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THERAPY

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We look forward to your suggestions.

FOREWORD

A bold step

Dear Readers,

Well, have you noticed yet? That's right! With the publication of the second issue of our magazine, we have made some improvements and taken a significant step towards internationalisation. THERAPIE is now THERAPY! This took some courage but it had to be done. We could never have dreamed that the magazine would enjoy such popularity worldwide.

In this issue, we continue with the topic of "best practice" alongside many other fascinating articles. That was another bold step! A best-practice model for device-based neurorehabilitation – this was unprecedented. And yet we demonstrated courage and tackled the issue. Our aim is to improve rehabilitation and we can see that it's working. The feedback has been positive and there is a great deal of demand for solutions. Since the start of the year, a "gold standard" has been established.

Best wishes on behalf of the editorial team,

Jakob Tiebel
Contact the editorial team at:
therapy@thera-trainer.de
(and tell us what you think!)

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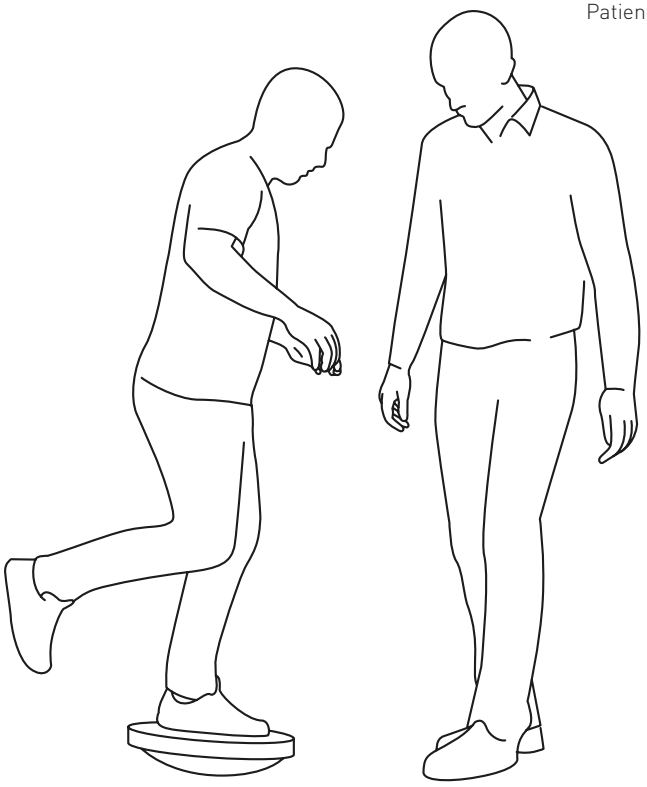
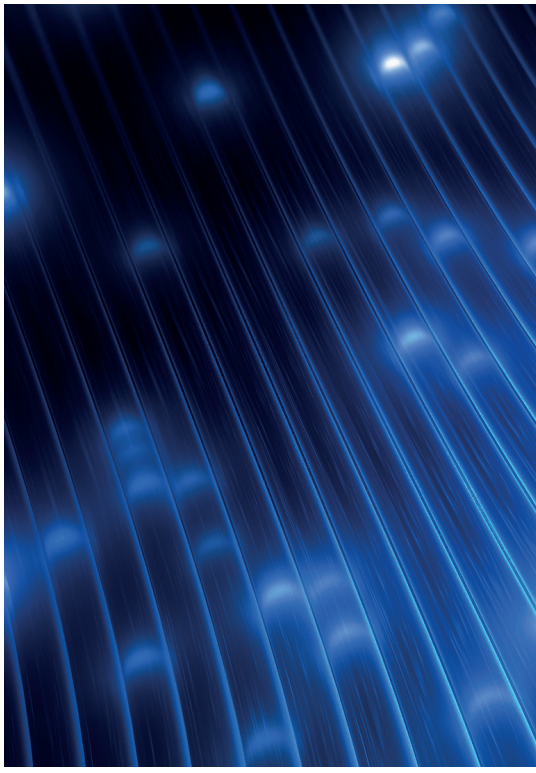
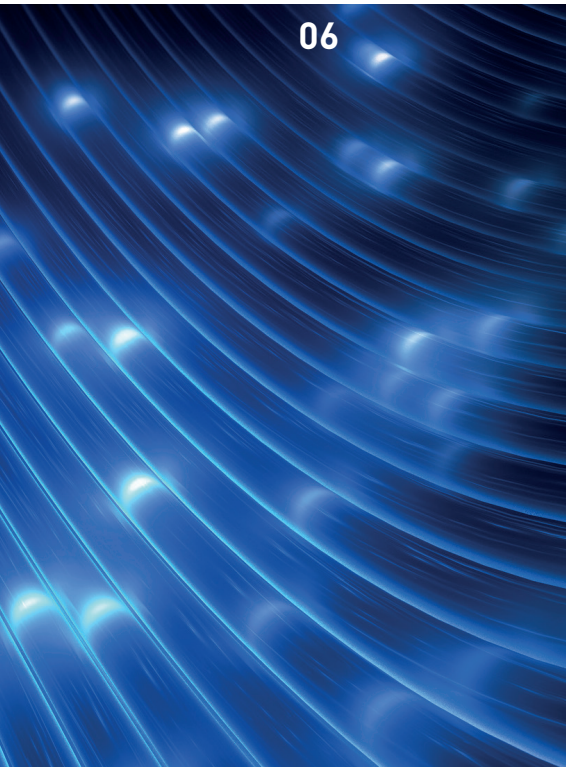
From evidence to clinical practice –
Patients undergoing rapid testing





The first complete solution for gait rehabilitation

It's all about nerves!
Neuroplasticity and
motor learning



Improving care structures
through networking

Cover story: It's all about nerves! Neuroplasticity and motor learning

Science

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COVER STORY

It's all about nerves! Neuroplasticity and motor learning

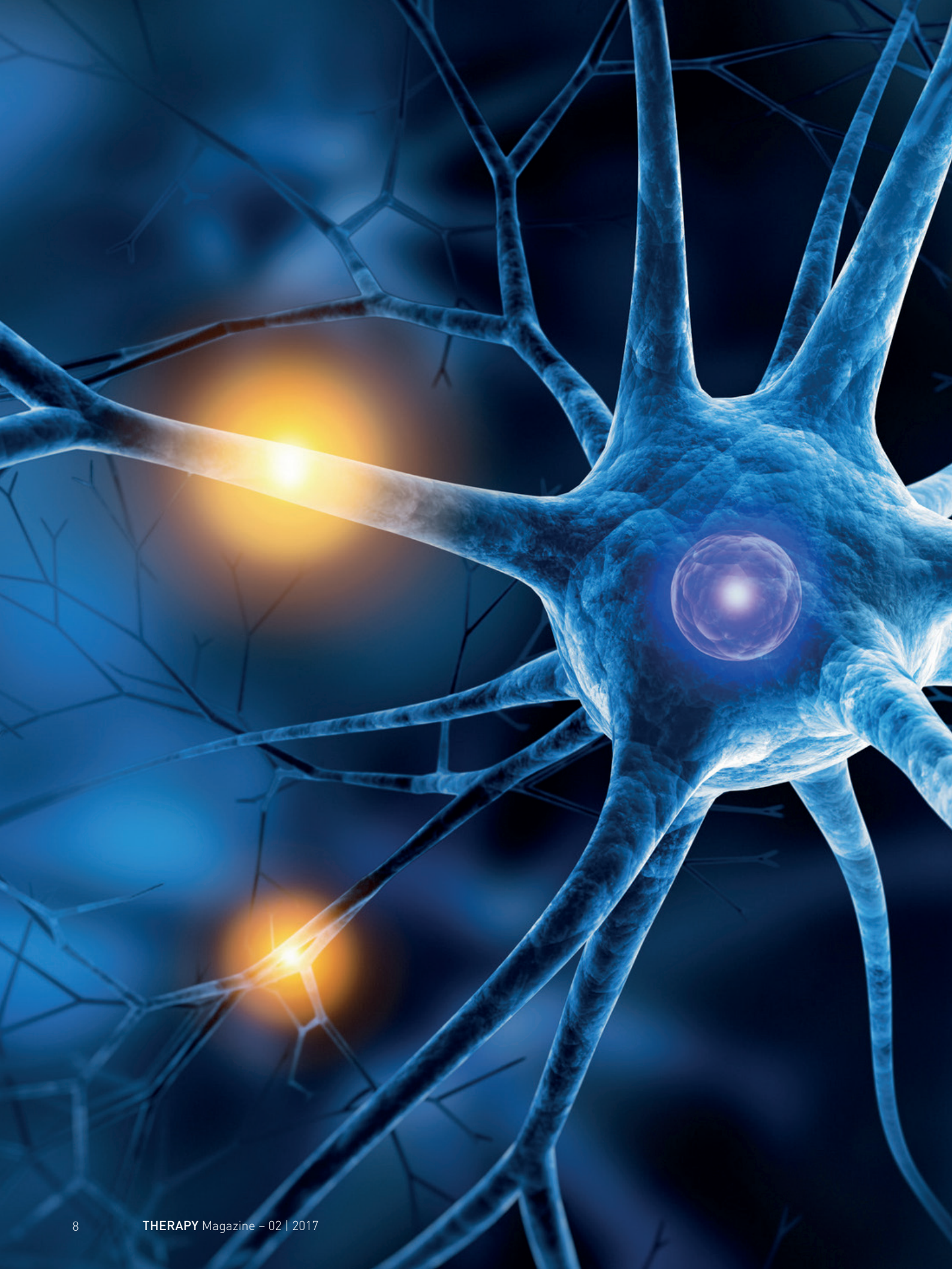
By Jakob Tiebel

The neural plasticity of the brain is the biological basis for successful motor rehabilitation following damage to the nerve system. "Neural plasticity" is any structural and functional adaptation of the brain that can result from changes to the environment and following damage to the brain [1, 5].

Lifelong plastic changes to the brain are possible through behavioural changes, training and learning [6, 7]. Above all, they are based on changes to the strength of connection between nerve cells [8]. In addition, research results in recent years show that depending on the scale and location of the damage, different neural plasticity mechanisms aid the nervous system to compensate for functional breakdowns in an impressive way [9].

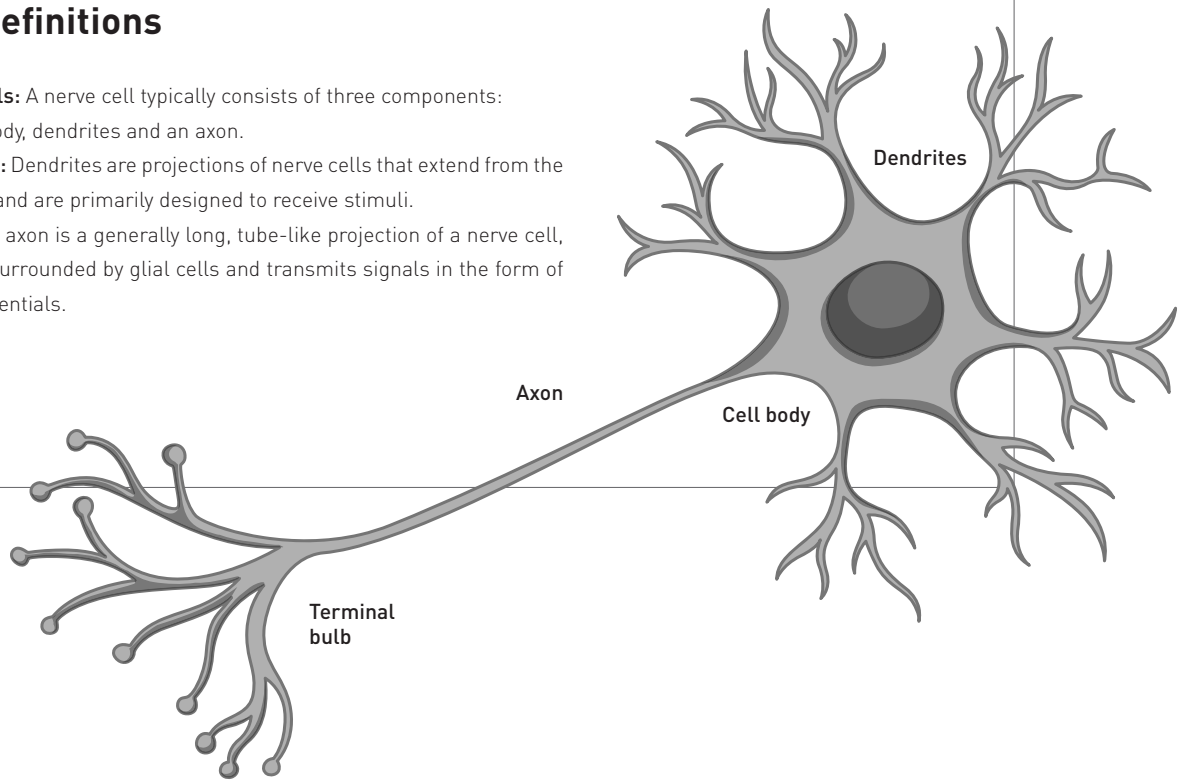
Spontaneous recovery

Damage in the region of the brain leads to the destruction of nerve cells, which is accompanied by a corresponding loss of neural functions. Intact regions that lies outside the damaged area of the brain but are connected to it often display reduced



Key definitions

Nerve cells: A nerve cell typically consists of three components: the cell body, dendrites and an axon.
Dendrites: Dendrites are projections of nerve cells that extend from the cell body and are primarily designed to receive stimuli.
Axon: The axon is a generally long, tube-like projection of a nerve cell, which is surrounded by glial cells and transmits signals in the form of action potentials.



function following the damage. Spontaneous reorganisation processes occur in the initial days and weeks, enabling the neighbouring regions to recover again. Ideally, this can significantly reduce the extent of the initial impairment.

In silent standby

In the process of unmasking suppressed intercortical connections, it is possible to bring about the activation of "silent" synapses [10]. Cao et al. have managed to provide evidence of the activation of areas neighbouring a damaged region after a stroke. As part of the recovering function, cortical representation fields are modified so that existing but unused, redundant nerve connections are activated [11, 12].

Newly sprouted

Plastic changes following brain damage can also be caused by dendritic branching in the sub-acute stage. Denervated neurons are capable of forming connections with other nerve cells by way of sprouting. This creates new contact points between nerve cells.

Along with dendritic growth, another potential mechanism of plasticity is axonal growth. As axonal growth takes significantly longer, the mechanisms will presumably only have a significant effect months or years after the damage is inflicted [3, 13, 14].

"Hebbian theory"

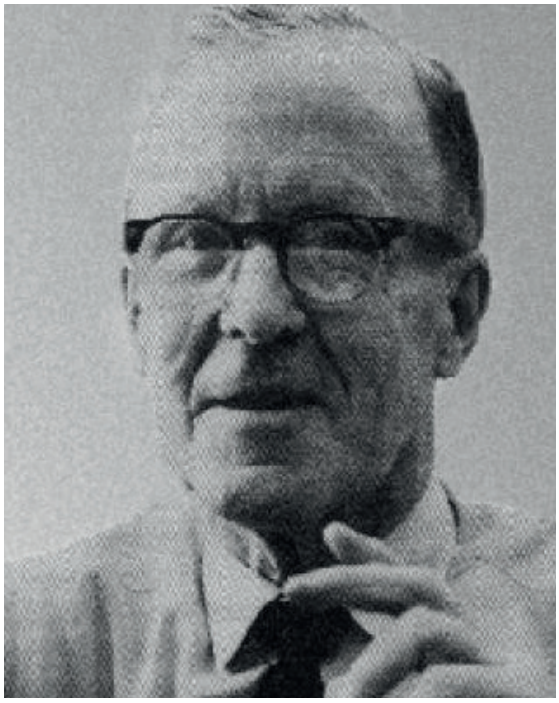
The most important mechanism for inducing plasticity is the modulation of pre-synaptic and post-synaptic efficiency in the sense of long-term potentiation (LTP) and long-term depression (LTD) [15].

The principle of LTP is also known as the "Hebbian theory" and is seen as the basis for all learning and memory processes. The "Hebbian theory" states that the strength of connection between two interconnected neurones increases when these are stimulated and fire simultaneously

Early detection with delayed effects

Donald Olding Hebb was a Canadian neuroscientist. From 1939 onwards, he was a professor of psychology at Queen's University in Kingston, Ontario. Based on his research into the intelligence of rats, chimpanzees and humans, he developed the fundamental idea that brain function is produced by complex interconnections in the neural networks of the brain. With this theory, he anticipated the concept of dynamic neural networks in the brain, discovered by the latest brain research using state-of-the-art technology.

"Hebbian learning" is the rule he established regarding the way in which learning takes place in neural networks or groups of neurons with common synapses. Hebb is therefore seen as the founder of the synaptic plasticity model, which forms the neurophysiological basis of learning and memory.

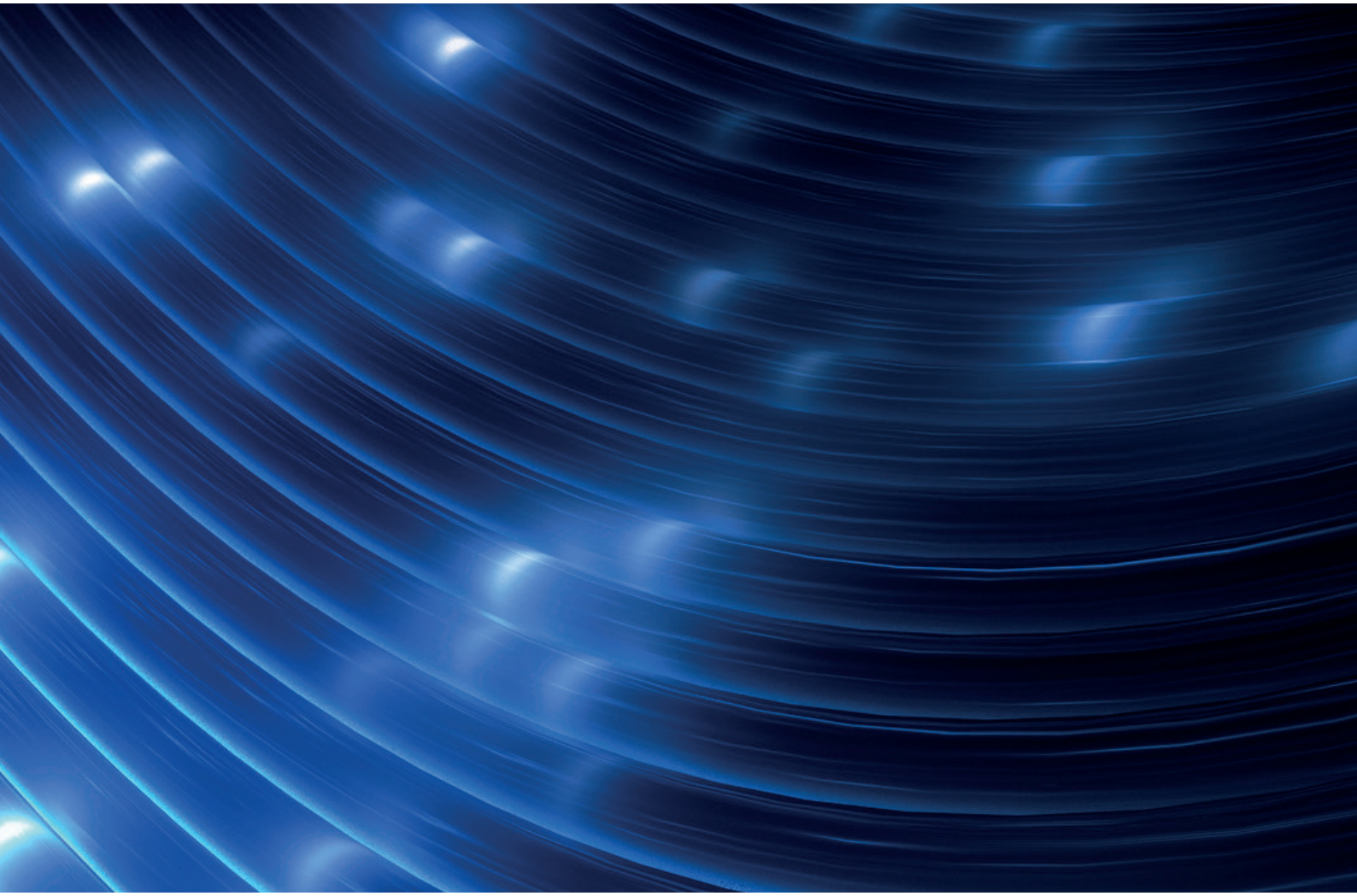


[1]. The theory applies to individual connections between nerve cells along with entire network structures [18]. Changes to the connection strength are based on growth processes and metabolic changes to one or more neurones [1].

With the long-term potentiation (LTP) and long-term depression (LTD) model, repeated synaptic activation patterns therefore alter the synaptic efficiency. In this way, contacts to other neurones and across the functions of cortical connections can be altered in the long term. This results in changes in the area of stimulation thresholds and receptive fields, which bring about a reorganisation of cortical representations [3, 9, 16].

Assumption of other pathways

The assumption of parallel and functionally similar pathways is known as vicariation. Other regions



of the brain take over the relevant functions in place of damaged regions of the brain. The areas of the cortex used for this generally have a similar microstructure. It can often be observed that the homologous structures of the contralateral hemisphere are involved in compensating for the loss of function [3, 9].

Sources for regeneration

The regeneration of neurones and the use of stem cells for restoring defective brain regions are the focus of ongoing research [9]. Experiments have already clearly shown that transplanted bone marrow cells can be differentiated for different nerve cell types [17].

The brain grows along with its tasks

Proof that the lifelong plasticity of our nervous system forms the basis of functional motor rehabilitation is one of the decisive catalysts for the paradigm shift in neurorehabilitation that has taken place in recent years. The insights into neural plasticity have paved the way for the targeted deployment of treatment technologies to positively influence the reorganisation of the nervous system following damage.

Basic principles

At this point, it is worth mentioning a few underlying principles regarding motor rehabilitation, which must be taken into account to ensure the best possible care for patients.

Important predictors for achieving a positive outcome, in terms of keeping the degree of disability to a minimum following neurological damage, include ensuring that therapy is initiated

as early as possible [19] and is as intensive as possible [20, 21]. It is assumed that a combination of the two factors is a more effective approach [22, 23]. Daily training is recommended to last around three hours for individual and group therapy, depending on the patient's physical capacity [24].

Active, repetitive practice of skills and movements relevant to everyday life has proven to be a key element of modern therapy measures [21, 22, 25, 26]. Important principles for motor learning following damage to the central nervous system were put forward by Carr and Shepherd in 1987 and Shumway-Cook and Wollacott [27, 28]. Modern neurorehabilitation is currently largely based on the principles of motor learning [29]. In the context of motor learning, Freivogel differentiates between "isolated sensomotory training", according to which individual movements are practised in isolation, and "task-oriented training", according to which everyday activities are practised. Both principles are relevant to the treatment of neurological patients [26].

Motor learning – A matter of principle

The ability to move is fundamental to people's ability to interact with their environments, and one that is often taken for granted. People are normally consciously engaged with the ability to move only if the processes involved do not take place automatically if, for example, they are affected by an illness.

The recovery of motor skills following damage to the central nervous system can be seen as a motor learning process with which functions can be restored through targeted exercise. Motor rehabilitation is therefore a form of motor learning that aids the relearning of movement [30, 31]. This is why the type of training has a decisive influence on motor leaning [24]. The motor learning process can be divided into three stages. Basic principles for instruction, feedback, repetition and shaping must also be taken into account. These are outlined below [32].

Learning takes place in stages

In the cognitive phase, the support of therapists

is important and beneficial to learning. However, information and assistance must be reduced to the bare essentials. Modern treatment is essentially based on a "hands-off" principle. The focus is on the goal-oriented activity of the patients, not the influence of the therapist. In this stage of learning, it does not yet make sense to have variations, which also disrupt the learning process [26].

The second stage of the learning process is known as the associative stage. In this stage, exercises can be varied with caution to gradually increase the level of difficulty. Targeted feedback from the therapist remains important, but after defined exercise intervals rather than after each individual movement.

In the autonomous stage, variations can and should be made regularly. As the patient's performance improves, additional difficulty can be integrated in order to intensify the exercise, making it necessary to readjust the movement. This creates the additional goal of continually improving particular aspects of movement.

Inside out – Where to focus attention

During therapy, patients can direct their attention towards various aspects. This largely depends on the instructions of the therapist. If the patient is advised to concentrate on the movement process, this is known as an internal focus. Focusing attention externally on the objective of the movement, however, has been shown to be more effective. Studies by Wulf et al. show that movements with an external focus are learned faster. When formulating movement orders, it can be helpful to use metaphors [33, 34, 35].

The objective of a 2013 study by Johnson et al. was to evaluate the proportional use of internal and external focus by physiotherapists during the treatment of stroke patients. On average, the therapists gave the patients instructions 76 times and feedback 22 times per therapy session. This corresponds to an average value of one instruction every 14 seconds. The therapists gave numerous instructions to ensure that the patients would have to reflect on many of the details of the task before them. They also repeated the instructions very often over a short space of time, including while

the movement was being performed. An average of almost 70% of instructions were focused internally and only around 30% were focused externally. Physiotherapists therefore mainly instruct their patients in such a way that they concentrate on the movement itself and the execution of the movement (internal focus). The authors of the study point out that it is precisely this approach that can hinder the automation of movements and motor learning, along with the ability for the learning to be successful [36].

Against this background, an external focus should strictly be the preferred option [33][34].

Feedback

The success of motor learning is largely based on the intrinsic feedback mechanisms of the patient. There is a distinction here between the knowledge of performance and the knowledge of result.

The therapist's external feedback mechanisms and, for example, the use of biofeedback can successfully support the patient's learning process. However, dosage here is also crucial. Intrinsic and extrinsic feedback often overlap. Less can often mean more for patients in this respect [37, 38].

Above all, therapists have the task of instructing and training patients to ensure that they are capable of creating the required intrinsic feedback themselves [31].

Repetition

There is no authoritative information on the number of repetitions required for relearning a movement. The number of repetitions depends on the complexity of the movement and the patient's ability to learn, among other things. However, it must be assumed that with complex movement processes a significantly higher number of repetitions is required for relearning than is used in therapy [26]. Mehrholz describes repetition as the single most significant factor for lasting and sustained progress in the execution of movements. It is the most important variable when learning many activities [39]. Frequent repetition and practice of simple and complex movements should be considered the main requirements for a successful learning process and bring about long-lasting automation and optimisation of movement processes [26, 40].

Reaching the limits of patients' capabilities

Successively increasing the degree of difficulty in the context of motor learning is known as "shaping". Patients should be given movement tasks that they are only just able to complete and can be made gradually more difficult based on their capabilities. Movement programmes can be further optimised if combined with frequent repetition and corresponding feedback on achievement of the movement target.

The target must be to systematically increase the requirements of the patient and to continually exercise at the limit of his or her abilities [41, 42].

LITERATURE

The references for this article are available at www.thera-trainer.de/therapy

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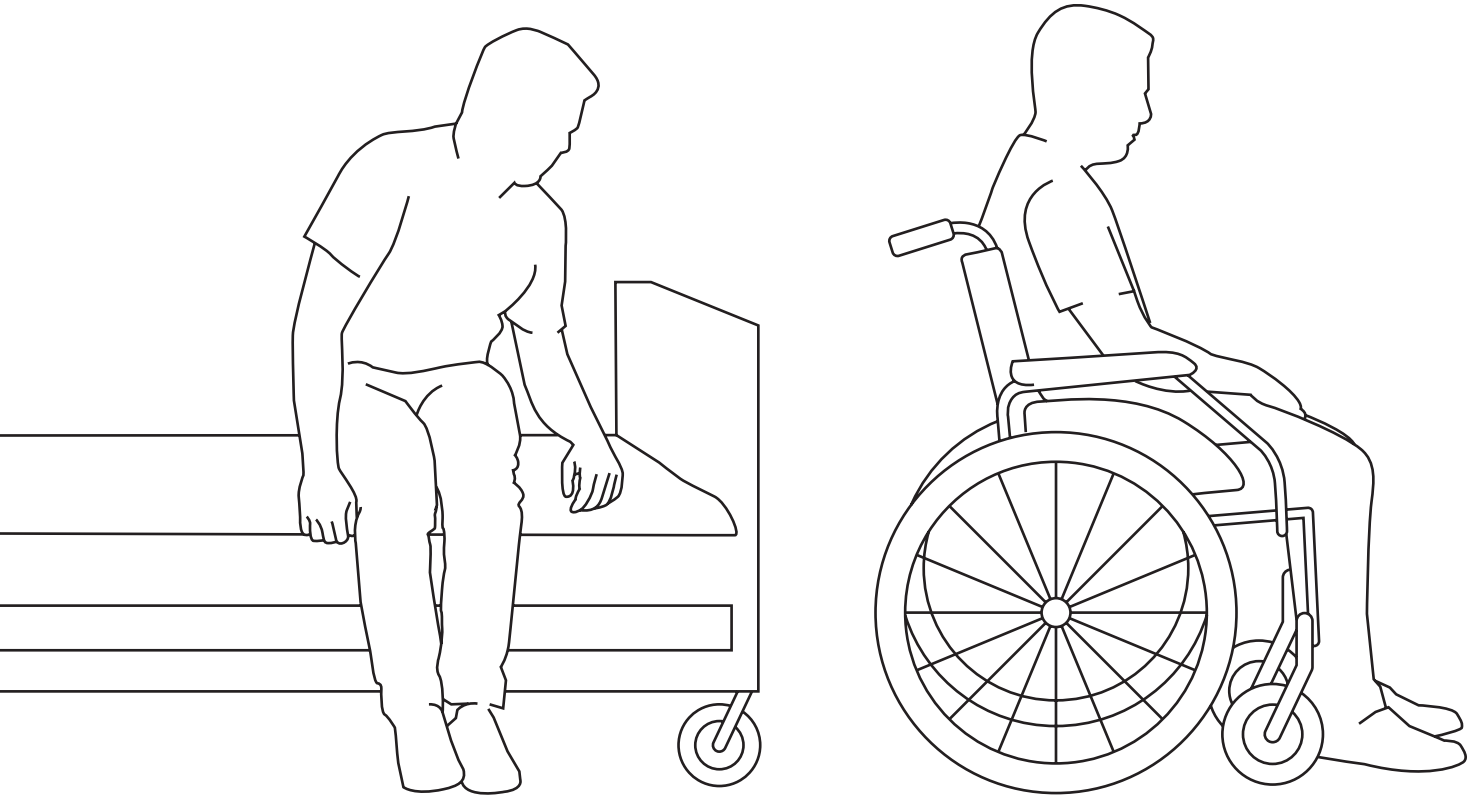

tice

Part 2 of a major series

COVER STORY

From evidence to clinical practice

The THERA concept offers extensive expertise to all facilities involved with active rehabilitation and patient care on the basis of the latest evidence. At the heart of the concept are practice-oriented guidelines for action that facilitate goal-oriented use of THERA-Trainer products across all phases of rehabilitation. This is based on the latest scientific findings taking account of all adjoining areas.

By Jakob Tiebel

Nowadays, in physiotherapy, it is crucial to have up-to-date knowledge. Treatments must be increasingly efficient and economical. The effectiveness of therapeutic measures is tested in studies to ensure that the best possible quality of care is given. This evidence-based practice approach is becoming increasingly popular. Despite the fact that physiotherapeutic research is still new in comparison with other branches of research, evidence-based practice has been in demand and actively encouraged for several years.

Evidence-based practice should bring the individual experiences of the therapists and the wishes and needs of the patients in line with current scientific and research findings (see THERAPY 1-2017). A critical examination of the effectiveness of the measures implemented is crucial to improve the quality of treatment and generate the best possible results. This is carried out on the basis of scientific studies. The results can determine which measures and procedures can be deemed as therapeutically effective and superior. The quality of the studies is crucial here. Randomised controlled trials (RCT) are generally used along with meta-analyses. Meta-analyses are procedures that quantitatively combine the findings from several studies with the same research question.

Guidelines have been developed to translate current findings from clinical research into practice. The knowledge gained from the wide variety of studies is summarised and recommendations are made to ensure best practice. Field and Lohr define clinical treatment guidelines as "systematically developed statements to assist practitioner and

patient decisions about appropriate health care for specific clinical circumstances" (Field, Lohr 1992). The first guidelines for rehabilitation of neurological patients were published around 10 years ago and have since been constantly expanded and adapted with new findings.

The THERA concept is mainly based on the recommendations of the Royal Dutch Society for Physical Therapy (KNGF) and the German Society of Neurorehabilitation (DGNR) [1-2]. Both organisations recently published high-quality clinical practice guidelines for the rehabilitation of stroke patients that reflect current scientific knowledge and have impressed due to their practicability.

LITERATURE

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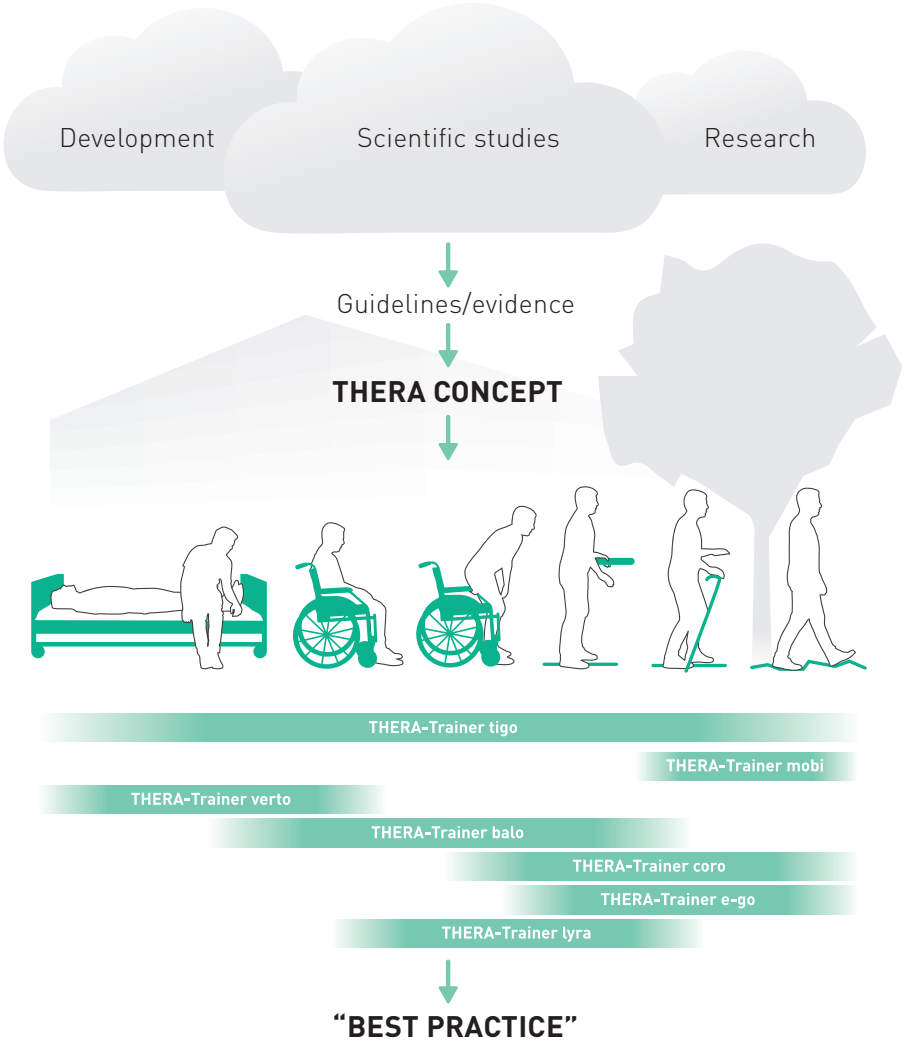
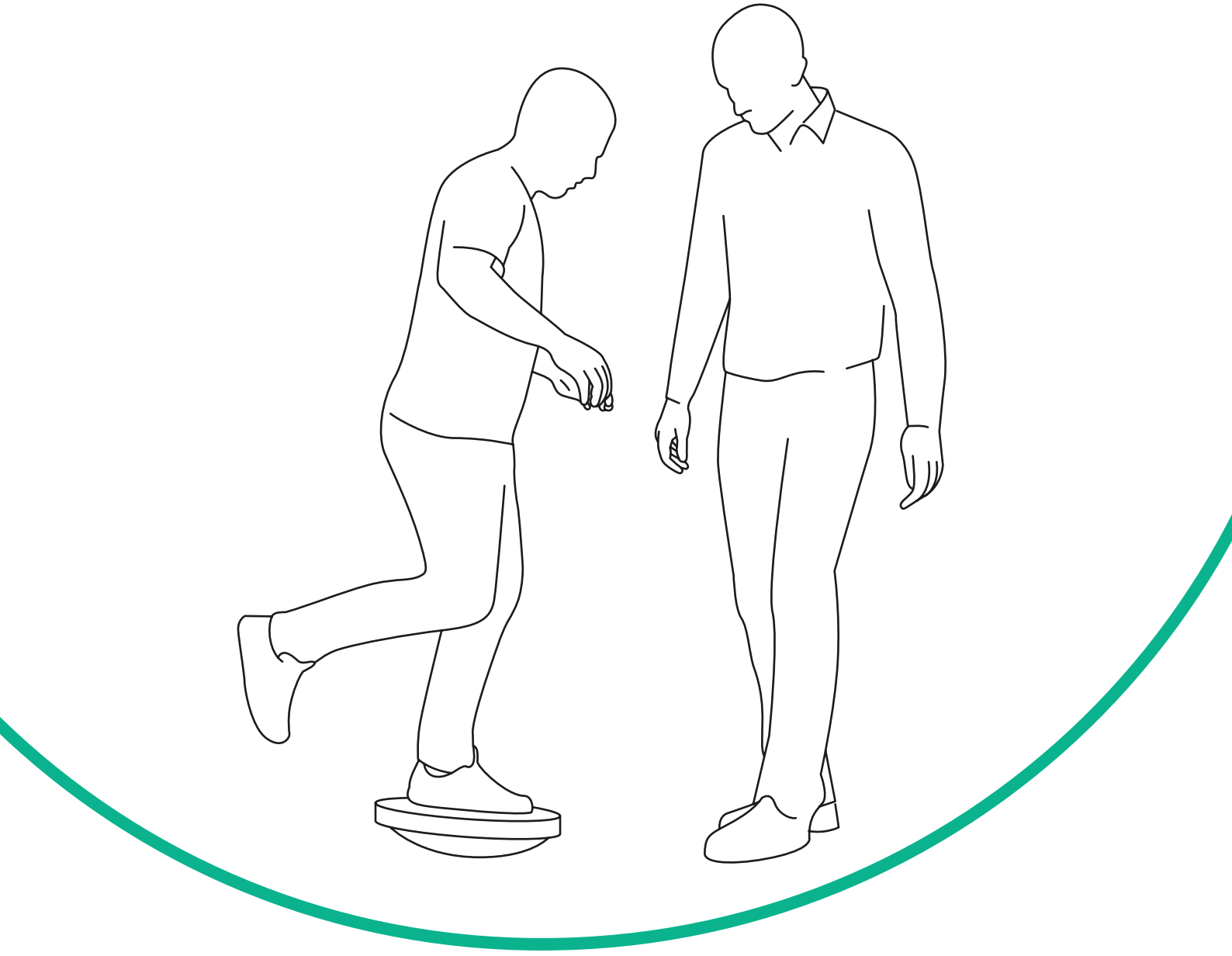


COVER STORY

Patients undergoing rapid testing

A procedure has been developed for THERA concept that is set to assist therapists in their clinical decision-making. Patients are assigned to sub-groups of specific interventions according to their capabilities. This makes it possible to use THERA-Trainer effectively in day-to-day clinical treatment and sensibly structure the device-based treatment measures.

By Jakob Tiebel



Assessments are made to determine a patient's cognitive abilities in a targeted manner. According to Platz and van Kaick, systematic and standardised recording of functional abilities and impairments is one of the fundamental tasks of modern therapy processes for enabling targets and appropriate measures to be determined together with the patients on the basis of results [1].

Modern rehabilitation concepts should always be based on careful evaluation of patient capabilities and a precise definition of targets. These are two significant elements of rationalised and conclusive rehabilitation management [2, 4].

Assessment instruments are currently largely based on the classification levels of the International Classification of Functioning, Disability and Health (ICF) of the World Health Organization (WHO) [1, 5]. The major benefit of the ICF is an underlying biopsychosocial approach, which facilitates an integrated and resource-oriented view of the patients [2]. According to the ICF, health problems are seen as the result of complex relationships between people, people-related factors and the environment [6].

A patient's abilities are determined in terms of bodily functions and structures (e.g. postural control), activities (e.g. standing and walking) and participation (e.g. involvement in everyday life). The measurements required for this should always be taken at the start of the rehabilitation

process and at regular intervals over the course of it. In this way, the effects of the treatment can be checked and the measures taken can be adjusted to the changing level of performance of a patient. In the long term, recommendations for improving the effectiveness of therapy can also be devised on the basis of documented results [7].

In practice, however, it is not always easy to select a suitable procedure for a specific application from the many assessments available worldwide [1]. Most rehabilitation facilities routinely use a selection of standardised survey procedures to determine the patient's capabilities in conjunction with the ICF and formulate objectives with the patient. However, in many cases the relevant instruments are deployed only sporadically and often non-specifically. As a result of this, the motor abilities of patients are recorded inadequately in day-to-day treatment. Many of the detailed assessments include measurement procedures that, while useful, are often lengthy and require a great deal of time and routine work to be applied to obtain meaningful results. Data can often be used only to a limited extent in interdisciplinary exchanges, as other professional groups are not familiar with the procedures.

In a bid to structure the treatment measures in the context of the THERA concept, there was a pressing need to establish a simple yet valid instrument for assessing motor skills, which could be implemented and interpreted by all the professional groups involved in the rehabilitation process and make it possible to assign patients to treatment modules based on their capabilities.

The THERA concept assessment is derived from assessments that have been thoroughly clinically analysed and are tried-and-tested, such as the Functional Ambulation Categories (FAC) and the Static Balance Test (SBT), which in turn is based on elements of the Berg Balance Scale [8][9]. It records patient capabilities in terms of activity and must therefore be implemented in a task-oriented way and enable a quick and reliable assessment of postural control, the ability to stand and (in combination with the FAC) ability to walk.

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The THERA-concept assessment

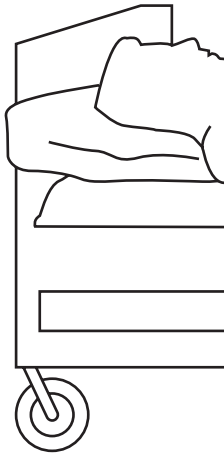
Various ability levels based on postural control, ability to stand and ability to walk can be determined with the help of the THERA-concept assessment in combination with the FAC. The ease of implementation is particularly compelling.

By Jakob Tiebel

Module 1

The patient cannot sit up, even with a lot of assistance

The patient mainly lies in bed and is mobile only for brief moments, if at all. The period of mobility is significantly less than three minutes. At least two assistants are required and the patient must be given maximum support. The patient does not have sufficient control over his or her head and body; active cooperation by the patient is not discernible at any time.



Module 3

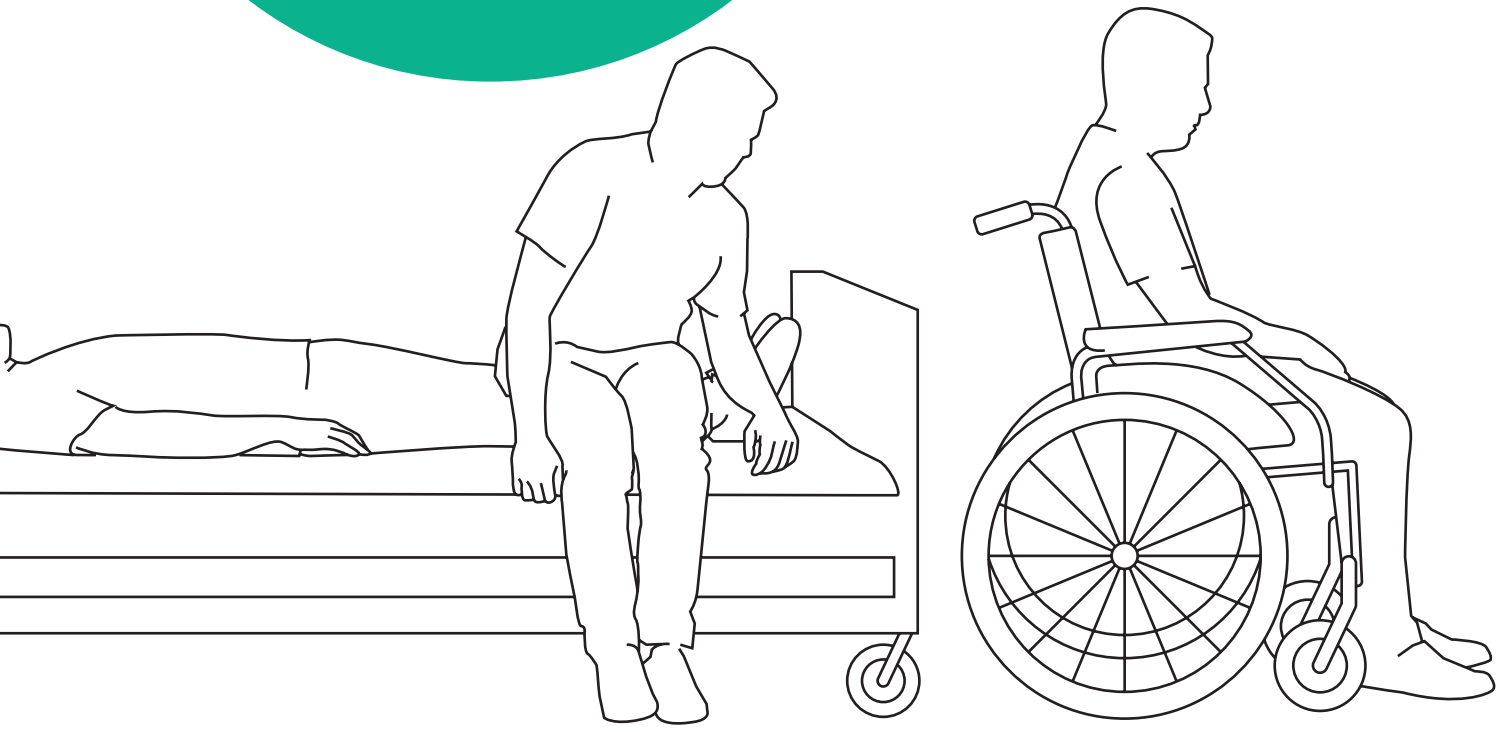
The patient can sit up with a little assistance

The patient relies on little to no direct physical support from an assistant. The assistant only uses hand contact for added safety. The therapist mainly uses verbal instructions to improve postural control. During the day, the patient is mainly mobile using a wheelchair, can keep his or her body upright against gravity for a sustained period of time, and can shift his or her centre of gravity when sitting.

Module 2

The patient can sit up with a lot of assistance

The patient is mobile with the support of at least one assistant, e.g. on the edge of the bed during therapy. Physical contact and stabilisation of the patient's body are required at all times and prevent the patient from losing his or her balance. A stable sitting position can be maintained for a brief moment under certain circumstances. There is no discernible shifting of bodyweight at any time.



Module 5 (FAC 1-2)

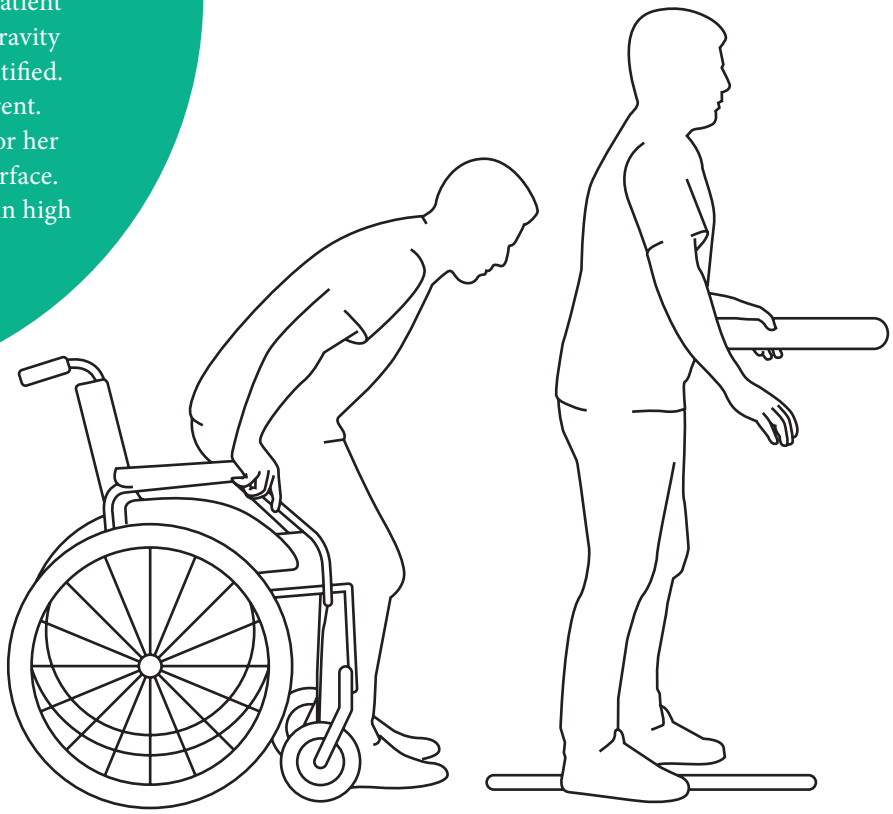
The patient can stand still

The patient can remain standing upright against gravity and can shift his or her centre of gravity over a flat area of support. Active shifting of balance is only possible with the help of an assistant. The patient risks falling over in the event of a distraction or disruption of equilibrium.

Module 4 (FAC 0-1)

The patient can stand with a lot of assistance

The patient can move his or her legs, pelvis and, where appropriate, body when standing with the support of at least one assistant. The patient cannot yet maintain his or her centre of gravity unassisted but initial attempts can be identified. The patient's active cooperation is apparent. The patient cannot yet safely balance his or her body's centre of gravity on the support surface. The patient is at a very high risk of falling in high starting positions.



Module 6 (FAC 2-4)

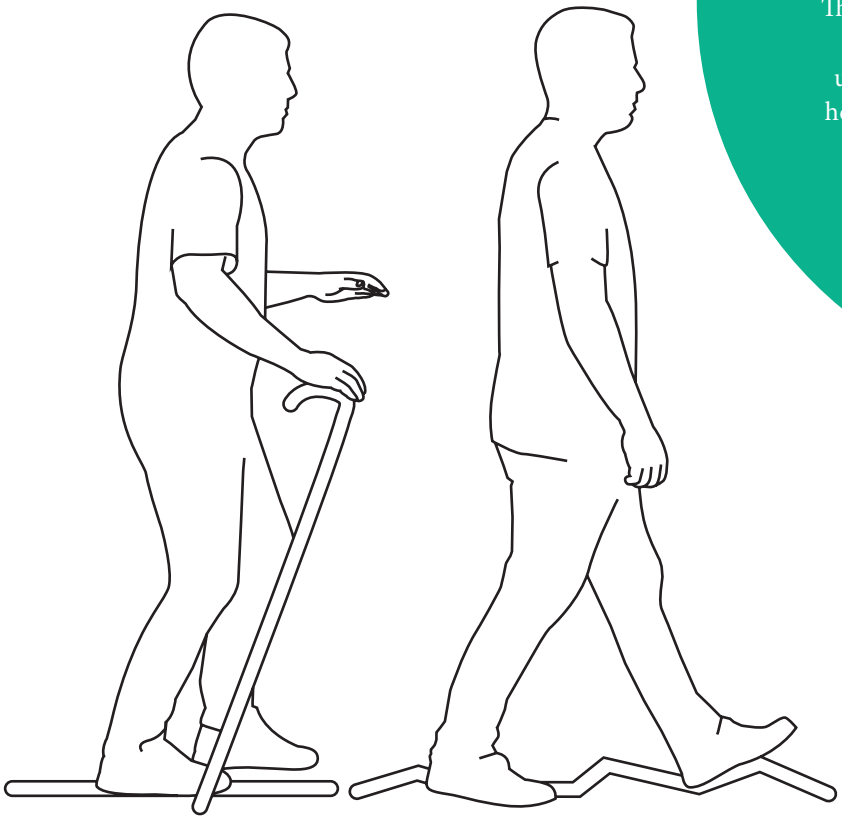
The patient has anticipatory balance control while standing

The patient is capable of shifting his or her centre of balance without contact from an assistant. Tasks can be performed safely while standing without disturbances. Contact with an assistant is still required on uneven and unstable ground to prevent the patient from losing his or her balance. Unpredictable and sudden disturbances to balance increase the risk of falling.

Module 7 (FAC 3-5)

The patient has reactive balance control while standing

The patient is capable of standing safely on uneven and unstable ground and can compensate for unpredictable and sudden disturbances to his or her balance. Endurance is still reduced depending on the patient's physical capacity and regular breaks are still necessary.



Objectives & interventions

The question remains unanswered as to which interventions are most suitable depending on the ability level and goals of the patient at a particular time over the course of rehabilitation, and which THERA-Trainers can be used to support his or her therapy.

THERA concept	Objectives according to ICF		
	Function and structure	Activity	Participation
Module 1 **Patient cannot stand/sit**	> Muscle activation session, body > Prophylaxes > Sensory input > Attention	> Sitting with assistance > Standing still with assistance > Transfers	> Own ADL activities (if possible)
Module 2 **Patient can sit up with a lot of assistance**	> Muscle activation session, body > Strength > Cardiovascular fitness > Prophylaxs	> Sitting up with a little assistance > Standing still with assistance > Walking with assistance > Transfers	> Own ADL activities > Increase of out-of-bed time > Participation in everyday life on the ward > Individual therapy in the group
Module 3 **Patient can sit with a little assistance**	> Strength > Strength-endurance > Cardiovascular fitness	> Sitting freely > Standing still with assistance > Walking with assistance > Independent transfers	> Own ADL activities > Broader participation in everyday life on the ward > Broader action radius > Participation in everyday life at the clinic (within the clinic) > Individual therapy in the group > Group therapy
Module 4 **Patient can stand still with a lot of assistance (FAC 0-1)**	> Strength > Strength-endurance > Cardiovascular fitness	> Standing still without assistance > Walking with assistance > Independent transfers	> Own ADL activities > Broader action radius > Participation in everyday life at the clinic within the clinic > Increased social interaction > Group therapy > Self-training
Module 5 **Patient can stand still with a little assistance (FAC 1-2)**	> Strength > Strength-endurance > Cardiovascular fitness	> Dynamic standing with assistance > Walking with assistance > Increasing the walking distance > Independent transfers	> Own ADL activities > Broader action radius > Participation in everyday life at the clinic including outside the clinic > Increased social interaction > Group therapy > Self-training
Module 6 **Patient has anticipatory balance control while standing (FAC 2-4)**	> Strength > Strength-endurance > Cardiovascular fitness	> Dynamic standing without assistance > Walking with assistance > Increasing the walking distance > Increasing walking speed > Walking outdoors on uneven ground	> Own ADL activities > Broader action radius > Participation in everyday life at the clinic including outside the clinic > Increased social interaction > Group therapy > Self-training
Module 7 **Patient has reactive balance control while standing (FAC 3-5)**	> Strength > Strength-endurance > Cardiovascular fitness	> Dynamic standing without assistance > Walking with and without assistance > Increasing the walking distance > Increasing walking speed > Walking outdoors on uneven ground	> Own ADL activities > Broader action radius > Participation in everyday life at the clinic including outside the clinic > Increased social interaction > Group therapy > Self-training

As mentioned in the previous article, the classification of modularisation is important given that patients show different motor deficits depending on their impairments, making personalised measures necessary when it comes to therapy [1][2]. The patient is therefore ideally assigned to one of seven treatment modules depending on his or her capabilities, for which target criteria for treatment can be defined.

In addition, knowing that the patient's limitations caused by damage must be viewed as limiting factors, the patient's capabilities and the activities for formulating objectives are the focus of the THERA concept. The definition of objectives forms the basis for subsequent intervention and treatment planning.

The following table provides an overview of the objectives and interventions for recovering the ability to stand and walk. The structure is also based on the ICF levels.

LITERATURE

1. **Guadagnoli MA** (2004). Challenge point: a framework for conceptualizing the effects of various practice conditions in motor learning. J Mot Behav Jun 36(2): 212-224.
2. **Pollock CL et al.** (2014). Use of the Challenge Point Framework to guide motor learning of stepping reactions for improved balance control in people with stroke: a case series. Phys Ther. 94:562–570.

Intervention			
Contents of the therapy		**THERA-Trainer**	**Supporting measures**
> Verticalisation > Mobilisation > Activation		> THERA-Trainer bemo with FES > THERA-Trainer verto > THERA-Trainer lyra	> FES
> Verticalisation > Mobilisation > Activation > Gait training > Orthotics		> THERA-Trainer bemo with FES > THERA-Trainer tigo > THERA-Trainer verto > THERA-Trainer lyra	> FES > Walking frames
> Postural control while sitting > Postural stability while standing > Activation > Strength training > Strength-endurance-training	> Cardiovascular training > Gait training > Transfer training > Orthotics	> THERA-Trainer tigo > THERA-Trainer verto > THERA-Trainer balo > THERA-Trainer lyra	> FES > Treadmill with safety belt > Walking frames
> Postural control while standing > Gait training > Transfer training (independent) > Activation > Strength training	> Strength-endurance-training > Cardiovascular training > Orthotics	> THERA-Trainer tigo > THERA-Trainer balo > THERA-Trainer coro > THERA-Trainer lyra	> FES > Treadmill with safety belt > MTT > Walking frames
> Postural control while standing > Gait training > Transfer training (independent) > Activation > Strength training	> Strength-endurance-training > Cardiovascular training > Provision of medical equipment	> THERA-Trainer tigo > THERA-Trainer balo > THERA-Trainer coro > THERA-Trainer lyra	> FES > Treadmill with safety belt > MTT
> Postural control while standing and walking (reactive components) > Gait training > Activation > Strength training	> Strength-endurance-training > Cardiovascular training > Provision of medical equipment	> THERA-Trainer tigo > THERA-Trainer coro > THERA-Trainer lyra > THERA-Trainer e-go	> FES > Treadmill with and without safety belt > MTT
> Postural control while standing and walking under difficult conditions > Dual-task, sensory weighting > Practising everyday situations	> Strength training > Strength-endurance training > Cardiovascular training	> THERA-Trainer tigo > THERA-Trainer coro > THERA-Trainer lyra > THERA-Trainer e-go	> FES > Treadmill > MTT

TECHNOLOGY & DEVELOPMENT

First complete solution for gait rehabilitation

With a well thought-out, device-based overall concept, a German-Swiss joint venture between THERA-Trainer and Ability Switzerland has in the last year not only managed to transfer current scientific knowledge for recovering walking ability into a best-practice model, but also exploit the previously untapped economic potential of rehabilitation. The Loko Solutions project has been in the process of setting the "gold standard" of modern gait rehabilitation since the start of the year.

By Jakob Tiebel

A patient exercising with THERA-Trainer coro incl. THERA-soft

Given that the central recommendations from the guidelines on neurological gait rehabilitation have been so precisely, effectively and efficiently transferred into practice with the Loko Solutions project, the concept received a strong response and exceptionally positive feedback from expert groups soon after it was announced. As well as initial queries about the project, one of the large German clinic operators requested that a pilot be carried out as soon as possible to decide on a roll-out across several potential sites by the end of the year.

"This is a wide-ranging project and it comes at exactly the right time. We have pooled our products and expertise to offer a tailored, successful portfolio for gait rehabilitation," explains Peter Kopf, owner and Managing Director of medica Medizintechnik GmbH. "There has never been anything like it before." The THERA-Trainer brand has been synonymous with the latest developments in the area of device-based therapy for several years. The Loko Solutions project was born in close collaboration with Swiss company Ability

and successfully launched on the market at the end of last year. As a result of the merger that took place in January 2017, the two companies have further pooled their resources and grown together to become the world's biggest comprehensive provider in the area of device-based neurological rehabilitation.

Fully tailored to the current reality of a clinic and its daily challenges, the now perfectly developed and practically tested THERA-Trainer comprehensive solutions comprise all solutions such as consultancy, training and service, besides a complete equipment fleet including robotics and the latest technology for movement analysis and training management.

The success concept is based on teamwork. THERA-Trainer defines and achieves objectives in close cooperation with the clinic partners. A standardised treatment process is developed in consideration of all interest groups and adjusted to individual customer requirements. This is therefore about more than just devices – the process is crucial. An unprecedented form of cooperation with the industry has therefore opened up, paving the way for setting new standards. It is now up to clinics to seize this opportunity.

TECHNOLOGY & DEVELOPMENT

Getting back on your feet through play

Effective balance training during rehabilitation is highly important for recovering maximum independence and mobility in day-to-day life (see THERAPY issue 1, 2017). Modern software technology enables treatment paths to be structured from the clinic through to the home environment. This means that patients actually learn to get back on their feet through "play".

The clock is ticking. The pirate on the screen rapidly dashes across the island to return the last remaining coins to the treasure chest – points are awarded for this. Mr Weber is concentrating hard and, with his last ounce of strength, shifts his bodyweight forwards once more.

A mobile harness frame supports his movements and prevents him from losing his balance. Sensors transmit the movement data directly to a computer. This makes it possible to intuitively control the pilot on the screen by transferring weight. It's a balancing act. Maintaining his balance is a major challenge for the patient, who is in his mid-sixties. Three months ago, he suffered a stroke and is only slowly regaining control of the right side of his body.

He goes to physiotherapy several times a week to actively train his ability to stand and further improve his balance. He claims that without the help of the dynamic standing frame, this would be unthinkable. The training device provides him with the confidence necessary to once again reach the limits of instability.

The faster and more precisely he carries out the movement orders, the greater his chances of success. According to Ms Zierau, his physiotherapist, this applies not only to the game but also to relearning movements. As with sport, therapy following a stroke must aim for the limits of the individual's capabilities. Only then are the stimuli required for improvement sent to the body.

This follows the principles of motor learning. With this procedure, it is not only the stressed muscles that are trained, but above all the brain. With the correct training intensity and frequent repetition of movement processes, new nerve connections are created that are then responsible for movement control.

The proverb "You can't teach an old dog new tricks" has long become obsolete. Knowledge of the nervous system's powers of reorganisation have led to a change in thinking regarding therapy. Exercise that closely mirrors day-to-day functions is becoming more and more common. The ability to stand is practised by standing and the ability to walk by walking. Ms Zierau explains that this is particularly effective, thereby echoing one of the pioneers of neuroscience and an "innovative clinical maverick", Prof. Stefan Hesse, who has strongly influenced modern neurorehabilitation over the last decade.

Therapists have become braver in this respect. A few years ago, there was disagreement over how early patients could be mobilised in bed after a stroke. Current studies make this very clear: as early as possible. Initial attempts to stand and walk are therefore now made on the acute patient ward in the hospital.

But improvements can still be achieved years after a stroke through the plasticity of the nervous system. Intensive exercise is an essential requirement for this, however. Mr Weber should therefore also receive a dynamic standing frame for exercising at home. He is due to leave the clinic soon and must ideally continue training without interruption.

In the case of Mr Weber, the costs of the device used for therapy are borne by his health insurance provider. However, this is not always the case. This kind of equipment is often subsequently

rejected by health insurance providers. For Ms Zierau, this is difficult to understand. This way, patients often take enormous steps backwards after rehabilitation. This is something she knows from personal experience, as besides her activities in the clinic, she provides outpatient care to stroke patients in a clinic.

When it comes to stationary rehabilitation, patients generally only receive physiotherapy once or twice a week. At just 30 minutes per session, this is simply not enough. This is also why self-training plays such an important role.

Mr Weber is currently learning exactly what he must look out for when training at home to ensure that no mistakes creep in. He takes his training programe home with him on a USB stick. The values are established at the start of therapy and only have to be adjusted after that. He does this completely independently. At the start of the therapy session, he selects a training programe on the computer and enters the difficulty to suit how he feels on a given day.

The results are automatically saved and can be evaluated after the session. To do this, Ms Zierau opens the results from the first and last training sessions and makes a before/after comparison. The graphical evaluation makes it instantly visible that weight transfer has significantly improved on Mr Weber's affected side.

It is hard to imagine modern physiotherapy without the use of therapy devices. In recent years, many new possibilities have opened up for therapy, particularly through the support of computer technology. Besides the precise motion analysis

Adventures in colourful gaming worlds promote behaviours involving physical activity and ensure that attention is not focused on the function.

and training management, the playful elements are of particular importance to patients.

Adventures in colourful gaming worlds promote behaviours involving physical activity and ensure that attention is focused not on the function but on the task. Hunting for treasure as a pirate is also a welcome change for the older generation and far more motivational than simply shifting the body's centre of mass over the support surface by rote.

Martin Huber explains the importance of being able to balance in the everyday lives of stroke patients. He is a lecturer on the bachelor's programe for physiotherapy at the ZHAW in Winterthur and an advisor on the neurorehabilitation and neurotherapy for post-graduate students.

As a specialist, he talks about the functions of postural control in combination with balance control for stroke patients. He explains that the ability to balance the body's centre of gravity over the support surface is an integral part of many everyday activities.

Postural control is an essential factor for participation an active lifestyle. From this perspective, postural control and quality of life are closely linked. Mr Weber feels this too. Initially, he was very anxious about facing the challenges of everyday life again.

But through balance training, he has regained his confidence. He knows his personal limits and has noted that through active exercise he can change aspects of his condition himself.

Part 1

Series of interviews with Martin Huber

THERAPY & PRACTICE

Effective training of postural control

Effective balance training during rehabilitation is highly important for recovering maximum independence and mobility in day-to-day life (see THERAPY issue 1, 2017).

Interview Andrea Sommer_ **Photos** Simon Bärsauter

The full interview is available at
https://www.youtube.com/user/THERAtrainer

Postural control therapy is a central topic of neurorehabilitation.

What is postural control?

Postural control is a synonym for balance. The function of balance is to control the body's centre of gravity over the support surface. This ability is an integral part of most of the everyday activities that we perform. Functioning postural control is based on several aspects. Elementary components for controlling the body's centre of gravity are the motor, sensory and cognitive functions. These interact in a very complex manner. Motor functions include aspects such as strength, coordination and contraction speed. Sensory functions include the integration of sensory information from the eyes, haptic and depth perception and organs of equilibrium. Among the cognitive aspects are the dual-task capability. There are also various different balance mechanisms. These are the steady-state balance mechanism, anticipative postural control and reactive postural control.

Why is postural control important?

Postural control is significant because it is an extremely important factor in participation and the ability to have an active lifestyle. From this perspective, postural control and quality of life are closely linked. For patients, a loss of postural control is critical. They often enter a vicious circle of anxiety and avoidance behaviour.

How is postural control therapy designed?

Postural control therapy is a central topic of neurorehabilitation. Many patients show impairments in this area. The differentiated therapy requires a comprehensive understanding of physiological mechanisms in order to be able to precisely identify and treat pathologies.

What must be taken into account during therapy?

According to current evidence it is preferable to take a task-oriented approach during therapy. Here, the things that need to be improved are practised directly. Standing by standing, walking by walking. The therapy session is preceded by a clinical reasoning, which establishes the individual focal points for the treatment. Therapy also takes aspects of motor learning into account, such as repetition, instruction, feedback and shaping.

Martin Huber is a physiotherapist, and in 2007 he gained his Master of Science in Neurorehabilitation. It was in 2012, in his article "Wissenschaft braucht Kutscher" ["Science needs people in the driving seat"] in the specialist magazine Physiopraxis, that he reported on the subject of "knowledge transfer" in neurorehabilitation. In an interview with THERA-Trainer, he explains which hurdles still need to be overcome.

Effects of additional, dynamic supported standing practice

Summary of a randomised, controlled study for evaluating the feasibility and effectiveness of additional dynamic balance training for patients who have suffered from subacute strokes compared to static standing practice with a conventional standing frame.

Original work: Tobias Braun, Detlef Marks, Christian Thiel, Dörte Zietz, Daniel Zutter and Christian Grüneberg
Hochschule für Gesundheit, Department of Applied Health Sciences, Physiotherapy Program, Bochum, Germany,
Rehaklinik Zihlschlacht, Neurorehabilitation Centre, Zihlschlacht, Switzerland

A significant proportion of stroke patients suffer from a severe impairment to their walking and balancing ability, which has a critical effect on mobility and quality of life. Although useful, static standing practice is not primarily aimed at improving balance, unlike the Balance-Trainer, a dynamically supported standing table. Future challenges facing stroke rehabilitation demand secure, effective, cost-effective and simple add-on interventions, which can thereby help to promote functional recovery in subacute stroke patients. The Balance-Trainer has the potential to fill this gap.

Objective

Checking the feasibility and effectiveness of additional, dynamically supported, task and goal-oriented standing practice on functional capabilities in subacute stroke patients, supervised by physiotherapy assistants.

Design

Single-blind, randomised, controlled pilot study.

Setting

Rehaklinik Zihlschlacht, Neurorehabilitation Centre, Zihlschlacht, Switzerland.

Participants

10 patients who have suffered subacute strokes and are unable to walk.

Intervention

The intervention group (n = 5) received the usual treatment with additional dynamically supported standing practice, which took place at least four times per week over five weeks. The control group received the same treatment but with static rather than dynamic standing practice.

Key measurements

The primary results variables regarding feasibility were the occurrence of undesired events along with patient satisfaction and motivation. Secondary results variables were the functional recovery of postural control, ability to walk, mobility and independence.

Results

Dynamic standing practice proved very feasible. In total, the five test subjects took part in 119 training sessions, without the occurrence of undesirable events. Both groups showed significant improvements in all variables, both after five weeks and after two weeks of follow-ups. After five weeks, the intervention group scored significantly better than the control group on the Berg Balance Scale, the Functional Ambulation Categories, the De Morton Mobility Index and the Functional Independence Measure.

Conclusion

Additional, dynamically supported standing practice is safe and easy to implement for subacute stroke patients. The low number of participants and the significantly larger scope of physiotherapy units in the intervention group indicate that this tentative effectiveness should be interpreted with caution.

Keywords

Stroke rehabilitation, additional standing practice, balance, repeated exercise therapy.

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CLINICAL MESSAGES

This study indicated that dynamic supported standing practice can be performed safely by trained helpers in the sub-acute phase after a stroke.

There is potential of dynamic supported standing practice to be more effective than static standing in a conventional standing frame. In a main randomized study, 116 participants are needed to reveal the moderate treatment effect on balance abilities.

Improving care structures through networking

For six years, ROLLETS has been providing interesting content in specialist seminars and intensive workshops regarding the complex topic of the provision of medical equipment. Further interesting content and comprehensive knowledge is set to be imparted in over 40 cities in 2017.

Thomas Hildenbrand founded ROLLETS with the motivation of providing resources in a goal-oriented and optimised way.

Interview Jakob Tiebel_**Photo** Maximiliane Windheim

I am meeting with Thomas Hildebrand for an interview in the contemplative setting of Hochdorf, in a traditional inn a stone's throw away from the medica Medizintechnik company headquarters. When I arrive, Tom is already there on his laptop. He tells me that he still has something to prepare for the next day's workshop. For the third time, ROLLETS is organising a seminar in cooperation with THERA-Trainer. And having clocked up over 70,000 kilometres in the car and a total of 244 seminars and over 6,000 partner contacts to date, working between hotel rooms has long since become a routine for Tom.

This is not our first meeting. We have known each other for a few years thanks to the close collaboration. The openness and cheerfulness with which Tom greets people is quite special. His attitude to life is fascinating and undoubtedly one of the reasons behind the success of the ROLLETS rehabilitation network. Tom manages to bring together people in the industry and impress them. He makes sure that they get talking. What about? About the best possible provision of medical equipment. In the interview, he provides an interesting insight into the ROLLETS project and explains why it is so important not to lose sight of the people involved when it comes to dealing with treatment using medical equipment.

What is behind the company ROLLETS?

ROLLETS is a rehabilitation network. The idea behind it arose from my previous work as an occupational therapist. Back then, I was already dealing extensively with the topic of provision of medical equipment and quickly established that there were severe deficiencies in the care structures. And not without reason. In many cases, therapists lack the time to ensure optimal care. Trained dealers are limited by the general conditions of the health system and are under a great deal of financial pressure. Family members are generally overburdened by the whole situation and do not have the requisite knowledge. One thing then quickly leads to another and, ultimately, the bottom line is that optimal care cannot be provided. I see ROLLETS as a sort of mediator between these two aspects. I bring the experts in individual fields

together and promote communication and the transfer of knowledge.

ROLLETS has developed very rapidly in the last few years. Was everything planned in this way from the outset?

To be honest, no! [Laughs]. At first I just wanted to make pleasant, lively seminars. However, I then quickly noticed that I could make a difference with this. This provides me with fresh impetus every day. I am very honest about this: ROLLETS has become what it is today through actions and enthusiasm and this, and only this, has allowed it to reach this point.

Would you say that you are living a dream and ROLLETS is a kind of vision?

Yes! And I am not at all sure if one lifetime is enough to put it into practice. I still have so many ideas and plenty of motivation to make a difference.

What's more, the demand for my workshops and seminars has increased enormously of late. Cooperation with manufacturers, who demonstrate their products and transfer knowledge as part of the events, is also steadily increasing. I have recently had to turn down interested parties as I would otherwise not have been able to cope. This is basically a luxury problem – I know – but it pains me to do this as I simply view every input as extremely important and I do not want to exclude anything. This is one of the underlying principles that have made the project what it is today.

What is different about ROLLETS and what makes the workshops so unique? Is there a secret recipe for success?

The key is and remains the wide-reaching interface work. There are also a few other seminars and events on the topic of provision of medical equipment. However, they are only ever intended for individual target groups. But what is exciting is precisely the idea of bringing those involved together, rather than considering them in isolation, and showing them that networking with each other is ultimately more effective. Everyone should be an expert in their field and know when they can rely on the expertise of others. I also believe that it is only through this coordinated interaction that actors in the health system can survive in the healthcare industry in the long term. In order to achieve this, I always consciously ensure that there is a mixed group in all seminars and workshops. I personally believe that this is the "secret recipe" and an important aspect that makes ROLLETS so unique.

What professional groups meet in the ROLLETS network?

There is a diverse mix! The entire health sector is represented: therapists, caregivers, manufacturers and medical suppliers. From time to time, we also get interested patients, family members seeking advice, and many more. The exchange that this leads to often brings about a deeper understanding of the problems and challenges faced by others. Therapists understand why it may not be possible to fulfil treatment requests, as perhaps they are too expensive or not practical. And they also find out what alternatives and possibilities they still have.

The right reason for treatment is also hugely important. Generally, the whole formal process of dealing with health insurance companies is a major issue. Here, many seminar participants learn that individual treatments must also be justified accordingly. This is because health insurance companies can ultimately only make decisions on the basis of available information. And if the key information is missing, this will result in a rejection even if the medical equipment is basically essential. In these cases, it is important to know, in turn, what rights insured persons have and how to fight for them. This topic is also the subject of some of my seminars. To better organise the thematic issues addressed, ROLLETS now offers basic and advanced seminars. Individual focus topics can be set in this way.

Is ROLLETS neutral despite the intensive consultancy activities?

Yes and no. Yes, because ROLLETS seminars are not advertising events. There is a transfer of

knowledge. However, manufacturers are also on board, along with medical suppliers and other actors in the health system. And they naturally also have a legitimate interest in presenting and explaining their products – particularly if they require an explanation. However, I take great care to ensure it does not become a bazaar. If that were to happen, I would only end up damaging myself, since the health market certainly does not need promotional excursions. However, they would never have been met with such a high level of demand. I am therefore relaxed about this. But we do keep checks on quality. I regularly visit the workshops myself and we gauge the satisfaction of participants through our quality management. Objectivity is the first priority. But we have never had a problem here either. ROLLETS stands for quality and only works with serious partners who understand and do not misappropriate my idea.

How did the cooperation with THERA-Trainer come about and why do you think device-based therapy, in particular, is an important aspect of care?

The cooperation came about through my personal network. This goes back to a first encounter at a trade fair. As ROLLETS then really took off, cooperation made perfect sense to me and the partnership immediately blossomed.

Precisely the ability to stand and the possibility of therapy with a dynamic standing frame have won me over completely. I find it simply ingenious how devices can be used in a therapeutic environment and am regularly amazed at the tremendous effects that this has had on therapy. I also always allow for a lot of things to be tried out in the workshops. People must actually feel and experience this.

At the same time, I always say this will not make the role of the therapist redundant. Some of those participating in the seminars are initially against therapy devices and feel that their credibility as therapists has been damaged. I believe they are worried that a therapy device can replace therapeutic work. But let's be honest: that's rubbish. Therapists will not become redundant. On the contrary, they can expand the scope of their capabilities. It is always fascinating to see how the impressions of individual participants change over a seminar day. The THERA-Trainer team makes an important contribution to this. This is because they manage to transfer the knowledge required for this in a scientifically sound way and with a great deal of experience.

Would you also welcome employees of health insurance companies and from the medical profession to the seminars?

We have already done this! And why not? After all, this is the aim and it would even be good if they, precisely as the most important actors, participated much more often. I think that there is often a lack of understanding here too regarding the opportunities and challenges.

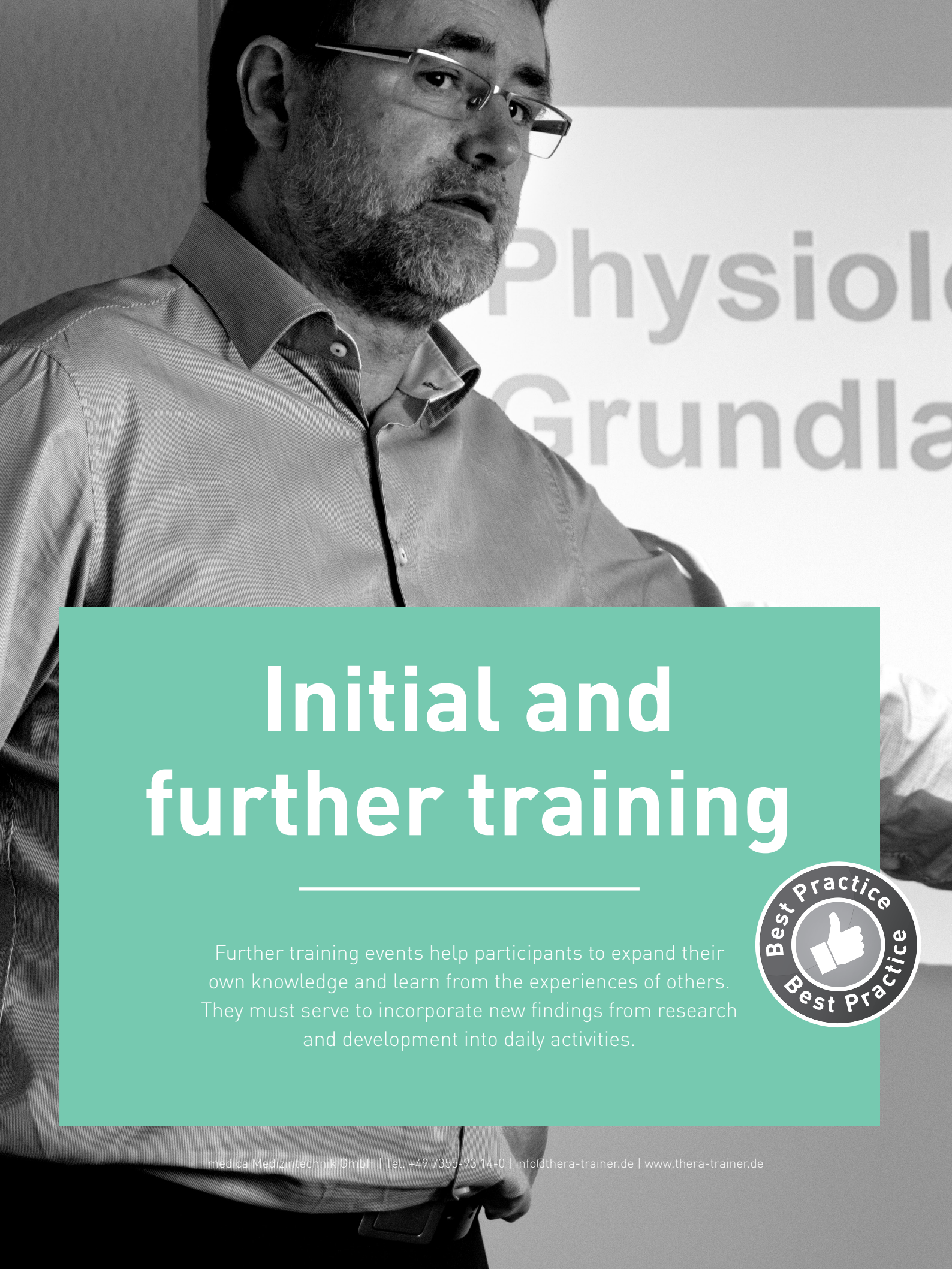
In your personal view, what should "optimal care" look like?

It is based on honest, fair and neutral advice and a focused implementation of all necessary measures. Sometimes this is not an achievable goal, as much as I wish it were. And it is not uncommon for the wrong decisions to prove very costly and be exasperating. Let me give you an example of this. I personally experienced this in the course of treatment in a clinic back when I was still active as a therapist. I had a patient who was initially approved for a complete home conversion. He then came to me and we established that providing him with a stand-up wheelchair would be much more suitable and would make the conversion unnecessary. The patient would be able to access all parts of his home as before thanks to the stand-up function of the wheelchair – even the wall units in the kitchen. The health insurance provider repeatedly rejected the use of the wheelchair and finally approved the conversion. That was twice as expensive and ultimately did not optimally solve the problem. I would call that rather "sub-optimal". In many cases, however, it works out well. It would be incorrect to paint an entirely negative image of this. What is needed above all else is knowledge, expertise and the necessary perseverance. In the end we still managed to get the patient a stand-up wheelchair.

And now the final question for you, Thomas: What do you wish for in the future, for yourself and ROLLETS?

To be cloned three times please, so I do not have to travel 70,000 km per year on Germany's congested motorways in, at times, seemingly endless traffic jams, but instead only travel 20,000 km and therefore have time for more seminars.

All the best for the future and thank you for this interesting interview!



Initial and further training

Further training events help participants to expand their own knowledge and learn from the experiences of others. They must serve to incorporate new findings from research and development into daily activities.

Best Practice Best Practice

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Everyone up to the challenge!

I first came into contact with movement exercisers from medica at the Parkinson's clinic in Beelitz-Heilstätten in 1998. We initially had two THERA-Trainer exercise bikes there. As movement therapy is of the utmost priority when treating Parkinson's disease, along with medicinal treatment, we used these two devices very regularly and intensively with the patients.

I quickly recognised the advantages of device-based therapy. That is because, in this way, it was possible to treat several patients at the same time in the course of a treatment unit. The patients were able to train on the devices largely independently. This meant that I always had a firm eye on all participants and they were able to "warm up" before the individual treatment.

It was remarkable how much the Parkinson's patients enjoyed training with the THERA-Trainer. Thanks to the motor support, movements felt easy to them again – you could see it in their faces. Little by little, my team and I began to document the fastest times of the day of our hard-working "cyclists" in the sports room. This spurred the patients on to continue to improve. Soon we set the patients the goal of completing at least one cycling unit every day. Everyone up to the challenge found the movement exerciser to be a reliable training partner.

As the number of patients increased, so too did the number of available devices. Soon, we had three trainers from medica, which were practically being used around the clock. The cranks were turning almost continuously.

In 2005, I started a new job at Bogenhausen hospital in Munich, where my tasks included neurological early rehabilitation. I was happy to

discover that here too, one of the devices used was a THERA-Trainer.

I soon began to allow some of the worst-affected patients to train on the device. It did not take long to see positive effects: reduced spasticity, increased joint mobility and improved strength. And not only this – it was also great to see the amount of joy the patients derived from training. The patients' own family members would listen with astonishment when we told them that, for example, their father had actively and independently cycled for three kilometres. Especially those who had enjoyed cycling before their illness had no trouble motivating themselves for training with the THERA-Trainer.

At that time, I also started to provide the patients with recommendations for medical equipment. I wanted to make it possible for people who I thought would particularly benefit from this kind of activity to also have daily walking training on the device. Through dialogue with medica, I received regular feedback on whether, for example, the medical equipment had been approved by the health insurance companies for individual patients. I was often positively surprised and was delighted when my patients received the approval to continue their training in their own homes.

I particularly remember a severely neurologically impaired patient, to whom I also recommended the movement exerciser. Having suffered a severe aortic aneurysm two years earlier, she came to the hospital to adjust her anticonvulsant medication. She suffered from severe spasticity and an extremely subluxated shoulder. As a result, she also suffered from acute pain and was completely dependent on external help in her everyday life. Training with the THERA-Trainer was extremely beneficial to her, reducing her tone and increasing her overall well-being. I had often seen that, particularly with damage to the upper motor neurone – where the central pattern generators attempt to continue to emit their impulses – the rhythmic pedalling movement of the trainer has been extremely beneficial to those affected. That was also the case for this patient. Happily, her health insurance provider approved a trainer for her at home. She was able to use the device on a daily basis and continued to improve.

Later, her husband stated that the THERA-Trainer had been something of a godsend for them both. Whenever his wife was unwell, agitated or in pain, he would put her in the movement exerciser – even in the middle of the night. After that, her condition continued to improve significantly. The patient herself also regularly requested the "bicycle rides", which helped her and her family to greatly improve their quality of life.

The THERA-Trainer models have changed over time, becoming more modern and equipped with colour displays with touchscreens. The biofeedback games increased the patients' motivation for training even more. For example, patients can fly around between planets in a spaceship controlled by the pedalling movement on the device, or train as a goalkeeper in a football match. Young patients in particular were immediately convinced by this idea and had a great deal of fun with it.

I now work as a physiotherapist at Klinikum Niederlausitz hospital in Senftenberg. Here too, there is a THERA-Trainer available for my day-to-day work. The head of cardiology is well informed about the findings of the latest unequivocal results of studies in device-based training therapy. He would therefore also like for almost all cardiology patients to train with the medical equipment in order to improve blood oxygenation, among other things. In addition, we may be provided with a dynamic standing frame in the near future.

It remains interesting to see whether medica's developers and engineers can continue to come up with innovations and useful products in the same vein. As yet, they have kept their promise. They have significantly facilitated and enriched my day-to-day therapeutic work.

Martin Felgentreu completed his training as a state-approved physiotherapist at Brandenburg Medical School in Brandenburg an der Havel in 1995. He has worked at several specialist neurological clinics (including Klinikum Bogenhausen in Munich). He has been working at Klinikum Niederlausitz hospital since 2014. There, he has carried out and assisted therapeutic studies with the Fraunhofer Institute and BTU Cottbus-Senftenberg. He is currently heading a study of vibration and telematics training. Felgentreu specialises in the field of neurology, with a focus on apoplexy, Parkinson's and vertigo.


THERA
TRAINER

SCIENCE

Cyclical leg movement training supports stroke rehabilitation

Besides neurological damage, strokes above all lead to decreased mobility in the victim, which in turn can result in secondary illnesses. As well as the physiotherapy and ergotherapy care given to the patients, the effect of training carried out independently on the everyday motor skills of stroke patients must also be examined.

Objectives

The effects on the motor skills of stroke patients on a four-month self-training regime with an exercise therapy device for the lower extremities were examined as part of this study. Above all, it was necessary to establish the influence of the training on the ability to walk and the endurance of the patient.

In addition, the researchers wanted to discover whether regular training with a therapy device of this kind was generally accepted, whether the test subjects used it according to the specifications, and whether they could independently adjust the intensity during the course of the training using the BORG scale to reflect performance progress.

Methodology

A randomised controlled study was carried out. The test subjects were stroke patients living at home with hemiparesis and an existing walking impairment. The subjects had to be physically and mentally capable of participating in the testing and training and following the instructions of the director of studies.

Patients whose general health did not allow them to perform the desired training at the sub-maximal performance level or could not perform regular training due to pain were excluded. Patients who could already train on a conventional bicycle ergometer were also excluded.

Intervention

The patients who fulfilled the above-mentioned inclusion and exclusion criteria were divided into two groups after randomisation. The test subjects in the intervention group (IG) were provided with a movement exerciser, with which, in addition to conventional physiotherapy and ergotherapy, they had to complete a brief 15-minute training session twice per day. Each of these featured passive warm-up and warm-down phases lasting two to three minutes and at least 10 minutes of active training time at a pedalling frequency of 50-70 rotations per minute. During training, the test subjects had to control the activity of the affected leg via a symmetry display on the device. The brake resistance had to be set up to that it corresponds with level 13 of the BORG scale ("somewhat hard"), which represents moderate endurance training from a scientific training research perspective.

The test subjects in the control group (CG) only received standard physiotherapy and ergotherapy.

Measurements

At the start and end of the intervention period, the walking speed (at a normal and fast pace) was measured with the 10-metre walk (10 MWT) test and the maximum walking distance in a given time was measured in the 2-minute and 6-minute walk tests (2/6 MWT). In addition, motor assessments were carried out: Tinetti Test (TT), Berg Balance Scale (BBS) and Timed "Up & Go"-Test (TUG).

The training data (time, distance, watts, pedalling frequency), was recorded on the devices.

Results

In total, 31 patients (16 IG/15 CG) were included in the study. Gender and lesions were equally divided between the groups. The average age was 65 ±9 years. Both groups received an average of two sessions of physiotherapy and ergotherapy per week during the intervention period. At the outset, there were clear differences in performance between the test subjects. However, these were evenly distributed, so there were no significant differences between groups.

For the statistical calculations, a significance level of $\alpha = 5\ \%$ ($p = 0.05$) was established. With the motor tests, a variance analysis was initially performed. If there were significant correlations ($p < 0.05$) between the intervention and control group, a t-test for paired samples was performed.

There were significant interactions between the intervention and control group with the initial values in the 2-MWT (80 ±38 vs. 70 ±29 metres; $p = 0{,}015^*$), the 6-MWT (238 ±116 vs.195 ±88 metres; $p = 0.003^{**}$), the 10-MWT at a normal walking pace (0.65 ±0.29 vs. 0.58 ±0.25 metres/sec.; $p = 0.024^*$) and in the TUG (22 ±14 vs. 27 ±15 seconds; $p = 0.016^*$).

After a before/after analysis of the intervention

group, the paired t-test revealed highly significant improvements in 2-MWT (66 ±31 vs. 80 ±38 metres; p= 0.001***), the 6-MWT(188 ±94 vs. 238 ±116 metres; p = 0.001***), the 10-MWT at a normal walking pace (0.53 ±0.24 vs. 0.65 ±0.29 metres/sec.; p= 0.002**) and in the TUG (29 ±18 vs. 22 ±14 seconds; p= 0.013*). This was not the case, however, in the control group.

Using the Pearson correlation coefficient, the researchers could also establish a connection (r = 0.72) between the input values from 6-MWT and the average wattage from week 1.

In addition, the evaluation of the training-specific parameters revealed that the training duration and pedalling frequency remained almost unchanged throughout. The participants exercised for an average of 18.20 ±0.46 minutes. Of this, 16.01 ±0.29 minutes were active and 2.19 ±0.17 minutes were passive. The average pedalling frequency was 58 ±2 rotations per minute. Therefore, it was not possible to establish a connection between the duration and distance (r = 0.357) or pedalling frequency and distance (r = 0.211) variables.

What did change, however, was the training effort (17 vs. 23 watts; p = 0.009**) and the distance (3,388 vs. 4,716 metres; p = 0.027). Here, it was possible to prove a conclusive connection (r - 0.948) between both variables.

Conclusion

The results of the study show that training with an exercise therapy device improves the sub-maximal performance level of stroke patients. Over the course of the test, subjects were able to increase their training effort by an average of 6 watts and were therefore able to cover much greater distances per training session than at the outset, with an increase of around 1,328 metres. As the scope of the training and the pedalling frequency remained almost unchanged, the increase in effort must have resulted from the change of brake resistance. Reaching a higher gear was therefore evidently a greater incentive for the test subjects. This is supported by the correlation between the parameters (r = 0.948) and indicates that the test subjects were able to independently manage the training with the BORG scale. The clear connection


THERA
TRAINER
44 1/min
7 Watt
0,8 km
01:06 min
3
15
RPM
STOP
START

(r = 0.72) between the input values from 6-MWT and the average wattage from week 1 makes it clear that the strain corresponded to the actual effort of the test subjects and improved this over the course of the test.

Training also had a positive effect on the ability to walk. Endurance and moderate walking speed increased significantly among test subjects in the intervention group. Compared with the values from the initial test, the participants travelled around 50 metres further by the end of the 6-MWT and increased their normal walking speed by an average of 0.12 metres/sec., while the values in the control group remained virtually unchanged.

As the walking distance and walking speed parameters for stroke patients are closely related to independence, it can be assumed that the training also had a positive effect on this. This is partially confirmed by the significant improvements in the TUG, which establishes the degree of independence based on basic motor skills (e.g. standing up from a bed, from a chair or from the toilet). However, the static evaluation of other motor assessments also showed that physical exercise could not improve other skills with everyday relevance or, according to the author, this could not be conclusively proved through the ordinal points scale of the test due to ceiling effects that could not be ruled out.

From the perspective of the authors, a high level compliance is reflected in the positive test results, an average training time above the target training time (the test subjects trained for an average of five minutes longer than predicted) and the high number of training sessions performed (204 ±56 sessions) per participant.

An additional reliable indication of the motivation of test subjects was increased interest after the study in continuing to train with a movement exerciser. 11 of 16 test subjects consulted their doctor regarding a prescription.

Comments

In any case, physical exercise is a useful addition to physiotherapeutic and ergotherapeutic treatment. This study shows that regular physical exercise improves the sub-maximal performance level of chronic stroke patients and has a positive effect on independence in everyday situations. This confirms that regular and intensive training is essential to aftercare, in order to ensure that progress is made in rehabilitation and to further improve motor skills and general physical fitness.

It is wrong to expect that no more improvements will be made six months or a year after a stroke. Quite the opposite: through training aimed at the limits of the individual's capabilities, significant improvements can still be made several years later. These no longer result from the restorative approaches but instead from learning theory approaches. Self-training and regular checking of this play a decisive role in this context, as frequent repetition is one of the most important determinants for successful treatment in the context of motor learning. Patients can actively cooperate here by making constructive use of their time when not in treatment. They therefore learn to take responsibility for the rehabilitation process and experience their own self-efficacy. However it is necessary for them to learn to correctly pace themselves and manage the training. However, patients who have received a movement exerciser for training at home are often only briefly trained in operating the device upon delivery and are then left to fend for themselves. Although they make enquiries into how to train correctly, they generally do not receive adequate answers. Against this background, it is a good idea to provide the test subjects with a simple instrument for independent training management in the form of the BORG scale.

The opportunities for effective training management with the movement exerciser should be pursued further in future at all costs. Many patients have a trainer at home but are unlikely to make full use of its potential. Technical software solutions, which provide support for training management, may be helpful in minimising consultancy costs and additionally improve the quality of care.

ORIGINAL WORK

Kamps A, Schule K. Zyklisches Bewegungstraining der unteren Extremitäten in der Schlaganfallrehabilitation [Cyclical physical exercise of the lower extremities in stroke rehabilitation]. Neuro Rehagil 2005; 11 (5): 259-269.

Tips

for effective
self-training

THERAPY & PRACTICE

How strenuous should it be?

After a stroke, self-training with a movement therapy device has been proven to help ensure that treatment is successful. However, therapists are often at a loss when it comes to making recommendations for training management, meaning that patients are often left to work their training out for themselves. The Borg scale, a reliable indicator with which therapists can record and assess the subjective exertion during training, can remedy this.

Self-training managed by the patients is essential to outpatient aftercare in order to maintain the progress achieved in the context of stationary rehabilitation and to continue to improve motor skills and physical fitness after a stroke [1].

In this context, the use of a power-operated movement exerciser has proven to be a useful extension of physiotherapy and ergotherapy. Intensive and regular training improves the ability to walk and general endurance, and increases independence in various everyday situations [2-4].

Self-training and regular checking of this therefore play an extremely important role in the outpatient setting as the therapy dosage is a crucial factor for success. The provision of outpatient medical care alone is no guarantee of the training intensity, duration and frequency required for motor learning. However, if patients use part of their time when not in treatment to independently train with the device, they can actively support the success of the treatment. In addition, they learn to take responsibility for themselves and their own situation and can experience their own self-efficacy [1,6].

Generally speaking, patients are able to carry out training of their own accord at home and without much difficulty after some practice. A movement exerciser soon proves to be suitable thanks to its construction, its simple and intuitive operation, and the high level of safety during training. It is a type of modified bicycle ergometer with a motor drive, with which patients who cannot walk or whose ability to walk is heavily impaired can perform repetitive arm and leg movements from their wheelchair or a chair. Here, the brake resistance can be precisely controlled and adjusted to the individual performance levels of the patient.

However, it is essential to successful self-training that patients learn from the outset how to use the equipment correctly and how to adequately manage and pace their training. Sadly, however, the networking and interdisciplinary cooperation required for this between providers, therapists and patients is something of a pipe-dream in the outpatient sector. A lack of communication and specialist knowledge, time constraints and a lack of clarity regarding the remuneration situation stand in the way of interdisciplinary coordination [5]. Patients who have received a movement exerciser for training at home are often only briefly trained in operating the device upon delivery and are then left to fend for themselves [3]. Although the patients often make subsequent enquiries into how to train correctly, they only rarely receive sufficiently useful information.

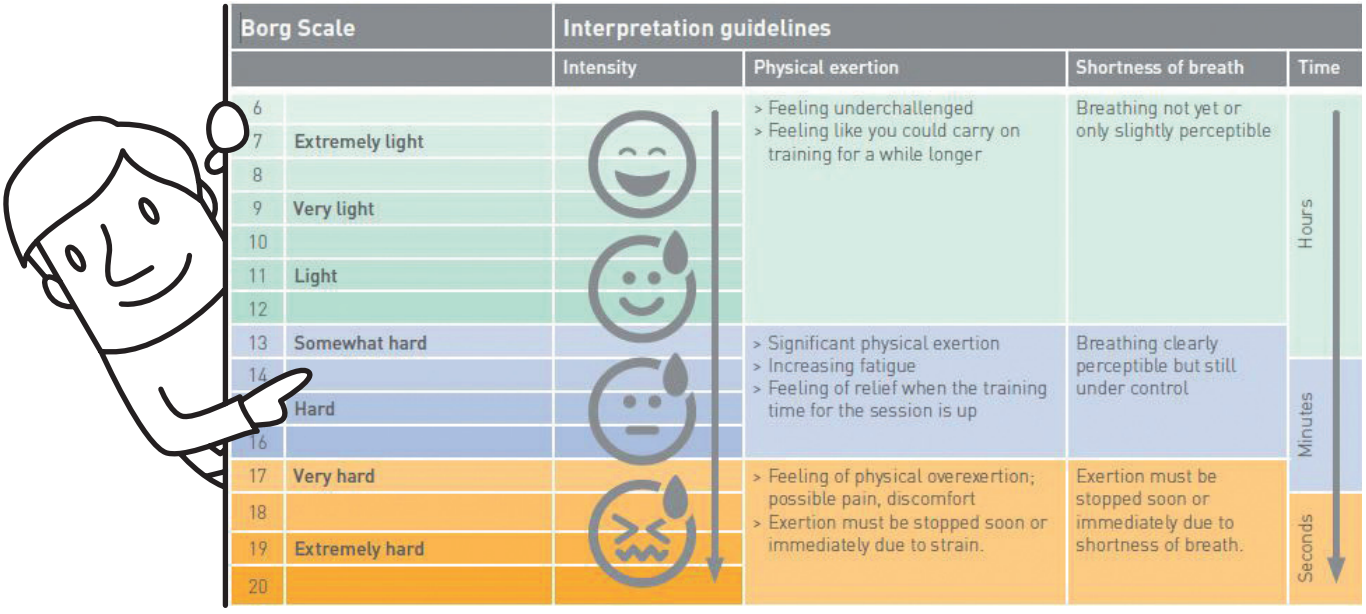
It is certainly no easy task to find the suitable intensity for adapted training and to correctly assess effort. It is often difficult to give a clear training recommendation, particularly to older persons or patients with cardiopulmonary and musculoskeletal conditions. Comprehensive endurance tests to determine physiological parameters (VO2 max, blood lactate) would be necessary but are far too complex and not at all feasible in an outpatient setting [6].

By contrast, a very simple yet precise option for identifying the perceived exertion of individuals and establishing the level of effort in training is the Borg scale, which was developed in 1970 by Swedish scientist Gunnar Borg. This 15-point scale is easy to apply and the patients themselves are capable of understanding it and using it to manage their training [6].

This type of assessment is widespread in neurological rehabilitation. It is often implemented in training studies for performance diagnostics and resistance control [6]. Kamps and Schüle, along with Dobke et al., were able to prove in 2005 and 2010 that the Borg scale works equally well for managing the physical exercise of stroke patients living at home. Firstly, they established the exertion for the training according to Borg, then compared the training-specific results with the results of a six-minute walking test and came to the conclusion that the exertion during training actually corresponded to general endurance in everyday situations. In addition, they established that regularly checking the performance level using the Borg scale was highly motivational for patients. Reaching a greater pedalling resistance was important to patients and provided them with an incentive to exercise, which resulted in them significantly increasing their performance during the course of training [3,4].

It is extremely simple to work with the assessment. Using the classic Borg scale, or "ratings of perceived exertion" (RPE), the patient's subjective perceived exertion during or directly after the training session was quantified. The 15-point intervals scale is divided into numerical values from 6 to 20. The odd numerical values are additionally provided with interpretive descriptions (from 7 = "Extremely light" to 19 = "Extremely hard") to ensure the linearity of the scale [6].

Depending on the performance level of the patients, the aim is to train at the sub-maximal level over a time period of around 15-20 minutes. A session always consists of warm-up and warm-down phases of two to three minutes, with the active walking phase between them. The brake

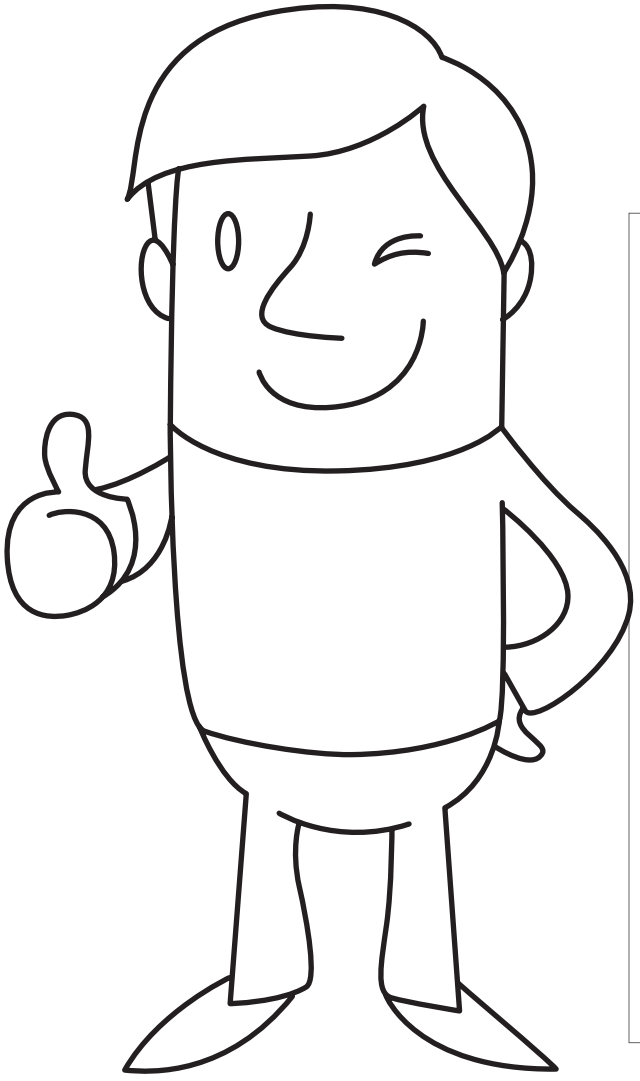


Borg Scale		Interpretation guidelines			
		Intensity	Physical exertion	Shortness of breath	Time
6			> Feeling underchallenged > Feeling like you could carry on training for a while longer	Breathing not yet or only slightly perceptible	Hours
7	Extremely light				
8					
9	Very light				
10					
11	Light				
12					
13	Somewhat hard		> Significant physical exertion > Increasing fatigue > Feeling of relief when the training time for the session is up	Breathing clearly perceptible but still under control	Minutes
14					
15	Hard				
16					
17	Very hard		> Feeling of physical overexertion; possible pain, discomfort > Exertion must be stopped soon or immediately due to strain.	Exertion must be stopped soon or immediately due to shortness of breath.	Seconds
18					
19	Extremely hard				
20					

resistance of the device has to be set up so that the exertion corresponds with level 13 ("somewhat hard"), which amounts to moderate endurance training from a scientific training research perspective [3,4].

Those who want to be more precise should determine the maximum performance in an initial test in order to then be able to establish the values for endurance training as accurately as possible. When identifying the training parameters for the sub-maximal performance level, the variation is generally larger. Following the initial test, the patients can then manage the training themselves using the scale and simultaneously use the values as a reference for reproducing the level of exertion in everyday situations [6].

For validity, it must be said in summary that all standard physiological criteria (heart rate, blood lactate, VO2 max %, VO2 %, breathing rate and ventilation) correlate equally strongly with the RPE scale. For practical reasons, however, the breathing rate is the best indicator of the degree of physical exertion [6].



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Quiz

12 Questions about stroke

1

True or false: Around the world, a person suffers from a stroke every two seconds.

a) True
b) False

2

How many strokes occur worldwide every year?

a) Approx. 1 million
b) Approx. 5 million
c) More than 15 million

3

True or false: Globally, stroke is among the main causes of disability.

a) True
b) False

4

Children can also suffer from stroke.

a) True
b) False

5

Strokes can be caused either by an infarction, i.e. an obstruction of a brain artery, or by internal bleeding of the brain. How often do each of these variants occur?

a) Approx. 80 percent of strokes are caused by a cerebral infarction, approx. 20 percent by bleeding to the brain.
b) Approx. 20 percent of strokes are caused by a cerebral infarction, approx. 80 percent by bleeding to the brain.
c) Approx. 50 percent of strokes are caused by a cerebral infarction, approx. 50 percent by bleeding to the brain.

6

What are the greatest risk factors for a stroke?

a) Strenuous sporting activities, particularly playing football (due to heading the ball) and boxing
b) High blood pressure, being overweight, high cholesterol, smoking, heart diseases
c) Consumption of large amounts of coffee, painkillers and very spicy food

7

Which statement is incorrect?

a) Approx. 15 percent of patients die within four weeks of suffering a stroke.
b) After surviving a stroke, a second occurrence is quite unlikely.
c) In around 50 percent of cases, a stroke can lead to permanent disability.

8

In the event of a stroke, several symptoms can arise. These include:

a) Impaired speech and vision, vertigo, severe headaches and weakness on one side of the body
b) Coughs and sniffles, fever and headaches
c) Nausea, diarrhoea and vomiting

9

In the event of a stroke, speech disorders may arise without impairing the patient's knowledge or ability to think. While they can perceive reality and understand contexts, they can no longer communicate verbally. What is this form of "speechlessness" called?

a) Amnesia
b) Aphasia
c) Anosmia

10

A TIA (transient ischemic attack) is a temporary loss of blood flow to the brain. Which statement is correct?

a) A TIA can present with similar symptoms as a stroke and is a warning sign – it is often followed by an actual stroke.
b) A TIA causes a brief feeling of dizziness but is not dangerous.
c) A TIA manifests itself in the form of severe headaches, but is mostly easy to treat with painkillers.

12

What should everyone do to prevent a stroke as far as possible?

a) After the age of 50, a head CT scan should be performed every five years.
b) After the age of 55, everyone should take anticoagulants and under no circumstances play football or box.
c) Eat healthily, practise sport, not smoke and regularly check blood pressure.

11

What is the correct response when symptoms of a stroke arise?

a) The most important thing is to treat the pain now. Headache tablets should be administered quickly.
b) The GP should be contacted in the next few hours.
c) Call emergency services immediately. The patient must be taken to a hospital with a specialist stroke station. Right now, every minute counts.

Solution
Question 1: a // Question 2: c // Question 3: a // Question 4: a // Question 5: a // Question 6: b // Question 7: b // Question 8: a // Question 9: b // Question 10: a // Question 11: c // Question 12: c

Preview

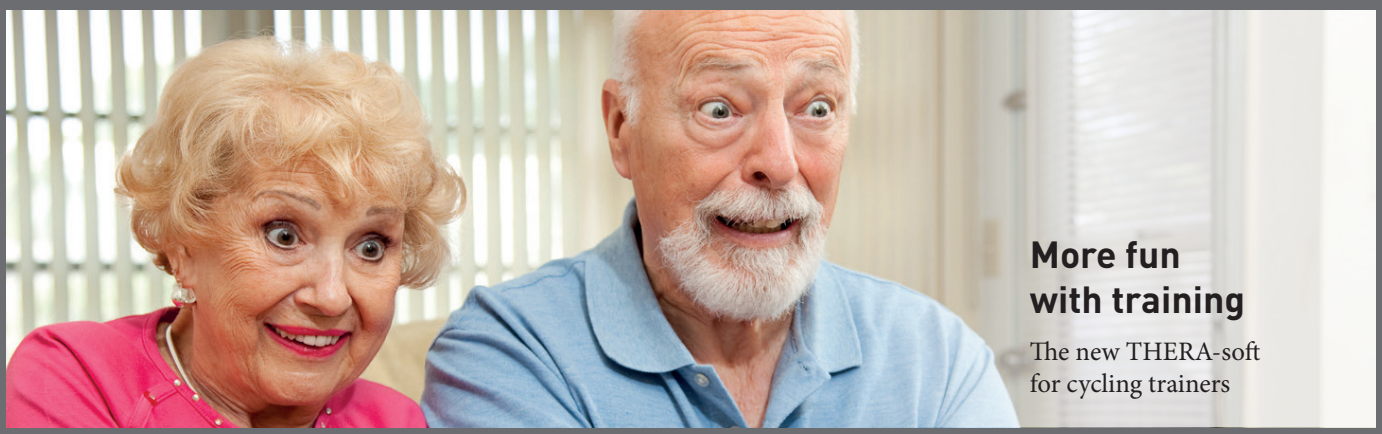
The next issue will be published in spring 2018

Motor therapy with multiple sclerosis

An expert report by Sabine Lamprecht

Loko Solution project

Results of a pilot project for device-based gait rehabilitation



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Subject to change.

Answers from "Um die Ecke gedacht" [Thinking outside the box] Therapie Magazine issue 1

Question 1: Terminal limb | Answer: **Leg** // Question 2. Mental pre-emption of a future movement pattern | Answer: **Anticipation** // Question 3. Simple, valid walking test (abb.) | Answer: **FAC** // Question 4. Brain disorder | Answer: **Apoplexy** // Question 5. Test procedure in therapy | Answer: **Assessment** // Question 6. Anatomical designation of location and direction | Answer: **Anterior** // Question 7. Flaccid paralysis | Answer: **Plegia** // Question 8. "Grandfather" of evidence-based medicine | Answer: **Sakett** // Question 9. Patient-centred scientific approach | Answer: **Evidence** // Question 10. Systematically developed treatment recommendations| Answer: **Guidelines** // Question 11. Systematic review (abb.) | Answer: **RCT** // Question 12. Greek physician | Answer: **Hippocrates** // Question 13. Specialist term in therapy for walking | Answer: **Locomotion** // Question 14. Mechanical movement restrictions | Answer: **Contraction** // Question 15. Pathologically increased muscle tension | Answer: **Spasticity** // Question 16. Specific disruption of attention | Answer: **Neglect** // Question 17. Acquired language disorder | Answer: **Aphasia** // Question 18. Contractile organ | Answer: **Muscle** // Question 19. Part of a nerve cell | Answer: **Dendrite** // Question 20. Acute medical therapy in the event of occlusions in the blood vessels | Answer: **Thrombolysis** // Question 21. Pathological cell death | Answer: **Necrosis** // Question 22. Damage to the heart muscle | Answer: **Heart attack** // Question 23. Ability to maintain an upright body position under the influence of gravity | Answer: **Balance** // Question 24. Involuntary, swift and homogeneous reaction Answer: **Reflex**

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