

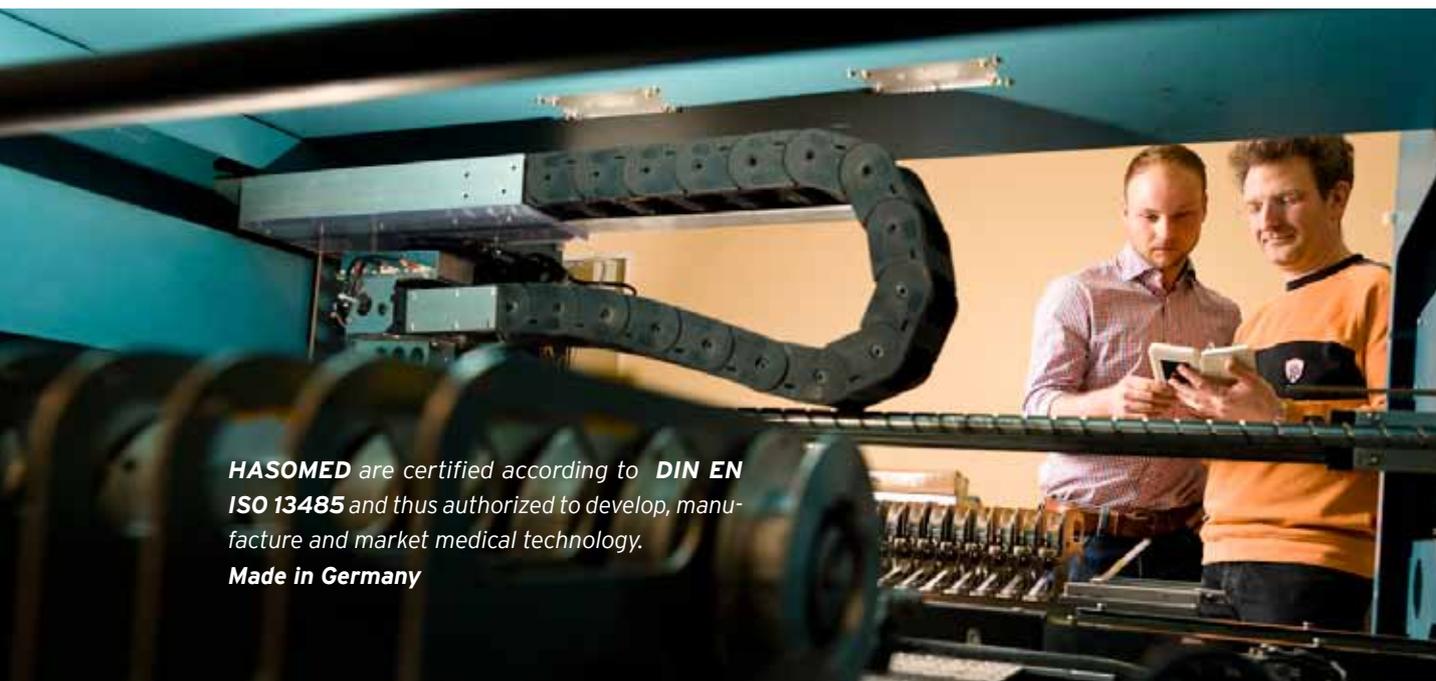
HASOMED

RehaMove[®]

Motion Training with Functional Electrical Stimulation



Your Partner for Technical Innovation in Medicine



*HASOMED are certified according to **DIN EN ISO 13485** and thus authorized to develop, manufacture and market medical technology.
Made in Germany*

SOMED 2011

HASOMED GmbH are an owner operated company in the field of medical technology. Founded in Kronberg/Taunus in 1992, the company moved to Magdeburg in 1995.

HASOMED GmbH originates from the Scientific Engineering Department of the Medical Faculty of the University of Magdeburg. In the early years, the focus of activity was the development and manufacturing of research technology. In recent years, the field of electrical stimulation for the treatment and mobilization of individuals with complex movement disorders and diseases of the neuromuscular system becomes more and more important.

In 2000 HASOMED GmbH started developing systems for Functional Electrical Stimulation. In collaboration with the Max Planck Institute in Magdeburg and national and international universities, the products RehaMove, RehaBike und RehaStim were developed.

During the past decades, studies and investigations in paraplegics as well as stroke patients did prove the beneficial effects of electrical stimulation on a person's general health and well-being.

What is Functional Electrical Stimulation (FES) all about?

Devices for Functional Electrical Stimulation (FES) support and replace lost motor coordination. Therefore the main therapy goal is to create functional movements.

FES makes use of electrical impulses that are sent via surface electrodes to the peripheral nerves of respective muscles in order to stimulate them. In contrast to common TENS machines, the stimulation with FES translates into complex movement patterns.

With low-frequency pulses, the action potential in the nerves and muscle fibers can produce muscle contractions.

Only due to such active cycling movement generated by electrical impulses, primary and secondary consequences of various neurological conditions can be minimized, prevented or even reversed.

HASOMED RehaMove®

Individuals with paralysis can improve their general state of health permanently by using the RehaMove, a combination of stimulator and MOTomed viva2 motion trainer.

HASOMED RehaBike®

By using the RehaBike, individuals are enabled to propel a tricycle with the power of their own paralyzed legs.

HASOMED RehaStim®

RehaStim is the basic stimulator for Functional Electrical Stimulation. It can be used in combination with a motion trainer or an outdoor bike and serves as stand-alone stimulation device as well.

Activate Muscles despite Paralysis

What if you cannot be active anymore?

Motor impairments after stroke can cause for instance gait disturbances and motion asymmetries. Lesions of the spinal cord and following spinal cord injuries often disable affected individuals from walking.

However, daily movement is an important component for the smooth operation of many body functions and for the general state of well-being. Human beings would normally walk 4.000 to 6.000 steps per day - without additional physical activities. In case of paralysis or weakness of the leg muscles, this component is diminished to a minimum

or even eliminated completely. This effect is intensified correspondingly in tetraplegia with an additional loss of function in both arms.

Due to the lack of movement, secondary diseases may develop such as increasing immobility by tendon shortening, joint stiffness (contractures), digestive discomfort, cardiovascular weakness, metabolic (water retention) or circulatory disorders.

These secondary diseases lead to an increasing need for care. Therefore it is important for all individuals with paralysis to prevent them.



Motion Training with Electrical Stimulation

Motion Training is a therapeutic method for the mobilization of patients and is widely used in clinical and therapeutic practice. Especially for affected persons with paralysis various motion trainers are used.

A large number of stroke patients and paraplegics suffer from the consequences of a damaged neuromuscular system. They often lose muscle strength in the paralyzed extremities within a short time. In Germany for instance 1.1 million individuals are affected.

An alternative for active movement is an adaptive motorised and motor supported movement of affected muscles. The method of muscle activating movement therapy is also known as passive - active application. In paralysis therapy, motion trainers like the MOTOMed, produced by the German company Reck, are used.

RehaMove extends such movement therapy by electrical stimulation - the ideal solution for safe and effective motion training. In combination with the MOTOMed viva2, active motion training is also available for persons suffering from complete paralysis.

"The product 'Systems for Functional Electrical Stimulation' from HASOMED GmbH is characterized by its innovative character and technical implementation as well as user-friendliness and improvement in the quality of life for individuals with disabilities".

Speech at the awards ceremony for the Innovation Award RehaCare International 2005



Prevent secondary Diseases effectively



“RehaMove convinced me immediately at the moment my legs suddenly moved independently. The same legs that I wasn’t able to move for weeks! From the very beginning I trained two times a week, initially intensified with motor support of the motion trainer. As time passed by, I noticed an improvement each time I used RehaMove.”

Heinz Radtke, aged 67

Medical Benefits

The primary goal during the RehaMove therapy is to prevent secondary diseases. In addition to preservation or rebuilding of the muscular system, the improvement of the blood circulation plays an important role. Thus, muscular training reduces possible spasms and improves the mobility of the joints. The improvement of the blood circulation is important for patients in wheelchairs in terms of a reduced risk for pressure sores (Decubitus Ulcer).

The impact on the mental health of persons affected of all types of neurological and neuromuscular diseases are not to be ignored: using RehaMove, many patients are able to move nearly independently for the first time since the beginning of their disease, despite paralysis. Concerning diabetes, physicians recommend a regular training with electrical stimulation to increase insulin responsiveness.

Indications of Use

RehaMove is used for following medical conditions with paralysis/ paralytic symptoms of arms and legs:

- Spinal cord injuries (SCI) with tetra- and paraplegia
- Stroke

Therapy Goals:

- Prevention or retardation of muscle atrophy
- Build-up of the muscular system
- Strengthening of the cardiopulmonary system
- Reduction of spasms
- Increase of the local blood circulation
- Preservation or improvement of mobility

In comparison with the standard movement therapy for complete spinal cord injury, the medical use of electrical stimulation is often clearly shown in scientific studies. As a summary, the main differences are described below.

Standard Movement Therapy without FES

- Paralyzed muscles are moved in a passive way, little or no physiological activation, e.g. wheelchair sports
- Only few muscles are activated
- Shoulders may be overloaded
- Little venous reflux
- Limited cardiovascular training
- Strong cardiovascular training (e.g. sauna) is not suitable for daily use

Movement Therapy with FES

- A physiological activation is safe and locomotion is not compensated by the use of arms (e.g. hand bike) but takes place with the legs
- Strong effects on the cardiovascular system by using the largest muscles in the body
- High training intensity
- Severe venous reflux
- Improvement of coordination
- Cosmetic aspects
- Patients can “use” their legs again

Stabilize the General State of Health



“As a result of my polyneuropathy I became a nursing case within a short time. I even couldn't get up in the morning. After several weeks of rehabilitation my therapist suggested the training with the RehaMove. So I had the opportunity to train my arms and legs with a single device. Compared with other therapy methods I recognized a clear benefit of the training with the RehaMove which is the possibility of symmetry control. Thus I can use my power exactly where I still have some deficits.”

Brita Rauch, aged 40

Preconditions

Before using RehaMove for the first time, interested persons should talk to their general practitioner. In collaboration with the physician they should check whether the training is medically safe for the user regarding contraindications. Together it can be decided what kind and duration of the RehaMove therapy is recommended.

Basic prerequisite for the motion training with Functional Electrical Stimulation is an intact lower motor neuron, i.e. an intact reflex circuit / peripheral innervation. This motor neuron is responsible for the execution of all movements and reflexes. A lesion would result into loss of strength of the corresponding muscles and a loss of relevant reflexes.



Contraindications

From the medical point of view, training with the RehaMove is absolutely contraindicated for patients with cardiac pacemaker. The electrical impulses may lead to disturbances of the pacemaker sensors which could cause a life-threatening situation.

Training with RehaMove is also not indicated for pregnant persons and individuals with unhealed fractures of the extremities that shall be trained.

Medically not recommendable is the use of the RehaMove for denervated muscles or severe spasticity.

Because of the cyclic rotation of the crank of the RehaMove, at least 100° knee and hip flexion must be possible; patients with limited/ heterotropic mobility may therefore have to be excluded from RehaMove training. Dysesthetic sensation of pain, skin injuries or open sores in the area of stimulation should also be checked as a potential criterion for exclusion.



“Training with the RehaMove can be practiced easily. You simply move the wheelchair in front of the device; you can stay in the wheelchair during training, only the legs need to be placed in the foot rests. After that you can soon start the training. Important for me, however, is the fact that I can stimulate circulation and influence constipation in a positive way. At the same time, my knee joints and ankles are moved which are otherwise inactive. I used to have cold legs and a bad sensation of coldness all over my body which also increases the back pain. Since I started using the RehaMove regularly, I feel much better.”

Cornelia Schade, aged 51
Paraplegic for 30 years

Stabilize and Improve the general State of Health actively

Components and Features

The strong interaction of two market leaders in the field of medical technology makes a product like the RehaMove available and offers unique application areas. For Functional Electrical Stimulation, the RehaMove makes use of the stimulation device RehaStim respectively RehaStim2 for universal applications.

The MOTomed Viva 2 of the German company Reck is a motor-assisted movement therapy device. It is designed specifically for the needs of disabled persons and wheelchair users also with additional handicap of the upper extremities.

The motion trainer and the stimulator communicate via interface. The sensors recognize both the position of the crank arms and the power of the patient. Thus the device "knows" when to send stimulating impulses at the right moment.

The RehaStim and the Motomed

The MOTomed is an intelligent system working adaptively to the power of the patient. In absence of muscle contraction or in case of very little muscle strength, a passive motor-supported movement takes place. An assistive regulation allows an active training in case of residual muscle activity. Having finished training, the user can check how long he was able to pedal completely on its own.

An automatic spasm detection prevents inappropriate strain by starting a special relaxation program immediately if spasms occur. Spasms are released by a gentle change in the rotation direction. At the same time, the electrical stimulation is stopped. After the resolution of spasms, the stimulation continues automatically.

HASOMED
RehaStim[®]
RECK MOTomed[®]



Sustainability

As a new therapy method, RehaMove allows active movement in the context of rehabilitation and physical therapy of persons suffering from complete or incomplete paralysis. Besides many benefits for patients, RehaMove improves the effectiveness of the therapy and thus relieves the therapist. That's an important aspect becoming more and more prevalent in the course of cost savings nowadays. Regular training with the RehaMove preserves and activates the muscles, can improve the general state of health and prevent secondary diseases.

“The RehaMove therapy gives me a good feeling to do something against the immobility and I have the feeling that my body remembers to move. My spasms are reduced and I also achieve a success with MOTomed even without stimulation. I am able to cycle even in the first gear for about 30 minutes after my RehaMove training. That is only possible since I use the RehaMove on a regular basis.”

Christiane Göldner, aged 33, paraplegic for 4 years



RehaMove for Children

Diseases of the CNS in Children

Movement disorders in children can occur as a result of traumatic paraplegia or infantile brain damages associated with an infantile cerebral palsy. They are mostly accompanied by complications of the voluntary movement coordination. Different forms of spasm and an increased muscle tonus (muscular hypertension) are the most common.



All Benefits of Functional Electrical Stimulation

The RehaMove for children also offers to the youngest patients all benefits of Functional Electrical Stimulation combined with the motion training at the MOTomed Gracile of the German company Reck.

- Reduce spasms
- Preserve mobility
- Build up muscles and prevent atrophy

Concerning their tactile sensitivity, children are generally more sensitive than adults. Due to the gradual adjustment of the stimulation intensity before and during training, you can move gently towards the exact tolerance level.



Perfect Ergonomics for the Youngest

The requirements of children differ from those of adults. The motion trainer MOTomed Gracile responds to these requirements. It is specifically designed for the need of little patients (body height > 90 cm) - be it an especially small pedal distance or a stageless height adjustment of the pedal axle.

MOTomed Gracile - the first movement therapy device for children where the pedal axle with the footrests is adjustable from 26 cm up to 46 cm (considered from the ground). For that reason the MOTomed Gracile can be adapted to different wheelchairs or seat shell heights.

Children are growing - and the MOTomed Gracile grows, too.

Very small Pedal Distance

The hip distance of a child is much smaller than of an adult. The MOTomed Gracile has an inner foot distance of only 12 cm. Therefore it is about 30% smaller than other motion trainers. Thus children with smaller hip distance respectively tight leg position can also train without inappropriate strain. Even more important for knee and hip joint is to avoid inappropriate strain during rotating movements - which is guaranteed by the MOTomed Gracile.



Enriches daily Life with Movement

Enjoy Cycling with your own Power despite Paralysis

Thanks to electrical stimulation, the RehaBike provides the opportunity to cycle with the power of your own legs. The RehaBike provides the highest degree of mobility and can basically be compared with the RehaMove. Thus, disabled individuals have the freedom to do outdoor sports independently and - despite limitation - to regain a piece of their quality of life.

RehaBike was developed for people who are restricted in their movement exercise due to illness or injury and nevertheless want to do sports. In contrast to a hand bike, the RehaBike moves exclusively with the power of your own legs. As with RehaMove, the focus of RehaBike is on the prevention of secondary diseases. The RehaBike consists of a tailored recumbent tricycle and a stimulator that causes the contraction of the muscles which are necessary for cycling. Both the speed and the intensity of stimulation can be controlled via a throttle during cycling.



Enriches daily Life with Movement

Honored with Innovation Awards

The RehaBike was developed in collaboration with the University of Glasgow and the Max Planck Institute in Magdeburg. Honored with the Innovation Award of the RehaCare 2005 and the Hugo Junkers Innovation Award Saxony-Anhalt 2006.



Picture taken on the 2nd International FES Sports Day in Glasgow which took place in June 19th and 20th, 2009

"With RehaBike I can preserve at least a part of my leg muscles. These muscles protect my legs and act preventively against pressure sores. Besides I think it looks better if my legs consist not only of skin and bones which has a positive aesthetic effect, too. I am also sure that this training has further positive effects on health. Most important to me is the possibility to move on my own without wheelchair."

Michael I., Switzerland



www.rehabike.de

Extended Therapy Options

The Solution for universal Applications of Electrical Stimulation

RehaStim is the only device of its kind which can be used both for a sequence training of individual muscle groups and a complex training in combination with a motion trainer. RehaStim stands for electrical stimulation which meets all requirements in clinical and ambulant therapies as well as scientific purposes. RehaStim can be used for various tasks in clinic, research and development. It provides a wide range of application and the highest ease of use.

A total of eight stimulation channels on two separately controlled modules allow overlapping pulse trains for complex movement patterns as special sequence training.



Extended Therapy Options

Operation via Touch Screen

RehaStim is operated via touch screen with a clearly arranged display. By touching the display and the intuitive user interface, the adjustment of the stimulator is user-friendly and easy to understand. This guarantees the highest degree of patient safety.



Individual Stimulation in the ScienceMode

For scientific applications, RehaStim provides a special software module: the Science Mode allows an external control of the stimulation sequence via connection to the PC. At the same time, compatible hardware can be connected. RehaStim serves as output device of the previously generated instructions. Thus stimulation sequences can be adapted to the individual threshold of the stimulated muscles. An additional medical and technical registration of the PC is not necessary. Depending on individual stimulation needs, personal stimulation sequences can be programmed in the ScienceMode. The user has different stimulation modes concerning the sequence order. Stimulation sequences can be repeated up to two times within a cycle by using duplets and triplets.



Honored with the Innovation Award
RehaCare International 2005

Technical Data

- Pulse current with biphasic rectangular impulses
- Pulse width 20-500 μ s
- Impulse intervals 10 μ s (1 μ s in ScienceMode)
- Current 0-130 mA
- 8 stimulation channels (2 modules with 4 channels each)
- Stimulation frequency 1-50 Hz (up to 140 Hz in the ScienceMode)
- Pulse edges <2 μ s
- Battery life 2-6 hours (depending on stimulation intensity)

| FES - the Next Generation



Apart from the modified appearance, the new stimulator RehaStim2 offers an even simpler operation. Via a rotary knob, the existing eight stimulation channels are assigned and defined with corresponding parameters.

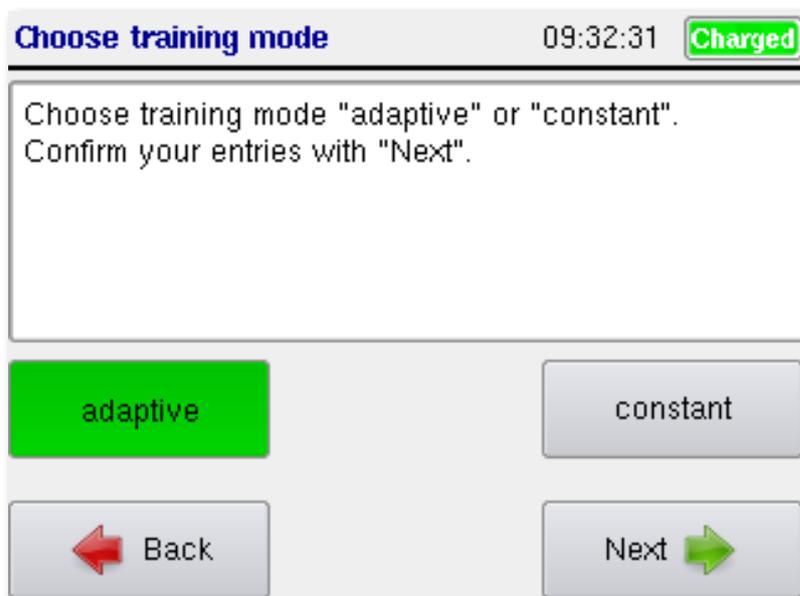
On the large color display the user can navigate easily. Color-coded channels for each muscle make it even easier and faster to apply the electrodes. In the extended memory, over 100 patients combined with their training settings can be stored and the respective course of therapy can be saved.

Upgrade your MOTomed with FES training

Due to the clear operation, the therapy with Functional Electrical Stimulation on RehaMove2, a combination of RehaStim2 and MOTomed viva2, becomes easier. RehaMove2 is more user-friendly and easier to operate and therefore can save time in the daily hospital routine. The integrated data storage also allows a detailed processing and assessment of the performed stimulation session.

For patients already using the MOTomed viva2, the upgrade of RehaStim2 for FES training is possible any time. We will be glad to give you more detailed information.

The RehaMove can be used in two different ways. The adaptive mode allows an automatic adaptation of the stimulation intensity to the power produced by the patient. In constant mode, the stimulation remains steady - regardless of speed or resistance of the patient.

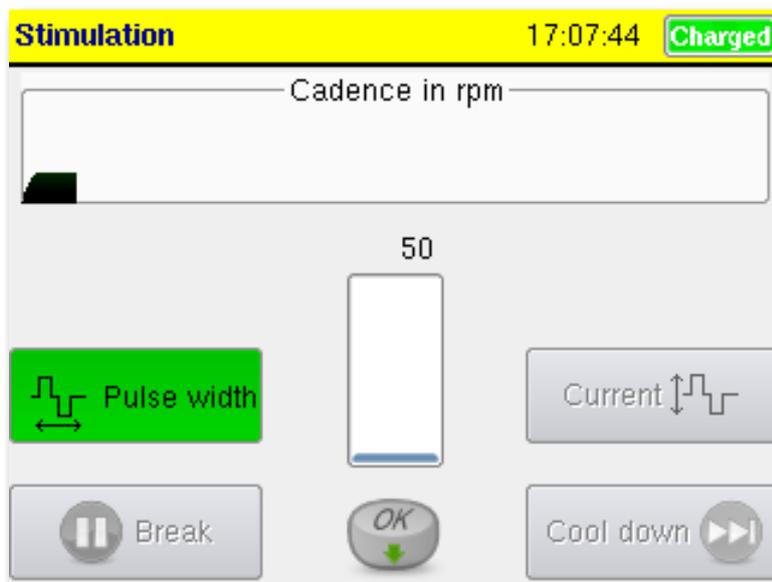


FES - the Next Generation

Feedback during Training

During training users receive feedback on most important parameters so they can check their performance immediately.

During stimulation, the therapist has the possibility to vary the stimulation intensity. For each channel, he or she can adjust the parameters to the optimum capacity or the constitution of the patient.

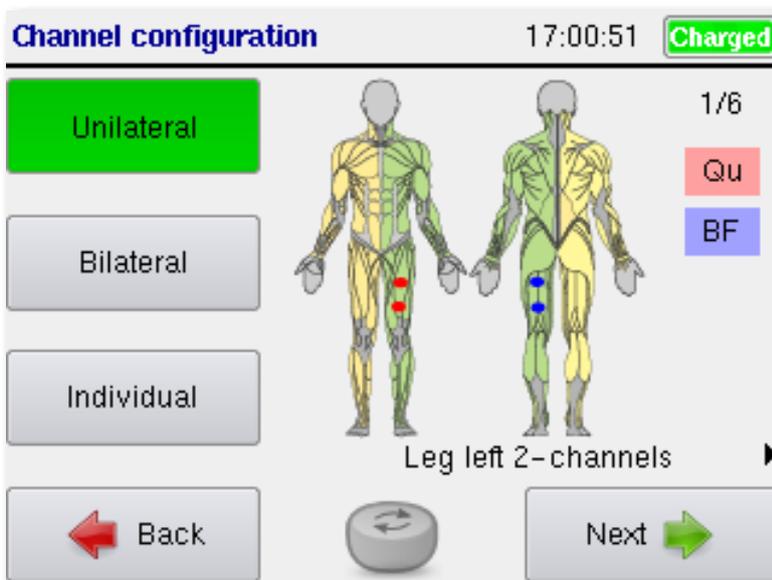


Easy setting via Templates and Current Test

The user can choose from pre-set templates for unilateral and bilateral stimulation. These correspond to the assignments of the most frequently used stimulation channels.

Due to the color coding of the channels on the templates, the correct electrode placement is easy to follow.

During the first training, the initial intensity for each channel can be adjusted via a current test. After that, the user can start training immediately.



Evaluation of the Course of Therapy

Data History

The progress display offers to both therapists and patients an overview of the changes of the stimulation parameters and the development in the course of therapy.

All important parameters, such as stimulation time, average pulse width or frequency, are indicated tabularly for each single training.

Thus, the development of the therapy of the respective patient can be documented and understood clearly.

History view JOHN_DOE 17:10:05 **Charged**

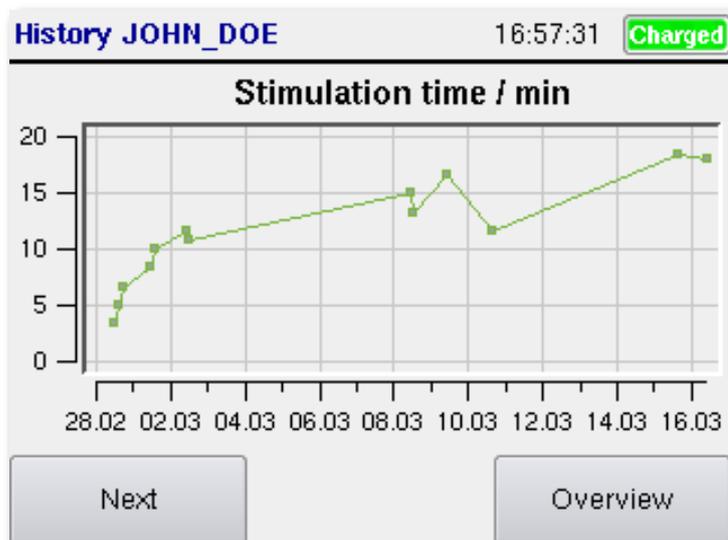
	1	13	
Date	2011-02-28	2011-03-16	
Start time (hh:mm)	12:01	10:25	
Stim. time (mm:ss)	03:20	17:56	↗
Aver. pulsewidth / μ s	13	16	↗
Frequency / Hz	20	27	↗

Results  Exit

Feedback at the End of Training

In a graph indicating the process, parameters are shown in a coordinate system. Changes respectively developments which occur in the tabular presentation only as numbers can be understood more clearly in graphs.

As a result, the therapist can recognize possible tendencies and react during therapy. The visible upward movement of the activity curve is a motivating argument for the patient concerning the success of the therapy.



Effective Rehabilitation |

Scientific Background

Reasons for the increased use of Functional Electrical Stimulation are the many positive experiences in daily clinical practice as well as various scientific studies.

Referring to **stroke** patients, a significant improvement of muscular strength, mobility, muscle tone and muscle atrophy by training with Functional Electrical Stimulation can be observed.

For patients with **residual muscle function after spinal cord injuries** a faster recovery is expected. In this context, the relearning of movement, the improvement of motoric function and muscle coordination play an important role. Particularly interesting is the comparison with control groups achieving lower therapeutic success by conventional physiotherapy. RehaMove thus supports an effective rehabilitation after incomplete paralysis.

The goal of the movement therapy for patients with **complete paraplegia** is the prevention of secondary diseases. Studies with quadriplegic patients showed for instance an improved blood circulation and significant vascular changes in the stimulated muscles. Promotion of the blood circulation reduces both the risk for pressure sores (Decubitus Ulcer) and thrombosis. In the range of an increase in bone density, scientists were able to prove positive results in studies with paraplegic patients suffering from osteoporosis.



"In recent years great progress has been made in the field of Functional Electrical Stimulation which can be applied in many ways for the promotion of voluntary motor functions and as neuro-orthosis. In many research projects as well as in therapeutic application, the walking function was supported by FES [...] and at the same time, the physical condition was improved."

Mangold S, Keller T, Was mit FES möglich ist, in pt_Zeitschrift for Physiotherapie_59, 2007

Scientific Background

In general terms, it could be confirmed that the atrophied main muscle fibers of the stimulated muscle increased due to the regular motion training with electrical stimulation. The increases could be found mainly close to the electrodes while the relation muscle/ fat tissue was improved simultaneously. From that point of view, it is confirmed that training with the RehaMove can prevent the loss of muscle. Concerning training effects of the cardiovascular or cardiopulmonary system, positive results were obtained in all recent studies.

For more information, please ask for our brochure “Medical Benefits of FES Cycling in Complete Paraplegic Individuals - A scientific Overview”!

Side Effects

Some users of Functional Electrical Stimulation in combination with motion training report on pain sensations (parasthesia), redness of the skin (erythema) and warming of the stimulated area. Concerning the electrodes, allergic reactions can also be caused. Sustained damages as a result of using RehaMove are not known.

So: the decision whether training with the RehaMove is possible and useful must always be made after consulting the attending physician.

Sources

Baldi JC, Jackson RD, Moraille R, Mysiw WJ (1998). *Muscle atrophy is prevented in patients with acute spinal cord injury using functional electrical stimulation*. Spinal Cord (1998) 36, 463-469

Bauman WA, Spungen AM, Raza M, Rothstein J, Zhang RL, Zhong YG, Tsuruta M, Shahidi R, Pierson RN, Wang J (1992). *Coronary artery disease: metabolic risk factors and latent disease in individuals with paraplegia*. Mt. Sinai J. Med 1992; 59:163-168

Berry HR, Perret C, Saunders BA, Kakebeeke TH, Donaldson ND, Allan DB, Hunt KJ (2008). *Cardiorespiratory and power adaptations to stimulated cycle training in paraplegia*. Med Sci Sports Exerc. 2008

Campbell JM (2002), http://www.ifess.org/Services/Consumer_Ed/SCI.htm, Zugriff vom 15.02.09

Davis GM, Nur AH, Fornusek C (2008). *Cardiorespiratory, metabolic and biomechanical responses during functional electric stimulation leg exercise: health and fitness benefits*. Artif Organs, 32 (8): 625-629

Demchak TJ, Linderman JK, Mysiw WJ, Jackson R, Suun J, Devor ST (2005). *Effects of functional electric stimulation cycle ergometry training on lower limb musculature in acute individuals*. Journal of Sports Science and Medicine (2005) 4, 263-271

Scientific Background |

Duffell LD, Donaldson N, Perkins TA, Rushton DN, Hunt KJ, Kakebeeke TH, Newham DJ (2008). *Long-term intensive electrically stimulated cycling by spinal cord-injured people: effect on muscle properties and their relation to power output.* Muscle Nerve. 2008 Oct.; 38 (4): 1304-11 1995; 32 (4):361-366

Gerrits HL, de Haan A, Sargeant AJ, van Langen H, Hopman MT (2001). *Peripheral vascular changes after electrically stimulated cycle training in people with spinal cord injury.* Arch Phys Med Rehabil 2001, Jun; 82 (6):832-9

Hooker SP, Scremin E, Mutton DL, Kunkel CF, Cagle G (1995). *Peak and submaximal physiologic responses following electrical stimulation leg cycle ergometer training.* J Rehabil Res Devel 1995; 32 (4):361-366

Janssen TWJ, Glaser RM, Shuster DB (1998). *Clinical efficacy of electrical stimulation exercise training: effects on health, fitness and function.* Top Spinal Cord Inj Rehabil 1998; 3 (3):33-49

Krause P, Szecsi J, Straube A (2008). *Changes in spastic muscle tone increase in patients with spinal cord injury using functional electrical stimulation and passive leg movements.* Clinical rehabilitation 2008;22:627-634

Mohr T, Andersen JL, Biering-Sørensen F, Galbo H, Bangsbo J, Wagner A, Kjaer M (1997). *Longterm adaption to electrically induced cycle training in severe spinal cord injured individuals.* Spinal Cord 1997;35:1-16

Newham DJ, Donaldson N (2007). *FES cycling.* Acta Neurochir. Suppl. 2007; 97 (Pt1): 395-402

Sloan KE, Bremner LA, Byrne J, Day RE, Scull ER (1994). *Musculoskeletal effects on an electrical stimulation induced cycling programme in the spinal injured.* Paraplegia 1994;32:407-415

Van der Salm A, Veltink PH, Ijzerman MJ, Groothuis-Oudshoorn KC, Nene AV, Hermens HJ (2006). *Comparison of electric stimulation methods for reduction of triceps surae spasticity in spinal cord injury.* Arch Phys Med Rehabil 2006 Feb; 87 (2):222-8

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