Porous structures help boost integration of host tissue with implants, study finds

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Results published today in FASEB (the journal of the Federation of American Societies for Experimental Biology) by researchers at Columbia University, including Jeremy Mao of the Columbia College of Dental Medicine, demonstrate a novel way of using porous structures as a drug-delivery vehicle that can help boost the integration of host tissue with surgically implanted titanium.

Instead of being acted upon by the body as an impenetrable foreign object, the synthetic bone replacement – currently being tested in rabbits – features a porous material that allows for the delivery of "microencapsulated bioactive cues" that speed up the growth of host tissue at the site and allow for the growth of new bone.

A critical finding is that the drug dose needed for host tissue integration by this controlled-release approach is about 1/10 of that by the traditional technique of simple adsorption of the growth factor.

The approach could bring to orthopedics and dentistry a treatment that has wrought much interest and success in the field of cardiology with the development of drug-eluting stents, which take what is ordinarily an inert tube, and infuse it with drugs to make the placement of what is essentially a man-made, foreign object more compatible with the patient's body, and at the same time, actively promoting healing of injured tissue.

After just four weeks, the porous implants that Mao and his team are

using showed a 96 percent increase in bone-to-implant contact and a 50 percent increase in the growth of new bone over placebos.

How were such results achieved?

Since stem cells play a vital role in the growth of new bone, Mao and his team have focused on impregnating the titanium implants with a factor that “homes” the bodies’ own regenerating cells to the potential growth site to create and build on a platform for new bone.

The new approach may in the future obviate the need to harvest bone from a non-injured site in the body for grafting into the site of injury, as commonly performed now. This strategy, although often effective, creates additional wounds. The work of Mao and his team suggests that it should be possible to harnesses the body’s natural tissue regeneration capacity to recruit the right cells to the site where new bone tissue is needed. Implants that naturally attract the mesenchymal stem cells that can readily differentiate into bone, fat, cartilage and other types of cells could be the way of the future, Mao says. “In comparison with donor site morbidity and pain in association with autologous tissue grafting, synthetic materials have the advantage of ready and endless supply without any sacrifice of donor tissue,” he says.

The approach also overcomes a practical obstacle confronting many orthopedic surgeons.

“This is a hybrid approach releasing biological cues from existing orthopedic and dental implants to recruit the body’s own stem cells. It’s unrealistic, at least from what we know now, to build a cell culture room next to every operating room,” Mao added. “Using these types of porous implants doesn’t require physicians to deliver stems cells so much as it allows the patient’s body to send its own cells to the right place.”

Source: Columbia University Medical Center

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