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3d Bioprinting: A Ray of Hope

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Introduction:

Three-dimensional printing is a technical and industrial revolution results in to reconstruction of a 3 D object by addition of material layer such as plastic, metal and so on based on a 3 D computer model. 3 D bio printing can be defined as the process where cells and cell compatible materials grouped together to print tissue or organ. It involves various steps. Time required for this process varied as per the complexity of structure, types of bioprinter used and the technique taken in to consideration. This technique has widened the scope of research and treatment facility in medical and paramedical fields. 3 D models prepared by this method will also enhance the better understandability about the cell and organ function. Models prepared by this technique are much more realistic and can represent the microenvironment and complexity during different disease conditions.

Steps of Bioprinting: Different steps required to produce a biological structure are:

1. **Designing of a structure**: Before the synthesis of any biological structure detailed information about that is required. This knowledge helps to create a digital model with the use of different computer-based software which will act as a blueprint for the printing process.
2. **Preparation of Bioink**: Bioink, a mixture of living cells and biocompatible material has to be prepared act as a input source and its choice depends on the type of tissue is going to be produced and its requirement.
3. **Printing with the Printer:** There are several types of printers available to produce the output 3 D object by deposition of bioink layer by layer as

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a. **Inkjet Printer: it uses droplets of bioink**
b. **Extrusion Printer: it uses continuous filament of bioink**
c. **Laser assisted printer: it uses laser pulse of bioink**

4. **Cross linking of biomaterial:** Cross linking of biomaterial is required to provide stability. It involves physical and chemical processes that result in to solidification of bioink ensure that printed structure maintain its shape.
5. **Maturation:** The printed structure has to be placed in a bioreactor to get mature and develops into a functional tissue. During this process printed structure has to be supplied by the oxygen, nutrients and mechanical stimuli to promote growth of cell and tissue formation.
6. **Validation and testing:** This is the last and final step involves the testing of functional ability and viability of the printed tissue to ensure that the structure meets the requirement of standards for the intended application.

Advantages:

1. It allows creation of patient specific tissues and organs which can reduce the risk of rejection in transplants.
2. It can produce complex tissue structures closely mimic to the natural tissue along with the presence of blood vascular network.
3. Process is faster and more efficient in comparison to traditional tissue engineering methods.
4. It can also help to reduce requirement of animal testing in drug development and other research.
5. It allow more accurate testing of drug and treatments on human like tissues as well as to speed up the development of new therapies.

Disadvantages:

1. Technology and materials required for 3D bioprinting are expensive.
2. Issue such as nozzle clogging, limited ink velocity and uneven ink size can affect the quality of printed tissues.
3. Survival and proper functioning of cells during and after the process remains a significant challenge.
4. Regulatory approval process can be lengthy and complex.
5. Ethical concerns about the implications of creating human tissues in lab are also questionable.

Conclusion

3D bioprinting is a transformative technology with the potential to revolutionize various fields, particularly in medicine and biotechnology. 3D bioprinting represents a paradigm shift in how we approach tissue engineering and regenerative medicine, with the potential to significantly impact healthcare and other industries in the coming years.

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