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3Д печать в медицине

Статья посвящена актуальности внедрения такой технологической новинки как 3D печать в важнейшую сферу нашей жизни - медицину. В ней обобщается практический опыт применения такого вида печати для восстановления функций человеческого организма и разобраны примеры успешного проведения операций соответствующего рода. Значительное внимание уделяется возможностям, которые открывает 3Dпечать перед медициной, хирургами и пациентами. В конце статьи предполагается возможное будущее 3D печати в медицине, акцентируется внимание на необходимости этого, нужных мерах по всеобщему внедрению и финансированию.

3D Printing in medicine

“3D printing is revolutionizing every aspect of the medical industry. It saves time, it saves more lives and it improves the efficiency of the surgery as well”

Dr Muhanad Hatamleh

Nowadays it’s obvious that 3D printing is actually a misnomer. It's actually 2D printing over and over again, and it in fact uses the technologies associated with 2D printing. Think about inkjet printing where you lay down ink on a page to make letters, and then do that over and over again to build up a three-dimensional object. In microelectronics, they use something called lithography to do the same sort of thing, to make the transistors and integrated circuits and build up a structure several times. These are all 2D printing technologies. So, today it is actually a reality that you can download anything from the web with its data, correct and specify it as you want, according to your preferences and you will see that the information sent to the desktop machine will be fabricated on the special spot not as a picture, but as a real product. We can actually print or build very rapidly a physical object and the reason we can do this is an emerging technology called additive manufacturing or 3D printing.

The technology of 3D-printer is more than 30 years old now and it is quite amazing to think that only nowadays it is started to be filtered into the public arena. Also known as rapid prototyping or additive manufacturing, it used to be the manufacturing industry's best kept secret but now the technology is being used to transform many industries, including medicine. Over the past year, hospitals around the world have begun talking about their burgeoning use of 3D printing in health care, from 3D printing an entire skull, to rehearsing incredibly complex surgeries and creating implants for reconstructive surgery. Only imagine the quantity of the opportunities 3D-printing gives: tissues with blood vessels, heart valve, ear cartilage and cranium replacement – this list still hasn’t found its end. Let’s go to real examples.

In 2011, Professor of Washington State University Susmita Bose, modified a ProMetal 3D printer to bind chemicals to a ceramic powder, creating intricate scaffolds that promote the growth of bone in any shape. Prof. Bose’s goal is to, one day, be able to implant the bone scaffold with bone growth factors in such a way that the implant is dissolved by natural bone material in even load-bearing bone structures.

At Cornell University Jonathan Butcher has printed a heart valve that will soon be tested in sheep. With a dual-syringe machine, he was able to print a combination of alginate, smooth muscle cells and valve interstitial cells, to control the valve’s stiffness.

Cornell’s Lawrence Bonassar used 3D photos of human ears to create ear molds. These molds were then filled with a gel containing bovine cartilage cells suspended in collagen, which held the shape of the ear while

cells grew their extracellular matrix. Bonassar and his team have since gone on to 3D print intervertebral discs to treat major spinal complications, while researchers at Princeton have 3D printed their own collagen ear, this time, with built-in electronic components for superhuman hearing.

If speaking about saving the people's lives, let's talk about the episode that happened in February of 2012 and reported by The New Yorker newspaper. The medical team at the University of Michigan's C. S. Mott Children's Hospital in Ann Arbor carried out an unusual operation on a three-month-old boy. The baby had been born with a rare condition called tracheobronchomalacia: the tissue of one portion of his airway was so weak that it persistently collapsed. This made breathing very difficult, and it regularly blocked vital blood vessels nearby, including the aorta, triggering cardiac and pulmonary arrest. The infant was placed on a ventilator, while the medical team set about figuring out what to do. The area of weak tissue would somehow need to be repaired or replaced—a major and dangerous operation in so small a patient. The team consulted with the baby's doctors at Akron Children's Hospital, in Ohio, and they soon agreed that they had just the right tool for this delicate, lifesaving task: a 3-D printer.

The researchers took a scan of the baby's chest, which they converted into a highly detailed three-dimensional virtual map of his altered airways. From this model, they designed and printed a splint—a small tube, made of the same biocompatible material that goes into sutures—that would fit snugly over the weakened section of airway and hold it open. It was strong but flexible, and would expand as the boy grew. The splint would last for three years or so, long enough for the boy's cells to grow over it, and then would dissolve harmlessly. Three weeks after the splint was implanted, the baby was disconnected from the ventilator and sent home. In May of 2013, in *The New England Journal of Medicine*, the researchers reported that the boy was thriving and that "no unforeseen problems related to the splint have arisen."

Joseph DeSimone, the chief executive of the 3D printing company Carbon3D and a professor of chemistry at the University of North Carolina at Chapel Hill 3D appeared at TEDx conference in March 2015: "Think about if you need a stent in an emergency situation, instead of the doctor pulling off a stent out of the shelf that was just standard sizes, having a stent that's designed for you, for your own anatomy with your own tributaries, printed in an emergency situation in real time out of the properties such that the stent could go away after 18 months: really-game

changing. Or digital dentistry, and making these kinds of structures even while you're in the dentist chair.” So, he suggested in his TED talk it might be possible to 3D-print a tooth in less than 10 minutes. He refers to this innovation as “point-of-sale manufacturing” for dentists. The bigger context is that 3D printers are leading to what can only be called a “replacement parts for humans” model. Just as cars have parts that need to be replaced after a certain number of miles, humans also have parts that need to be replaced after a certain number of years. That’s especially true as people live longer than ever before. Think of 3D-printed teeth as just small replacement parts that can be customized for your mouth.

We see that even such an innovative thing as 3 dimensional printing gets more improvements and transformations throughout past years. It becomes wide spread and will have an opportunity to help more and more people in need of emergent surgery. As the technology improves, it’s possible to see 10 times, even 100 times, improvements in speed. What once took hours or more, can now be accomplished within the space of a few minutes. That increase of speed, coupled with the promise of being able to make perfectly fitted teeth that have been customized for each person’s mouth, makes it almost a certainty that you might one day see a 3D printer next to all the other tools and instruments in your dentist’s office. Gartner analyst Pete Basiliere says the most exciting use of 3D printing is to make medical devices. "By 2018, we expect that there will be 2.3 million 3D printer units sold," he told IBTimes UK.” Surgeons are implanting 3-D-printed stents, prosthetics, and replacement segments of human skull. The exponents of 3-D printing contend that the technology is making manufacturing more democratic; the things we are choosing to print are becoming ever more personal and intimate. This appears to be even more true in medicine: increasingly, what we are printing is ourselves.

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Технология GPRS

GPRS является самой широко используемой технологией среди поставщиков услуг. GPRS - это своеобразная производная от GSM к мобильным сетям третьего поколения 3G. GPRS-это скоростная передача данных посредством сетей GSM. Данная технология предоставляет пользователям возможность делать телефонные звонки и отсылать данные одновременно. Самым заманчивым аспектом технологии GPRSдляпоставщиков услуг, кроме понижения стоимости эксплуатации, является простота управления при ее использовании,