Manipulation of Live MCS Incorporating Hydroxyapatite as a Regenerative Bioscaffold

Bourland, Angelica
Bourland IV, Charles

Biomechatronics is the synergistic application of mechanics, biology and electronics. Examples of biomechatronic implants are cardiac pacemakers and neurostimulators, which are implanted in humans. Worldwide, there is a shortage of organs available for donation. As such, biomechatronic replacement parts for diseased organs are being bioengineered in the lab, infused with a patient's own stem cells, and later implanted in patients as bioscaffolds. The goal of this project was to introduce hydroxyapatite into the fermentation process of bacterial cellulose in order to engineer a nanocomposite with potentially attractive applications for tissue regeneration. Two biomechatronic, four chamber hearts were made from live bacterial cellulose and implanted with two electromechanical recirculating pumps in each heart. One of the hearts was made with pure bacterial cellulose, and the second had hydroxyapatite added to the cellulose during the fermentation process. Hydroxyapatite is a complex compound of calcium and phosphate and published research has demonstrated the compound's unique ability to act as a scaffold to assist with bone regeneration. This current study wanted to research hydroxyapatite's effect on living tissue strength and regeneration. The hypothesis was that manipulation of live microbial cellulose structure (MCS) incorporating hydroxyapatite would create a stronger bioscaffold demonstrating faster tissue regeneration within a biomechatronic heat. The results proved the hypothesis, as bacterial cellulose fermented with hydroxyapatite produced a more consistent tissue, with 35% higher tensile strength. In conclusion, this type of bioengineered living tissue has promising applications in biomechatronic implants to assist disease-damaged organs with regeneration.

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