

HASOMED

RehaMove[®]

Functional electrical stimulation



FES applications

For all therapeutic areas

The functional electrical stimulation (FES) is highly important for the therapy and rehabilitation of paralytic illnesses. If correctly used, FES is an effective method for preventing atrophies and paralysis-induced resulting diseases. Whether it is used to improve motor behaviour, to build-up strength or stabilise the cardiovascular system – FES with RehaStim2 opens up new possibilities!

Extended opportunities with sequence training

With the help of sequence training, FES applications from 1-channel hand extension to 8-channel gait training are possible. Standard templates allow an easy and quick setup of the motion sequence to be stimulated. Any sequence training template can be customized by individually adjustable stimulation and resting periods.

Flexibility in usage

- Automatic timing of simulation sequences
- Manual initiation of single sequences with one touch
- External hand switch for several stimulation sequences



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Application examples

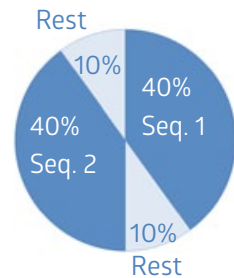
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Percentage or seconds?

The stimulation sequences can be programmed in an absolute manner (in seconds) or relative to the complete movement cycle (in percent). The interval setting determines the resting interval after each movement cycle.

Percentage:

One complete movement (e.g. one double step) corresponds to 100%. The duration of the period indicates the movement duration. The user defines the relative proportions of the individual sequences of the complete movement in percent. The resting intervals are generated automatically.



Sample calculation for a period of 10 seconds:

Sequence 1 = 4 s, Resting interval = 1 s, Sequence 2 = 4 s, Resting interval = 1 s

Seconds:

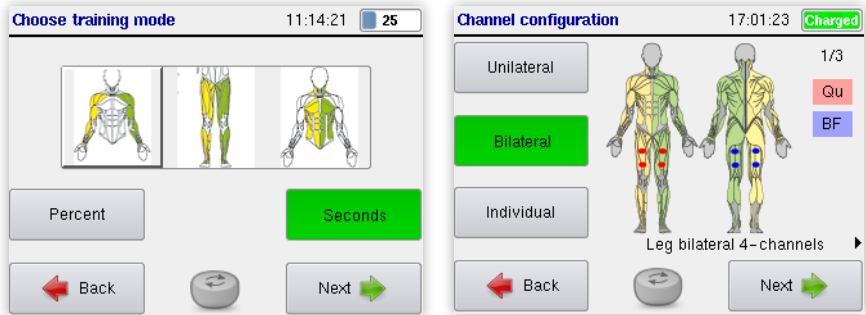
The duration of each individual sequence is indicated by the start and end time in seconds. The resting times between the individual sequences result from the end and starting points of two consecutive sequences.

Example: Sequence 1 (0-3 s), Sequence 2 (4-6 s) -> automatic resting time = 1 s



Using stimulation templates

There are a number of pre-made templates for a variety of sequence training applications. The muscles to be stimulated are assigned fixed channels and stimulation times.



The templates are sorted according to the application area: upper extremities, lower extremities and trunk. Templates can be individually customised and modified. Assignment of muscles and stimulation channels as well as defining the stimulation periods / percentages can be done individually at any time.

Correct stimulation parameters

People are different in terms of their muscular constitution, physical nature and their individual stimulus thresholds. Therefore, parameters for electrical stimulation must always be individually adjusted.

Frequency

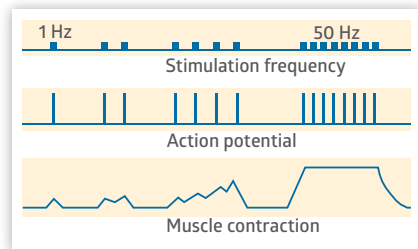
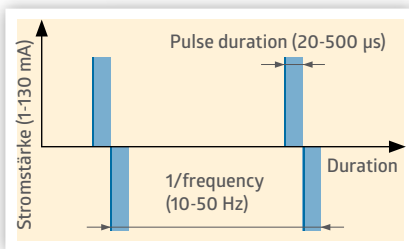
Number of single pulses per second; crucial for the contraction intensity and muscle fatigue

Pulse width / pulse duration

Duration of the impulse, which is crucial for fibre recruitment (long pulses recruit more motor and sensitive nerve fibres)

Current / amplitude

Pulse height, which is relevant to threshold crossing (sensitive, motor or painful suprathreshold)



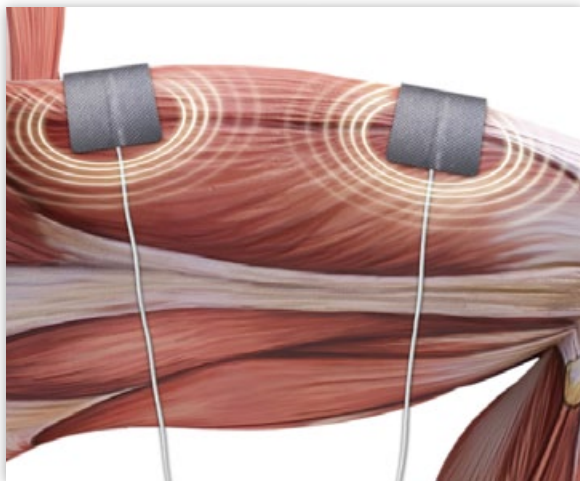
Stimulation duration depends on the desired therapeutic goals. Lower intensities allow longer stimulation periods, high intensities should only be applied for a short period.

For exact details on duration and frequency of the particular application should be settled in consultation with the patient, therapist, and doctor.

Positioning of the electrodes

With the help of FES, the motor nerve of a muscle gets stimulated. The action potential is directly generated within the effereence. A 100% exact and reproducible positioning of the electrodes is almost impossible due to the different location of the motor nerves.

The electrodes should be placed to ensure stimulation over the belly of the muscle, with a distance of at least one electrode between them. If required, or in case of an unsatisfactory stimulation result, the electrode position can be adjusted at any time.



Hand extension

The hand extension is essential to carry out simple tasks in daily routines. Having adequate strength is fundamental to these movements and can be stimulated effectively with FES. In case of an apoplexy or a tetraplegia in particular, there are restrictions that can be treated supportively with FES.

Stimulated muscles:

M. extensor radialis, M. brachioradialis

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 100-400 μ s (depending on degree of muscle innervation)

Amplitude: individually approx. 10% above the motor threshold

(Example: motor threshold at 20 mA, then adjust amplitude value to 22 mA)

Frequency: 35-50 Hz for strengthening, 10 Hz for detonising

Electrode size:

4 × 6.4 cm / 1.5 × 2.51 inch (oval shape)



Template:

· wrist_extension_1K (unilateral/bilateral), SECONDS



Hand flexion

Due to spasms, there is often a hypertonic fixation of the hand flexion. In order to strengthen the antagonistic extensor muscles, it is vital to detonise the spastic flexor muscles. A low stimulation frequency is used to reduce hypertension.

Stimulated muscles:

M. flexor radialis, M. flexor ulnaris

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 100-200 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 10 Hz detonising / relaxing spasms, 35-50 Hz for strengthening

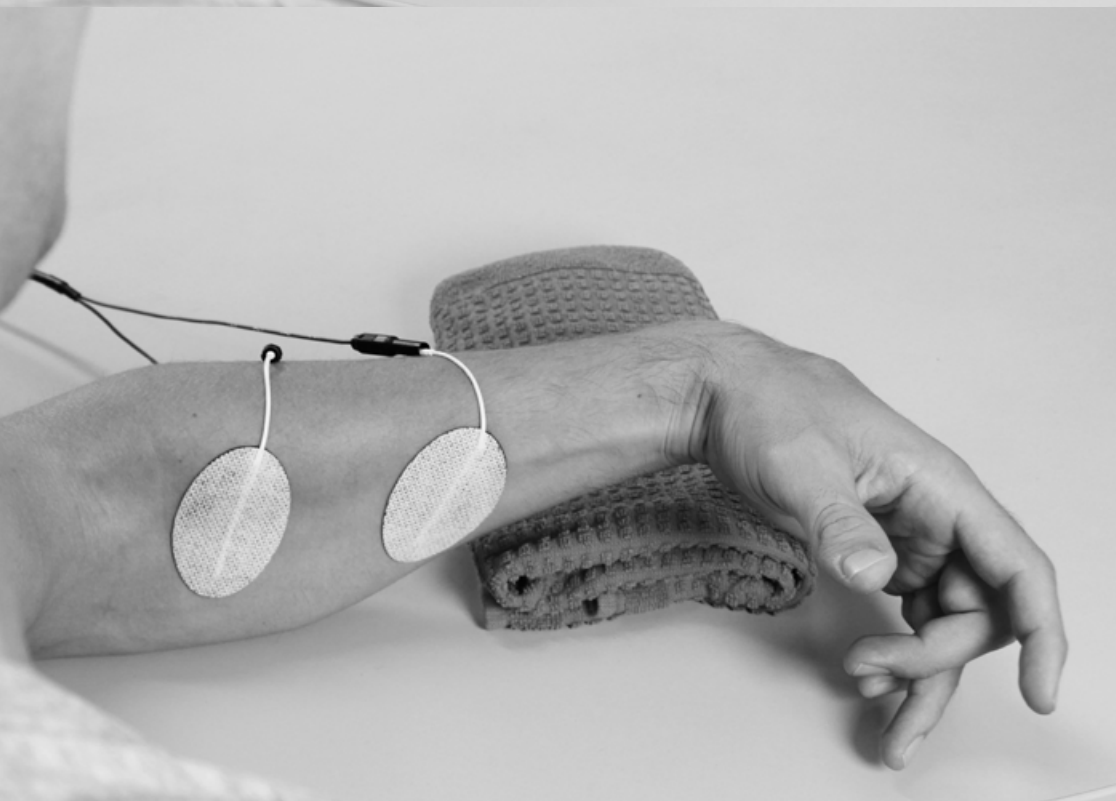
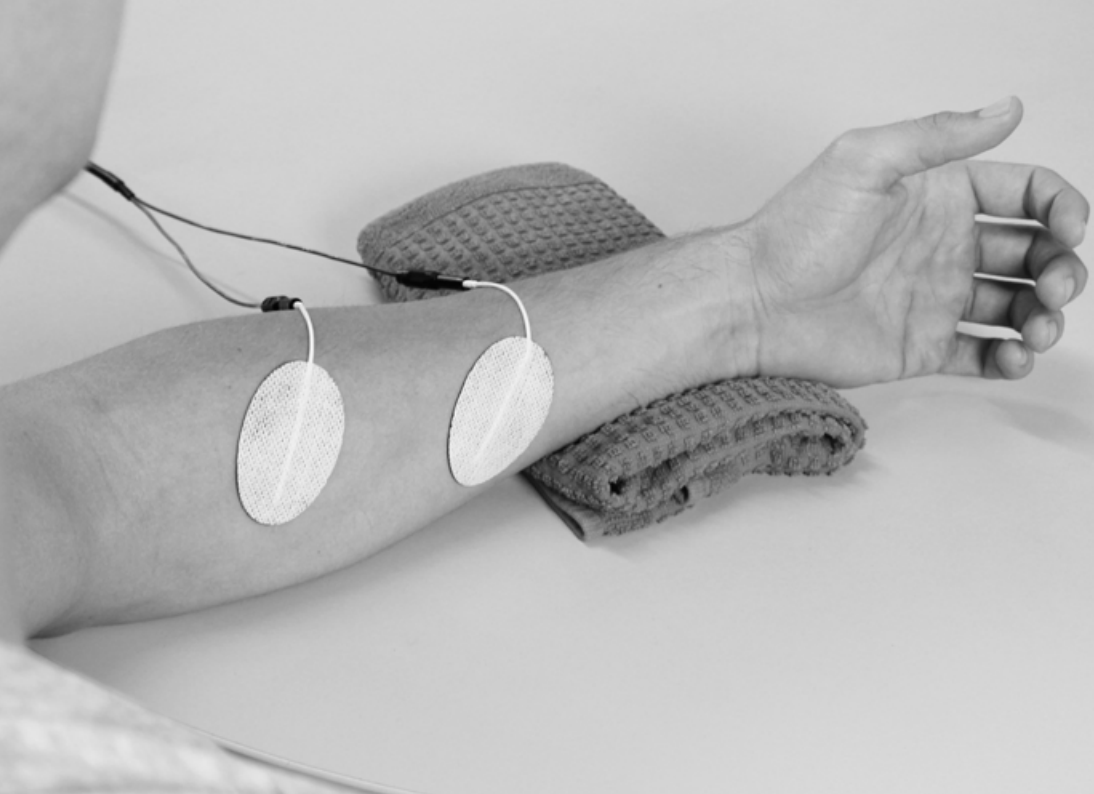
Electrode size:

4 × 6.4 cm / 1.5 × 2.51 inch (oval shape)



Template:

· thumb_radial abduction (unilateral/bilateral), SECONDS



Elbow extension

Especially with tetraplegic patients, the elbow extensor muscles are often only partially innervated. Movements like the simple support step are only possible with difficulty. When flexion spasticity is also present, there is the danger of elbow contracture. Stimulation of the M. triceps brachii can support muscular balance and improve muscular function.

Stimulated muscles:

M. triceps brachii

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 100-400 μ s (depending on degree of muscle innervation)

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening

Electrode size:

4 × 6.4 cm / 1.5 × 2.51 inch (oval shape);

for sensible patients: 5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



Elbow flexion

A basic tone and / or corresponding strengthening of the elbow flexor is important for co-ordinated hand-eye-movements or for grabbing. To detonise existing spasms, the flexor muscles must be relaxed, similar to relaxing hand flexion.

Stimulated muscles:

M. biceps brachii

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 100-200 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening, 10 Hz for detonising

Electrode size:

4 × 6.4 cm / 1.5 × 2.51 inch (oval shape);

for sensible patients: 5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



Knee extension

Knee extension is the prerequisite for standing or gait movements. If the M. quadriceps is partially innervated or atrophied, FES can strengthen and initiate motor function. Maintaining muscle structure and tone plays another important metabolic role.

Stimulated muscles:

M. quadriceps (M. vastus medialis, M. rectus femoris)

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 200-500 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening, 10 Hz for detonising

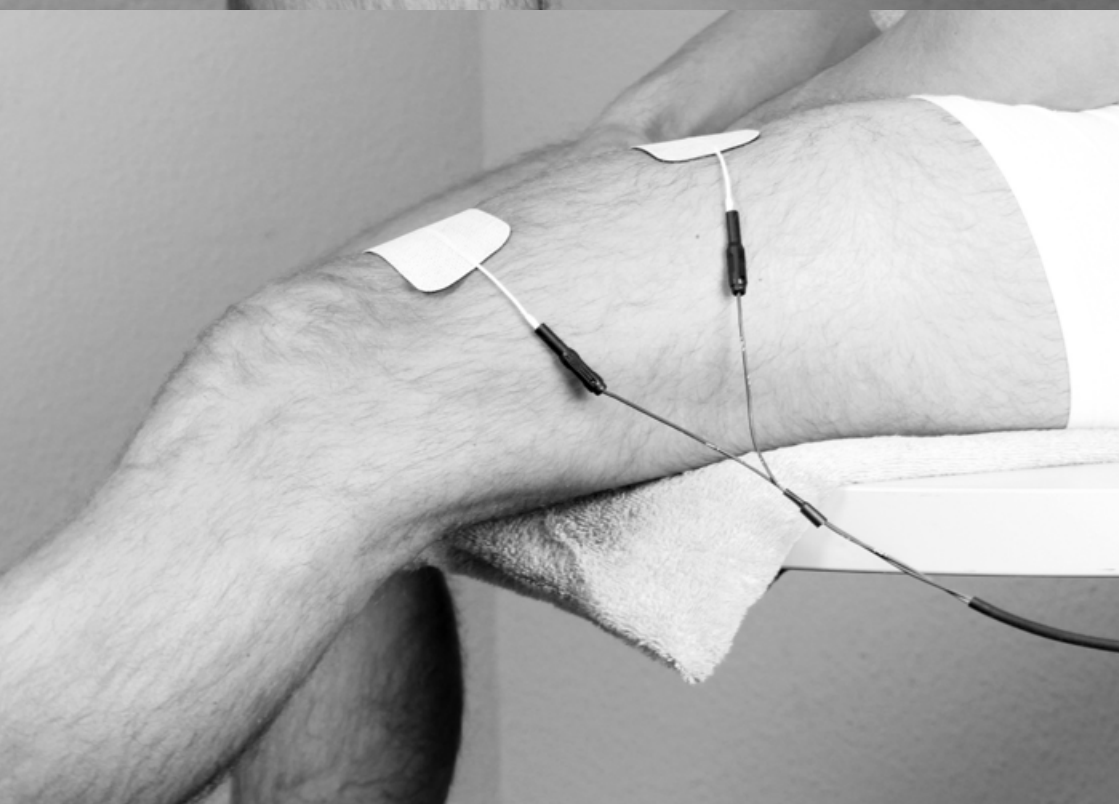
Electrode size:

5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



Template:

· knee_extension_1K (unilateral/bilateral), SECONDS



Knee flexion

As antagonist of the M. quadriceps, the knee flexion muscles are an important opposer of extension spasms. By stimulating the flexors, you can achieve an indirect stretch of the extensors. Additionally, strengthening in the sense of increasing tone and metabolic rate is helpful.

Stimulated muscles:

M. biceps femoris

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 200-500 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening, 10 Hz for detonising

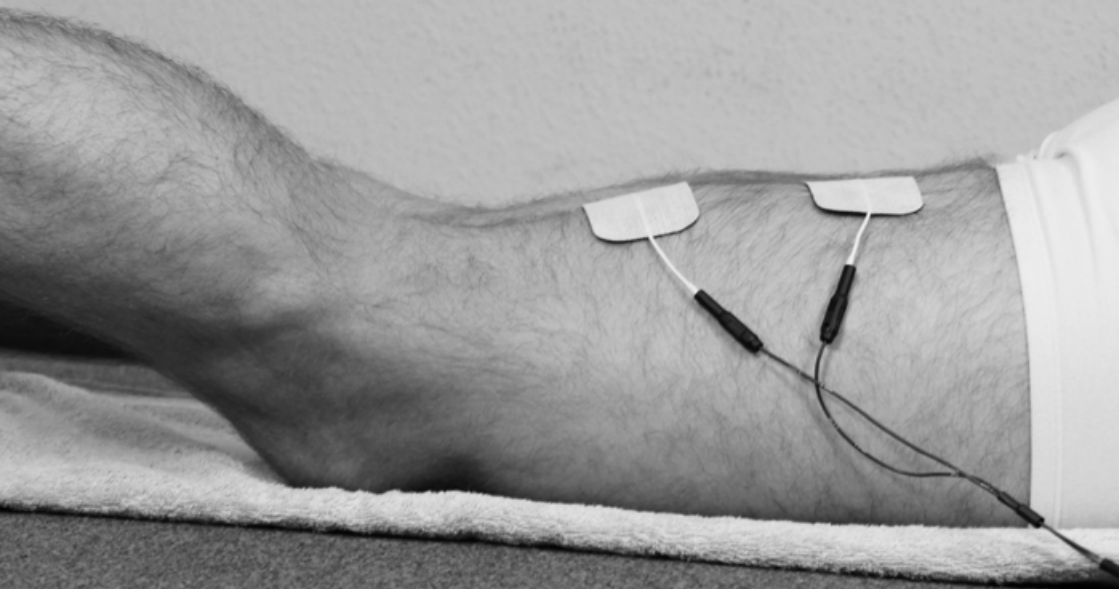
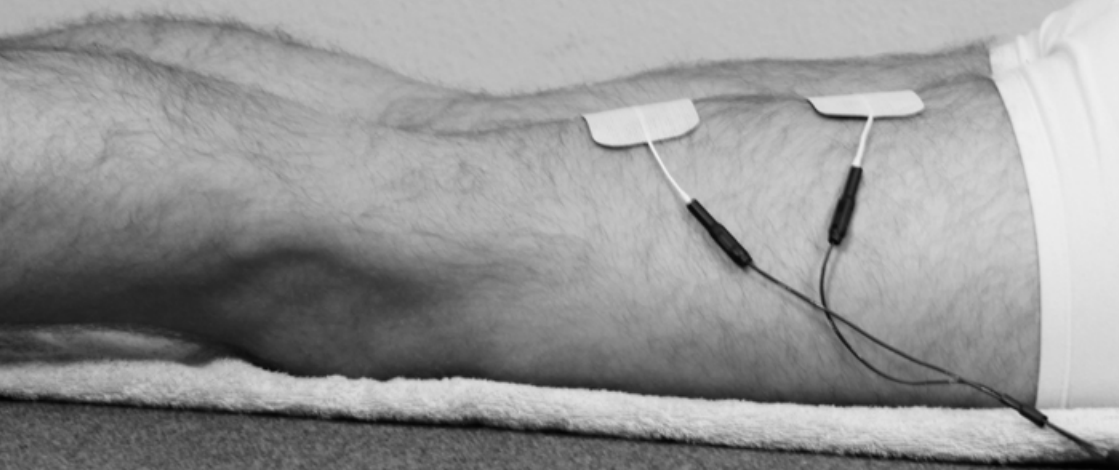
Electrode size:

5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



Template:

· knee_flexion_1K (unilateral/bilateral), SECONDS



Foot raise

To prevent drop foot symptoms in case of an hemi or paraparesis, it is helpful to strengthen the muscles for dorsiflexion of the foot. Usage as neuroprosthesis is an important field of application to improve the gait pattern and prevent compensation-related complications..

Stimulated muscles:

M. tibialis anterior, M. peronäus

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 250-500 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening

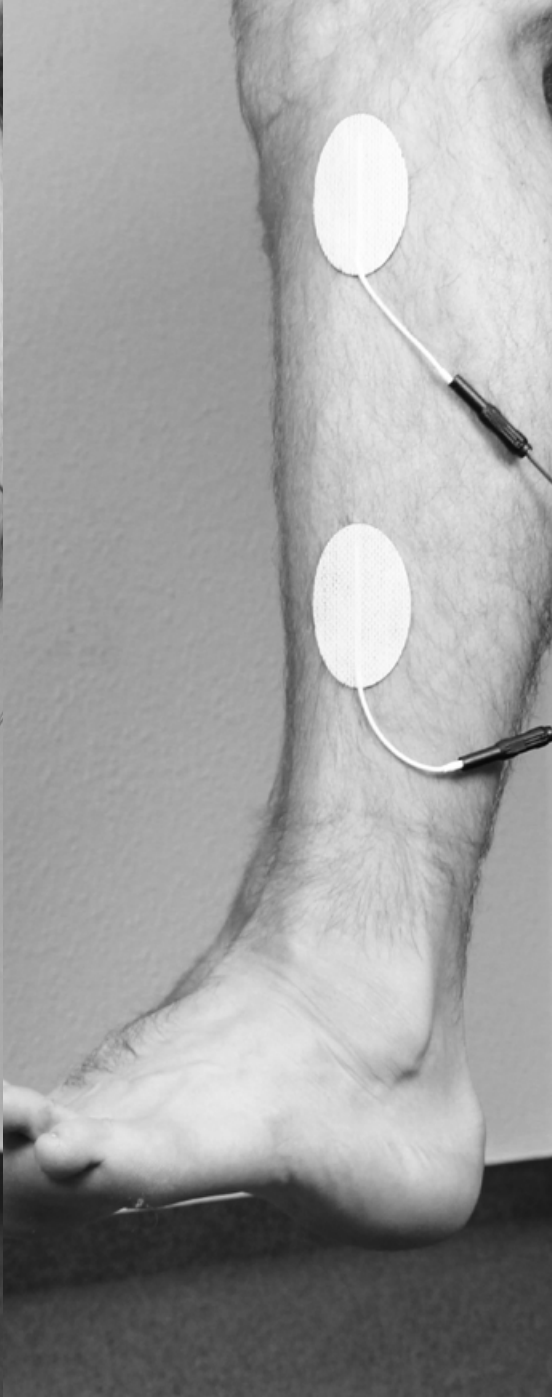
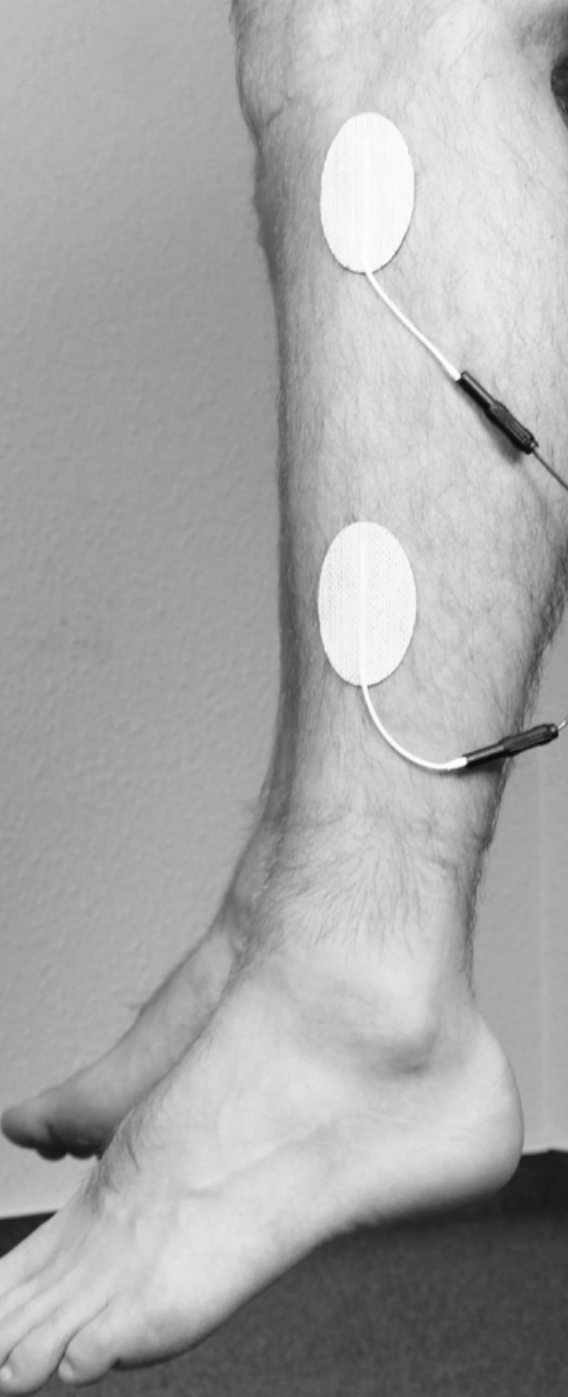
Electrode size:

4 × 6.4 cm / 1.5 × 2.51 inch (oval shape)



Template:

· foot_dorsal extension_1K (unilateral/bilateral), SECONDS



Foot extension

The calf musculature is important to a stable cardiovascular system. In case of long lasting inactivity and high spasticity, its function as venous pump is strongly affected. FES also allows for an effective thrombosis prophylaxis and strengthening of the calf muscles.

Stimulated muscles:

M. gastrocnemius

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 200-350 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening, 10 Hz for detonising

Electrode size:

4 × 6.4 cm / 1.5 × 2.51 inch (oval shape)



Template:

· foot_dorsal ext./plantar flex._2K (unilateral), SECONDS



Shoulder stabilisation

Particularly with hemi and tetraplegia there is a great danger of shoulder subluxation due to the atrophy of the rotator cuff muscles. FES of the affected musculature helps to strengthen and improve movement control.

Stimulated muscles:

M. deltoideus, M. supraspinatus

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 100-350 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening

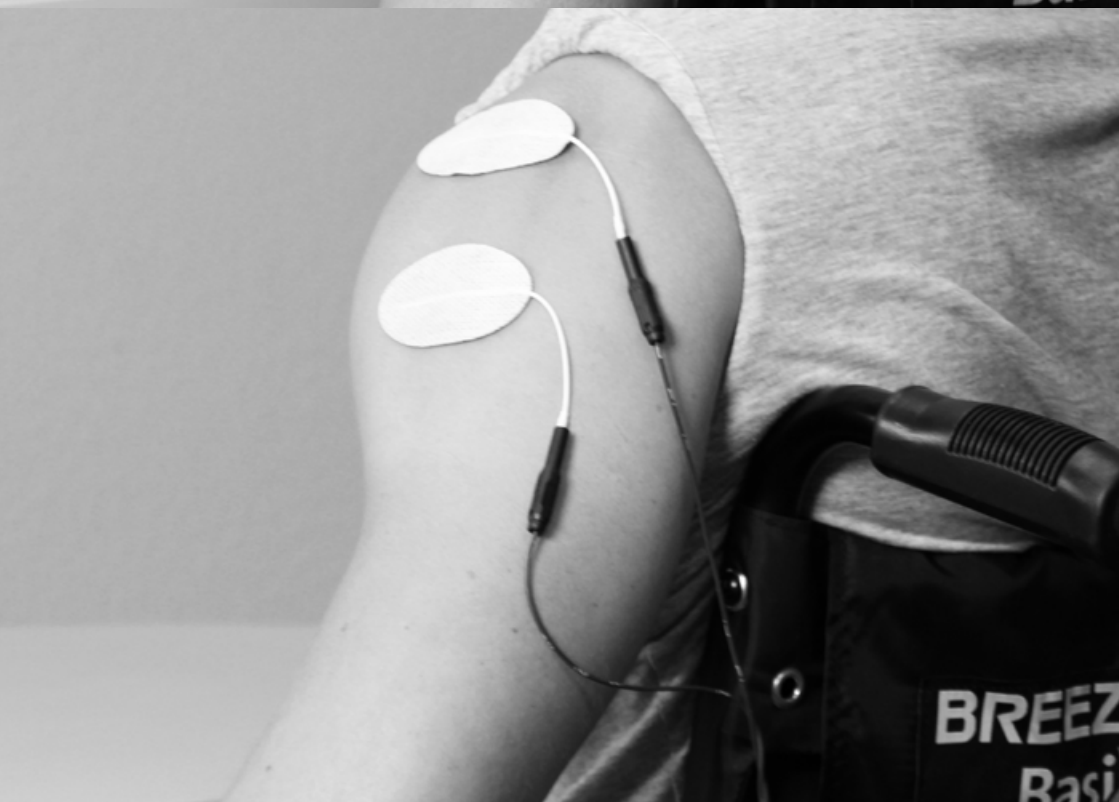
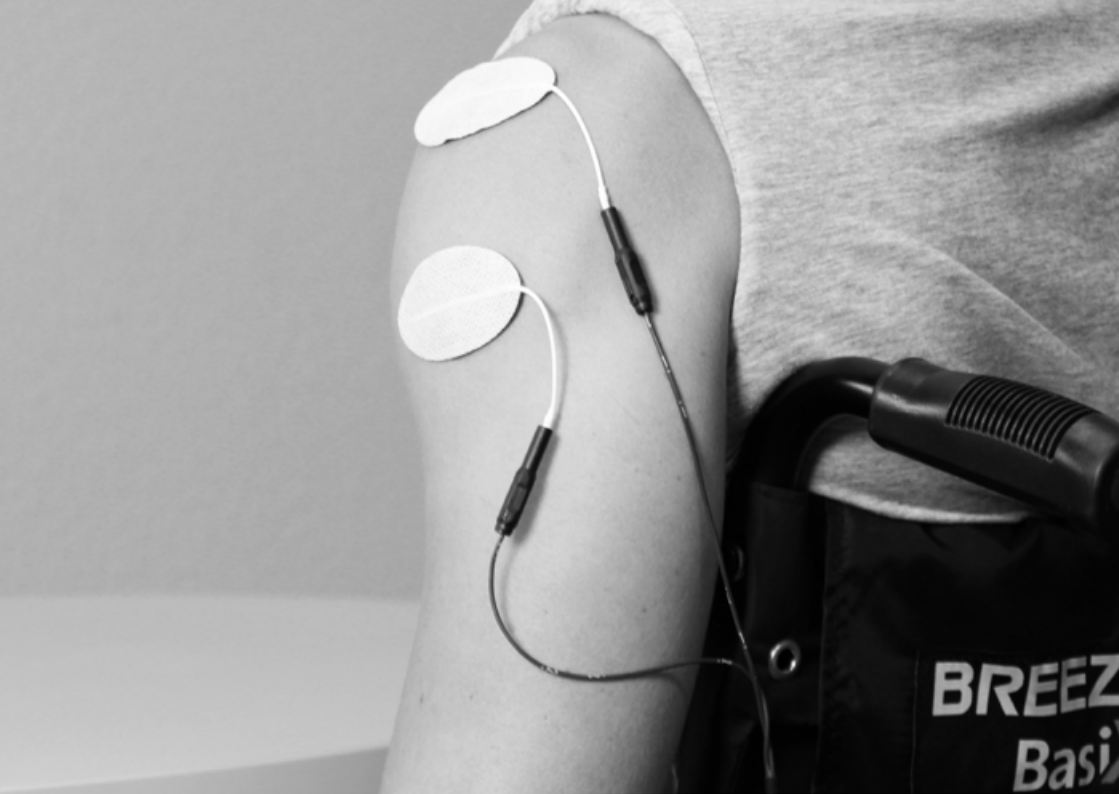
Electrode size:

4 × 6.4 cm / 1.5 × 2.51 inch (oval shape)



Template:

· shoulder stabilisation_2K (unilateral/bilateral), SECONDS



Shoulder straightening

Stimulation of the rhomboidei is a proven method to improve posture, in particular of wheelchair users. Straightening/ stretching of the thoracic spine is an effective prophylaxis against hunchback symptoms and supports the respiratory muscles.

Stimulated muscles:

M. rhomboideus

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 150-350 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening

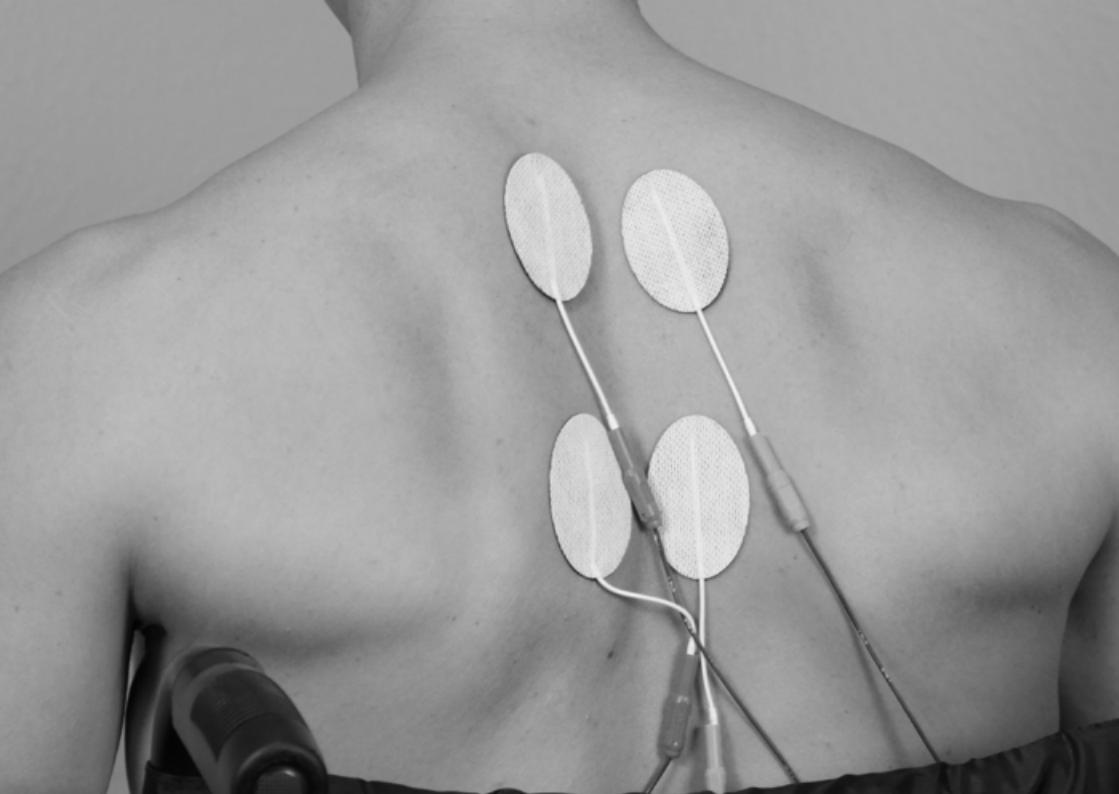
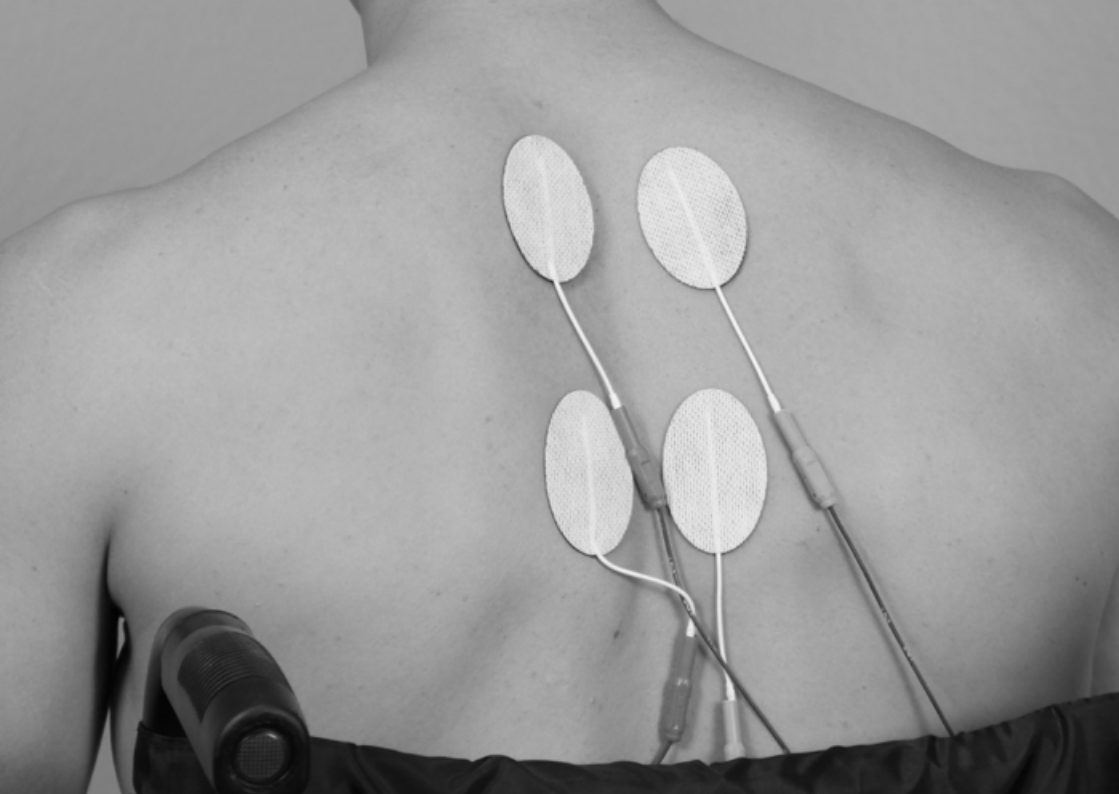
Electrode size:

5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



Template:

· lumbar spine_extension_2K (bilateral); SECONDS



Torso stabilisation, unilateral

A muscular imbalance of the torso stabilising muscles can result in malpositions of the spinal column, e.g. scoliosis. Stimulation of the atrophic muscles can have a preventative, as well as an improving, effect.

Stimulated muscles:

M. rectus abdominis, M. obliquus abdominis

Stimulation duration:

depending on constitution, 5-20 minutes

Stimulation parameters:

Pulse duration: 150-350 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening

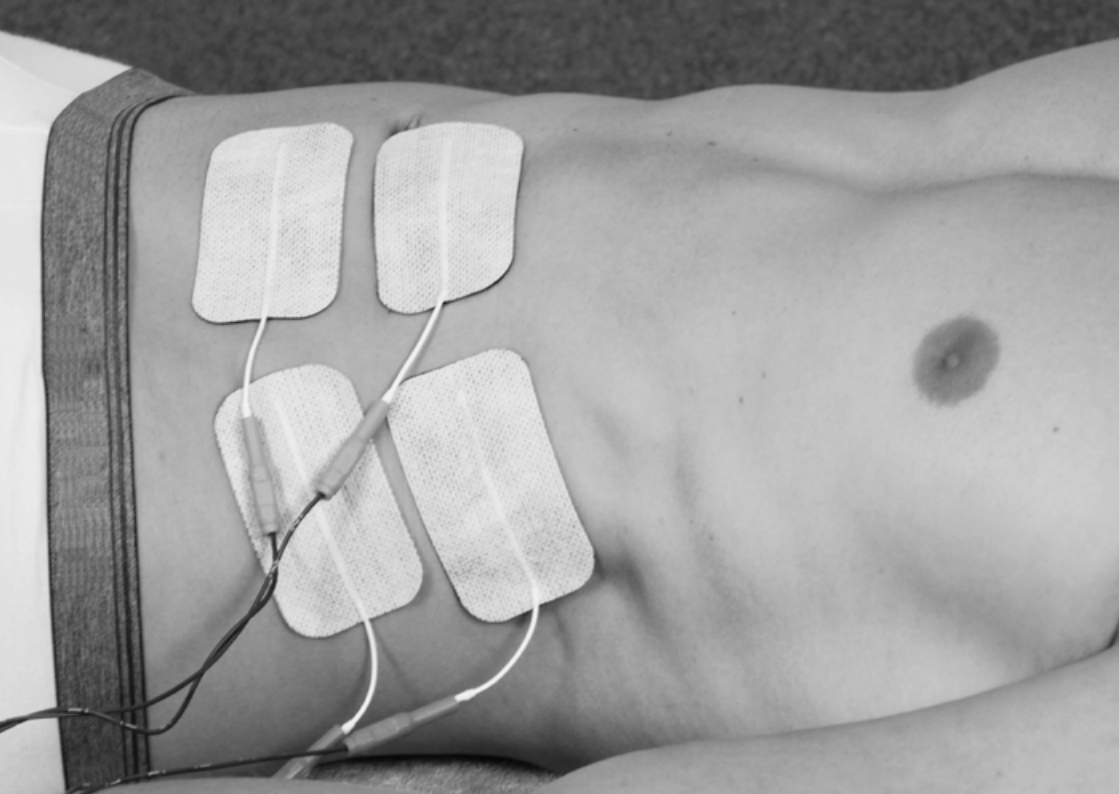
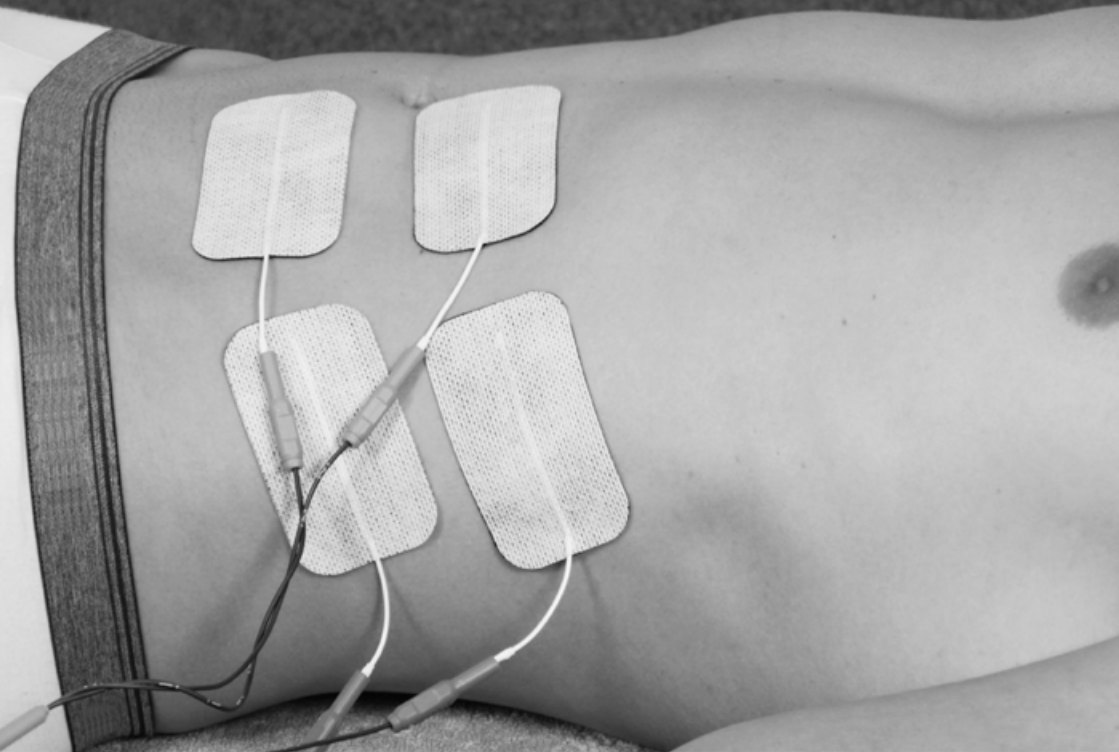
Electrode size:

5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



Template:

· lateral_inclination_le/ri_2K (unilateral); SECONDS



Abdominal training

For torso stabilisation, stimulation of the straight abdominal muscles is often applied - especially for tetraplegic patients. Support of the respiratory muscles can be achieved as a positive side effect by raising the thorax.

Stimulated muscles:

M. rectus abdominis

Stimulation duration:

depending on constitution, 10-45 minutes

Stimulation parameters:

Pulse duration: 150-350 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening

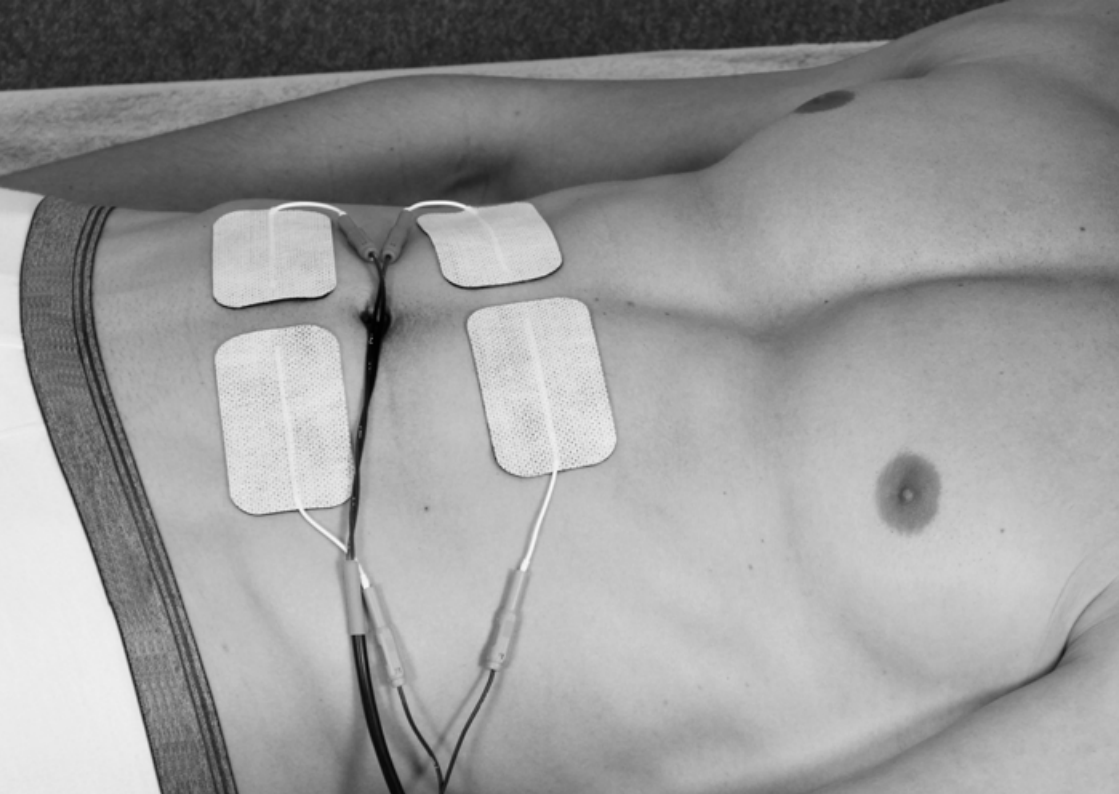
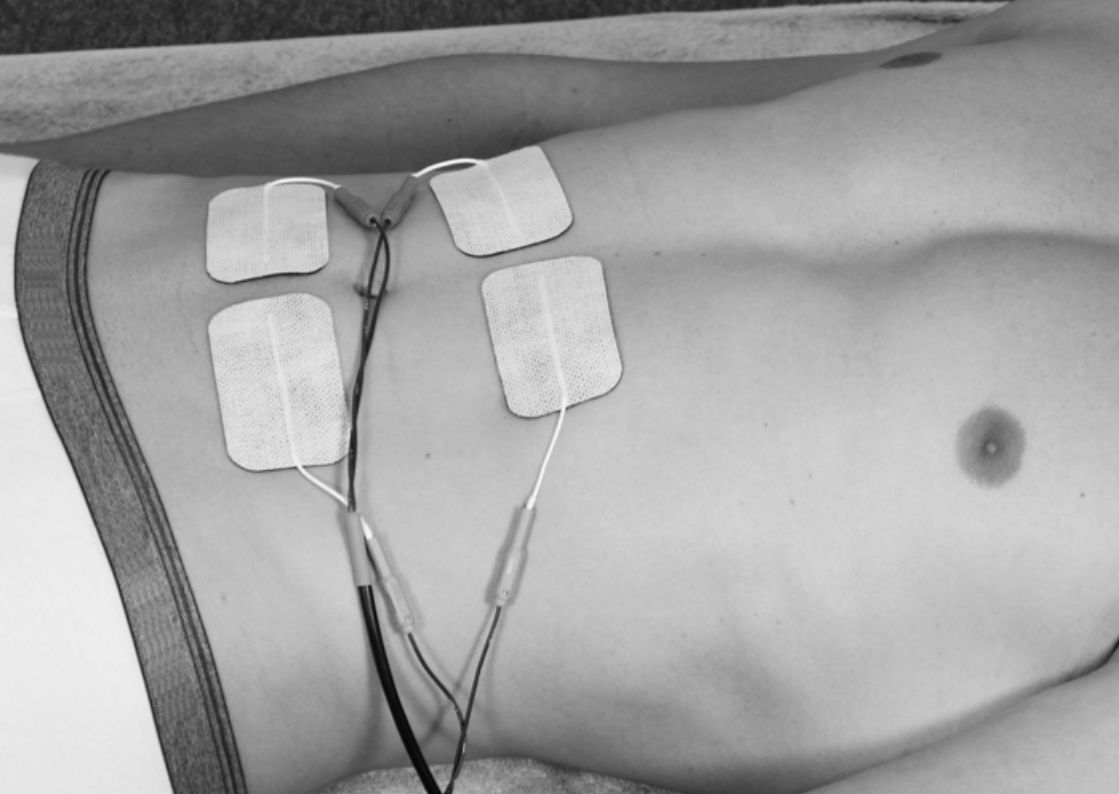
Electrode size:

5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



Template:

· lumbar spine_flexion_2K (bilateral), SECONDS



Back strengthening

Similar to strengthening the abdominal muscles, stimulation of the back extensor muscle group is useful for posture correction and torso stabilisation in case of tetraplegias or high paraplegias. This relief of the lumbar spine plays an important role in this application.

Stimulated muscles:

M. erector spinae

Stimulation duration:

depending on constitution, 10-45 minutes

Stimulation parameters:

Pulse duration: 150-350 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening

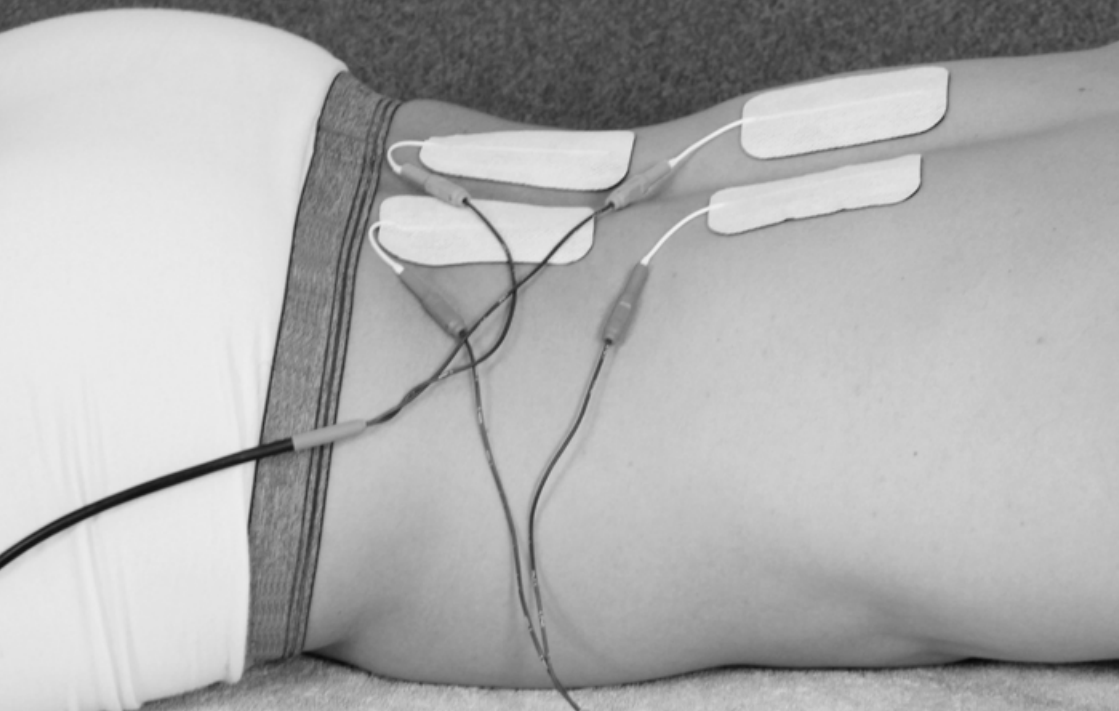
Electrode size:

5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



Template:

· lumbar_spine_flexion_2K (bilateral), SECONDS



Standing (up) training

Transferring from the wheelchair to free standing, up to walking, is one of the most important goals in the treatment of incomplete paraplegia. Stimulation of the most important muscles involved can effectively support this process. Because of the great resistance to overcome, a high stimulation intensity is required for this application.

Stimulated muscles:

M. quadriceps, M. gluteus maximus, M. biceps femoris

Stimulation duration:

as required and after possible stand up attempts

Stimulation parameters:

Pulse duration: 250-450 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 40-50 Hz for strengthening

Electrode size:

5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



Template:

- knee_flexion/extension_4K (bilateral), PERCENT
- Step_OS/US_6K (bilateral), PERCENT
- Step OS-4K to be individually adjusted to:
QU_L + QU_R: 0-100%, BF_L + BF_R: 50-100%
- Step OS/US_6K to be individually adjusted to:
QU_L + QU_R: 0-100%, GL_L+GL_R: 40-100%, BF_L + BF_R: 50-100%



Gait training

Retrieving and relearning the gait pattern is almost the greatest therapeutic challenge for paralysed patients. When FES is integrated into gait training, the neuronal pattern can be learned more effectively by an increased proprioceptive input. Simultaneously, the muscles involved in the gait are evidently strengthened by the stimulation.

Stimulated muscles:

M. quadriceps, M. biceps femoris, M. gluteus maximus, M. tibialis anterior, M. gastrocnemius

Stimulation duration:

depending on the number of possible gait cycles

Stimulation parameters:

Pulse duration: 250-450 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening

Electrode size:

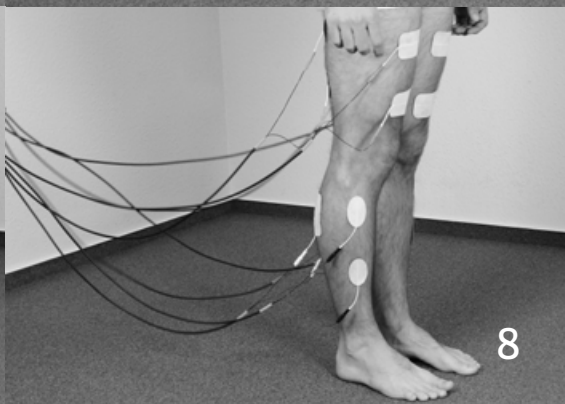
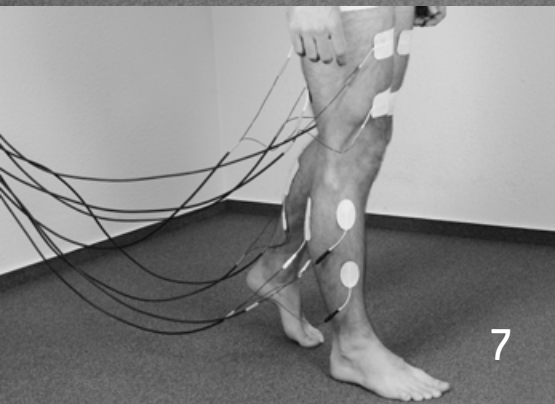
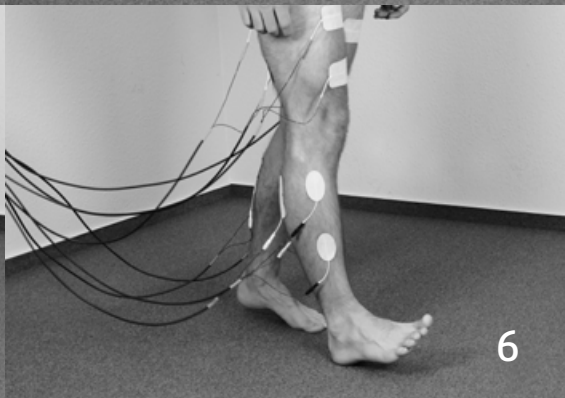
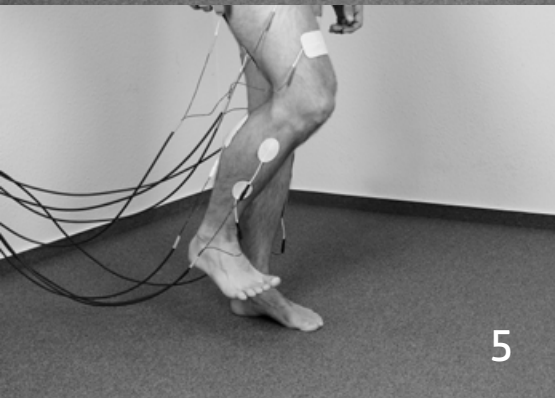
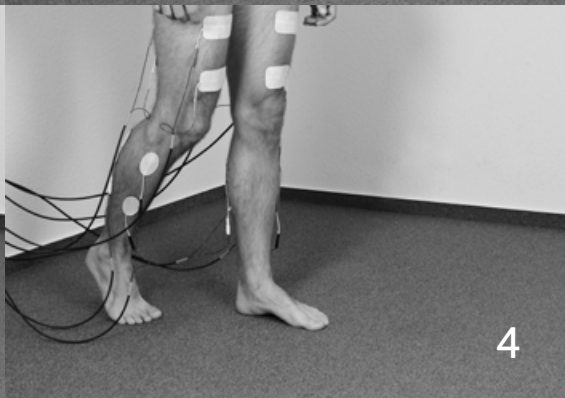
4 × 6.4 cm / 1.5 × 2.51 inch (oval shape) for lower legs;

otherwise 5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



Template:

- Step_OS/US_4K (bilateral), PERCENT
- Step_OS/US_6K (bilateral), PERCENT
- Step_OS/US_8K (bilateral), PERCENT



Crawling

Crawling is the first neuronal movement pattern which is obtained in early childhood. With plegic patients, the basic position is favourably used together with a POSTUROMED® to stabilise the static postural muscles. FES also helps with initiating movement.

Stimulated muscles:

M. quadriceps, M. biceps femoris, M. gluteus maximus, M. iliopsoas

Stimulation duration:

depending on the number of possible gait cycles

Stimulation parameters:

Pulse duration: 250-450 μ s

Amplitude: individually approx. 10% above the motor threshold

Frequency: 35-50 Hz for strengthening

Electrode size:

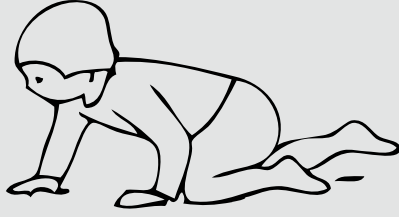
5 × 9 cm / 1.9 × 3.5 inch (rectangular shape)



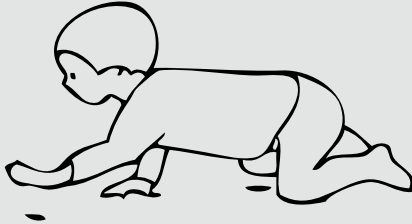
Template:

· Crawling_8K (bilateral), PERCENT

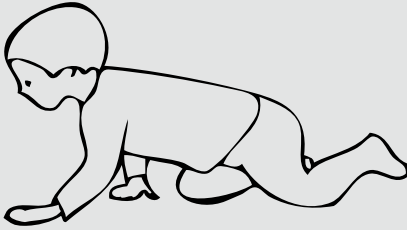
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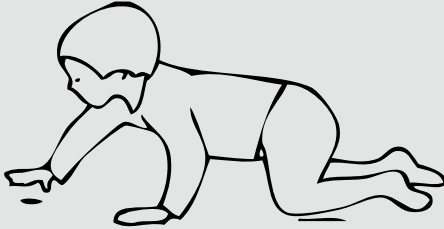
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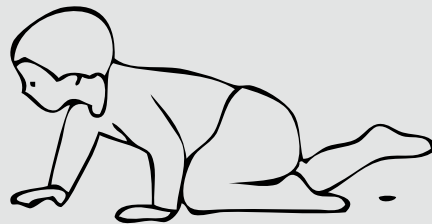
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