'Bio pen' allows surgeons to design customised implants

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A handheld bio pen developed in the labs of the University of Wollongong will allow surgeons to design customised implants during surgery.

A handheld 'bio pen' developed in the labs of the University of Wollongong (UOW) will allow surgeons to design customised implants on-site and at the time of surgery.

The BioPen, developed by researchers from the UOW-headquartered

Australian Research Council Centre of Excellence for Electromaterials Science (ACES), will give surgeons greater control over where the materials are deposited while also reducing the time the patient is in surgery by delivering live cells and growth factors directly to the site of injury, accelerating the regeneration of functional bone and cartilage.

The BioPen works similar to 3D printing methods by delivering cell material inside a biopolymer such as alginate, a seaweed extract, protected by a second, outer layer of gel material. The two layers of gel are combined in the pen head as it is extruded onto the bone surface and the surgeon 'draws' with the ink to fill in the damaged bone section.

A low powered ultra-violet light source is fixed to the device that solidifies the inks during dispensing, providing protection for the embedded cells while they are built up layer-by-layer to construct a 3D scaffold in the wound site.

Once the cells are 'drawn' onto the surgery site they will multiply, become differentiated into nerve cells, muscle cells or bone cells and will eventually turn from individual cells into a thriving community of cells in the form of a functioning a tissue, such as nerves, or a muscle.

UOW's Professor Gordon Wallace and his team at the Australian Research Council Centre of Excellence for Electromaterials Science developed the device.

The device can also be seeded with growth factors or other drugs to assist regrowth and recovery, while the hand-held design allows for precision in theatre and ease of transportation.

The BioPen prototype was designed and built using the 3D printing equipment in the labs at the University of Wollongong and was this week handed over to clinical partners at St Vincent's Hospital Melbourne, led by Professor Peter Choong, who will work on optimising the cell material for use in clinical trials.

The BioPen will help build on recent work by ACES researchers where they were able to grow new knee cartilage from stem cells on 3D-printed scaffolds to treat cancers, osteoarthritis and traumatic injury.

Professor Peter Choong, Director of Orthopaedics at St Vincent's Hospital Melbourne and the Sir Hugh Devine Professor of Surgery, University of Melbourne said:

"This type of treatment may be suitable for repairing acutely damaged bone and cartilage, for example from sporting or motor vehicle injuries. Professor Wallace's research team brings together the science of stem cells and polymer chemistry to help surgeons design and personalise solutions for reconstructing bone and joint defects in real time."

The BioPen will be transferred to St Vincent's for clinical projects to be carried out at the proposed Aikenhead Centre for Medical Discovery in Melbourne.

"The combination of materials science and next-generation fabrication technology is creating opportunities that can only be executed through effective collaborations such as this," ACES Director Professor Gordon Wallace said.

"What's more, advances in 3D printing are enabling further hardware innovations in a rapid manner."

Provided by University of Wollongong