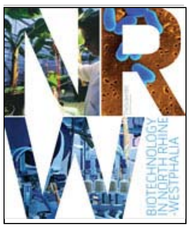

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News:

Worm glue to repair bones

Posted by Jef Akst
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Mimicking an adhesive naturally produced by marine worms, researchers have created a new glue that may help surgeons reconstruct shattered bone, they reported today (August 17) at the American Chemical Society (ACS) 238th National Meeting in Washington, DC.

"It's a wonderful advance," said biophysicist Bob Baier of the State University of New York at Buffalo, who was not involved in the research. "It's a nice extrapolation from marine science to orthopedics."


Sandcastle worm
Image: Russell Stewart

The sandcastle worm builds its tubular home out of sand and broken shells, which it glues together piece by piece with a protein-based cement. The most impressive part of the process: It's done entirely underwater. Bioengineer Russell Stewart and his colleagues at the University of Utah are studying the adhesive in hopes of creating a synthetic glue that could be used to reassemble the small fragments of bone that result from complex breaks that must be glued within the wet environment of the body.

"There's lots of synthetic adhesives in widespread use for other things, [but] there's no adhesives used for deep tissue repair," Stewart said. Current remedies are primarily mechanical fixes, such as screws, pins, and plates, which can be an inefficient method for repairing highly fractured bones.

In 2004, the researchers cloned the genes that code for the natural adhesive and found that it is composed of highly charged proteins -- either strongly positive or strongly negative. They hypothesized that these proteins associate electrostatically to paste the worms' sandcastle homes together, and set out to make synthetic polymers with the same proportion of positively and negatively charged components that might mimic the adhesion properties of the natural glue.

Indeed, combined together, the synthetic polymers formed a liquid mixture that solidified upon a change of temperature or pH, securing two wet bone fragments from a bovine femur. Although their first attempt yielded a synthetic adhesive with only 1/3 the bond strength of the natural worm glue, Stewart reported in his talk today that their most recent creation is approximately twice as strong -- as tested on wet aluminum plates -- as the worms' version. The researchers have not yet tested the compound in live animals.

"The nice thing about synthetic mimics is you can tailor the system," said bioengineer Jonathan Wilker of Purdue University in Indiana, who did not participate in the research. "You don't have to be stuck with what nature's given you," which means it may be possible to create an adhesive that's better than the natural version.

An additional advantage to using synthetics is quantity, Wilker said. While the worms secrete only a fraction of a microliter of adhesive each time they glue a bit of shell or sand together, synthetic polymers can be "made on the ton scale" -- enough to properly test the agent and produce it commercially should it eventually be approved for clinical use.

The most recent version of the synthetic adhesive, in which one of the synthetic polymers is replaced with an analogous protein, is also more biodegradable, Stewart said, which means that as the bone heals, the adhesive would degrade away. However, there's the risk that by adding a foreign protein, "you're opening the door for a self versus non-self rejection phenomenon," Baier said. So far, the new glue has not shown any signs of being toxic in cell cultures, Stewart reported.

"We'll probably be tweaking the chemistry until I retire," Stewart admitted, "but I think we're close to a point where we move on to the next steps." Those will involve a more thorough analysis of the biocompatibility and biodegradability of the new glue, including testing it in live animals, and working out the details of the adhesion process.

A good bioadhesive must "set in wet environment, be biocompatible, and create a strong bond," said Wilker. "That combination of three things is really tough, [but Stewart's] work is really promising."

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