries successfully reproduced their offspring, and the Chinese company performed surgeries on implantation of blood vessels, which already shows a lot.

So far, only internal organs and skin have been created from human body parts, and the nose and ears have also been created in a reduced size, while full-fledged organs are planned to be created by 2030.

How does bioprinting work?

Research teams develop different concepts of bioprinting:

Frame printing. Live cell growth on an inorganic basis that disappears with the development of natural bonds between cells. The main difficulty is the selection of a material that is as elastic or rigid as the organ to be replaced. It must degrade quickly so as not to interfere with the strengthening of the intercellular matrix and dissolve, leaving no toxic compounds. Hydrogel, titanium, gelatin, synthetic and biopolymers are suitable for frame printing.

Frameless. Application of ready-made cells to hydrogel base. While the cells are in the printer, they are cooled and are in thin hydrogel spheroids. When printed, the temperature rises to 36.6°, the spheroids dissipate and the cells gradually form the natural framework - the cell matrix - themselves. This printing is less widespread than the frame printing it appeared later and is more difficult to reproduce.

Mimicry. It represents the technology of the future, assumes creation of full copies of organs at once. For it, bioprinting at the molecular level is developed and in-depth studies of the nature of cells are carried out.

What are the methods of 3D printing?

Inkjet. They were the very first to print, and this method is also used to print conventional printers. They store biological material in cartridges, which is sprayed

on a hydrogel substrate like ink on paper. The drawback of these printers is the inaccurate release of droplets and clogging of the spray nozzle, which can cause cell death. Inkjet printing of organs on the printer is not suitable for viscous materials because they are not sprayed. The field of application is limited to bone, cartilage, muscle and skin repair. The advantage of cheapness and mass reproducibility.

Microextrusion. This method is used in inorganic 3D-printing. Pneumatic feeding of the material into the movable extruder head, which stacks the cells, is used for printing. The more heads, the more accurate and faster the printer is. The downside is that the denser the cells are stacked, the less likely they are to survive. At comparable stacking densities, micro-extrusion printing kills more cells than inkjet printing. Another advantage is that it is suitable for 3D printing of high-density organs.

Laser printing. Widespread in the industry, but applied in bioprinting. Use a laser to heat glass with a liquid cell substrate. Overpressure is created at the point of beam concentration, which pushes the cells to the desired area of the substrate. A reflective element is placed between the beam and the biomaterial glass, which reduces the power of the beam. There are more disadvantages, than the previous ones, it is the increased metal content in the cells from the evaporation of the reflective element. Price. The advantage is the controlled down to the individual cells, the stacking of the biomaterial.

What are the prospects for bioprinting?

3D bioprinting has gone from concept to working and commercially successful technology. The main clients of bioprinting companies are large pharmaceutical corporations. They accelerate the testing of drugs by immediately testing them on printed human tissues. Unfortunately, bioprinters will not be available in our hospitals soon, but some patients are already recovering from 3D printing. The jaw of an 83-year-old Belgian woman has been struck by osteomyelitis. Recovery would have been more expensive and would have taken longer than the removal of the patient's jaw and the implantation of the printed new one, but the team of doctors under the guidance of Professor Jules Pucan performed the operation and the woman

could speak immediately after the operation. The development of bioprinting will lead to medical practice, where it is easier to remove the damaged limb and raise a new one than to treat injuries that are now treated without amputation. Medicine of the distant future minimizes mechanical interference in the body.

In 2018, it is planned to fully print the human organ on the printer - kidneys. Then we plan to print bronchi, arteries and heart. But even before the clinical trials on people about 10 years, and mass 3D printing of human organs and body parts will come even later. In addition to doctors, 3D printers are attractive for cosmetologists and plastic surgeons. The desire to stay young and beautiful, not the treatment of rare and complex diseases, will make 3D printing of human organs mass. It is possible that people of the future will change organs and appearance as easily as smartphones.

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