Advanced Manufacturing of Biodegradable Shape Memory Polymers Increases In Vivo Success

Greater biocompatibility of polymers needed for biomedical implantations

Biomedical implantations are utilized to restore, replace, or support existing tissue, and in particular for soft tissue repair. Biocompatible devices are used for these implantations in cases ranging from a newborn with a congenital complication to the elderly with endothelial dysfunction. Though minimally invasive techniques are less risky, when introducing a foreign object into the body there is always the possibility of infection or complete rejection, and this must be considered in light of the current antibiotic resistance crisis. Hence, there is a critical need to develop materials that minimize a foreign body reaction and reduce the number repair procedures. For example, patch repair recurrence rate is >50% amongst congenital diaphragmatic hernia patients between 0 years old and 3 years old using the standard of care, Goretex synthetic patch. Each recurrence requiring an additional procedure increases the infection or rejection risk.

Improving porosity, surface roughness and patterning increases rate of tissue integration

New shape memory polymers offer an improved approach to soft tissue repair because they provide adaptability – most important in pediatric patients – and can be biodegradable. This technology applies the following innovative physical and chemical modifications to the implants to enable catalyzing repair and regeneration of surrounding tissues for a faster recovery: laser cutting, casting, EDC NHS modification, and porosity. With improved tissue regeneration and cell attachment at a faster pace than existing solutions, the risk of infection or rejection is decreased. Furthermore, the structural (e.g., micropatterns, dimensional patterns) and chemical (e.g., acid and base treatment, solvent casting) adjustments to the polymer reduce recurring procedures for repairs and may prevent advanced clinical antibiotic intervention. Despite the significant modifications, all the methods permit the polymer to maintain its predefined shape. There is cost savings to the healthcare system, manufacturer, and patient while reducing healthcare complications and improving patient outcomes.

See also: 8655 Biodegradable Shape Memory Polymer for 3D-Printed Tissue and Biomedical Devices

Summary Bullets

- **Faster healing**: Improvements catalyze the regeneration of tissue for a faster recovery

- **Increased efficacy**: Decreases the likelihood of rejection because the polymers are manufactured in such a way to increase tissue ingrowth and cell attachment
- **Reduced healthcare resource utilization**: When initial implantation is successful, it reduces the need for secondary procedures or advanced clinical care for infection

Solution Advantages

- **Faster healing**: Improvements catalyze the regeneration of tissue for a faster recovery
- **Increased efficacy**: Decreases the likelihood of rejection because the polymers are manufactured in such a way to increase tissue ingrowth and cell attachment
- **Reduced healthcare resource utilization**: When initial implantation is successful, it reduces the need for secondary procedures or advanced clinical care for infection

Potential Commercial Applications

- Pediatric and adult surgical implantation devices for cardiovascular, musculoskeletal, gastrointestinal, and other soft tissue repair applications
- Minimally invasive surgery
- Veterinary medicine

Inventors

- Dr. Sriharsha Ramaraju
  Research Engineer - Georgia Tech Coulter Department of Biomedical Engineering
- Dr. Scott Hollister
  Professor and Patsy and Alan Dorris Chair in Pediatric Technology, Associate Chair for Translational Research - Georgia Tech Coulter Department of Biomedical Engineering

IP Status

Patent application has been filed : PCT/US2022/072442

Publications

Designing Biodegradable Shape Memory Polymers for Tissue Repair, Advanced Functional Materials - July 16, 2020

Images

Visit the Technology here:
Advanced Manufacturing of Biodegradable Shape Memory Polymers Increases In Vivo Success