Researchers develop first non-invasive test to measure skin aging

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Physicists and medical researchers for the first time have demonstrated a new technique that non-invasively measures in real time the level of damage to the skin from sun exposure and aging, and initial results suggest that women's skin ages faster than men's. Findings appear in the October 1 issue of *Optics Letters*, a journal of the Optical Society of America.

This new laser-based technique images the fabric of the deeper layers of the skin, combining methods for imaging collagen and elastin, whose degeneration causes the appearance of wrinkles and the progressive loss of skin smoothness. The technique measures relative amounts of collagen and elastin by a single factor, which can be positive or negative, like temperatures. Higher values of the factor correspond to higher collagen content, and to lower elastin content. Previously, each of the imaging techniques had only been tested on tissue extracted from live patients. Last year, Sung-Jan Lin, of National Taiwan University in Taipei, and collaborators, defined the collagen/elastin factor and demonstrated that it gave results consistent with the results of existing lab techniques.

In the new paper, researchers at Friedrich Schiller University, in Jena, Germany, at the Fraunhofer Institute of Biomedical Technology, in St. Ingbert, Germany, and at JenLab GmbH, a Jena-based laser technology company, tested the technique directly on the forearms of 18 patients, measuring the collagen/elastin factor. The team was also able to obtain images of tiny swaths -- one-fifth of a millimeter wide -- of the proteins'

fibrous matrices, showing the physical appearance of the dermis, the white lower-layer of skin that gets exposed in deep abrasions.

Large variations appeared from patient to patient, and even from one part of a patient's forearm to another. "In a healthy 35-year-old, some areas can appear like the skin of a 25-year-old, and others like that of someone who's 50," said Johannes Koehler, a dermatologist at Friedrich Schiller University and a coauthor of the *Optics Letters* paper. But on average, both the collagen/elastin factor and the physical appearance of the network showed a clear dependence on the patients' age. The dependence appeared to be sex-dependent, with women's skin losing collagen at faster rates than men's.

The two methods combined in the imaging technique use the ability of ultra-brief pulses of laser infrared light to stimulate tissues to emit light at shorter wavelengths -- blue in the case of collagen, and green in the case of elastin. Since the upper layer of the skin, called the epidermis, is virtually transparent to infrared light, the infrared laser can reach the dermis with intense pulses of light without damaging the upper layers. By two different quantum processes, collagen and elastin will then respond by glowing blue and green.

Currently, dermatologists who want to check out the collagen network of a patient's dermis need to remove a sample of tissue and analyze it in the lab, under a microscope or by other methods. In particular, it is impossible to monitor variations in the very same spot as aging progresses. "You would like to measure changes in collagen content over time," Dr. Koehler said. "Moreover, current techniques provide a qualitative assessment of the state of the matrix, but no precise measure of the collagen or of the elastin content, which is what the new technique does," he said.

Although the technique is still at the experimental stage, the authors

hope that someday it could become useful in studying skin diseases that affect the collagen structure. Those include scleroderma, a poorly understood disease characterized by excessive deposits of collagen in the skin, and some chronic complications of graft-versus-host disease, which occur when the tissues of bone marrow transplant patients are attacked by immune cells coming from the donor. "Perhaps the technique could help monitor the progress of the disease, or the success of a treatment," Dr. Koehler said. Testing the effectiveness of anti-aging cosmetic products could also become easier. "Some cosmetics are thought to change the content of collagen in the skin," Dr. Koehler said, "but until now, to measure that you had to cut out a piece of skin."

Citation: "In vivo assessment of human skin aging by multiphoton laser scanning tomography," by Martin Johannes Koehler, Karsten Kцnig, Peter Elsner, Rainer Bьckle, and Martin Kaatz, Optics Letters, Vol. 31, Issue 19, pp. 2879-2881.

Source: Optical Society of America