Medical and Healthcare

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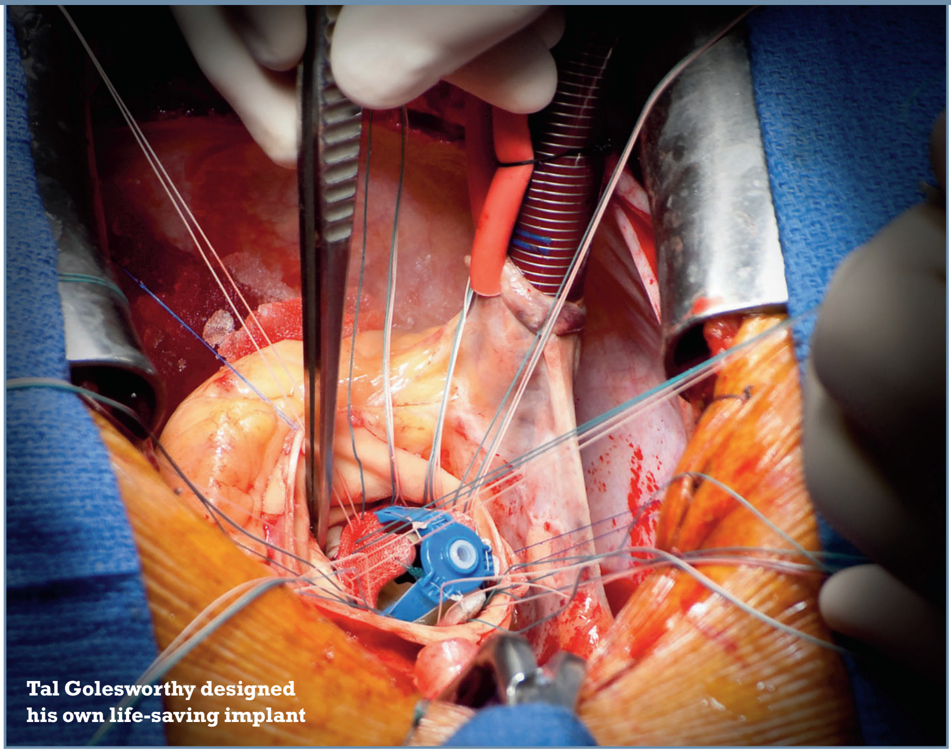

Tal Golesworthy designed his own life-saving implant

SMARTNAIL

Smith & Nephew, University College London, Royal National Orthopaedic Hospital

A telemetric nail that can monitor how well broken bones are healing has been developed through a collaboration involving engineers from medical device firm Smith and Nephew, and orthopaedic specialists from University College London (UCL).

Metallic bone implants — also known as intramedullary nails — have been used since the 1940s to treat fractures but have hitherto been mainly passive. The new device, dubbed SmartNail uses sensors and processors to actively measure the stresses and strains on an injured bone. This data can then be downloaded by a wearable device.

Currently, clinicians rely on X-rays to monitor and diagnose fracture healing, a process that requires expert professional judgement and leaves the patient at risk of over-loading their fracture during a post-operative period. SmartNail will eliminate some of this risk by providing validated quantitative data about fracture healing.

The implant will record the direction of the exerted load, allowing physicians and patients to know exactly which type of activity triggers too much stress. The device will also be able to record high load events yielding data that could corroborate decisions about resumption of normal activities, a more scientific approach than subjective pain feedback from patients. It will also record temperature, so localised inflammation from a periprosthetic infection can be caught early.

Smith & Nephew believes that wireless communication between orthopaedic implants and an external system could dramatically change the way clinicians and surgeons interact with the body, and it believes the device could grab a big share of the global IM nail market.

The technology is currently undergoing pre-clinical trials, after which Smith & Nephew hopes to introduce it on a nail for mending fractures of the tibial shaft.

EXTERNAL AORTIC ROOT SUPPORT

Exstent, Imperial College London, Royal Brompton Hospital

Tal Golesworthy's story is an inspiring demonstration of Plato's adage about necessity being the mother of invention. Faced with a life-threatening heart condition the trained process engineer developed and then became the world's first recipient of a revolutionary medical implant.

Golesworthy suffers from Marfan syndrome, a potentially fatal condition which, among a host of other symptoms, causes progressive dilation of the heart's aortic root. The conventional treatment for this condition is known as the Bentall Graft, a highly invasive treatment that involves cardio pulmonary bypass (CPB), body cooling, heart arrest and draining, all of which involve significant cost, risk and recovery time to the patient. The procedure also requires patients to take anti-coagulation drugs for the rest of their life.

Working with cross-disciplinary team of clinicians, surgeons and engineers, Golesworthy used MRI scans, CAD and rapid prototyping technology to design and manufacture a textile external support that can be fitted around the aorta.

On 24 May 2004, Golesworthy became the first recipient of the External Aortic Root Support (EARS) implant. He has since formed a company, Exstent, to commercialise the technology and a further 23 patients have successfully had the implant fitted. According to Golesworthy, the technique will soon replace the Bentall procedure.

NEUROCHIP

Leicester University, Imperial College, Newcastle University

Patients with spinal cord injuries could one day move paralysed parts of their bodies with a wearable robotic device controlled by a wireless chip implanted in the brain.

The technology is being developed through a £1m government-sponsored research programme involving academics from Leicester University, Newcastle University and Imperial College London.

The team has developed a low-power implantable chip able to monitor and wirelessly transmit the activity of the neurons of the brain that could usher in a new generation of assistive devices such as computers, robotic prostheses and wheelchairs.

Until now, so-called brain machine interface (BMI) technology has relied on connecting intracortical electrodes to external amplifiers via wires passing through the skin. This approach breaches the body's natural barrier to bacterial infections, presenting a serious danger to patients and also requires powerful computers.

Thanks to a neural spike sorting algorithm developed by Leicester University, the ultra-low-power implantable chip currently under development has its own processing capability and thus significantly decreases the necessary bandwidth to be transmitted and allows low power wireless transmission.

The group believes that the low-power chip could be a key component in a variety of neural prostheses. Neural devices now constitute a $2bn a year industry that is predicted to grow twice as fast as the cardiac implant market.