Severed nerve regrows to bridge a gap

Biodegradable chemicals have succeeded in encouraging severed nerves in rats to regenerate and span a ⅔-inch gap in tissue. Preliminary results of this work, reported last week in Chicago at the American Chemical Society's national meeting, suggest that these chemicals might become the basis for a device to treat trauma patients with significant damage to nerves in the extremities.

Moreover, the fact that the same polymeric material "can induce regeneration of two very distinct tissues [the sciatic (leg) nerve and skin]," says Ioannis Yannas of the Massachusetts Institute of Technology (MIT), "suggests very strongly that there is potential for regeneration in other organs that has been significantly underrated." Yannas collaborated on the nerve regeneration device with colleagues at MIT, Case Western Reserve University in Cleveland and two Boston hospitals.

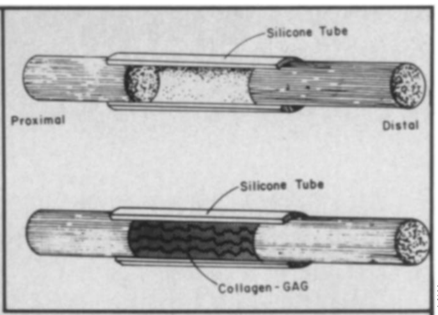
Yannas was a developer of the "artificial skin" used to grow new epidermis on human burn victims (SN: 1/30/82, p. 73). He says the nerve regeneration device employs the same chemistry: a plastic silicone outer layer (here a tube) filled with cowhide-derived collagen (connective tissue) that has been chemically bonded to a carbohydrate polymer — glycosaminoglycan, or GAG — derived from shark cartilage.

The collagen-GAG polymer acts as an initial "scaffold" to support the nerve endings' new growths. By the time the polymer had degraded — six weeks after surgery — "we saw continuous nerve fibers bridging the 15-millimeter gap," Yannas says. (In any final device, the plastic tubing would also have to be replaced with a biodegradable material.)

Yannas notes that work led by Swedish researcher Goran Lundborg showed that severed nerves guided by an empty silicone conduit could regenerate across a 6- to 12-mm gap — but not across 15 mm. "So we worked at 15 mm," Yannas says, "to find out if our material was offering a significant advantage over what was thought to be the best previous work."

Last year Luis de Medinaceli and his colleagues at St. Elizabeth's Hospital in Washington, D.C., reported that they had restored nerve function in rats whose sciatic nerves had been severed, splinted back together and allowed to reattach (SN: 1/28/84, p. 52). Referring to Yannas's work, de Medinaceli says, "He is addressing an issue which I have not — how to bridge a gap." Spanning gaps is "fundamentally important" to reconstructive surgeons, he says, but only if nerve function returns. And establishing that will be essential to proving the value of Yannas's device, he believes.

De Medinaceli likens nerve tissue to a trunk line of optical fibers transmitting telephone messages across the Atlantic. He notes that while merely reattaching



Polymer-filled device (lower) promoted reattachment of proximal and distal nerve stumps.

two stump ends of the fiber bundle may be enough to restore most American callers to a party in Europe, if the original ends of each fiber are not matched precisely the American caller will reach a stranger, not the party dialed. In the body, he says, similar confusion may arise if nerve tissues don't know whom they're addressing. De Medinaceli says tests of how well the rats walk again show that his patched nerve ends match reasonably well the original connections.

Yannas concedes that similar tests need to be conducted on rats whose nerves grew back across a 15-mm gap. However, he says it's not unreasonable to suspect that enough valid reconnections can span a gap to restore function. Citing unpublished data on tests that his group conducted two years ago, he says rats regained the ability to walk after severed sciatic nerves regenerated across a 5-mm polymer-filled gap. — *J. Raloff*

Pinning down the pole's position

Columbus and other mariners found their way around the globe by noting their latitude as measured by the height of the North Star above the horizon. Centuries later, scientists discovered that there are subtle variations in this height caused by the circular excursions of the earth's spin axis relative to its solid crust — a motion called the Chandler wobble (SN: 10/24/81, p. 269). Measuring this wobble is important not only for surveying and navigation but also for understanding the planet's inner workings that cause it. Until recently, however, these measurements were too inexact to shed much light on the dynamics of the pole's peculiar dance.

Now the accuracies of two measurement techniques have reached new heights. In the Sept. 20 SCIENCE geophysicists report that estimates of the earth's pole position made by satellite laser ranging (SLR) and very long baseline interferometry (VLBI) differ by about 2 milliseconds (msec) of arc, or about 6 centimeters, indicating that this is the maximum total root-mean-square error for both techniques together. For comparison, the total displacement of the pole during the corresponding 14-month Chandler period was about 500 msec of arc, or about 15 meters.

"A lot of people were very startled by this accuracy," says Douglas Robertson at the National Geodetic Survey (NGS) in Rockville, Md., who co-authored the paper with William Carter at NGS and three researchers at the University of Texas at Austin. The errors of other methods currently in use range from about 3 to 10 times greater than those of SLR and VLBI.

The high degree of accuracy of SLR, which involves bouncing a laser beam from earth off a satellite, and of VLBI, which measures at different observatories the differences among arrival times of radio waves from very distant quasars, has been available for only a few years. When Robertson and Carter last compared the time series data from these two techniques, in 1983, they obtained a root-mean-square error of about 6 msec of arc. Both this and the more recent study are part of an internationally sponsored project called MERIT (Monitor Earth's Rotation and Intercompare Techniques of Observation and Analysis).

By improving the accuracy of these measurements scientists hope to resolve the debate over which forces drive the Chandler wobble. Most researchers agree that the earth's spin axis is affected by any change in the distribution of mass in the earth, oceans and atmosphere. Some believe that the disproportionately heavy snowfall in Siberia is primarily responsible, while others have argued that the wobble is due mainly to changes in the atmosphere and winds blowing on mountains. Still others think that large earthquakes are the real culprits.

"The answer is likely to be all of the above and then some," says Robertson. "The bottom line is that we want to get accurate measurements [for a while] and then let the theoreticians squabble over what the numbers mean."

In their recent paper, Robertson's group took a quick look at the possibility that earthquakes affected the motion of the pole during the study period. They found no discernible effect near the times of earthquakes with a magnitude 7 or larger. Robertson notes, however, that some models have predicted that earthquake-induced effects might be delayed by as much as 20 years and then spread out over

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