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Magnetically-Responsive Gradient Electrospun Fiberous Materials

Tissue engineering as a means for musculoskeletal damage repair is an ever-growing field. One of the challenges in this tissue engineering is effective interfacial tissue engineering –interfacing between musculoskeletal tissues such as connections from muscle to tendon and ligament to bone. Such interfacing requires gradients in structure, chemical composition, and mechanics. In musculoskeletal repair surgeries, the regeneration of the interfacial tissue is often overlooked, which is a significant cause for re-injury and loss of mechanical performance. Therefore, it is necessary to continue to develop means for interfacial tissue engineering with gradients to enable musculoskeletal repair to have more comprehensive and long-term success.

Researchers at Arizona State University have developed a new technique for electrospinning a fibrous structure involving both a fiber alignment gradient and a chemistry gradient along one scaffold. Electrospinning is a technique for fabricating fibrous structures by collecting polymers as micro/nanofibers. Electrospinning techniques of magnetic and offset electrospinning are utilized to create structural and chemical gradients within the same layer of fiber collection.

The magnetic electrospinning to create an alignment gradient operates on the principle that magnetic field strength decreases at increasing distances from the magnet; the technique makes the fibers less aligned as the field strength decreases.

The offset electrospinning creates a chemistry gradient by offsetting independent polymer components along the polymer collector. The overall result is the creation of a fibrous scaffold for interfacial tissue engineering that better models the extracellular matrices of these tissues, developing the gradients necessary for interfacing.

Potential Applications

- Musculoskeletal tissue engineering
- Interfacial tissue engineering

Benefits and Advantages

- Efficiency: Creates gradients in fiber structure an alignment within the same layer of fiber deposition
- Integration: Scaffold synthesized with this technique more closely resembles the fibrous nature of the extracellular matrix
- Supply: No longer dependent on donor availability for interfacial tissue, can produce unlimited amount
- Control: Enables control of and alterations to both the fiber alignment gradient and the chemistry gradient of the polymers