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10 Highlights of the EnvisionTEC 3D-Bioplotter's Long Career

by Clare Scott | Aug 9, 2017 | 3D Printers, 3D Printing, Exclusive Interviews, Medical 3D Printing, Science & Technology, Sponsored |

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Last week, we took a look at what has become one of the most commonly used 3D bioprinters in the industry. The 3D-Bioplotter from EnvisionTEC has now been used in more than 200 peer-reviewed research studies. That's an impressive accomplishment, and it's definitely worth taking a look at the important work that has been done using this 3D printer. Most people don't have the time to wade through 205 papers, however, so we decided to pull out 10 that have been especially significant.

[Image: EnvisionTEC]

3D Printed Mouse Ovary

In May of this year, a team of researchers from Northwestern University used a 3D-Bioplotter to 3D print an ovary, which was then implanted into a mouse whose natural ovary had been removed. Once the mouse was bred, she became pregnant and gave birth to a healthy litter of babies. The bioprinted ovary functioned in all the ways that a natural ovary would, even allowing the mouse to lactate and nurse. The study has important implications for infertility, particularly that which has been caused by cancer treatment.

Tympanic Membrane Perforation Repair

Tympanic membrane perforations, or TMPs, are, quite simply, holes in the eardrum. They can be caused by injury or infection, and are a common cause of hearing loss in children. TMPs can be repaired through a process called

tympanoplasties, which involve grafting tissue onto the perforation, but success rates are variable because it all depends on the surgeon's ability to carve the graft into the exact shape of the perforation. This year, a group of scientists used a 3D-Bioplotter to 3D bioprint grafts, which they then implanted into chinchillas. The chinchillas demonstrated improved healing rates with the 3D printed grafts.

Hyperelastic Bone

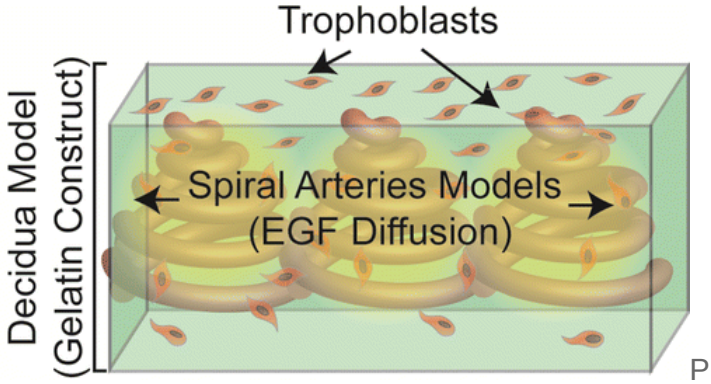
Last year, researchers at Northwestern University developed a new kind of 3D printed bone implant. Most 3D bioprinted bone tends to be brittle, but the hyperelastic bone developed by these researchers is more durable and flexible, and is also capable of integrating with the body's system. Moreover, it can actually grow as children grow. The hyperelastic bone was successfully tested in mice, rats and monkeys, and principal investigator Dr. Ramille Shah predicts that clinical trials will take place within five years.

[Image: Adam Jakus]

3D Printed Tissue from Pluripotent Stem Cells

Very recently, a team of researchers at the University of Wollongong revealed that they had successfully 3D printed tissue constructs from human-induced pluripotent stem cells (iPSCs), which are stem cells that can differentiate into any type of adult cell. The researchers' work included 3D printing neurones, which are nerve cells in the brain that produce chemicals such as GABA and serotonin. Deficiencies in these chemicals can lead to diseases like epilepsy and schizophrenia. In addition to that breakthrough, the research is a step closer to 3D printing functional human organs for transplant without risk of rejection.

3D Printed Placenta for Preeclampsia Research



Preeclampsia is a dangerous condition that can affect pregnant women, and it can result in the death of both

the mother and baby. Little is known about what causes preeclampsia, but thanks to a team of scientists with a 3D-Bioplotter, progress is being made. The scientists 3D bioprinted a placenta, a highly complex organ that only forms in the case of pregnancy, to study the migration of a type of cell called trophoblasts. These cells could never be properly studied before, but the 3D printed placenta helped the scientists gain a better understanding of them and their role in preeclampsia, and even to begin working on possible treatments.

3D Printing for Tooth Regeneration

Scientists 3D printed scaffolds seeded with periodontal ligament stem/progenitor cells and placed them on the roots of teeth that had had the cementum removed. Cementum is what anchors teeth to the alveolar bone. After several weeks, a new cementum-like layer had formed, showing promise for the regeneration of lost teeth.

Cartilage Regeneration Using a 3D Bioprinting Pen

A research team from Australia developed the BioPen, a 3D printing pen that uses stem cells to “draw” tissue directly into the bodies of patients. Earlier this year, the researchers successfully tested the pen by drawing cartilage into the knees of injured sheep. The sheep regrew cartilage stronger than that which is typically regrown after knee replacement surgeries, and could successfully put weight on their previously injured joints. The researchers hope to begin human trials within a year.

[Image: St. Vincent’s Hospital]

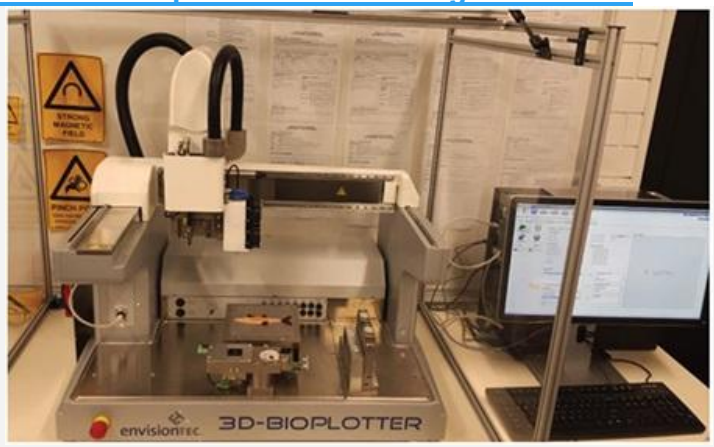
3D Printed Implants Release Drugs to Prevent Bone Infection

A number of complications can happen after a surgery or injury, and bone infection is a scary one – and a difficult to treat one. A team of scientists 3D printed implants out of a nanocomposite of bioceramic and PVA, and placed three different antimicrobial drugs within compartments in the implants. Testing showed that the implants released the drugs either immediately or on a prolonged basis, depending on the type of scaffold. This combined drug therapy proved itself to be able to destroy multiple bacteria types as well as inhibit the growth of new bacteria; the implants also facilitated bone regeneration.

3D Printed Scaffolds for Spine Stabilization

A group of researchers used a 3D-Bioplotter to 3D print an implant that was used to stabilize the spines of injured rats. The rats whose spines were stabilized with the 3D printed implants showed significantly improved motor function; moreover, the implants prevented connective tissue from infiltrating the site of the injury. According to the researchers, the study shows a lot of promise for the use of 3D printing to treat spinal cord injuries.

3D Printed Foods for People With Swallowing Difficulties

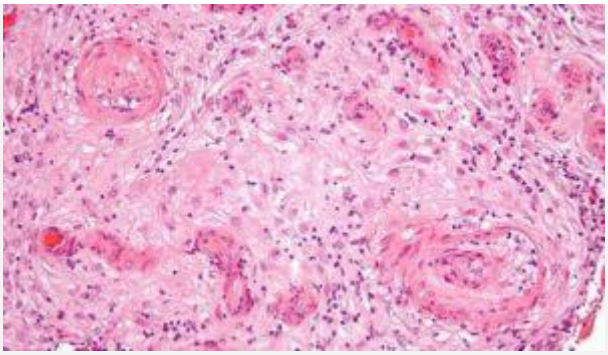


[Image: KNE Publishing]

The 3D-Bioplotter isn't only used for 3D printing tissue – it can also be used for 3D printing food. In this case, that 3D printed food serves an important medical purpose. Dysphagia is a condition in which people have difficulty swallowing, and those people are often relegated to eating tasteless, unappealing purees. 3D printing has been discussed as a way to make these foods more appetizing. In this study, pureed pumpkin, tuna and beetroot were 3D printed in a way that was both visually appealing and easy to swallow for people with dysphagia.

Those are just a few of the studies that have used the 3D-Bioplotter to conduct research that will make a real difference in people's lives. All of these disparate areas of study have used a common piece of equipment for work in various areas that may soon have big implications in research and further developments.
To better understand what it is that makes the 3D-Bioplotter such a favored device in these labs, we turned to the researchers themselves. Che-Ying (Vincent) Kuo, MS, a graduate research assistant and doctoral candidate with the University of Maryland's Fischell Department of Bioengineering as well as Sheikh Zayed Institute for Pediatric Surgical Innovation, Children's National Health System, was an author on both the TMP and preeclampsia studies. He shared his thoughts regarding these studies' use of the 3D-Bioplotter, as he is part of a team that has put the advanced bioprinting machine to use for three years now.
"We wanted to acquire a 3D-Bioprinter because Dr. Peter Kim, the VP of the Sheikh Zayed Institute(SZI), wanted to establish a tissue printing program within SZI, which is in collaboration with the University of Maryland School of Engineering," Kuo told us.
"In 2014, I was put in charge to find a suitable bioprinter and we arrived to the 3D-Bioplotter by EnvisionTEC because we felt it was a very versatile platform that enables us to make our own material with the most control of various parameters (temp of the build plate and material, UV capability, position of the printer arm…etc). In addition, our lab already has another 3D printer that is also

manufactured by EnvsionTEC, so we have an existing relationship with the company."



Cells in the placenta during preeclampsia are inflamed due to hypertension. [Image: Wikipedia]

A critical part of success in a laboratory environment is the equipment in use, and trusting that equipment allows for greater work to be done. Through their relationship with EnvisionTEC, Kuo's team understood the importance of working with a company that has established a strong reputation over the last 15 years, as well as having already formed a strong basis for trust through ongoing use of the company's 3D printer.

"Within SZI, the Bioplotter is mainly used to bioprint living tissues by encapsulating cells and growth factors in hydrogels (e.g. Gelatin, Fibrin) to build tissue grafts and tissue models," Kuo continued. "However, we have also used it to print other materials such as silicone and other synthetic polymers (PCL, PLGA)."

Kuo noted that the team has two projects associated with the 3D-Bioplotter, both of which are included in this list, featuring the bioprinted grafts for TMP repair, in the study led by ENT surgeon Dr. Brian Reilly, and the bioprinted placenta model.

A lot of exciting work is happening in the field of 3D bioprinting, and the field is only growing more advanced every day. We're looking forward to seeing what unfolds in the next few years, and it's likely that a lot of what unfolds will involve a 3D-Bioplotter in some way.

What do you think about the 3D-Bioplotter's career? Let us know in the EnvisionTEC 3D-Bioplotterforum thread at 3DPB.com.