MICROFES

Functional Electrical Stimulator System

Model 200 Microfes Professional Kit
Model 100 Microfes Personal Kit

CE

Introduction

The Microfes stimulator is a FES (Functional Electrical Stimulation) device designed primarily for drop-foot correction in all patients suffering from this problem as a consequence of upper motor neuron lesion. The stimulator can either be used by clinicians as an adjunct when re-educating a neurological impaired patient during the course of rehabilitation or by the patient him/herself as an orthotic aid for active correction of drop-foot in everyday life. In addition the drop-foot correction, the Microfes stimulator can be used in various other applications during gait (e.g. stimulation of quadriceps muscle), during re-educating volitional selective movements (e.g. arm, hand and finger movements), or in shoulder subluxation problems.

Typical Indications

- acute and chronic patients with insufficient active dorsiflexion for functional ambulation
- patients with passive range of motion in dorsiflexion of no less than 0 degrees with some volitional activation of dorsiflexor musculature.
- patients with insufficient active knee extensors (absent or weak knee extension, knee instability)
- patients with insufficient active knee flexors (absent or weak knee flexion)
- patients with insufficient active hip extensors (absent or weak hip extension, pelvis instability)
- patients with shoulder subluxation problems
- patients with spastic flexed elbow
- patients with spastic flexed wrist and fingers

IMPORTANT! Preserved excitability of motor nerve fibers, neuromuscular transmission (at least partially) and contractability of the stimulated muscles is required.

Candidates

- CVA patients
- traumatic brain injury (TBI) patients
- incomplete spinal cord injury (SCI) patients
- multiple sclerosis (MS) patients
- CP children
- other patients with upper motor neuron dysfunction

Special considerations

- dorsiflexors subject to rapid fatigue
- severely limited muscle endurance
- hypersensitivity to the stimulation
- pre-existing conditions such as heart disease or epilepsy
- all general contraindications for FES application

Stimulator features

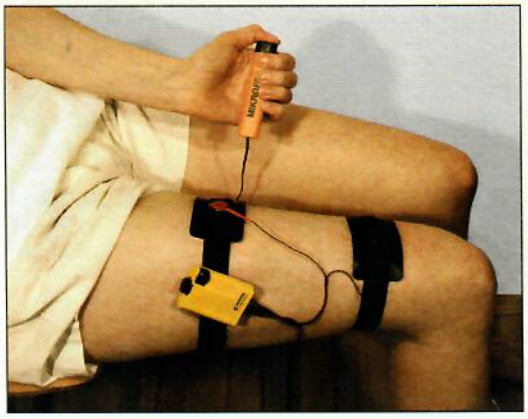
The stimulator permits trains of stimulating pulses triggered by manual- or heel-switch. After the manual-switch is depressed or the heel-switch released, the stimulation ramps up and lasts maximum for about 5 seconds, if not interrupted earlier by changing the state of the switch.
The repetition rate is 25 pulses per second and the pulse duration is 150 microseconds. These parameteres are optimized in order to provide smooth tetanic muscle contraction and to minimize muscle fatigue. They are preset by the manufacturer and cannot be changed. The careful selection of their values on one hand enables an easy application of the system by the patient and on the other hand allows clinicians to choose various applications of the system during the rehabilitation program.
The intensity of biphasic charge balanced stimulating pulses can be set individually between 0 and 50 mA. The intensity knob with "on" and "off" function is the only control that needs to be adjusted by the patient for a successful application.
In order to prevent foot slapping as a result of discontinued stimulation after heel-contact an additional feature enables a 50 to 350 milliseconds pulse train prolongation into the stance phase. This delay is adjusted individually by the clinician during the fitting period.
The stimulator is powered by one AA alkaline battery or NiCd accumulator. The electronic device is light weight and small. The whole system is designed to be carried below the knee, which renders short electrode and heel-switch leads and fulfills the cosmetic requirements for such a system. In other applications the stimulator can be easily attached in the vicinity of electrodes (e.g. to electrode straps, pocket, belt).

Microfes stimulator used in drop-foot correction

Drop-foot is a common problem among neurological impaired patients in whom the ankle is advanced in a plantar-flexed and often inverted position during the swing phase of gait due to weak or absent dorsiflexor activity. Conventional bracing provides support to drop-foot, but tends to discourage muscle activity and joint motion often resulting in disuse atrophy of dorsiflexors and in limited ankle range of motion. Substituting a traditional orthose with Microfes stimulator provides additional treatment benefits to the affected musculature. The electric stimuli and resultant muscle contractions may facilitate process of neuromuscular re-education. Stimulation that assists movement through the normal gait sequence provides the potential for discontinuing the use of the electrical orthotic device rather than promoting dependency. By active correction of drop foot in chronic patient, the Microfes stimulator enables safe, relatively effortless, cosmetically pleasing walking in everyday life, carried out at an automatic level.

Microfes application for drop-foot correction

Microfes stimulator used in gait training



Microfes application in knee extensors strengthening

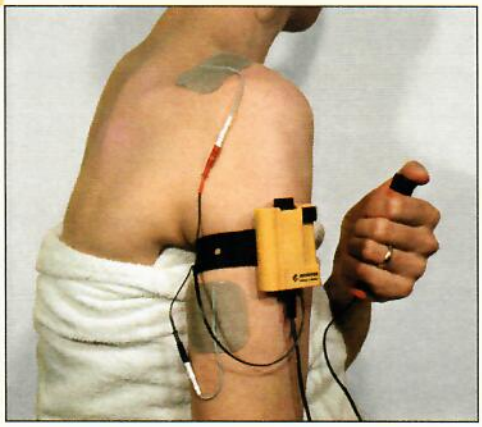
Although most CVA and TBI patients suffer from several disabilities, gait is one of the most important goals of rehabilitation. Patients as well as their relatives often consider improvement of their locomotion capacity to be of the utmost importance.
Various patterns of gait deviations tend to develop during the rehabilitation period. In CVA patients this includes pelvis drop or elevation during stance phase, knee instability during stance phase, knee back-thrust during loading phase, insufficient knee extension at the end of swing phase or insufficient knee flexion during swing. In TBI and in incomplete SCI patients the impairment is often bilateral, while one side being more affected than the other.
By applying Microfes stimulator to the hip extensors, knee flexors, or knee extensors in combination with the peroneal nerve stimulation (when required), better foot-floor contact and improved weight support during loading and stance phase will be provided. In weak muscles an initial re-strengthening program should be carried out. With patient in prone or supine position stimulation is triggered by manual switch simulating

gait timing. As soon as the patient is able to transfer weight to the affected side and sustain it with help of therapist, walking can be facilitated. The synchronization of stimulated muscle with the gait cycle is performed by the accompanying therapist using a manual switch. The electrical stimulation will provide the patient with proper muscle contraction resulting in a synchronized functional movement of extremity and the ascending sensory pathways will provide additional information to CNS, which may promote re-learning process. Sometimes the goal of applying the electrical stimulation to designated muscles is to inhibit the development of pathological reflex synergy. The spasticity in antagonist muscles can be moderated by electrical stimulation of agonists.

Microfes stimulator used in arm and shoulder applications

The recovery of motor functions, which include selective movements of arm hand and fingers, is very important for the patient. If the volitional muscular activity is lost in the shoulder, the force of gravity acting on the upper limb tends to stretch the ligamentous structures about the glenohumeral joint and may lead to shoulder subluxation. Such malalignment of the humerus and glenoid fossa may produce severe pain and may not be corrected even if voluntary control and muscle strength return during recovery.

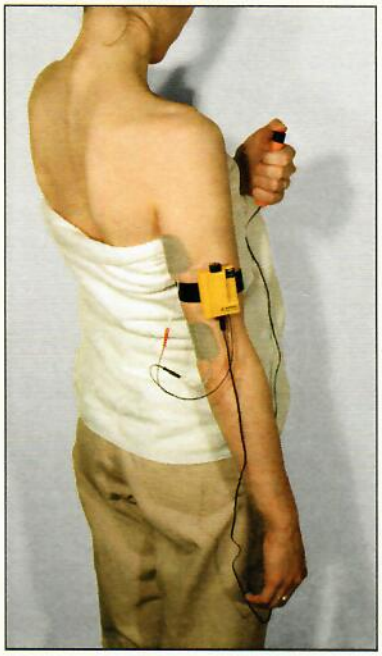
Microfes stimulator is applied to activate supraspinatus muscle and posterior deltoid muscle in order to produce re-alignment of the humerus in the glenoid fossa. The trains of stimulating pulses are triggered with manual switch.



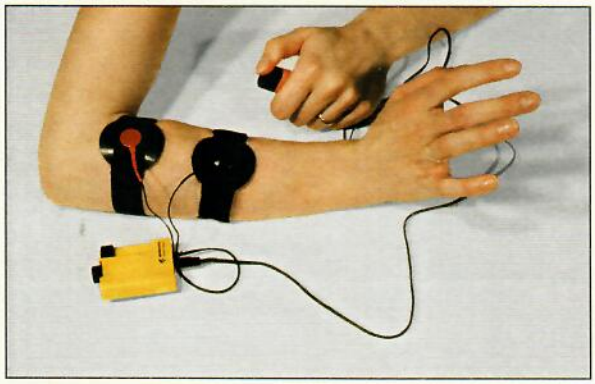
Microfes application for correction of shoulder subluxation

The application of Microfes stimulator to triceps brachii muscle is performed in order to reduce muscle tone in elbow flexors. The stimulation can be performed in seating position with the purpose to reduce antagonist spasticity or to help the patient perform different functional tasks (e.g. reaching for an object), or during gait in order to facilitate reciprocal swing of the arm during the stance phase of ipsilateral leg and to prevent the associated reactions during gait.

The application of the Microfes stimulator to wrist and finger extensors is performed in seating position with the purpose to: reduce muscle tone in wrist and finger flexors, improve range of motion, re-strengthen muscles, reduce edema by activating the muscle blood pump or to re-educate the muscles in order to perform selective movements. Microfes stimulator can be used to assist the patient performing different tasks (e.g. grasping and releasing an object).



Microfes application for elbow extension



Microfes application for extension of wrist and fingers

Literature

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Merletti R., *et al.:* Clinical Experience of Electronic Peroneal Stimulators in 50 Hemiplegic Patients, Scand J Rehab Med, Vol. 11 (3), pp. 111-121, 1979.
Singer B.: Functional Electrical Stimulation of the Extremities in the Neurological Patient: A Review, Aust J Physiotherapy, Vol. 33, pp. 33-42, 1987.
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Faghri PD., *et al.:* The Effects of Functional Electrical Stimulation on Shoulder Subluxation, Arm Function Recovery, and shoulder pain in Hemiplegic Stroke Patients, Arch Phys Med Rehabil, Vol. 75, pp. 73-79, 1994.

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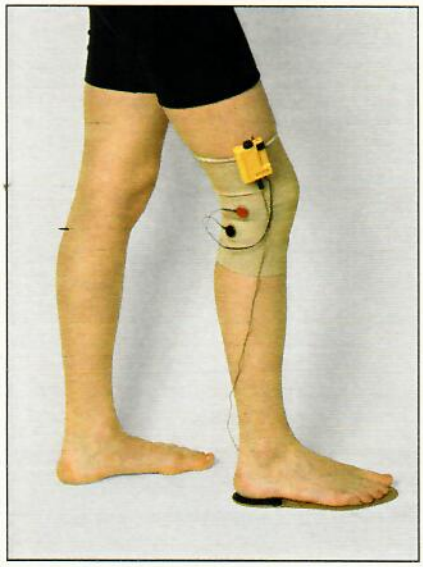
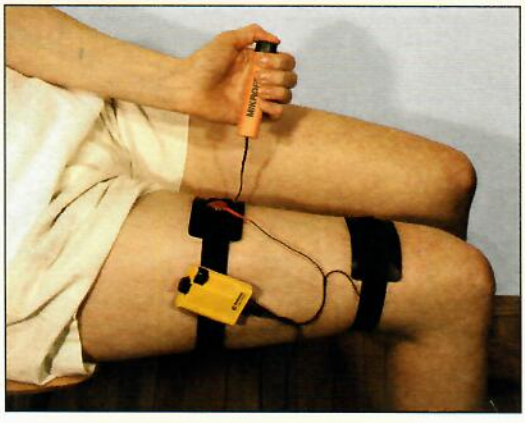


Microfes application for drop-foot correction

Microfes stimulator used in gait training



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System Components

Microfes Model 200 Professional Kit

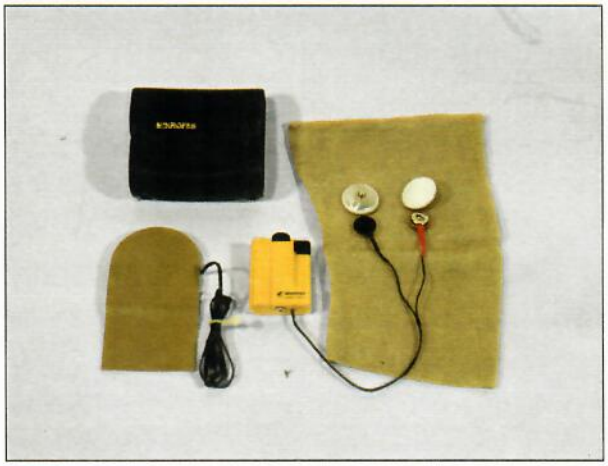
Microfes stimulator
3 packages of various size disposable electrodes
Velcro elastic holding strap
2 heel pads
Manual control switch
Battery
Screwdriver
Storage case
Operations manual

Model 200

Microfes Model 100 Personal Kit

Microfes stimulator
1 package of 4 disposable electrodes
Velcro elastic holding strap
2 heel pads
Battery
Screwdriver
Leather carrying case
Operations manual

Model 100



Technical characteristics

Output current	0 - 50 mA (0 - 1800 Ω load)	adjusted by the patient or therapist
Waveform	current output, rectangular, balanced, asymmetrical, biphasic pulses	
Frequency	25 Hz	fixed
Pulse duration	0.15 ms	fixed
Stimulation-on time	0 - 5 s	controlled by the heel switch or manual switch
Stimulation-off delay after heel contact	50 - 350 ms	adjusted by the clinician
Battery	1.5 V alkaline battery, or 1.24 V rechargeable NiCd accumulator (optional)	AA cell (R6 - IEC)
Dimensions (HxWxD)	64 x 46 x 20 mm	
Weight	65 g	battery included

Design: Barbara Bogataj-Kokalj, Printed by: Digital Colour Print, Birografika Bori