

Biomedical Engineering

Rick Weiss reports from San Antonio, Tex., at the World Congress on Medical Physics and Biomedical Engineering

High-tech rehab research goes mobile

Researchers are optimistic about recent, experimental improvements in an orthopedic device that allows paraplegics to assume upright posture and a nearly normal walk with only the help of a walker. The Reciprocal Gait Orthosis (RGO), developed by researchers at Louisiana State University Medical Center in New Orleans and gradually improved by them over the past 10 years, is a hip and leg brace with a system of cables that allows an otherwise wheelchair-bound patient to stand and perform reciprocal leg extension and flexion — the coordinated left and right “stepping” action of walking. The patient provides the energy for upper leg movement, while the brace provides structural support and coordinates the reciprocal action. With the aid of a walker or crutches, these patients can, with some effort, walk and even climb stairs.

In a recent improvement of the RGO, Moshe Solomonow and his co-workers at Louisiana State University added a four-channel electrical-stimulation unit that allows a patient to manually contract the contralateral quadriceps and hamstring muscles in the legs for more graceful, effective and energy-efficient movement while using the walker. Hand-operated switches on the walker handles allow the patient to stimulate each leg electrically to extend and flex. Preliminary data suggest the energy expenditure of walking is reduced as much as 50 percent in comparison to values for the RGO without electrical stimulation. Muscle atrophy from disuse is also apparently reversed after only six weeks of use, and circulation seems improved.

Solomonow says one of his highly motivated patients can already do something resembling “the Michael Jackson spacewalk, walking backwards.” This is “not something to giggle at,” he adds, reminding the more mobile among us that the ability to maneuver backwards is a great advantage, especially in small spaces such as bathrooms.

Disabled communication: The eyes have it

In other research aimed at assisting the severely disabled, British scientists report software improvements and increasing success with a device that allows patients to use their eyes as the sole means of communicating and controlling their environment.

Eye movement typically survives intact even after serious neurologic damage, and a few systems are now on the market that turn eye movements into a person's functional link to the world. However, most of those systems require the patient to remain directly in front of a video screen and camera (in order to track the user's eyes), don't allow for uncontrolled head movements, and in some cases require the user to wear headsets that are uncomfortable or otherwise discouraging to wear. With their self-esteem already challenged, says Peter A. Griffiths of St. Georges Hospital in Lincoln, England, “these people don't want to be surrounded by heaps of paraphernalia.”

Griffiths and his colleagues have developed an eye movement system that allows an otherwise paralyzed user to write letters, dial and speak on a telephone (with the assistance of a speech synthesizer) and even play Monopoly—with the simple application of small, disk-shaped sensors to the user's left and right temples. The sensors measure the electrical potential between the front and back of the eyeballs, and as such can detect left and right movements of the eyes. Those signals are fed into a processor that is programmed to choose letters of the alphabet, words or phrases on a screen, or to control domestic devices — such as telephones — in response to the patterns of eye movements.

The experimental system, manufactured in small quantities by a British company that specializes in flight simulators, is undergoing trials by Britain's Department of Health.

Acupuncture: An old debate continues

Controversy about acupuncture's usefulness as a painkiller continues to rage. In the past 10 years, a small but steady stream of research has suggested that certain acupuncture treatments are indeed analgesic. But the ongoing mystery of acupuncture's mechanism of action — and the less-than-ideal experimental designs characteristic of so many acupuncture trials — have left many Western scientists and journal reviewers skeptical. From the range of findings reported last week:

- Joseph M. Helms, a physician with the American Academy of Acupuncture in Berkeley, Calif., performed acupuncture treatments on 43 women diagnosed with primary dysmenorrhea (menstrual pain). Some of the women received real acupuncture treatments, some received placebo acupuncture (shallow needle treatments, not at actual acupuncture points), some had monthly, nonacupuncture visits with the doctor and some were followed with no intervention.

The women recorded “monthly pain scores” based on intensity and duration of menstrual pain during a three-month treatment period and for nine months following the cessation of treatment. Later, researchers compared these levels to pretreatment scores, calculated by the women at the beginning of the study. These scores described pain levels for either the month previous to treatment or from an average of the preceding six months, whichever value was highest.

In the real acupuncture group, 10 of 11 women showed significant improvement (defined as pain scores averaging less than half the pretreatment scores). Four of 11 in the placebo acupuncture group showed improvement. Of the other two nonacupuncture groups, 2 of 11 and 1 of 10 showed improvement.

In addition, Helms says, the real acupuncture group required 54 percent fewer pain medications during treatment and 41 percent fewer during the nine-month follow-up. No other group showed similar reductions.

- If acupuncture does alleviate pain, does it do so by activating the body's own opioid (painkilling) system in the brain? J. Ronald Lake and David H. Malin at the University of Houston-Clear Lake, Malcolm Skolnick at the University of Texas Health Sciences Center in Houston and their colleagues measured rats' responses to a standardized, mildly painful stimulus with and without acupuncture pretreatment, and with and without injection of the opioid-blocking drug, naloxone. By using flinch responses to small electrical currents as a measure of pain thresholds, they found significant pain reduction among rats pretreated with acupuncture. And in support of the opioid mechanism of action, they found that giving naloxone blocked the analgesic effects of acupuncture.

- Benson Martin of the University of Pennsylvania School of Veterinary Medicine in Kennett Square used laser-beam acupuncture for the treatment of chronic back pain in racehorses. Of the various means of stimulating acupuncture points in horses, Martin says, infrared laser stimulation has advantages over needles. “Horses don't like having needles stuck in them, but they don't mind the laser,” he says. Martin used a 300-microwatt laser (enough to create a sense of “tingling” in human skin), treating nine acupuncture points on each horse, once a week for an average of 12 weeks.

Before treatment, Martin says, “all 15 of these horses were unable to perform at all at an acceptable level to the owner, trainer or veterinarian.” After acupuncture, he says, performance was improved in 11 of 14 horses (one was sold and lost to follow-up), as measured by their ability to race with acceptable results. Four of the 11 went on to win races.

Martin concedes that such data provide no way to rule out natural healing of injuries. But he notes that despite numerous other treatments, the horses had remained disabled for as long as four years.