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NASA Space Technology Shines Light On Healing

Doctors at the Medical College of Wisconsin in Milwaukee have discovered the healing power of light with the help of technology developed for NASA's Space Shuttle. Using powerful light-emitting diodes, or LEDs, originally designed for commercial plant growth research in space, scientists have found a way to help patients here on Earth.

Doctors are examining how this special lighting technology helps hard-to-heal wounds, such as diabetic skin ulcers, serious burns, and severe oral sores caused by chemotherapy and radiation. The project includes laboratory and human trials, approved by the U.S. Food and Drug Administration and funded by a NASA Small Business Innovation Research contract through the Technology Transfer Department at NASA's Marshall Space Flight Center in Huntsville, Ala. "So far, what we've seen in patients and what we've seen in laboratory cell cultures, all point to one conclusion," said Dr. Harry Whelan, professor of pediatric neurology and director of hyperbaric medicine at the Medical College of Wisconsin. "The near-infrared light emitted by these LEDs seems to be perfect for increasing energy inside cells. This means whether you're on Earth in a hospital, working in a submarine under the sea or on your way to Mars inside a spaceship, the LEDs boost energy to the cells and accelerate healing."

Dr. Whelan's findings will be summarized in upcoming issues of Space Technology and Applications International Forum 2001 and in The Journal of Clinical Laser Medicine and Surgery. Other related peer-reviewed journals have published articles on Whelan's medical research with light-emitting diodes. Dr. Whelan's NASA-funded research has already seen remarkable results using the light-emitting diodes to promote healing of painful mouth ulcers caused by cancer therapies such as radiation and chemotherapy.

The treatment is quick and painless. The wound-healing device is a small, 3.5-inch by 4.5-inch (89-millimeter by 114-millimeter), portable flat array of LEDs, arranged in rows on the top of a small box. A nurse practitioner places the box of LEDs on the outside of the patient's cheek about one minute each day. The red light penetrates to the inside of the mouth, where it seems to promote wound healing and prevent further sores in the patient's mouth.

"Some children who probably would have had to be fed intravenously because of the severe sores in their mouths have been able to eat solid food, " said Dr. David Margolis, an oncologist at Children's Hospital of Wisconsin in Milwaukee and an assistant professor of pediatrics at the Medical College of Wisconsin. Margolis, whose pediatric cancer patients are participating in the study, explained that, "Preventing oral mucositis improves the patients' ability to eat and drink and also may reduce the risk of infections in patients with compromised immune systems."

Dr. Whelan's collaboration with NASA began when Ronald Ignatius, owner of Quantum Devices Inc. in Barneveld, Wis., learned about Dr. Whelan's brain cancer surgery technique using drugs stimulated by laser lights. Laser-light surgical probes are costly and cumbersome in the operating room because they are heavy, with refrigerator-size optical, electrical and cooling systems.

Ignatius originally designed the lights for plant growth experiments through the Wisconsin Center for Space Automation and Robotics, a NASA commercial space center at the University of Wisconsin in Madison. "The LEDs needed to grow plants in space produced the same wavelengths of light the doctor needed to remove brain tumors," said Ignatius. "Plus, when we developed the LEDs for NASA, they had to be lightweight to fly aboard the shuttle and have small cooling systems.

These traits make the LED surgery probes easier to use in the operating room and thousands of dollars cheaper than laser systems." Quantum Devices altered the surgical probe to emit longer wavelengths of red light that stimulate a photodynamic drug called Benzoporphyrin Derivativeä. Doctors at the Children's Hospital of Wisconsin recently completed the first-ever surgery with the improved probe and medicine. The drug also has fewer side effects after surgery. The ongoing brain surgery study is described in a 1999 peer-reviewed journal article in Pediatric Neurosurgery.

"At NASA, we work with companies like Quantum Devices to take technologies developed for use in space and bring the benefits back home to Earth," said Helen Stinson of Marshall's Technology Transfer Department. "NASA is proud to support a program that helps children with brain cancer -- and promises to help even greater numbers of people with technology to accelerate the healing process."

In the laboratory, Whelan and his team have shown that skin and muscle cells grown in cultures and exposed to the LED infrared light grow 150 to 200 percent faster than ground control cultures not stimulated by the light. Scientists are trying to learn how cells convert light into energy, and identify which wavelengths of light are most effective at stimulating growth in different kinds of cells.

To expand the wound healing study, Whelan -- a commander and diving medical officer in the U.S. Navy reserve assigned to Naval Special Warfare Command (Naval Special Warfare Group TWO) -- is working with doctors at Navy Special Warfare Command centers in Norfolk, Va., and San Diego, Calif. They reported a 40 percent improvement in patients who had musculoskeletal training injuries treated with the light-emitting diodes.

A wound-healing device was placed on the USS Salt Lake City submarine, and doctors reported 50-percent faster healing of crewmember's lacerations when exposed to the LED light. Injuries treated with the LEDs healed in seven days, while untreated injuries took 14 days.

The LED research project will continue for the next 18 months, with doctors studying 100 patients at two major teaching affiliates of the Medical College of Wisconsin. Researchers will continue to examine the influence of LEDs on cells grown in the laboratory, and will explore the benefits that LEDs might provide to counteract possible cell damage caused by exposure to harmful radiation and weightlessness during long space missions.

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