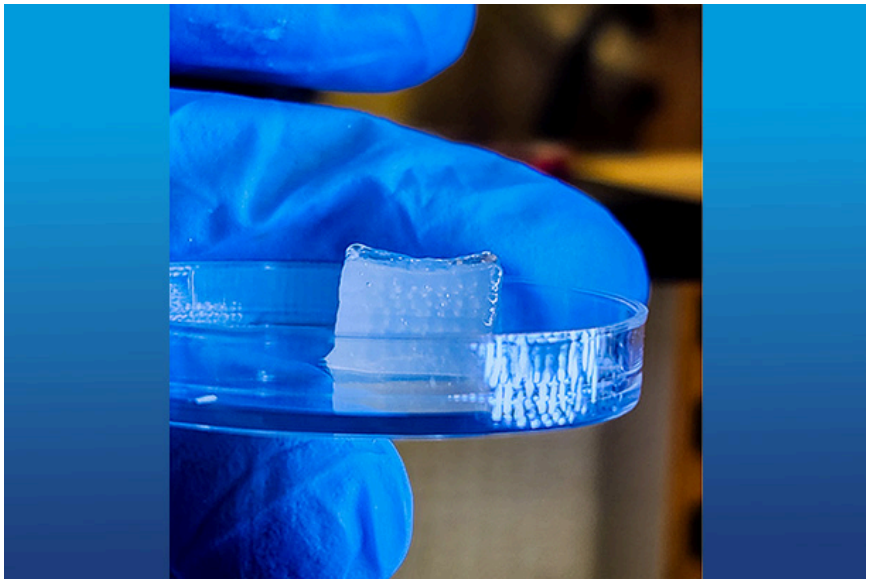
Penn State Researchers Develop Rapid Bioprinting Technique for Functional Tissue



By Sahas Kadire March 25, 2025

A team of researchers at Penn State University has unveiled a groundbreaking bioprinting technique that significantly accelerates the creation of functional human tissue. This innovative method, known as the High-throughput Integrated Tissue Fabrication System for Bioprinting (HITS-Bio), enables the production of complex tissues at speeds ten times faster than existing technologies, marking a substantial advancement in the field of regenerative medicine.

Advancements in 3D Bioprinting

Traditional three-dimensional (3D) bioprinting involves layering living cells encapsulated in bioinks to construct tissue structures. However, achieving the high cell density necessary for functional human tissues has been a persistent challenge. The new approach developed by the Penn State team utilizes spheroids—clusters of cells that mimic the density and functionality of natural tissues—to overcome this limitation.

The HITS-Bio Technique

HITS-Bio employs a digitally controlled nozzle array capable of manipulating multiple spheroids simultaneously. Arranged in a four-by-four configuration, the array can pick up and precisely place 16 spheroids at once onto a bioink substrate. This method not only enhances the precision of tissue fabrication but also dramatically increases the speed, enabling the construction of a one-cubic-centimeter cartilage structure in under 40 minutes—a process that previously took several hours.

In Vivo Applications and Future Implications

Demonstrating the practical applications of their technique, the researchers successfully bioprinted spheroids directly into a rat's skull wound during surgery. By programming these spheroids to differentiate into bone cells using microRNA technology, they achieved 91% wound healing within three weeks and 96% after six weeks. This in vivo application underscores the potential of HITS-Bio for on-demand tissue repair in clinical settings.

Expert Insights

"This technique is a significant advancement in rapid bioprinting of spheroids," stated Ibrahim T. Ozbolat, the Dorothy Foehr Huck and J. Lloyd Huck Chair in 3D Bioprinting and Regenerative Medicine at Penn State. "It enables the bioprinting of tissues in a high-throughput manner at a speed much faster than existing techniques with high cell viability."

Conclusion

The development of HITS-Bio represents a pivotal step forward in bioprinting technology, offering a scalable and efficient method for fabricating functional tissues and organs. This innovation holds promise for accelerating advancements in tissue engineering and regenerative medicine, potentially transforming therapeutic approaches to tissue repair and organ transplantation.

For more information, refer to the original article on Penn State's website.