3D Bioprinting of Bodyparts

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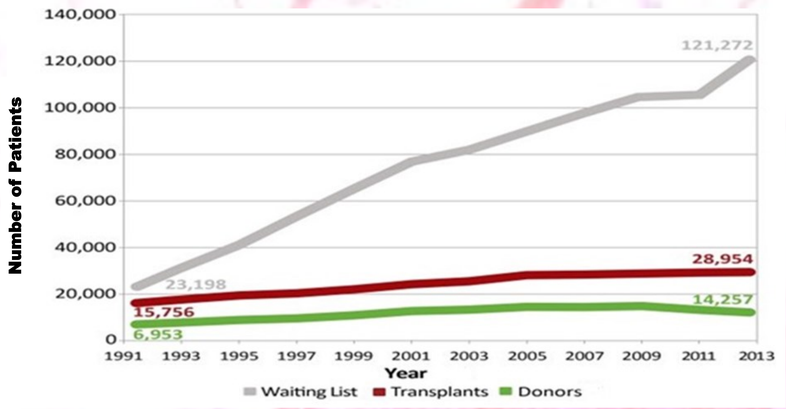
Situation

The growing demand for organs is placing pressure on both doctors and patients on waiting lists. The gap between the number of organ donors and the number of organ recipients has caused doctors to look for alternatives, one of these is bioprinting.

Table 1: Disparity between required and donated organs (USA) [1]



The Bioprinting Process

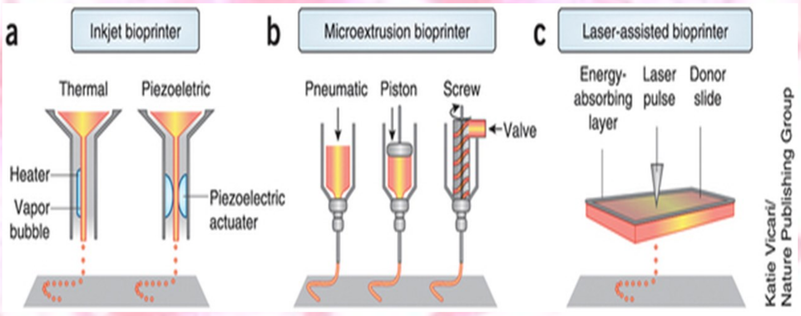


Figure 1: Different bioprinter models [2]

Bioprinting is an evolving tissue engineering technology. It utilizes computer controlled three-dimensional printers for rapid and high-precision construction of three-dimensional biological structures [3]. There are three main types of bioprinters:

a. Inkjet bioprinter: involves the use of actuators to control the motion of inkjectors,

b. Microextrusion bioprinter: uses three different pistons to print large organs,

c. Laser-assisted bioprinter: uses a laser-beam to saturate the biomaterial forming the "print".

Problems

Compared with non-bioprinting, 3D bioprinting involves additional complexities that must be addressed:

1) The need to find suitable biomaterial for printing the organ, that will ensure the proper functioning of the organ,

2) Difficulty in printing thin blood vessels and organs with a long life span,

3) Expensive and time-consuming depending on the organ printed.

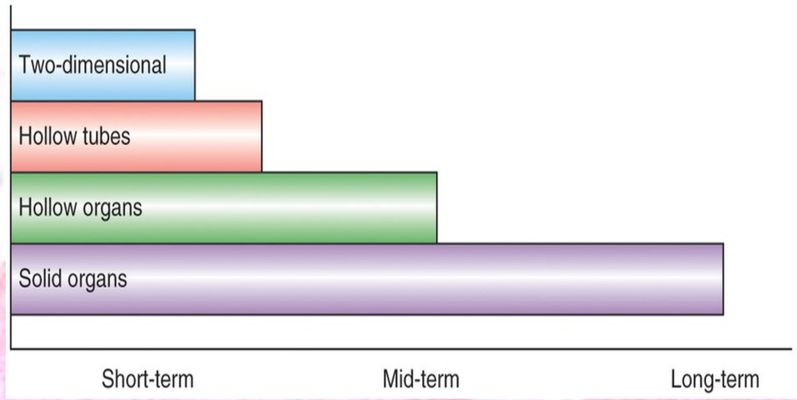


Figure 2: Organs and time required to print [3]

Solutions

1) Create a skeleton of blood vessels

2) Make the tubes of a blood vessel completely hollow by creating an extra cellular matrix

3) Use one of the three different types bioprinters available depending on the type and nature of organ needed

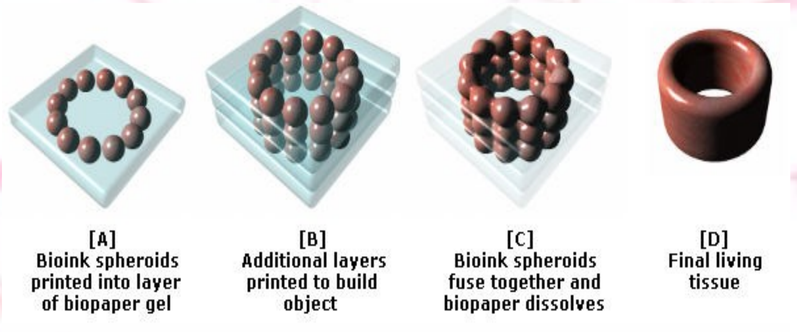


Figure 3: Layering Process [4]

Evaluation of Solutions

There are three basic types of 3D bio printers that provide different pricing options ranging from relatively affordable to expensive.

1) **Printing quality**
Inkjet printers have wide error margins
Microextrusion bio printers are able to print high cell densities with high precision
Laser assisted bio printers are the most accurate and precise bio printers to date

2) **Printing speed**
Thermal inkjet printers are relatively slow
Microextrusion bioprinters print at a relatively convenient speed
Laser assisted bioprinters are very fast

3) **Practicality**
Advanced replacement tissues are being researched and are still in the experimental stage. Currently, bio-printing is used in operations such as supplemental tissues, that aid regeneration.

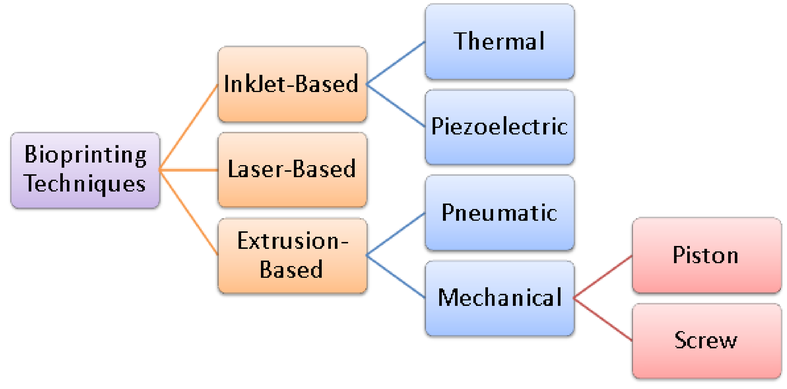


Figure 4: Different types of bioprinters [2]

References

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[3] V. Mironov et. al, "BIOPRINTING: DIRECTED TISSUE SELF-ASSEMBLY". *Chem. Eng. Prog,* vol.103,no.12 ,pp. S12-S17, December 2007. [Online] Available: Proquest. www.proquest.com [Accessed: Oct 13,2014].

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