Researchers use light to detect Alzheimer's

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A team of researchers in Bedford, Mass. has developed a way of examining brain tissue with near-infrared light to detect signs of Alzheimer's disease.

In the March 15 issue of the journal *Optics Letters*, published by the Optical Society of America, the team describes how they used optical technology to examine tissue samples taken from different autopsies and correctly identified which samples came from people who had Alzheimer's disease. Alzheimer's currently afflicts some 4.5 million Americans and is the most common cause of dementia among older people in the United States.

"We're primarily interested in finding a way of diagnosing and monitoring Alzheimer's disease during life," says U.S. Department of Veterans Affairs Research Scientist Eugene Hanlon. "We think this technique has a lot of potential for detecting the disease early on."

The new technique developed by Hanlon and his collaborators at Harvard Medical School/Beth Israel Deaconess Medical Center and Boston University can detect alterations to the optical properties of the brain that occur as the tissue undergoes microscopic changes due to Alzheimer's—sometimes far in advance of clinical symptoms. The technique is now being tested for its effectiveness at diagnosing Alzheimer's disease in living people.

For several years, Hanlon and his colleagues have looked at the possibility of analyzing the brain with near-infrared light, which has the

advantage of being able to safely penetrate the skull and pass harmlessly through the brain. Inside the head, some of the infrared light scatters, however, and how the light scatters can tell researchers about the condition of the brain.

In their paper, the team reports observing an optical effect due to the presence of microscopic features of Alzheimer's. Amyloid plaques, one of the telltale signs of Alzheimer's disease, scatter light differently from normal brain tissue. What Hanlon and his colleagues showed was that as the microscopic plaques accumulate, the optical properties of the brain change. The team found that this change is detectable and that their technique could quantify differences between in-vitro samples and correctly identify signs of Alzheimer's.

This technique will be a boon to medicine if it is able to detect microscopic changes that can be related to disease progression. While techniques like MRI are good at identifying the gross anatomical features associated with Alzheimer's, they cannot detect more microscopic changes.

Although Alzheimer's disease is one of the leading causes of death in the United States, claiming tens of thousands of American lives a year, there is no definitive way to diagnose it—at least not while someone is alive. After someone with Alzheimer's dies, pathologists can perform an autopsy and examine slices of the brain under the microscope, looking for the same signs that Alois Alzheimer first recognized when he identified the disease more than a century ago. Finding accumulations of amyloid plaques in the brain substance and tangle-like proteins in nerve cells is the only way to confirm with certainty that someone had Alzheimer's while they were alive.

Since there is no way to safely examine the brains of living people this way, doctors currently diagnose Alzheimer's disease using other

methods. They rely on reviewing medical histories, administering physical exams, and taking into account the results of a battery of neuropsychological assessments that measure cognitive performance. A positive diagnosis is made when all other possible causes have been eliminated, but even under the best of circumstances, these diagnoses can be incorrect 10 percent of the time or more.

Accurate, early detection of Alzheimer's could save many lives. While there is no cure for the disease, clinically proven treatments can slow its progress—especially if they are administered early on. Moreover, being able to follow the disease progression over time would greatly enhance the ability of researchers and pharmaceutical companies to find new and improved drugs and treatment strategies for people at all stages of the disease.

A current rich area of research seeks to get information about what is going on in the brain without actually looking at the tissue. Some scientists, for instance, look at whether proteins and other biomarkers in the blood or spinal fluid indicate disease progression. Others try to image the brain with established techniques like MRI or PET scans. Optical methods, like the one used by the Bedford researchers, are an emerging approach to imaging.

Source: Optical Society of America