From Orthopedics to Power Transfer—A Bright Future for Implants

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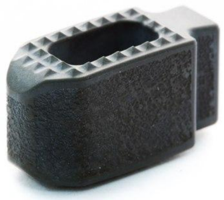
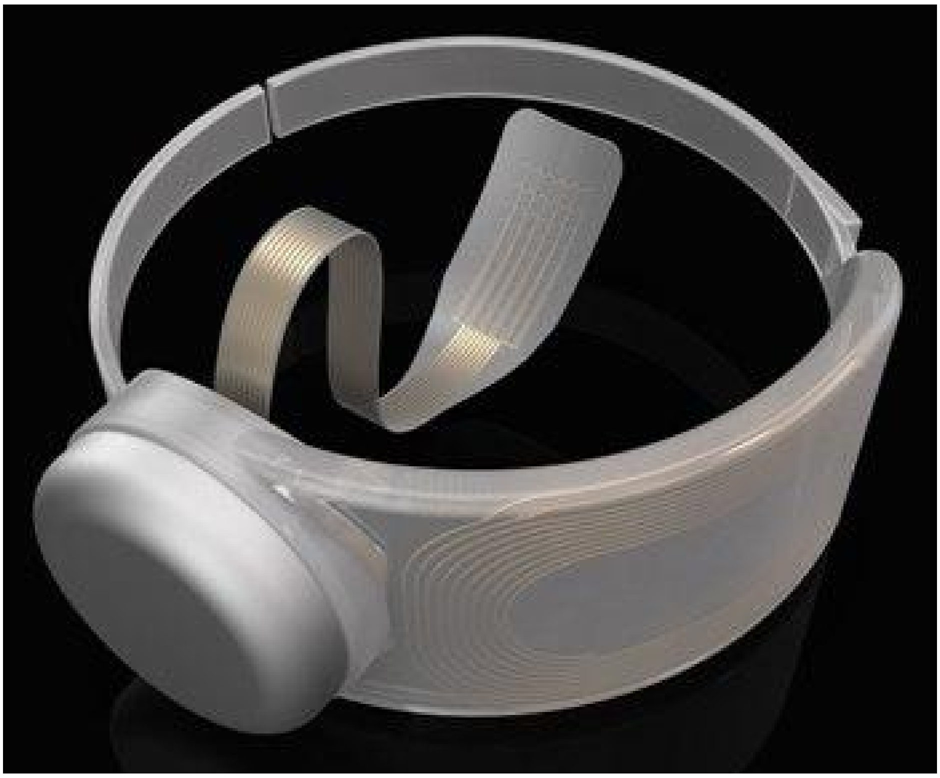
Much like other medical technology, implants are adapting to a post-depression economy brimming with new materials, new ideas, and ambitious plans for the future. The result is a focus on designing safer, more bio-compatible products for local markets.

3D Printing for Personalized Implants
Though 3D printing has been used as an expensive “toy” in the past, it holds great promise for the medical field once it reaches a certain state of sophistication. One problem with implants, particularly in pediatrics, is that there are so many different anatomies and types of patients, but limited options when it comes to implant designs, says Venkat Rajan, industry manager at Frost & Sullivan [1].



With 3D printing, one could potentially perform an advanced imaging scan and decide the patient needs a spinal implant of a certain size and range specific to his or her body and needs. Then the doctor would send those specifications to a 3D printer to print out the correctly sized implants. This could potentially evolve to custom hip implants that offer a better fit and less risk of complications.

Material for Spinal Implants
Traditionally, biomaterials for spinal implants are poly-ether-ether-ketone (PEEK) or titanium (Ti), which are vulnerable to bacterial growth and can be challenging when it comes to imaging. In an effort to provide a better alternative, Amedica [2] began using silicon nitride—a heat resistant ceramic material that reduces the risk of infection and promotes bone growth when compared to PEEK or Ti, according to peer reviewed studies. The material, which showcases its strength in military and aerospace applications, can be manufactured to be dense or porous and finished as highly polished or texturized, which allows for a wide variety of options and applicable situations for the implants.



Retinal Implants for Blind Patients

Retinitis Pigmentosa (RP), an inherited retinal degenerative disease affecting roughly 100,000 Americans, often results in nearly complete blindness for its sufferers. However, with the development of the retinal prosthesis called Argus II System from Second Sight Medical Products [3], those suffering from RP and other outer retinal degenerations might be able to see again. Though the implant won't restore vision completely, it will provide visual patterns that the patient can learn to interpret, allowing them to regain some visual function, according to Robert Greenberg, MD, Ph.D., president and CEO of Second Sight. The system converts video images into electrical pulses that stimulate the retina's remaining cells via electrodes on the surface of the retina. The pulses, transmitted wirelessly, result in patterns of light that the patient will see. The implant, the first of its kind, has been approved by the FDA (2013) and received European Approval (2012).

Implantable Drug Delivery Systems

Drug delivery implants present designers with a multitude of issues from how to deliver a steady dosage to the issue of removing the implant versus creating a biodegradable solution. TissueGen [4], a drug-loaded biodegradable fiber, is part of a new approach to provide both pharmaceutical and mechanical support from the same material, according to Kevin Nelson, MD, founder of TissueGen. In addition to a continuous stream of drugs, the fiber protects the drug so it's not released until it should be and won't "rub off" during the insertion or handling process. The technology works with any medical textiles currently used in the medical field by replacing the existing fibers with the TissueGen fibers. Single strands or small groups can be used in "smart" sutures, ocular drug delivery, tumor remediation, spinal implants, and a wide range of other applications, says Dr. Nelson. The biodegradable fibers hold great promise in medicine as a "scaffold for use in tissue engineering and regenerative medicine" with the ability to provide localized delivery to cells attached to the fibers, according to Dr. Nelson.

Neurological Implants

In a development that holds great potential for severe neurologically impaired patients, a team of neuroengineers at Brown University developed a fully implantable, rechargeable, wireless brain sensor, capable of untethered broadband neural data collection in primates, according to a recent paper in the *Journal of Neurological Engineering*. The ultra-low power, 44.5-g titanium-encased implant is capable of operating continuously across 100 channels for up to seven hours. It has been operating in non-human primates for over 12 months and data was successfully transmitted at 24 Mbps, according to the study. The hope is that eventually, this technology will allow neurologically impaired patients more mobility and freedom, while allowing for a more natural integration of assistive device technology.

Energy Transfer

As traditional medical devices evolve to wireless implants, the challenge of how to charge the devices is taking center stage. One option would be to remove the pacemaker, heart assist pump, or other implant and replace the battery. Obviously this isn't ideal because it requires an additional procedure. WiTricity [5] is a wireless power transfer technology that utilizes magnetic resonance and can be used in conjunction with implants like ventricular assistance devices to facilitate charging through the patient's skin without raising the temperature of the tissue, according to David Schatz, vice president of sales and business development at WiTricity. The technology allows for a power source several centimeters above the skin to charge a deeply embedded implant, allowing for more patient comfort and lower risks.

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