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PARAPLEGIA NEWS

*Is FES in
your future?*



Carlos Rodriguez

Making History for 47 Years

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Discover
CUSHION COMFORT

FES

a stimulating system

by Jeanne O'Malley Teeter and Denise L. Brown-Triolo

What is functional electrical stimulation?

Where can you find it?

What does the future hold for this high-tech treatment?

W here can I get FES?"

"What type of FES are you interested in?" we ask, anticipating the typical response.

"Well..., I didn't know there were different kinds."

"Tell me more about what you want FES to help you with."

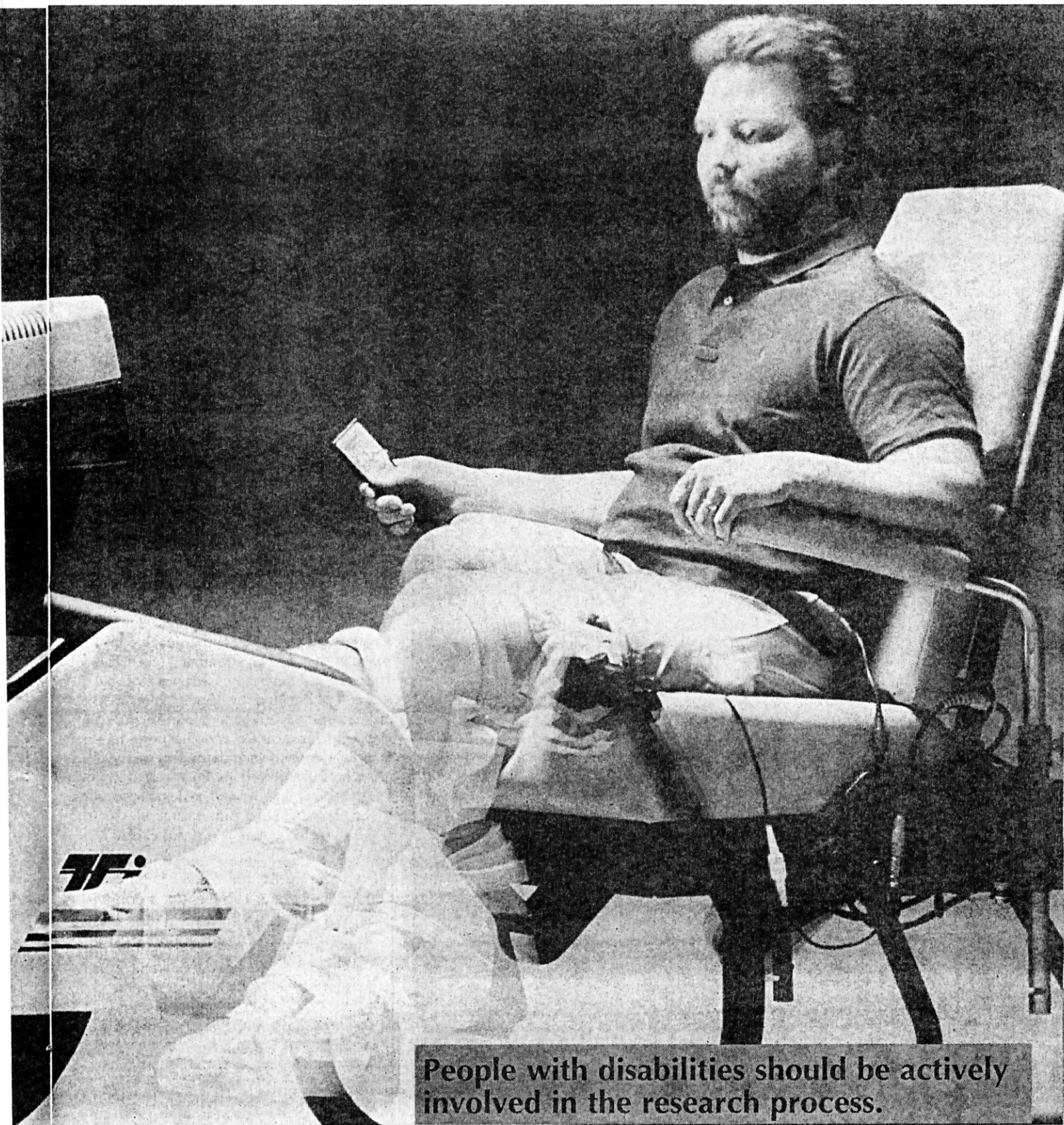
First-time callers to the FES Information Center (Cleveland FES Center) want all the options to maximize their health and independence.

Thanks to support from the Paralyzed Veterans of America (PVA) Spinal Cord Injury Education and Training Foundation and Buckeye PVA, much of the information the Cleveland FES Center staff needs to answer FES (functional electrical stimulation) questions is at their fingertips. Last year with the support of these organizations, the center published the *FES Resource Guide*, the one and only source book on this treatment for individuals with spinal-cord injury (SCI) or multiple sclerosis (MS).

Although people have been hearing

about FES since the mid-1980s, many are confused about what it means, what it can do, and whether it is actually available. Lately, cure research has





People with disabilities should be actively involved in the research process.

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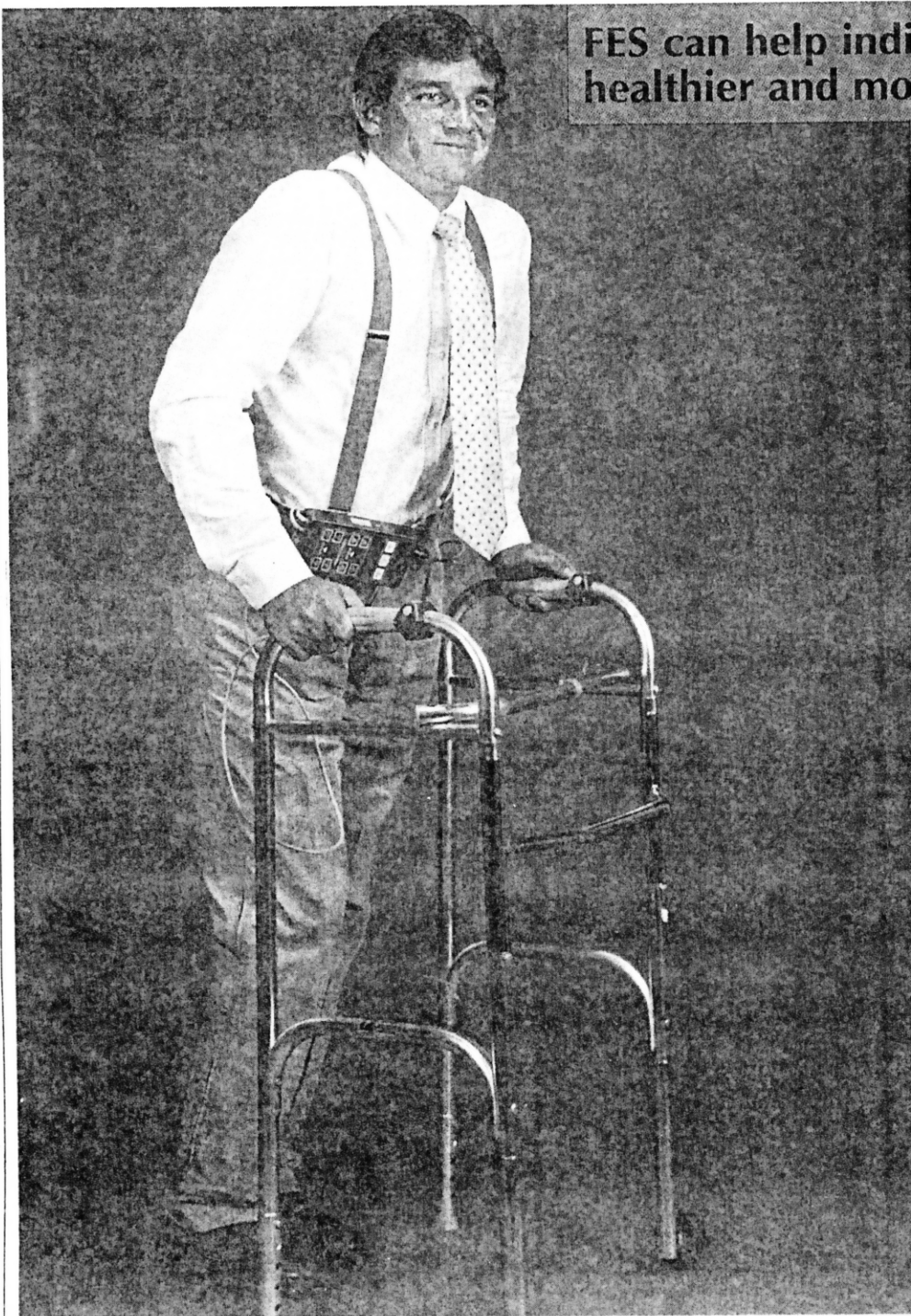
been in the spotlight. In writing our book, we set out to clear up these issues by going directly to the experts. Here's what we found.

WHAT'S IT ALL ABOUT?

FES, the process of electrically stimulating muscles to react as though they're receiving impulses from the brain, can

help people with SCI live healthier and more independent lives (see table). Some short-term treatments can improve voluntary movement during the acute phase of

FES can help individuals with SCI live healthier and more independent lives.



be activated. Close-fitting garments might have these conductors sewn into them. Sometimes the electrodes are inserted through the skin (percutaneously).

The most complex systems have one to two dozen electrodes implanted inside the body along with one or more pacemaker-like stimulators. Individuals can use these neuroprostheses in combination with orthopedic or neurological surgical procedures. Any type of FES system often has other components such as special switches, splints, braces, or mobility aids.

MAKING CHOICES

If you are thinking about trying FES, explore traditional options and discuss all of them with your healthcare professionals. Safety and effectiveness are keys. Weigh the benefits against the risks, and check out the credentials of service providers. After deciding to pursue the treatment, you will probably need a medical evaluation to determine if you are a suitable candidate.

Most FES systems require that you have no lower motor-neuron damage in nerve(s) that will be stimulated (see "The Human Nervous System: Master Organizer" by Lisa Hudgins [September 1996] for a discussion of anatomy).

Cost and availability are other considerations. These will vary, depending on the specific FES application of interest, the particular technology used, status in regard to the Food and Drug Administration (FDA), and the extent to which the treat-

SCI. Other types such as FES exercise equipment (bicycle ergometers) are for regular health maintenance. Neuroprostheses are a permanent replacement for a paralyzed function; for example, a phrenic pacer allows individuals to breathe without respirators.

This technology is never a cure for paralysis, although some researchers are studying ways to use it to enhance neural regeneration techniques. Experts suggest that once a cure is found, FES will

still have a role as a motor-training tool or a permanent replacement for any residual deficits.

FES equipment varies depending on the specific application (purpose) of the electrical treatment. Minimum systems have a stimulator that generates tiny electrical impulses and an electrode that delivers the pulse to the nerve or muscle. Simple types may consist of a stimulator about the size of a Walkman[®] and a couple of electrodes that adhere to the skin over the muscles to

The FES Information Center is part of the Cleveland FES Center, a consortium including the Cleveland Department of Veterans Affairs (VA) Medical Center, Case Western Reserve University, and Metro-Health Medical Center. The VA Office of Research and Development (R&D), Rehabilitation R&D Service, and the National Institutes of Health provide primary support.

Contact: FES Information Center, 11000 Cedar Avenue, Suite 207, Cleveland, OH 44106-3052. (800) 666-2353 / (216) 231-3257 / 231-3258 / fes_info@po.cwru.edu / <http://feswww.fes.cwru.edu>.

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FES Stats

- ◆ 59 clinics/centers in 22 states provide FES services
- ◆ Nine clinics are affiliated with Department of Veterans Affairs (VA) medical centers
- ◆ 48% serve people with paraplegia; 52% with tetraplegia
- ◆ 24% serve people with multiple sclerosis
- ◆ 63% serve adults; 16%, seniors; 21% children and adolescents
- ◆ 66% conduct research in FES

ment is endorsed by healthcare providers.

Generally, cost increases with the complexity of the technology, especially when specialized training is needed to prescribe it. Healthcare providers make most reimbursement decisions regarding FES on a case-by-case basis. Third-party payers typically weigh future cost savings (reduced hospitalizations) against the cost of the treatment.

Ask for a written estimate of services to be provided, including cost and time required. If the FES program is experimental or investigational, the charge may be less if a research grant helps cover expenses. However, selection criteria are usually very strict, requirements can be demanding, and the treatment's effectiveness is still under study. Volunteers will sign informed consents that outline potential risks and benefits associated with the program. Note that reimbursement may be available for "investigational" devices.

WHAT'S OUT THERE?

What is on the market today? Dozens of manufacturers produce neuromuscular electrical stimulators for muscle strengthening and other therapeutic applications. Some offer systems specifically designed to build up atrophied muscles in arms, legs, and abdomens.

Several vendors now offer FES bicycle equipment with new features such as more comfortable stimulation. *Phrenic nerve pacers* and *spinal-cord (dorsal column) stimulators* are neuroprostheses that have been commercially available for more than a decade. Several years

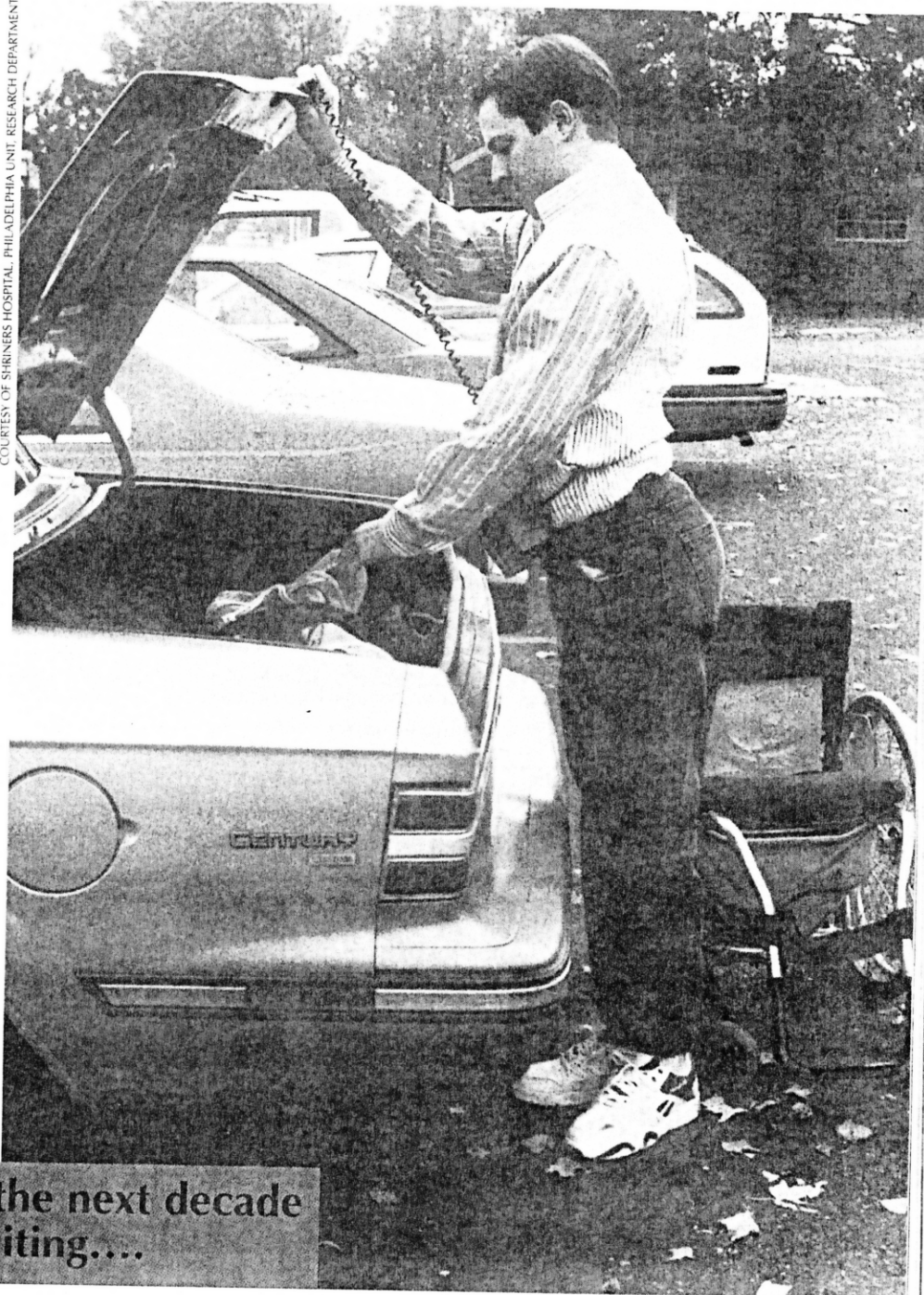
ago, a company introduced a walking system. This year FDA approved an FES grasping system (surface electrodes) and will soon give the go-ahead to another one (implanted electrodes). A U.S. company is testing a bladder neuroprosthesis that is commercially available in Europe.

Is FES easy to find? People who live near major medical and research centers that specialize in SCI will have more options. Some high-tech, innovative approaches using FES may be complex and only available at a few "centers of excellence" that have the appropriate

expertise to provide the service. On the other hand, low-tech treatments that don't require extensive clinician training or expensive equipment should have more widespread availability (at most SCI or MS clinics).

A warning—clinicians are not universally trained in FES techniques, and they (along with third-party payers) may not be aware of the current status of various FES applications. Sometimes, consumers or clinicians have to gather the necessary community resources to make the treatment available.

COURTESY OF SHRINERS HOSPITAL, PHILADELPHIA UNIT RESEARCH DEPARTMENT



FES advancements in the next decade will be even more exciting....

Current Status of FES Type of FES System	Availability* of FES	Research Progress	
		Ongoing Research	FDA Approved**
Cardiovascular exercise	Wide	X	X
Breathing assistance	Restricted	X	X
Cough assistance	Restricted	X	
Grasping and reaching	Limited	X	X
Bladder and bowel control	Limited	X	X
Transfers and standing	Limited	X	X
Stepping and walking	Limited	X	X
Erection and ejaculation	Wide	X	
Improving circulation	Wide	X	X
Preventing pressure sores	Restricted	X	
Treating pressure sores	Wide	X	X
Controlling spasticity	Limited	X	X
Preventing/treating contractures	Wide	X	X
Preventing/treating osteoporosis	Restricted	X	
Treating weak muscles	Wide	X	X
Controlling tremor (MS only)	Restricted	X	
Restoring sensation	Restricted	X	
Regaining voluntary function/improving control of motion	Limited	X	X

©1997 FES Information Center, Case Western Reserve University. *Availability: Restricted = available in only a few specialized rehab centers or clinics (1-6 in the U.S.); people with SCI or MS; personnel require specialized training to provide this treatment. Wide = available in most rehab centers serving people with SCI or MS; personnel require specialized training to provide this treatment.

What's Inside the *FES Resource Guide*?

- ◆ "Learning About FES": Explains how FES works; details 18 different applications
- ◆ "Where to Get FES": Profiles more than 200 FES applications offered at clinics and research programs
- ◆ "More Resources on FES": Identifies suggested readings, information centers, professional organizations, and manufacturers
- ◆ "Glossary on FES": Contains more than 200 entries to help understand terminology
- ◆ "Index": Provides a cross reference to topics and organizations

Order the *FES Resource Guide* from the University Bookstore, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, Ohio 44106-7102. (216) 368-1656 / 368-5205 (fax). The price is \$13.35, plus shipping and handling.

LOOKING AHEAD

FES advancements in the next decade will be even more exciting, as researchers continue to develop ways to use electrical stimulation to improve the health and independence of people with disabilities beyond the levels attainable with conventional rehabilitation. Clinical feasibility tests have already begun on neuroprostheses that incorporate multiple implants and offer the possibility of controlling limbs and organ systems.

Studies have demonstrated that "natural" signals (recorded from the user's body) may provide an effective way to control FES devices. Researchers are

When to Use FES (Rehab Stage)			FES Can Help With (Rehab Goal)			
Acute	Inpatient	Outpatient/Long-term	Mobility	Activities of Daily Living	Health & Wellness	Medical Needs
	X	X			X	
X	X	X				X
	X	X				X
	X	X		X		
	X	X				X
	X	X	X	X		
	X	X	X	X	X	
	X	X			X	X
X	X	X			X	X
X	X	X			X	
	X	X				X
X	X	X			X	X
X	X	X	X		X	X
X	X	X	X		X	X
	X	X	X	X	X	X
X	X	X		X	X	X
		X		X		
X	X	X	X	X		

U.S. serving people with SCI or MS; personnel require extensive training to provide this treatment. Limited = Available in some but not all rehab centers or clinics serving
 onne may require training but it is readily available. **FDA Approval: At least one type of FES system has been approved for this purpose by the FDA.

testing implanted sensors that measure joint position and will allow, for the first time, sophisticated computer-control of limb movement outside the laboratory. Scientists are designing new nerve electrodes and arrays [electrodes that have multiple contacts arranged in a grid] to selectively record from and activate nerves; these offer the possibility of eliminating unwanted nerve activity and controlling precise activation patterns.

A supportive research environment drives these advances. More forums are available for scientists and clinicians to share their experiences. The recent establishment of the International FES Soci-

ety; publication of numerous textbooks, book chapters, special journal issues, and conference proceedings; and continued and new funding of federal and private research grants are evidence of a vital FES research community.

People with disabilities should be actively involved in the research process. They can help set priorities as members of federal or local advisory boards, as conference presenters, as focus-group participants, and as members of research and development teams. With this investment, we can look forward to future FES systems based on functional needs, evaluated on measurable outcomes, and made wide-

ly available to individuals who may benefit from them.

About the Authors

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