

Organ Printing

Vi Tran, *Biomedical Engineering, University of Rhode Island*
BME 181 Second Presentation, April 1, 2013 <vitran625@gmail.com>

Abstract—Today, organ printing, a process where an artificial organ is printed from a 3-D printer, has become a popular research project that is being explored by many companies and researchers. Integrating biology and 3-D printing technology, organ printing could possibly allow scientists to print out artificial human organs and eliminate the need for organ donors in the future.

I. INTRODUCTION

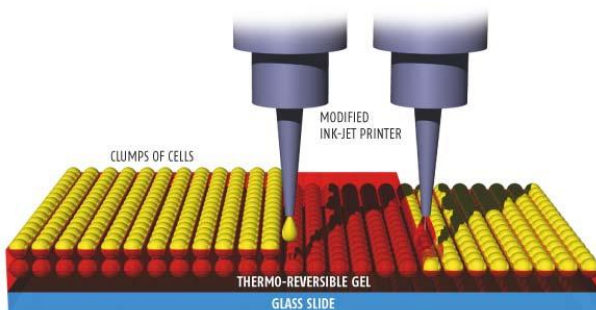
According to organdonor.gov, a total of 117,521 people currently are in need of an organ. Each day in the United States, 18 people will die from not receiving an organ transplant. Due to this fact, many scientists are currently working in creating artificial organs through organ printing to address these high demands.

II. METHODS

The 3-D printer will use bioink, a mixture containing stem cells, to create the layers of organ tissue. As the printer moves back and forth, a precise needle will drop one bioink particle at a time to form one layer of tissue. Each layer is printed on biopaper, which is made up of water, collagen, and hydrogels, to hold the shape of the printed tissues together. These layers are printed on top of each other. Once the cells have completely fused together into the desired structure, the biopaper is either dissolved or removed.

PRINTING ORGANS

Organs could be built up layer by layer by printing clumps of cells onto a gel that turns solid when warmed. Once the cells have fused the gel can be removed simply by cooling it



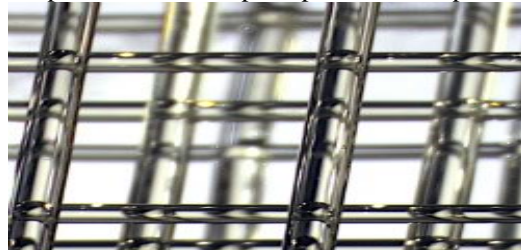
III. RESULTS

So far, many achievements have been made through this process. In 2008, Organovo, a biotechnology company, had successfully created artificial blood vessels and cardiac tissue using chicken cells. Since then, this company has been working with Invetech, a medical device manufacturing company, and AutoDesk, a software company, to develop a functional organ printer.

In 2011, Dr. Anthony Atala, the director of the Wake Forest Institute Regenerative Medicine and a current surgeon, had successfully printed a kidney from human cells using a 3-D printer within seven hours. Although the kidney is not implantable in humans yet, it symbolizes a future hope in

organ printing.

Also, researchers at the University of Pennsylvania have been working in creating a vascular network for printed organs. In July 2012, Dr. Jordan Miller, Dr. Christopher Chen, and Dr. Sangeeta Bhatia, successfully created a sugar template that can help shape the development of a vascular



network. Once the template was created by the 3-D printer, living cells were inserted and grown into the desired network shaped. After the network had finished developing, the sugar template was dissolved. The template created by the researchers can be seen in the figure above.

IV. DISCUSSION

With rapid advancements in tissue engineering and 3-D printing technology, the idea of creating an organ from this type of bioprinting could be achieved in the future. With this revolutionary process, the waiting period and the need for organ donation would be eliminated. Also, using the patient's own cells, these artificial organs would be personalized for the patient and no DNA rejection would occur. Although organ printing has many advantages, there are several potential issues to consider. Organ printing is an extremely tedious and an expensive process. Currently, the cost for the printer is hundreds of thousands of dollars and can take hours or days to create the desired 3-D structure. The use of stem cells also makes organ printing a controversial process. Despite its setbacks, organ printing would change the medical world for the better by saving lives.

REFERENCES

- [1] Lerner, Evan. "Penn Researchers Improve Living Tissues With 3D Printed Vascular Networks Made From Sugar." N.p., n.d. Web. <<http://www.upenn.edu/pennnews/news/penn-researchers-improve-living-tissues-3d-printed-vascular-networks-made-sugar>>.
- [2] <<http://www.explainingthefuture.com/bioprinting.html>>.
- [3] "GROWING HUMAN ORGANS — DR. ANTHONY ATALA BLOWS THE MINDS OF A TED AUDIENCE." Singularity Hub, n.d. Web <<http://singularityhub.com/2011/03/15/growing-human-organs-%E2%80%94-dr-anthony-atala-blows-the-minds-of-a-ted-audience/>>.
- [4] "Media Coverage." Organovo, n.d. Web. <<http://investors.organovo.com/Newsroom/Media-Coverage/default.aspx>>.
- [5] "A 3-D Printer Will Soon Print You New Organs." N.p., n.d. Web <<http://www.fastcoexist.com/1681116/a-3-d-printer-will-soon-print-you-new-organs>>.