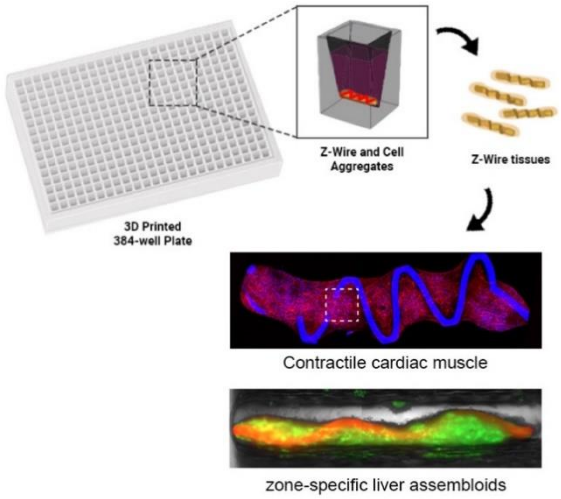
3D Tissues and Assembloids Using Z-Wire Scaffolds



The Z-wire scaffold technology facilitates scalable production and minimally invasive delivery of functional tissues and assembloids with preserved 3D anisotropic alignment and spatial organization.

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Stage of Research

Proof of principle data available

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Abstract

Developing engineered tissues and organoids has become a central focus in regenerative medicine and drug discovery. Currently, there is a need to create complex functional tissues that resembles the spatial alignment and organization of native tissues (e.g. aligned and contractile cardiomyocytes in myocardium, organoid zonation in liver, etc.). Since current techniques for tissue implantation are invasive and difficult to implement, there is also a need for the development of minimally invasive delivery methods of delivery of functional tissues.

McMaster researchers have developed a biocompatible "z-wire" scaffold as a novel strategy for tissue engineering and organoid assembly. Through a scalable and gel-free process, the z-wire scaffold structurally supports the development of cell aggregation and organoid assembly into a functional tissue construct with precise spatial organization (e.g. patterning of zone-specific liver organoids to create hepatic cord assembloids). The z-wire design also reinforces longitudinal alignment of aggregated cells while allowing compressibility, which is particularly important for muscle fiber tissues that require specific biomechanical properties (e.g. cardiac muscle tissue contractility). These smart scaffolds also incorporate nanoscale magnetic particles which aid in macroscopic tissue alignment post-delivery by means of external magnetic guidance. These properties support the intramuscular implantation of functional tissues using minimally invasive injection.

Applications

- Medical Applications
  - Damaged tissue repairs, replacement and therapy (e.g. post-surgery, heart attack or liver injury)
  - Functional tissue implantation in patients via injection
- Drug Discovery, Research & Development
  - Use as miniaturized 3D models of functional tissue.
  - High-throughput microfabrication and testing platform.

Advantages

- Biocompatible and bioresorbable scaffold material
- Structurally supports tissue constructs to remain mechanically stable and easily handled/manipulated during implantation.
- Elongated structure generates functional muscle fiber tissues.
- Simple, scalable, and cost-effective method to develop, screen and assay functional 3D tissue constructs.
- Minimally invasive tissue delivery, alignment, and assembly *in vivo*

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