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THERAPY

THE MEDICA MEDIZINTECHNIK GMBH MAGAZINE

Balance

THERAPY & PRACTICE
Balance disorders and therapy

TECHNOLOGY & DEVELOPMENT
Steep learning curve with a long-term learning effect

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"We humans face up to a task only when we're convinced that we can successfully master it."

Editor Jakob Tiebel

FOREWORD

Self-efficacy

Dear Readers,

People who have confidence in their own abilities feel themselves to be self-effective. Confidence in one's own abilities greatly influences our feelings and ways of thinking, our actions and our successes.

Canadian psychologist Albert Bandura developed the concept of self-efficacy. He describes self-efficacy as the personal conviction to be able to handle challenges or problems through one's own actions. By that he means having confidence in oneself and one's own abilities.

So think about how this relates to our patients. Every minute a stroke unexpectedly poses major and unsettling challenges for at least one person on our planet. Will I learn how to walk again and look care of myself? For many patients, this represents a loss of control, underlined by the belief that they will only ever be able to achieve anything with external help.

Our task in therapy is to get these people back on their feet, in the truest sense of the word. Bandura discovered that we humans only face up to a task when we are convinced that we can master it successfully.

Free standing and walking without loss of balance and the fear of falling, as well as regaining self-confidence in one's own abilities, are the main topics we'll be investigating in this issue.

Have fun reading this edition of THERAPY Magazine!

Jakob Tiebel
Contact the editorial team at:
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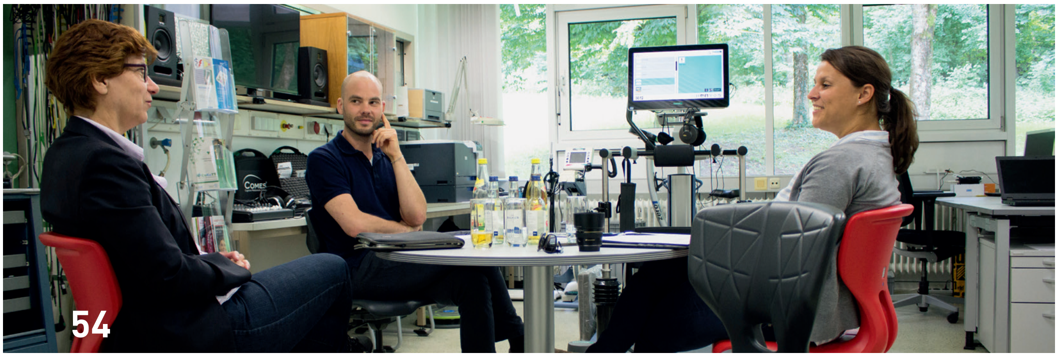
(and tell us what you think!)

The interaction model offers a practical framework to rehearse interventions for the training of motor skills, sensory skills or cognition



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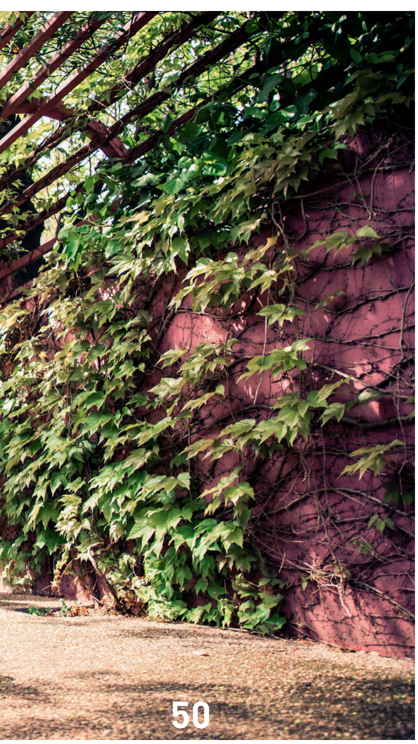

How the environment can influence genes

Cover story: Balance

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BALANCE

Balance disorders and evidence-based therapy

In issue I/2018 of the THERAPY Magazine, a reference framework model (known as an interaction model) for the understanding and analysis of postural control was established in the article "What keeps us in balance?". With reference to this model, this article illustrates the typical disorders and that evidence-based treatment of postural control (PC).

Martin Huber

Did you miss the first article in the series? Write to us at: therapy@thera-trainer.de
We'll send you a PDF copy of the issue.

DOI: 10.6084/m9.figshare.7000400

Which typical PC disorders occur following neurological diseases?

All aspects of the individual, including motor skills, sensory perception, and cognition, can be affected by neurological disorders. Accordingly, the disorders set out below (following neurological disease) can be assigned, based on the interaction model.

Typical motor disorders are:
- lack of anti-gravity muscle activity
- restricted postural synergies (e.g. ankle strategy (upper ankle joint), protective steps)
- In addition, limitations in joint mobility (often due to adaptive phenomena of the musculature, particularly in the upper ankle area) may play a role

Typical sensory disorders are:
- limited surface and depth sensitivity, particularly in the area of the feet
- limited ability for sensory weighting
- a strongly-altered body schema (e.g. in patients who push or who exhibit a neglect)

Typical cognitive disorders are:
- limited dual-task capability
- reduced problem-solving ability
- reduced self-efficacy

In everyday clinical practice, these disorders can be identified based on the following "symptoms" [7, 11, 22, 27]:
- Unsteadiness when standing freely
- Increased use of the upper extremities (UE) (holding on, durable medical equipment)
- Restricted upper ankle strategy, increased use of the hip joint strategy
- (Very) restricted stability limits (cone of stability) when standing
- Restricted, slowed lateral weight transfer, particularly to the more affected side (asymmetry)
- Inability to perform single-leg stance
- Slowed change from double-leg to single-leg stance
- Visual fixation (visual acuity dependency)

For some patients, the steady-state situation can itself be difficult.

In which "tasks" do balance disorders typically occur?

Of course, this depends heavily on the individual (motor, sensory and cognitive) disorder pattern. For some patients, the steady-state situation can itself be difficult. For others, the challenge lies primarily in dynamic-anticipatory and/or reactive tasks. Investigations indicate that unsteadiness and falls can often occur during transfers, when walking (and turning), during the transition from sitting to standing, but also when standing [3, 5, 20, 21].

Environmental aspects also affect balance

Environmental factors such as unevenness, unstable and/or sloping surfaces [14] as well as restricted light conditions [12] similarly influence balance behaviour and should therefore be taken into account in therapy.

What does this mean for therapy?

The different disorder patterns outlined above can be influenced through therapy. There is evidence for the effectiveness of interventions that specifically train particular aspects of motor skills, sensory perception or cognition.

In order to structure the interventions, the interaction model can provide a practical framework (see Issue I/2018).

Examples of evidence for treatment of the motor component:

- postural synergies (upper ankle strategy):
- improved performance [6, 16]
- increased speed [19]
- anticipatory postural control: improved weight transfers when standing [25]
- protective steps: improved, faster performance [15, 18]

Examples of evidence for treatment of the sensory component: sensory weighting: improvement [4, 10, 24, 25]

Examples of evidence for treatment of the cognitive component: dual-task capability: improvement [23]

Systematic, plausible implementation with a taxonomy

For the systematic and structured design of balance training, the application of what is termed a taxonomy (system) is proposed. This system is based on the interaction model and offers the possibility of being able to offer highly patient-centred and goal-oriented therapy through the targeted application of task and environmental parameters (see Fig. 1).

This taxonomy is also the basis of THERA-soft for the THERA-Trainer standing & balancing devices.

The taxonomy is perfectly compatible with the current evidence. Both results from individual studies as well as conclusions from reviews [1, 2, 28, 29] and recommendations from guidelines [8, 9, 17, 26] can easily be integrated into this system.

For example, the KNGF Stroke Guideline (2014) from the Dutch Professional Association of Physiotherapy makes the following recommendation: "Practicing balance during various activities improves balance when sitting and standing and performing basic activities of daily living (ADL)."

The Guideline of the Australian Stroke Foundation (2017) suggests that "task-oriented practising of standing balance should be offered to patients who have difficulty standing. This can include the performance of functional tasks when standing."

The common basis of both recommendations is the task-oriented approach. This essentially means practising the thing that needs improvement. "The interventions are also designed in such a way that the person practising can develop efficient and effective (task-specific) strategies to solve functional, meaningful and individually-relevant tasks" [13]. Using the taxonomy, task-oriented balance training can be systematically, practically and individually created. Shaping (continuous and systematic adaptation of the task level to the current performance of the person practising), as one of the most important principles of motor learning, can also be designed specifically with it.

Fig. 1: Set the THERAPEUTIC OBJECTIVE before applying the taxonomy (e.g.: improved weight transfer to the left leg (focus: lateral stability), improved upper ankle strategy in weight transfer to ventral (focus: activation distal); improved anticipatory PC status for eye tracking movements, and similar.)

		"easy"	"moderate"	"difficult"
Task	Balance mechanism	steady state	anticipatory	reactive
	Balance strategy		Focus: Upper ankle strategy activation distal	Focus: Protective steps reaction speed distal
	Size of support surface	Parallel standing	Stepping stand – Tandem stand	Single-leg stance
	UE (LE/head)	rebound	catch range within arm's length	catch asymmetrically range beyond arm's length
	Sensory system	multisensory	Eyes closed Eye tracking/gaze stabilisation	Sensory conflict, eye tracking/ gaze stabilization
	Cognition	single task	dual task	multiple task
Environment	Support surface	level, stable	sloping	sloping diagonally, unstable
	Durable medical equipment	several	one	none

Martin Huber is a physiotherapist and gained his Master of Science in Neuro-rehabilitation in 2007. As a therapist, he mainly treats patients with damage to the central nervous system. Since 2010 he has been working on a freelance basis in outpatient physiotherapy with neurological patients. Several years ago he reported on postural control and task-oriented therapy in well-known scientific journals, and he has been a speaker at various national physiotherapy conferences.

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SCIENCE

Large increase in multiple sclerosis

In 2015, 223,748 statutory health insurance patients were treated on an outpatient basis for multiple sclerosis (MS) nationwide. In 2009, there were only 172,497 patients. This corresponds to an increase of 29 per cent in six years. The scientists at the Versorgungsatlas [provision atlas] of the central institute for medical insurance, the Zentralinstitut für die Kassenärztliche Versorgung (Zi), come to this conclusion in a new study, evaluating accounting data relating to contract medicine. What is striking are the different regional distributions in disease frequency and new cases of disease. It shows that MS occurs more frequently in western Germany, and that more people fall ill with the disease each year there than in eastern Germany. An exception is Berlin, which is at the western level.

While statistically there are only 15 new cases of MS per 100,000 people with statutory medical insurance in eastern Germany each year, in western Germany there are on average 19 patients, which is about 25 per cent more. The numbers of patients treated for MS show a similar pattern. In the west, about 27 per cent more patients were treated for MS in 2015 than in the east. The reasons for this are not known. Women are about 2.5 times more likely to be affected by MS than men.

SOURCE

MTD Medizinisch-Technischer Dialog, Offizielles Organ ZMT/BVS, ISSN 0935-137X, Issue 06/2018, June, p. 19

THERAPY & PRACTICE

Rethinking rehabilitation

The 7th THERA-Trainer Symposium in September 2018 offered visitors an attractive programme, inviting them to reflect and rethink. Through its high-profile lectures, workshops and discussions, participants were updated on neurorehabilitation.

Melanie Grom

The framework conditions in neurological rehabilitation have been changing for years, and the industry is constantly on the move. While the number of patients requiring treatment is growing, the framework conditions in everyday clinical practice are becoming increasingly difficult: shortage of skilled labour, cost pressures and new scientific findings present major challenges.

Against this background, the symposium brought together therapists, experts and innovators in neurorehabilitation. Exciting new ideas and concepts from well-known speakers and innovators formed the basis for intensive dialogue and constructive exchange. The main topics of the event, under the scientific direction of the two physiotherapists and neurorehabilitation experts

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Sabine Lamprecht and Martin Huber, were the (new) requirements in neurorehabilitation, particularly in gait rehabilitation. The latest research results and guidelines need to be combined with proven therapeutic procedures and implemented in best practice therapies in day-to-day clinical practice.

Dr. Werner Nickels, Head of Neurology at the SRH Health Centre Dobel, and Helmut Krause, Managing Director of AMBUTHERA, addressed the conflict between the requirements and the reality of evidence-based neurorehabilitation, as well as the possibilities for establishing new clinical treatment pathways and ensuring their quality. According to Nickels, radical optimisations in terms of effectiveness, efficiency, transparency and cost-effectiveness are necessary to keep treatment costs within reasonable limits. Although – or perhaps because – many patients still insist on a hands-on therapy and consider it better, the chief physician developed a novel concept in his clinic: in a new type of group training, his patients receive individualised therapies, resulting in a much higher treatment density. The reorganisation has enabled patients to receive between 50 and 60% more therapy, which equates to around two additional hours per day; Phase C patients receive up to 80% more therapy. A group does not always have to be "equal to 10 people" – even two or three patients could be grouped together.

New clinical treatment pathways must not only be established, but their quality must also be ensured, says Krause. Due to the multi-professional nature of neurorehabilitation, changing established structural and conceptual notions of therapy is a challenge. Nickels and Krause, and later also Gunter Hölig, agree that successful practical implementation of new therapeutic methods is always dependent on the openness of the therapist to new concepts, but that the employees must also be brought on board as these are introduced. But the patient must similarly be "engaged", by boosting his self-confidence and his motivation via a process of education. To that end, it is necessary to formulate therapeutic goals to be as close to everyday life as possible and, above all, to give quantitative feedback.

In a research project, Zurich's RehaZentrum Wald is investigating the effectiveness of gait trainer therapy in stroke rehabilitation compared to conventional physiotherapy under conditions as close as possible to everyday life. A conventional treatment comprising five individual therapies per week is compared with the combination of three individual therapies plus two sessions with the THERA-Trainer lyra gait trainer per week. As yet, no clear trends are detectable.

Gunter Hölig, head of therapy at the Medical Park Bad Rodach, started by addressing movement, as the overarching theme of the event: Only after a short, active loosening-up programme did he begin his lecture about requirements and strategies for efficient in-patient treatment of stroke patients. In his opinion, it is indisputable that a physiotherapy treatment in combination with robotics is better than physiotherapy alone.

In addition, he says, it is quite possible for a therapist to take care of four patients during a therapy session, with the help of device training. However, the concrete implementation and scheduling of these methods in the treatment path is also frequently unclear, in his view.

The more you know about the brain, the more you realize how much you don't know.

Medica Product Manager Jakob Tiebel took as his subject the wide gap between practice and research: He stated that there is a great deal of research and it has now been proven that active-practise procedures are superior to traditional treatments, above all due to the higher intensity of exercise. However, only 2% of the relevant studies deal with the implications for the daily routine of treatment. Environments needed to be created that make it possible to satisfy demands from studies or the ReMoS Guideline. There was intensive discussion amongst participants of the question: What does evidence mean, and how is science translated into practice? The type and scope of studies, together with the inclusion criteria used to select patients, were also critically considered. Ultimately, in the practice, patients could not be excluded from therapy, even by applying certain criteria. "We have to treat all patients, whether they meet any criteria or not," said one of the therapists at the event. She is convinced that this situation creates a "natural defensive attitude" towards new concepts and studies, if a large number of patients at the practice cannot be included in a new therapy.

Health economist Ann-Kathrin Miller also provoked discussions with her lecture. When is it sensible to use the THERA-Trainer Complete Solution or another form of therapy? And how can this be defined? A clear distinction is difficult, because a therapy or its results always comprise several aspects. For example, it is not just walking ability that can be improved using a gait trainer. Other positive effects are also possible: improved quality of life, making it possible to (re-)experience walking itself, or training movement and motor skills. Miller also demonstrated that device-based circuit training can ensure better compliance with ReMoS guidelines and improve the outcome and quality of individual therapy.

Anne Boese, head of occupational therapy at Aatalklinik Wünnenberg, has similarly been very successful in implementing study results in practice. Similarly operating against the background where therapy for acquired brain damage is often not feasible with the scientifically recommended intensities in day-to-day working life, together with colleagues and the medical director, Dr. Buschfort, she developed a gait lab that consists of various therapy devices. Through accurate evaluation of patients and taking into account their (own!) therapy goal, an algorithm specifies the training in the gait lab and creates an individual training plan for each patient. As a result, the intensity of therapy can be increased by up to 250%, saving on resources.

Martin Huber looked at models for practical and effective motor learning. He is convinced that "active is better than passive" and "success is the basis for even more success." He draws on studies that prove the importance of taking responsibility, autonomy, motivation and variety for motor learning and therapeutic success. For him, learning means achieving lasting change. The THERA-Trainer Complete Solution, for instance, offers excellent scope for training motor learning and self-efficacy.

Sabine Lamprecht, who owns her own neurological practice, concluded the lecture series. In closing, she forged the link to outpatient treatment. Her assessment was a sobering one: "Really good neurological practices are very rare. Most do things too late, too little and wrong." A high-dose combination of conventional and technology-assisted therapies is more effective than standard care, she believes. This is because treatment results show that even years after the brain has been damaged, significant improvements can be achieved if the type and dose of therapy are right. However, she adds, many outpatient neurological practices are not well-equipped and barely work with devices, but almost only manually. Some patients in neurorehabilitation are given Parkinson's-specific training, for example, and then find themselves in the outpatient clinic, on the massage bench. She sees one of the main reasons for this situation in the training of young physiotherapists, which is carried out using outdated standards and not state-of-the-art. Many newly-trained physiotherapists would therefore not know the current guidelines at all.

While the first day of the event provided a lot of input and discussion, on the second day participants had the opportunity to contribute their own opinions and experiences and play an active part in proceedings. In a workshop led by medica managing director Otto Höbel and product manager Ann-Kathrin Miller, there was the opportunity to engage with the product development process and to introduce needs from the customer's point of view. Additionally, participants had the option to discuss change management and process changes in connection with device-based circuit training, or to test out various training devices.

In addition to networking and professional exchanges, the culinary arts were not neglected. After the programme had ended, the latest topics were discussed in a relaxed atmosphere during the evening program, with new contacts being made.

Part 3
Ataxia and somatosensitivity disorders in MS and neurorehabilitation of severely-affected MS patients

THERAPY & PRACTICE

Motor therapy for multiple sclerosis

Paresis, fatigue, Uhthoff's phenomenon and spasticity in multiple sclerosis (MS) – the two preceding parts of the expert report by physiotherapist and neurorehabilitation expert Sabine Lamprecht covered these themes. The focus of the concluding part will be ataxia and somatosensitivity disorders, together with neurorehabilitation of severely-affected MS patients.

Sabine Lamprecht

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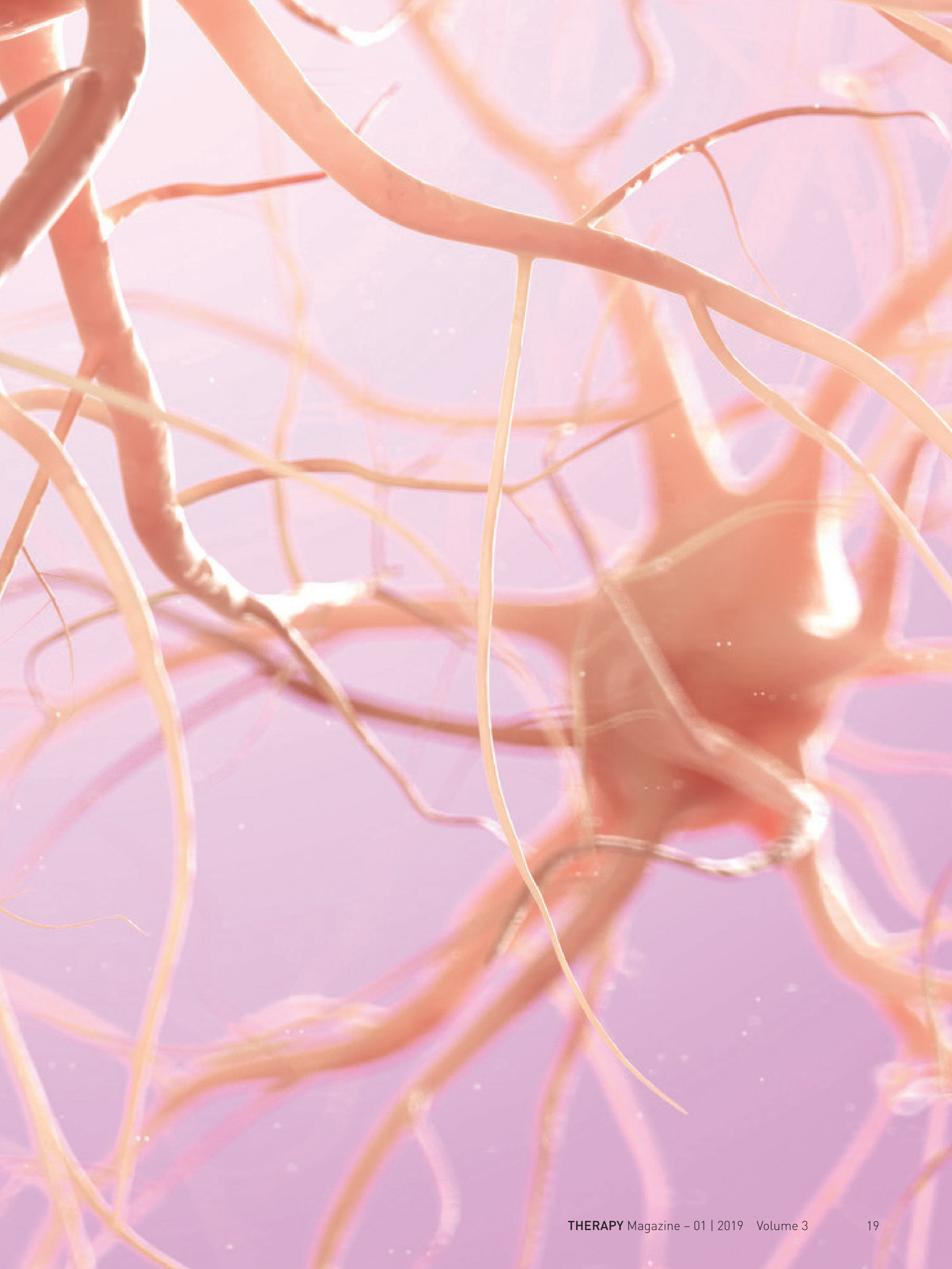
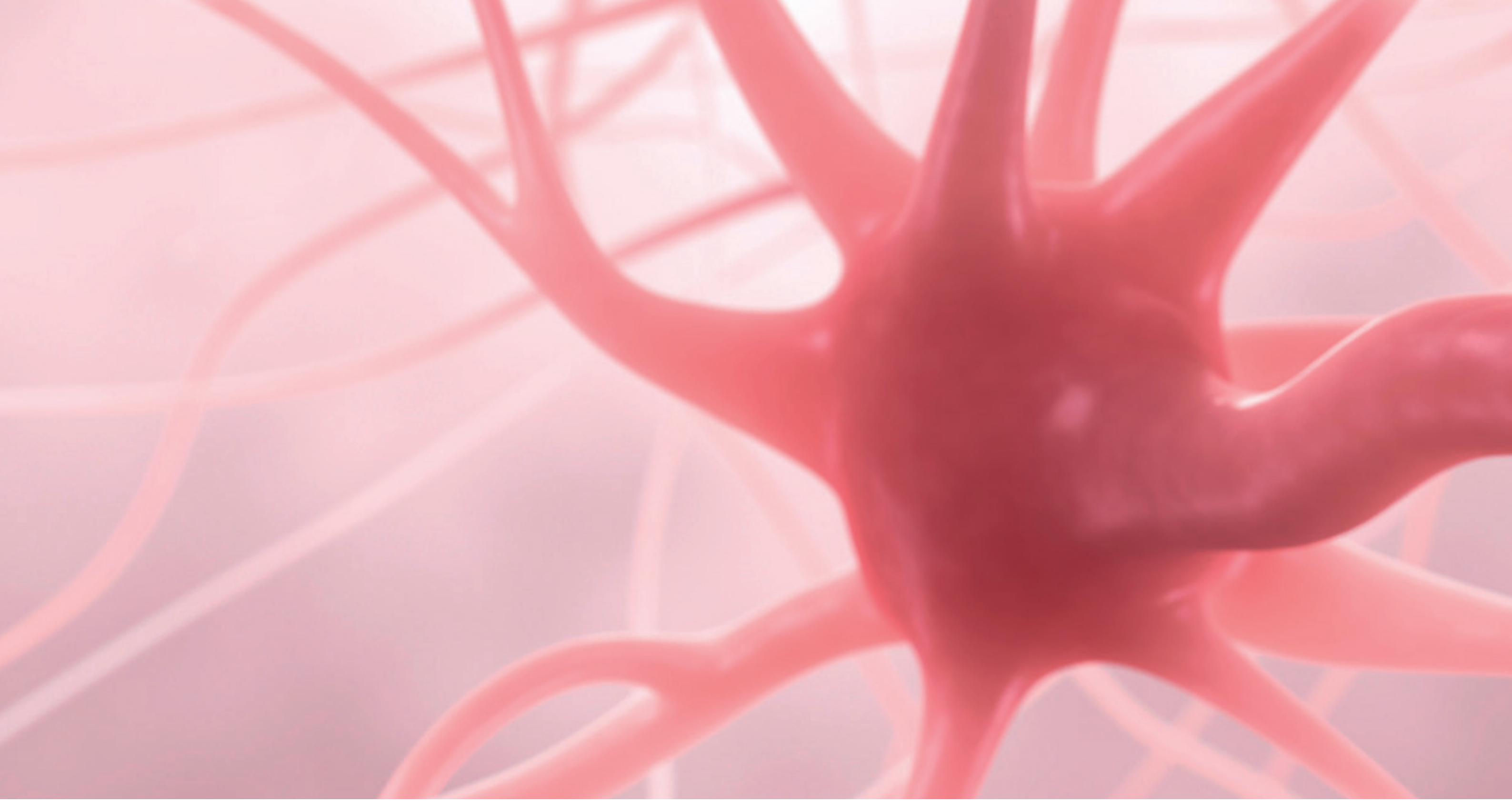




Review

MS sufferers are functionally most affected by paresis. In combination with motor fatigue and Uhthoff's phenomenon, paresis and weakness are the reason why exertion is often avoided in MS therapy, despite the fact that this avoidance means a continuous decline in functions for those affected with MS [3]. Contrary to what is commonly believed, exertion does not trigger relapses. The temporary worsening of symptoms is not permanent damage. It is a sign of the MS-specific pathophysiology and not a reason to cut down on regular training.

MS patients should engage in targeted and long-term training with an effective training stimulus and a suitably high number of repetitions in order to strengthen the affected muscles. Training weak muscles should also be at the forefront of spasticity therapy, because it can improve function while reducing spasticity. Increased activity can actually achieve a sustained reduction in spasticity.

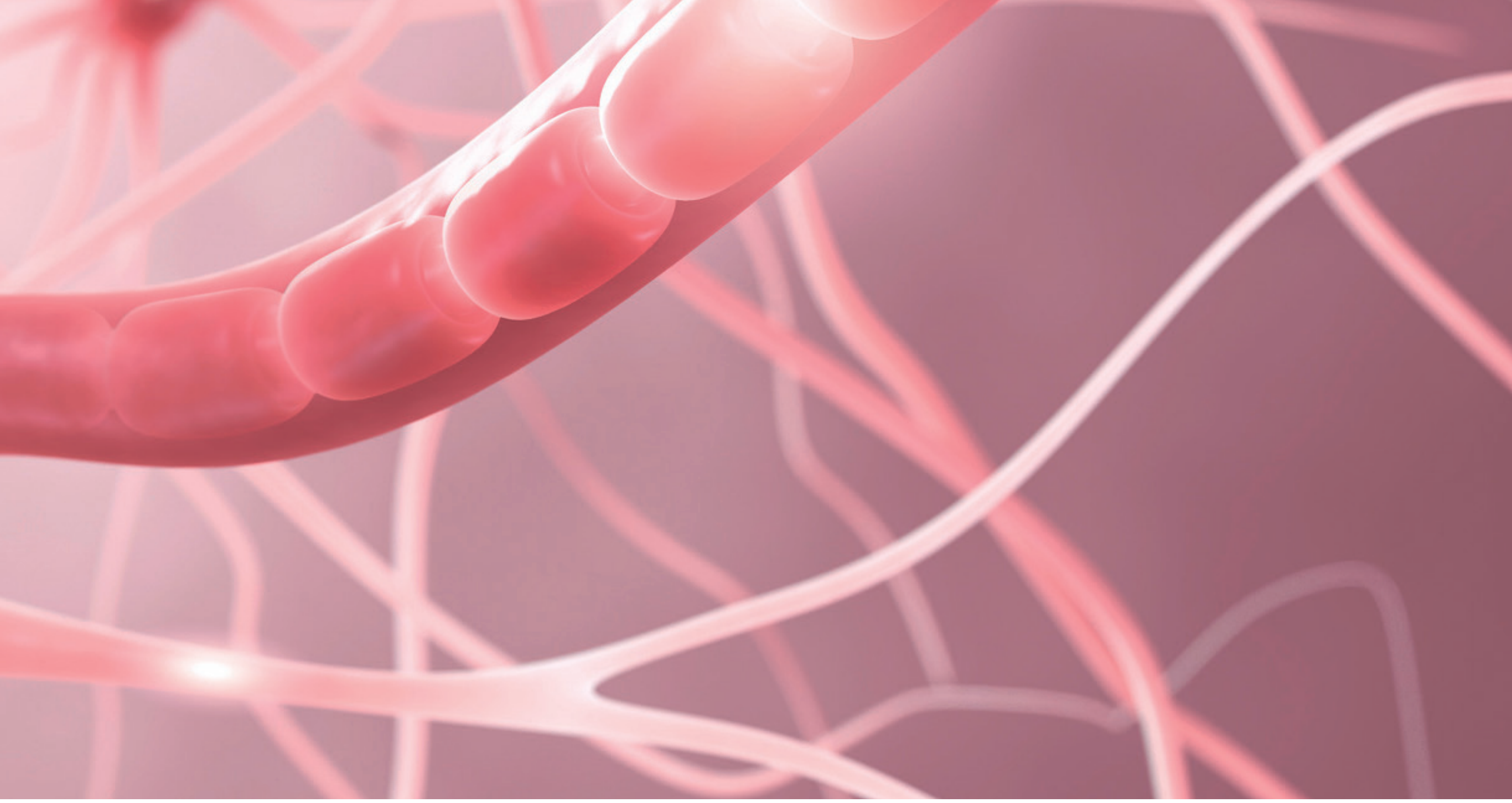
The most important qualities, particularly for walking, are stamina and speed. While stamina is improved through targeted interval training, speed can be trained up to the limit of capability in a fall-safe environment, including with the aid of a gait trainer such as the THERA-Trainer e-go. Effective gait rehabilitation also includes targeted training of the affected muscles and targeted balance training. Stamina and strength training improve functional abilities without increasing spasticity; on the contrary, they generally reduce spasticity. [1]

Tests and therapeutic approaches to ataxia

Ataxia is commonly used as an umbrella term for damage to the cerebellum and/or cerebellar pathways. Atactic movement disorders occur in over 80% of MS patients and are therefore a widespread phenomenon. [4]

They require a targeted approach. Fundamentally, the usual ataxia tests should be performed. These include the following:

- Finger-nose test
- Finger-finger test
- Heel-knee test (or extended heel-knee test incl. shin edge)
- Dysdiadochokinesia test



- Rebound test
- Romberg's test
- Unterberger's stepping test
- Tightrope walker's gait

If a patient has very slight balance problems, he or she can be tested for single-leg stance. MS patients, in particular, often show problems of afferent information due to spinal or sensory ataxia, which worsens without visual checking and is caused by spinal plaques in the afferent cerebellar pathways. For therapists, therefore, it is important to distinguish whether the difficulties occur with open or closed eyes. The background to this distinction is that if there are increased difficulties without visual checking, the afferent pathways to the cerebellum (= posterior column pathways or spinocerebellar pathways) are affected. Only these can be compensated via the visual acuity. If the afferents are to be trained, no compensation from visual acuity should be permitted.

For example, if a patient can stand well with eyes open in the Romberg's test, but wobbles markedly when eyes are closed, the patient needs to practise balance including without visual and tactile checking. The usual balance training should therefore be carried out either with eyes closed or at least with change of gaze. As far as possible, the patient should not hold onto the Thera bands or ropes, or should use them only as an aid.

Afferent information can also be improved by increased perceptual and sensory input, e.g. by having pimples and other strong sensory stimuli on the sole of the foot and for proprioception.

The same procedure applies for the upper extremity: if, for example, the finger-nose test with visual acuity check can be performed much better than without, it must be practised without a visual acuity check.

Ataxia therapy

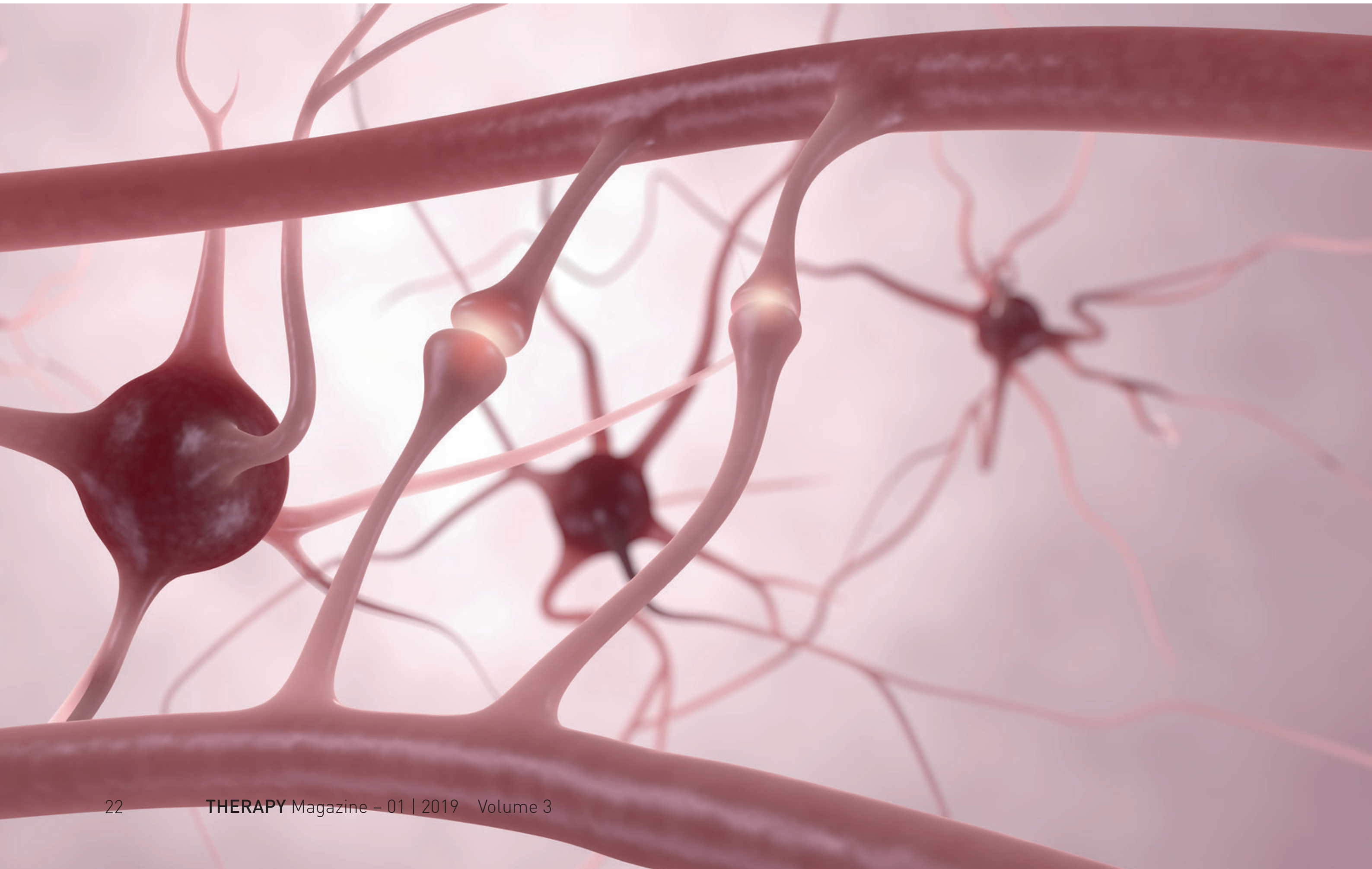
Therapeutic approaches to ataxia are characterised by the pathophysiology of ataxia. If the afferent pathways are affected, this results in difficulty with depth sensitivity or proprioception for the patient. This should be repetitively trained as described above without visual checking with a lot of peripheral input.

Overall, the same principles apply to balance training in ataxia patients as in the usual balance training: from easy to difficult, from large to small support surface, from hard to soft. Balance must always be practised while standing or walking, and always at the limit of performance. The patient must be brought out of balance or fight to maintain balance. If possible, dual-task exercises should also be included - meaning that the patient should not concentrate on balance, but as far as possible should perform two or more things at the same time. For example, standing on one leg and talking, performing a calculation or searching for something. In most cases, balance training is practical in MS patients excluding visual acuity or with change of gaze, whereby the patient should not be holding onto anything. This can be specifically trained in the THERA-Trainer balo balance trainer. Here, the patient is in a safe environment. The less the patient leans on the device, the greater the challenge.

The problem of dysdiadochokinesis shows the coordination difficulties in atactic movement disorders. Reciprocal movements, in particular, need to be trained specifically. In terms of coordination, fast movements are easier than slow ones. Ataxia patients should therefore be trained from fast to slower, preferably reciprocal, movements. This is easier for ataxia patients if they are able to perform a guided movement. For that reason, upper and lower extremity exercise trainers are ideal, as are Cross Walkers or other closed systems.

Cerebellar damage is always associated with a general reduction in strength and tone. For that reason, dynamic strength and endurance training is practical. Resistances make it easier for the patient to perform the movements. Therefore, it is easier for them to train with a little more weight or resistance. As training increases, weight and resistance are reduced. Weights can also be used as an aid. This refers to weight vests and weights on the upper and lower extremities, for example.

Movement transitions from low to higher positions should also be practised. Crawling can be a purposeful self-training for many ataxia patients, as they are not afraid of falling and at the same time exercise the muscles of the whole body in a reciprocal manner. This is also possible with an exercise trainer such as the THERA-Trainer tigo, using rhythmic pedalling with agonistic/antagonistic change of leg or arm activity. Even with strong ataxia, this allows for effective training.



As mentioned earlier, ataxia patients also train more easily here at high speed and against resistance. To increase the training, resistance and speed can be purposefully reduced. These two parameters can be accurately dosed on the THERA-Trainer tigo, while normal ergometers are set differently due to their watt-controlled training. Here, more resistance is given at slower revolutions, but MS patients need less resistance at slower speeds – regardless of whether they become more tired through paresis and motor fatigue or are specifically training coordination in the case of ataxia.

For ataxia patients, too, it can be useful to specify the revolution speed, so that the patient cannot exercise at above the pre-set speed. This can also be set with the THERA-Trainer tigo, using the corresponding program.

Even severely-affected ataxia patients can move in a balance trainer such as the THERA-Trainer balo. Here too, training with more resistance is easier and safer than training with reduced resistance.

Somatosensory disorders

Somatosensory disorders are a common symptom in MS patients. Depth sensitivity has already been treated in the ataxia section. But surface sensitisation disorders similarly occur in about 80% of MS patients. The treatment approach is to desensitise, because strong sensory stimuli can influence feelings of furriness. However, it must be ensured that this can also be carried out by the patient in self-training. Stretching exercises, too, can often have a positive influence on somatosensory disorders.

Lhermitte's sign

With rapid flexion of the head, a sudden pain may be experienced, which radiates along the spinal column to the arms and/or legs, known as Lhermitte's sign. The cause of Lhermitte's sign is suspected to be dura immobility due to plaques. Whole-body extensions in the sense of neurotension, giving special consideration to the flexion of the cervical spine, can therefore be used in therapy. Similarly, this is the case with many yoga exercises.

Neurorehabilitation for patients with severe MS

In severely-affected MS patients with an Expanded Disability Status Scale (EDSS) of 7 or above (patient can still walk five metres), the focus is similarly on activity [3]. If walking is still possible, walking should be further trained – every step counts. Here, gait quality is subordinate. What is crucial is that the patient walks several times a day. The number of steps per day should be determined with a pedometer, for example, and increased steadily. Appropriate provision of aids or provision with sufficient walking aids is enormously important. If patients can no longer stand upright for any time, a standing trainer for the home is absolutely necessary.

Dynamic standing trainer THERA-Trainer balo

The THERA-Trainer balo is not only suitable for standing, but is also ideal as a training device for dynamic balance training. Since the right intensity is crucial and the patient should be exercising daily for at least one hour in the vertical, the patient should have a standing device at home.

The benefits of standing include:

- Cardiovascular prophylaxis
- Contracture prophylaxis
- Thrombosis prophylaxis
- Pneumonia prophylaxis
- Activation of the pelvic floor
- Improved alertness and cognition

The standing trainer can be used not only for standing, but also for stretching, strengthening, to improve balance and in therapy as a targeted therapy device.

Self-training using a movement trainer (e.g. THERA-Trainer tigo) is a practical addition. It should be ensured that, even with strong spasticity, a certain resistance is set, so that not only a reduction in spasticity, but also increased activation of the muscles is achieved at the same time. If the patient is unable to actively pedal, he or she should think about pedalling, as mental training.

It is also advisable to always include the upper extremity in the exercise training, as patients who rely on walking aids or the wheelchair need strong arms and a correspondingly strong shoulder girdle for coping with daily activities.

Any physical activity is recommended for severely affected patients. Care should be taken to ensure that the training is fun for the patient. Self-training using the THERA-Trainer balo software is a practical option for activity; particularly if the therapist chooses suitable biofeedback exercises. But any form of cycling in or outside the house, e.g. with a tricycle, a hand-bike or a wheelchair front attachment are pleasant leisure activity options. Moving in a wheelchair outdoors, even with residual power boosting (e-motion), or in an electric wheelchair, brings many benefits.

Overall summary

Multiple sclerosis should not be equated with other neurological conditions. The disease must be diagnosed and treated individually and symptomatically. Motor symptoms of MS can be very well targeted for therapy and improved with specific training, which should be based on the latest findings in neurorehabilitation. New findings regarding the illness make physiotherapy procedures and occupational therapy procedures even more important than in the past.

Especially in the rehabilitation of MS patients, the following holds good: Exercise and activity are effective, passive therapies, protection from and fear of over-exertion are completely outdated and can lead to deconditioning and further deterioration.

However, it is important to train in a targeted way and to structure the training in a practical manner. We therapists should create a personalised training program for patients, based on a targeted finding that includes strength testing and targeted balance tests, so that patients benefit from their training. MS patients require strength and strength-endurance training of the affected muscles.

The basis of the therapy must be strength, endurance, gait and specific balance training. In walking patients, improving the gait is often the main focus. Here, endurance training should be used specifically to increase the walking distance and/or speed training used to increase speed. Even for severely affected patients, every step counts. The focus should be on the number of steps, and not on the manner of walking.

Likewise, balance must be specifically tested and practised accordingly. Here, differentiation between balance training with opened or closed eyes is required, to specifically improve the afferent pathways and proprioception.

Daily standing is fundamentally important for severely-affected patients who sit in a wheelchair. Patients who can no longer stand independently must be verticalised. When standing, many activities can then be specifically trained again. Especially for patients who have been severely affected, activities outside the home are enormously important, in addition to standing. Ideal activities are cycling using adapted bicycles, or simply active use of the wheelchair in the fresh air. The fact that social contact can be encouraged and depression reduced when doing so can be an important side-effect. In addition, if properly adjusted, exercise trainers can not only loosen up and avoid contractures, but can also very specifically build up strength and effectively reduce spasticity as a result.

In addition, the patient should perform additional "sports" depending on the symptoms and severity of the condition. These should be fun and have a specific effect on the motor deficits. Possibilities include Nordic Walking, Tai Chi, archery, wheelchair dancing, climbing or diving.

The Medical Training Therapy offers a wide range of training that people with MS can effectively use. Hippotherapy is a recommended additional therapy option. [2]

Neurorehabilitation for multiple sclerosis means:

- interdisciplinary thinking and acting
- intensive specific training
- individual therapeutic procedures geared to everyday and symptom-oriented actions
- therapy goals must be at the level of activity and participation

Targeted activities – targeted training – no fear of over-exertion, and most important of all: training that's fun. Depending on the symptoms, an individual concept geared to the long term should be developed together with those affected and their relatives, because therapy, sports, and self-help are the pillars of therapy for patients with MS.

Missed the first two parts of our expert report and want to catch up?

Contact us! We'll be happy to send you the two issues of THERAPY by email.

Sabine Lamprecht passed her physiotherapy exam in Berlin in 1982. Since then, she has completed various further training programmes. In 2006 she gained her Master of Science in Neurorehabilitation at Danube University Krems, Austria. From 1983 she worked as lead physiotherapist at Neurologische Klinik Christophsbad where she helped to set up the Physiotherapy Department. In 1987 she opened her own practice with her husband. She was a lecturer at the University of Applied Sciences in Heidelberg and is now a lecturer at Dresden International University in Fellbach.

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SCIENCE

Effects of a device-based over-ground gait training

Regaining ability to walk again is one of the most important goals in the field of neurological rehabilitation. In this paper, we describe the use of the motorized assistive gait trainer device THERA-Trainer e-go and the corresponding effects of an over-ground gait training in neurological patients. Results suggest that the proposed training paradigm may successfully ascertain training conditions that correspond well to patient capabilities and therefore may potentially be useful in improving over-ground walking during gait rehabilitation of neurological individuals.

Jakob Tiebel

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Background

Regaining ability to walk again is one of the most important goals in the field of neurological rehabilitation.

In ambulatory patients with neurological disease often an impaired coordination of walking and a significant reduced walking speed and endurance can be observed [2]. Only about 7% of individuals discharged from inpatient rehabilitation are able to achieve average walking speed and distance, required for unrestricted mobility in the community [7].

In clinical practice training of walking on a task specific and repetitive basis, seems to be most effective to improve patient's gait performance [2, 3].

However, next to specific interventions, like speed-dependent treadmill training, walking should be trained under conditions of everyday life [4, 5, 7].

In order to practice an intensive training of over-ground walking under fall-safe conditions, a mobile over-ground gait trainer system that supports a patient much as needed can be a helpful and decisive advantage [1, 8].

Objective

Main objective of this case series study was to report feasibility and observed effects of a device-based over-ground walking training with the gait trainer device THERA-Trainer e-go.

Patients

The study was conducted at the Stroke Rehabilitation Hospital RehaNova in Cologne, Germany. Three patients with neurological disease were recruited by physiotherapists according to inclusion criteria between March 2014 and April 2014. Generally, we included inpatient adults with an upper motor-neuron syndrome (UMNS), maximal 12 weeks post-injury and a mobility impairment determined by using the Functional Ambulation Categories (FAC). At study onset patients at least had to be able to walk minimum 10 meters with assistance of one helping person, which corresponds to an FAC score >/= 2.

In the following we report on the patients with average post-injury time of 8 weeks. All three patients met inclusion criteria and agreed to participate before intervention started.

Subject 1: a 66-year-old man with post-stroke right hemiparesis, 5 weeks post-injury and FAC 2. Subject 2: a 70-year-old man with Guillain-Barre syndrome, 12 weeks after hospital admission and FAC 3.

Subject 3: a 57-year-old woman with post-stroke left hemiparesis, 8 weeks post-injury and FAC 2.

Intervention

Patients trained walking for three weeks with the THERA-Trainer e-go device, 3 - 5 times per week in addition to conventional physiotherapy.

Standard physiotherapy training was 45 min/day, followed by the training with the gait trainer device for a duration according to each patient's endurance. The routine motor rehabilitation used a task-oriented and goal-oriented approach that included gait-preparatory interventions and balance exercises while sitting and standing. The treatment was modified according to the patient's needs and the rehabilitation teams' goals. Walking aids and orthoses have been prescribed according to individual needs of the patients.

Description of the device

The THERA-Trainer e-go is a motorized assistive gait trainer device developed by medica Medizintechnik GmbH (www.thera-trainer.com).

Two independent motorized wheels, one on each side of the base platform of the device, provide necessary actuations to exercise the essential movement manoeuvres (moving forward, accelerating/decelerating and turning left/right) with adjustable linear and angular velocity. On the same base platform helical springs, one on each side, are housed in steel cylinders. Between the helical spring and the walls of the steel cylinder, there is a resistance adjustment ring with a handle. By displacing the adjustment ring upwards, the bending length of the spring becomes shorter, thus making the spring stiffer. Conversely, by lowering the adjustment ring the bending length of the spring is longer, thus making the spring more compliant. Each spring connects to a vertical rod that is coupled with supporting horizontal bars and the table top to constitute a supporting frame. During

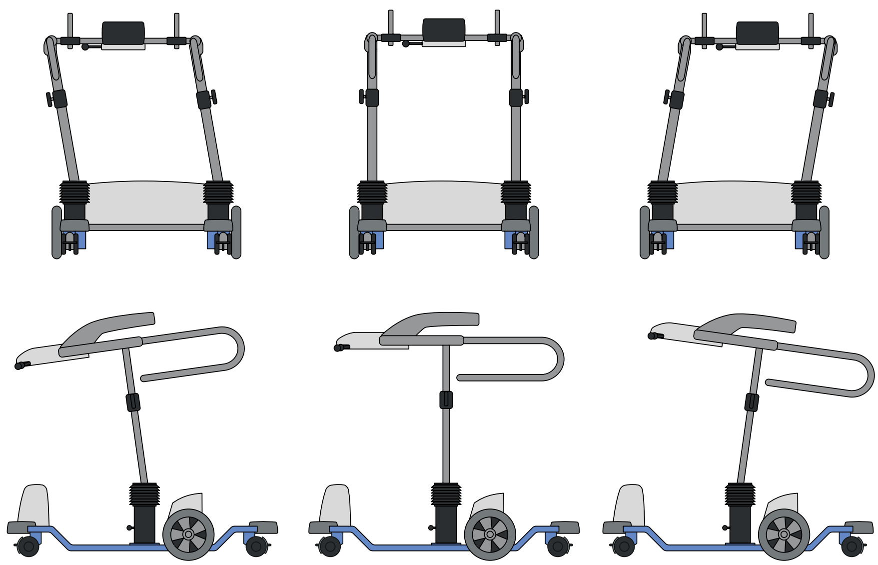


Fig 2. Schematic representation of Gait Balance Trainer. The helical springs allow the standing frame to comply in sagittal and frontal plane while interacting with the subject during training which assures natural pelvis movement [6].

training the individual is embraced around pelvis with harness and attached to the supporting frame on each side in a way that minimizes relative movement between the supporting frame and the individual, but at the same time to allow natural pelvis movement.

Therefore, if the individual leans forward or backward and/or sideways, the supporting frame follows the movement, which provokes the helical spring to bend, thus providing horizontal support. The level of supporting force is selected such that it provides minimal needed assistance.

The speed and direction of the e-go is therapist controlled with a manual control module. The device measures time and walking distance of each training session. Maximal walking speed is 3 km/h. The device does not offer body weight support; however, leather harness suspended from horizontal rods can easily accept whole weight of an individual in case of sudden vertical drop due to insufficient strength of leg muscles, to ensure fall-safe training conditions.

Measurements

The following tests were performed: walking capacity (measured with 2-Minute-Walk-Test, 2-MWT), walking speed (measured with 10-Meter-Walk-Test, 10-MWT) and Functional Ambulation Category (FAC), to evaluate ambulation ability. The severity of activity limitation in ADL was evaluated using the Functional Independence Measure.

Measurements were taken through within-session and across-session changes at baseline and after the intervention period of 3 weeks with a pre-test (before training session), post-test (after training session) and retention-test (24h after training session). In addition, we also measured the walking distance (average walking distance of

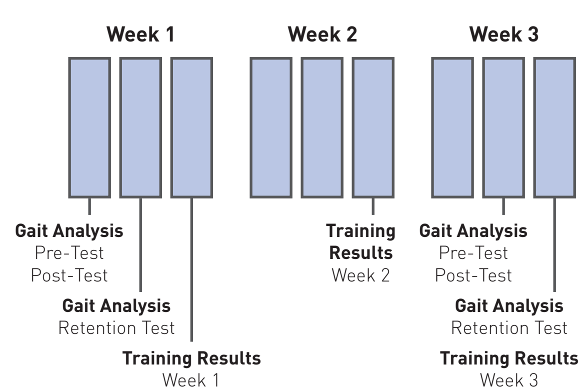


Fig 3. Measurement time points

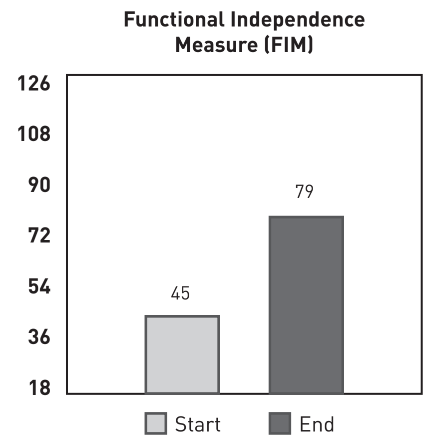


Fig 4. Subject 1's FIM score at baseline and after three weeks.

the training sessions) and the walking speed (average walking speed of the training sessions).

Results

No adverse events occurred during training. Physiotherapists did not report any significant problems with the training device handling, and there was no additional staff required to set up the participant in the device.

As expected, all patients improved from baseline to end of study measurement in walking speed, walking distance, FAC and FIM score.

Subject 1: After three weeks of training, the patient's walking ability changed from FAC 2 to 4. While at study onset the patient was able to walk with help of one therapist, after three weeks of train-

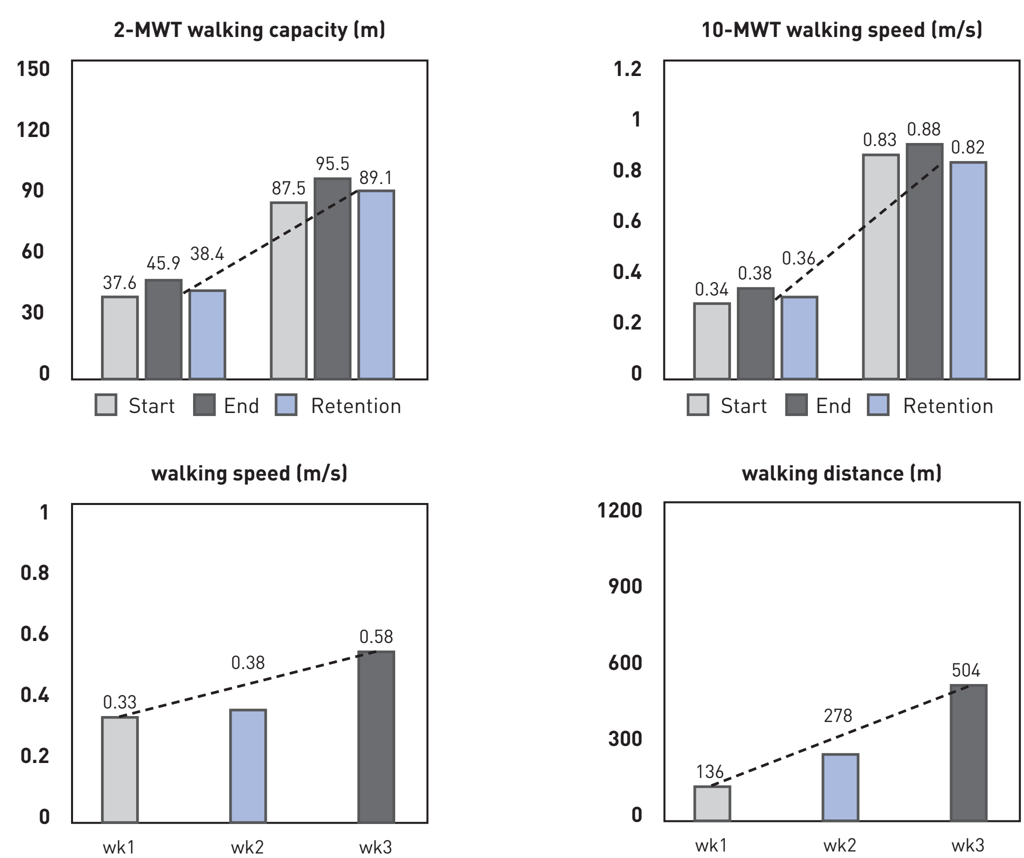


Fig 5. Subject 1's improvements in 10-MWT, 2-MWT and walking speed, walking distance during training three weeks.

ing the patient was able to walk independently with a crane inside the hospital. At study end, there was a significant improvement of 31.4% (FIM: 45 to 79) in ADL independency.

Walking speed, increased about 0.46 m/s (wk3: 0.82 m/s - wk1: 0.36 m/s) in 10-MWT and walking capacity increased about 50.7 m (wk3: 89.1 m - wk1: 38.4 m) measured with 2-MWT. Comparison based on the first with last week's retention test results.

The evaluation of the averaged training results shows a continuous extension of walking distance and walking speed over the course of three weeks training. From first to second week walking speed increased about 0.05 m/s (wk2: 0.38 m/s - wk1: 0.33 m/s) and from second to third week about 0.2 m/s (wk3: 0.58 m/s - wk2: 0.38 m/s).

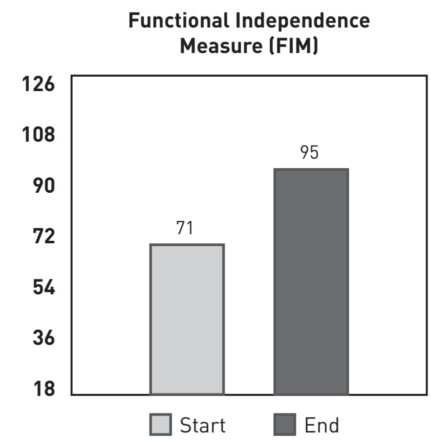


Fig 6. Subject 2's FIM score at baseline and after three weeks.

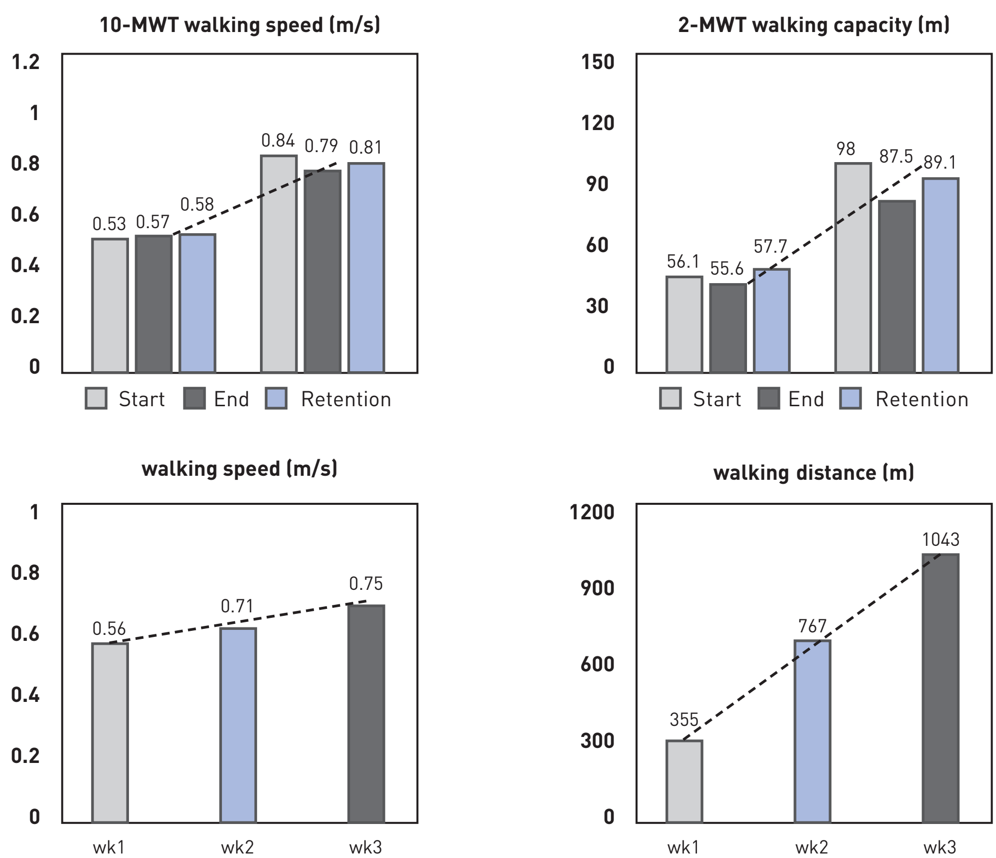


Fig 7. Subjects 2's improvements in 10-MWT, 2-MWT and walking speed, walking distance during training

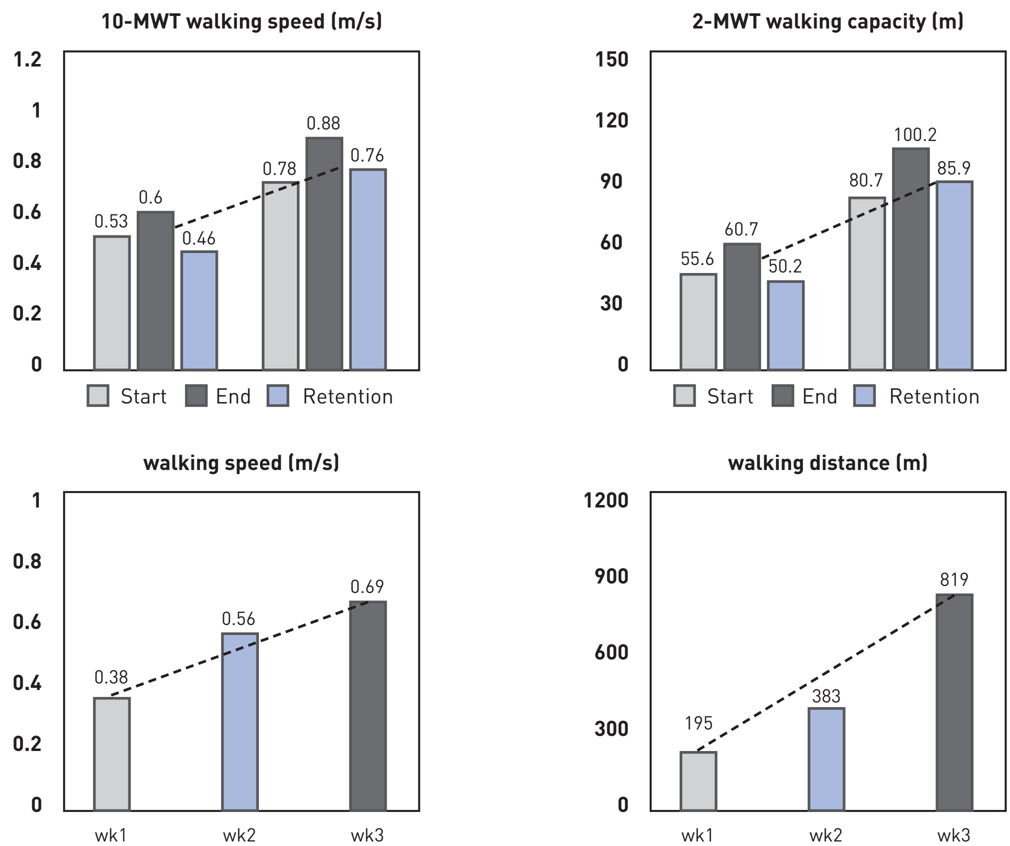


Fig 8. Subject 3's improvements in 10-MWT, 2-MWT and walking speed, walking distance during training

Walking distance increased from first to second week about 142 m (wk2: 278 m - wk1: 136 m) and from second to third week about 226 m (wk3: 504 m - wk2: 278 m). The overall changes comparing the results from first and third week, were 0.25 m/s (wk3: 0.58 m/s - wk1: 0.33 m/s) walking speed and 368 m (wk3: 504 m - wk1: 136 m) walking distance.

Subject 2: After three weeks of training, the patient's walking ability changed from FAC 3 to 4. While at study onset the patient was able to walk supervised by a therapist, after three weeks of training the patient was able to walk independently with a cane inside the hospital. At study end, there was a significant improvement of 22.2% (FIM: 71 to 95) in ADL independency.

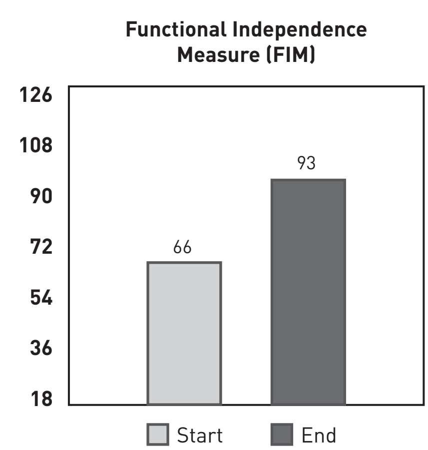


Fig 9. Subject 3's FIM score at baseline and after three weeks.

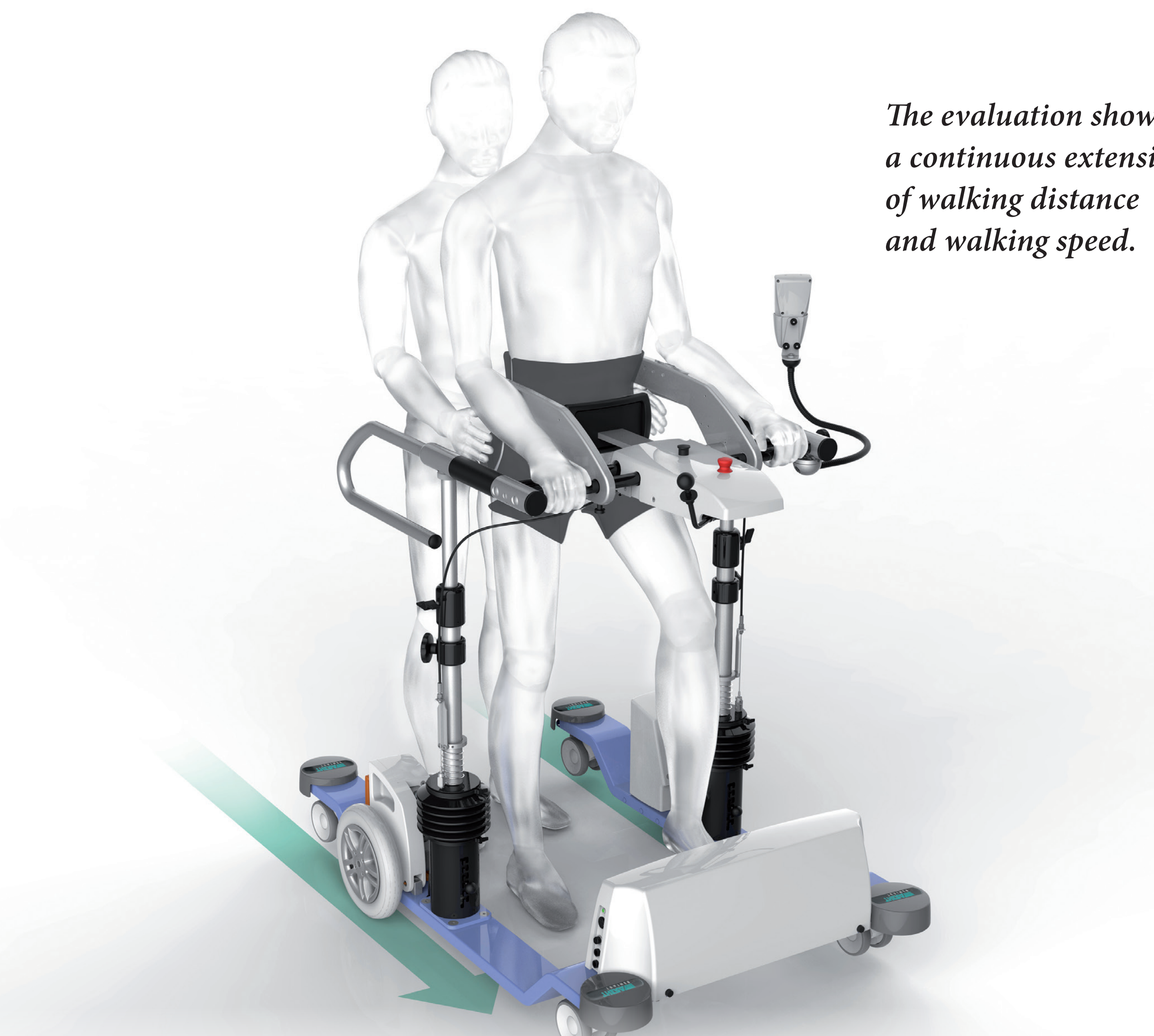
Walking speed, increased about 0.23 m/s (wk3: 0.81 m/s - wk1: 0.58 m/s) in 10-MWT and walking capacity increased about 31.4 m (wk3: 89.1 m - wk1: 57.7 m), measured with 2-MWT. Results based on comparison of the first with last week's retention test results.

The evaluation of the averaged training results shows a continuous extension of walking distance and walking speed over the course of three weeks training. From first to second week walking speed increased about 0.15 m/s (wk2: 0.71 m/s - wk1: 0.56 m/s) and from second to third week about 0.04 m/s (wk3: 0.75 m/s – wk2: 0.71 m/s).

Walking distance increased from first to second week about 412 m (wk2: 767 m – wk1: 355 m) and from second to third week about 276 m (wk3: 1043 m - wk2: 767 m).

The overall changes comparing the results from first and third week, were 0.19 m/s (wk3: 0.75 m/s - wk1: 0.56 m/s) walking speed and 688 m (wk3: 1043 m - wk1: 355 m) walking distance.

Subject 3: After 3 weeks of training, the patient's walking ability changed from FAC 2 to 4. While at study onset the patient was able to walk with help of one therapist, after three weeks of



The evaluation shows a continuous extension of walking distance and walking speed.

training the patient was able to walk independently on even surfaces with a walker inside the hospital.

Walking speed, increased about 0.30 m/s (wk3: 0.76 m/s - wk1: 0.46 m/s) in 10-MWT and walking capacity increased about 35.7 m (wk3: 85.9 m - wk1: 50.2 m), measured with 2-MWT. Results based on comparison of the first with last week's retention test results.

The evaluation of the averaged training results shows a continuous extension of walking distance and walking speed over the course of three weeks training. From first to second week walking speed increased about 0.18 m/s (wk2: 0.56 m/s - wk1: 0.38 m/s) and from second to third week about 0.13 m/s (wk3: 0.69 m/s - wk2: 0.56 m/s).

Walking distance increased from first to second week about 188 m (wk2: 383 m - wk1: 195 m) and from second to third week about 436 m (wk3: 819 m - wk2: 383 m).

The overall changes comparing the results from first and third week, were 0.31 m/s (wk3: 0.69 m/s - wk1: 0.38 m/s) walking speed and 624 m (wk3: 819 m - wk1: 195 m) walking distance.

Discussion

In this series case study, we described the use of the motorized assistive gait trainer device THERA-Trainer e-go and the corresponding effects of an over-ground walking training in neurological in-patients.

Results suggest that the proposed training paradigm may successfully ascertain training conditions that correspond well to patient capabilities and therefore may potentially be useful in improving over-ground walking during gait rehabilitation of neurological individuals.

We demonstrate the feasibility and advantage of using the within- and across-session changes for evaluating the improvements during clinical gait rehabilitation with the gait trainer device.

In conclusion, the THERA-Trainer e-go appears to be a comfortable and easy to use gait trainer device, that confers a sense of freedom and safety to subjects during over-ground gait training. That helps to increase the intensity of training. During over ground gait training the device can safely deliver assistance to patients with risk of falling and helps to improve ability to walk independently. That also seems to have an impact on patients' independence in activities of daily living.

Acknowledgements

We thank all patients and their caregivers who participated in this study. We gratefully acknowledge the support of the clinical staff at the RehaNova and all those involved in this project.

Consent for publication

Subjects of the study gave consent to use and publish data in such way that anonymity will be assured.

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SCIENCE

Skin test enables early Parkinson's diagnosis

In the past, the detection of alpha-synuclein was only possible in the brain – after the death of the patient. Now a practical skin test for early diagnosis of Parkinson's is being used. / dpa

"This brings with it the prospect of opening up the long-awaited pre-symptomatic Parkinson's therapy"

The Würzburg researcher team under Kathrin Doppler showed as early as 2014 that alpha-synuclein is not only deposited in the brain of Parkinson's patients, but also in the skin. They found pathological protein aggregates in the small nerve fibres of the skin in around half the patients with Parkinson's disease they examined. However, early diagnosis remained difficult due to non-specific symptoms. In its latest study, the team has succeeded in detecting alpha-synuclein in the prodromal phase. The protein is therefore suitable as a biomarker for diagnosing Parkinson's in the early stage, in which the typical impairments to movement do not generally appear.

Neuroscientists led by Kathrin Doppler and Claudia Sommer from Würzburg and Wolfgang Oertel from Marburg examined 18 patients with REM sleep behaviour disorder (RBD), 25 patients with early Parkinson's disease and 20 healthy control subjects. Sleep disorder is considered a characteristic early symptom of Parkinson's disease. It expresses itself in aggressive dreams and conspicuous movements in dream sleep. Around 85 per cent of those affected develop Parkinson's disease within

15 to 20 years. Deposits of alpha-synuclein are also found in the brain in cases of REM sleep behaviour disorder.

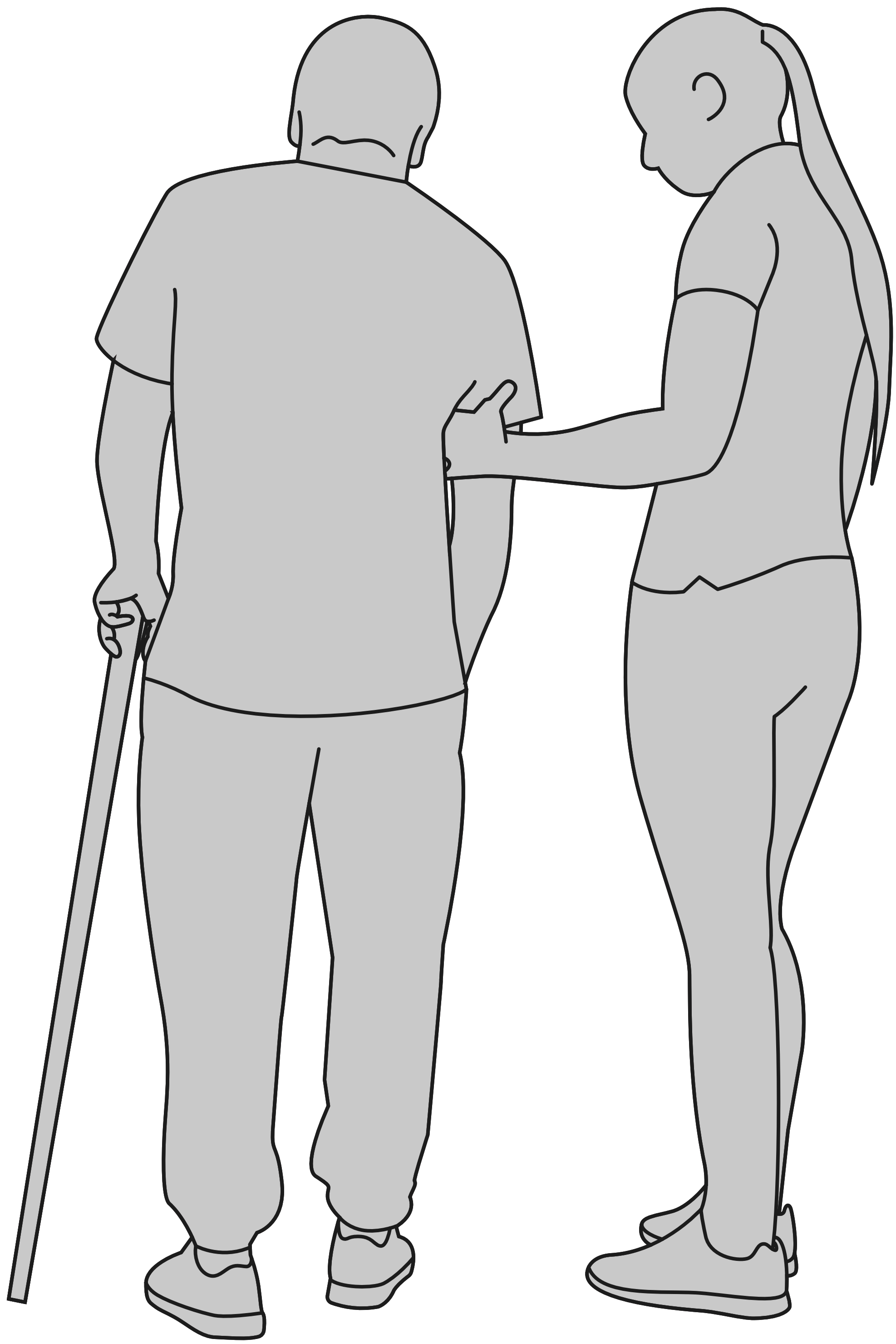
Phospho-alpha-synuclein was detected with 55.6 per cent sensitivity in 10 out of 18 RBD risk patients. With a sensitivity of 80 per cent, evidence of alpha-synuclein deposition was found in 20 out of 25 patients with early Parkinson's disease. By contrast, no deposits were found in the healthy control subjects.

"This brings with it the prospect of opening up the long-awaited pre-symptomatic Parkinson's therapy," comments Günther Deuschl, an expert in Parkinson's at the University Hospital of Schleswig-Holstein in Kiel and President of the European Academy of Neurology.

In short: α-synuclein is a small, soluble protein in the brain, which regulates the release of dopamine, among other things. It is able to form membrane channels and therefore belongs to the transport proteins. Mutations in the SNCA gene are responsible for synucleinopathies, such as the hereditary forms of Parkinson's disease.

LITERATURE

Doppler K et al. Dermal phospho-alpha-synuclein deposits confirm REM sleep behaviour disorder as prodromal Parkinson's disease. Acta Neuropathologica, April 2017, Volume 133, Issue 4, pp 535–545



Assistive gait training for advanced Parkinson’s syndrome

Investigation of the efficiency of specialised gait training using the THERA-Trainer e-go compared to conventional training methods to improve mobility and quality of life in patients with advanced Parkinson’s syndrome

Background and purpose

Idiopathic Parkinson’s syndrome (IPS) leads in the course of the chronic progressive disease to various restrictions on mobility, in addition to numerous non-motor symptoms. These are often associated with reduced independence in everyday life and reduced quality of life. Impairments in postural control and in the complex system of walking ability are insufficiently responsive to drug treatment. The use of complementary therapies is thus increasingly becoming part of neurorehabilitation and its research areas. Results from previous studies of patients with IPS suggest that activating therapies, such as treadmill training and the use of gait robots, have a positive effect on general motor skills, walking ability, balance and quality of life, especially in patients with pharmaco-refractory symptoms. However, to date it has not been possible to identify a therapy that is superior to the other methods.

The main objective of this study was to investigate the efficiency and rehabilitative potential of gait training with the newly-developed “THERA-Trainer e-go” in patients with IPS in the moderate to advanced stage of disease and to compare this with conventional gait training of equal therapy frequency and intensity relative to the general motor skills, gait characteristics and static and dynamic balance.

Methodology

In this controlled trial, 66 patients with Idiopathic Parkinson’s Syndrome (IPS) stages 3 and 4 in accordance with Hoehn & Yahr were randomised for gait training with the “THERA-Trainer e-go” or for conventional gait training with a gait therapist. Through block randomisation, the patients in the intervention and control groups were equally distributed by age, gender and disease stage. There were no relevant differences between the groups in terms of dropouts, illnesses or acceptance of the respective treatment. All patients received five 30-minute sessions of individual therapy per week, over a three-week period.

Primary outcome variables were changes in the motor Unified Parkinson's Disease Rating Scale (mot. UPDRS) and in the timed 10m walk test (10-MWT). Secondary outcome variables were changes in 10-MWT with 3m entry and exit distance, in the Parkinson's Disease Questionnaire (PDQ-39, on disease-related quality of life), timed "Up & Go", functional reach test, slalom course, modified Romberg's test and tandem gait. Changes in care dependency in everyday life were evaluated using the Barthel index. All tests were taken before and after completion of the three-week gait training. The investigators were blinded in terms of the study-specific intervention.

Results

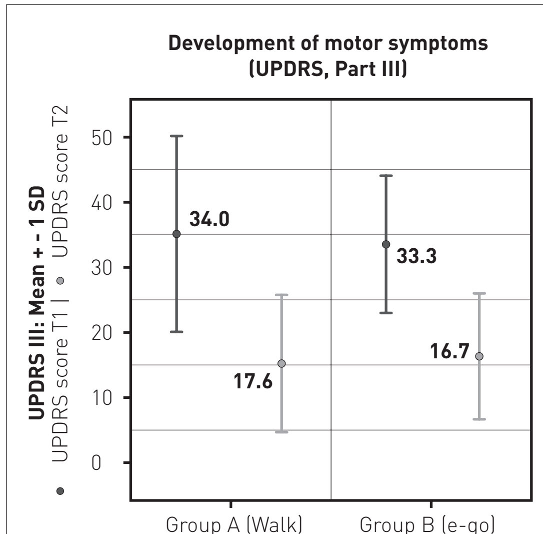
A key finding of this study is that both gait training with the "THERA-Trainer e-go" and conventional gait training delivered statistically significant and clinically relevant improvements in the primary target variables, mot. UPDRS and walking pace in the 10-MWT. The differences between the groups were statistically insignificant and different with respect to the two main target variables (better improvement in 10-MWT from conventional gait training and a tendency to better improvement from training with "THERA-Trainer e-go" in mot. UPDRS and the sub-group "legs").

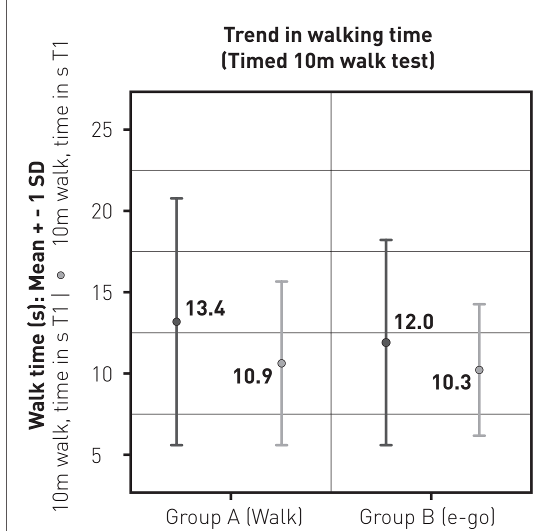
With regard to the secondary target variables, in the 10-MWT with 3m entry and exit distance, in the modified Romberg's test, in the functional reach test, in the tandem gait and in the PDQ-39, numerically and by percentage more patients improved following gait training using the "THERA-Trainer e-go" than following conventional gait training. The group difference was statistically significant at the level of tandem gait side-steps.

Particularly noteworthy is that patients in more advanced stages of the disease (Hoehn & Yahr stage 4) clearly benefited more from gait training with the "THERA-Trainer e-go" with regard to walking pace and balance, while patients in the moderate stage of the disease (Hoehn & Yahr stage 3) achieved greater progress in the same areas through conventional gait training.

Conclusion

The results of this study show that the use of the "THERA-Trainer e-go" in the neurorehabilitation of patients with IPS is practical and safe and can enable an increase in mobility and quality of life even in the advanced stage of idiopathic Parkinson's syndrome. The question of whether gait training with the "THERA-Trainer e-go" is superior to conventional gait training or treadmill training in patients in the advanced stage of IPS needs to be investigated in another controlled randomised study with a larger number of patients.





The results of this study show that use of the THERA-Trainer e-go in the neurorehabilitation of patients with IPS is practical and safe and can enable an increase in mobility and quality of life even in the advanced stage of idiopathic Parkinson's syndrome.

Dissertation

Schmitt A: Vergleichende Studie zur Untersuchung der Effizienz eines spezialisierten Gangtrainings mittels THERA-Trainer e-go gegenüber herkömmlichen Trainingsmethoden zur Verbesserung von Mobilität und Lebensqualität bei Patienten mit fortgeschrittenem Parkinsonsyndrom [Comparative study to investigate the efficiency of specialised gait training using the THERA-Trainer e-go compared to conventional training methods to improve mobility and quality of life in patients with advanced Parkinson's syndrome]. Faculty of Medicine, University of Ulm, 2015 (Diss.).

SOURCE

m&i hospital group Enzensberg: Research Report 2017, reporting period 2014 - 2016, p. 54 - 56.

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PROMOTION

internal

PERIOD

7/2013 to 12/2016

COVER STORY

Less fear of falling!

Influence of robot-assisted gait training with the THERA-Trainer e-go on self-experienced gait stability of patients with acquired brain damage.

Jakob Tiebel

Introduction

The top therapy goal of every person is to regain or maintain their unrestricted independence. An important element of independence is the ability to walk. Numerous studies have shown that restrictions in the ability to walk are a major concern in patients with neurogenic movement disorders. The physical activity of those affected is often greatly reduced, and balance is limited. This has negative effects on the various activities of daily life and on individual quality of life. This

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often results in a much higher fall risk. Those affected find themselves in a vicious circle of fear and avoidance behaviour.

A task-specific therapeutic approach has proven to be particularly effective for the re-learning of walking. Those affected need to practise the function of walking. And in as intense and sustained a way as possible. What is critical is training at the patient's individual limit of performance. In the case of existing balance disorders, this includes walking in the multimodal setting (multiple tasks) with and without disturbances (perturbations). That way, confidence in one's own abilities can be recovered. But how is this possible in the clinical-therapeutic setting, without provoking the risk of falling and manifesting existing fears in those affected?

The THERA-Trainer e-go is a mobile gait trainer capable of practical therapy support. It is a mobile training device equipped with electric motors. During the therapy, the patient is secured to a supporting frame by a pelvic belt. The securing system has no influence at all on the upper body. However, the patient is completely protected against falls thanks to the pelvic belt safety device, so that controlled walking exercise on the level is possible without relieving body weight.

The device is controlled by the therapist via a wired control unit. A speed adjusted to the patient's individual performance level can be selected via a stepless speed control system. It is also possible to force higher walking speeds and speed variations. Directional changes can be made from standing and in the forward movement. The THERA-Trainer e-go also has a two-stage adjustable balance release unit, which allows individual adaptation during exercise to the patient's ability to balance.

The patient walks independently, which requires active displacement of the body's centre of gravity. Even more extended walking distances, up to the limit of performance, are therefore possible without a risk of falling. The arms can swing reactively during walking. Even everyday activities such as carrying and transporting objects can be practised under realistic conditions. With soft floor mats and suitable tread surfaces which can be moved over using the THERA-Trainer e-go, it is possible to simulate various surfaces. This ensures that training is specific, task-oriented and relevant to everyday life. The patient's self-activity is encouraged.

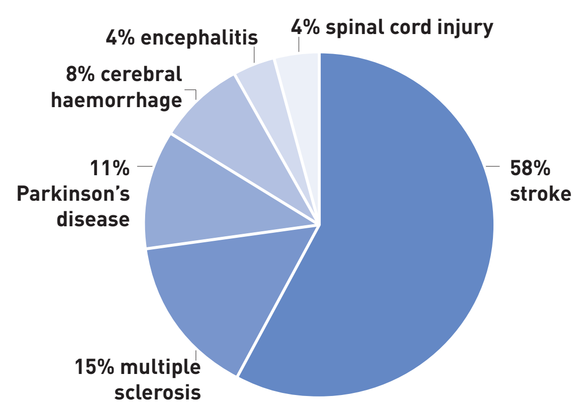
As of 2018, the THERA-Trainer e-go has already been used internationally in numerous rehabilitation facilities in gait therapy. However, to date there has been insufficient research into the influence of training on self-experienced gait stability and self-efficacy of patients with acquired brain damage.

The aim of the present study was to investigate the influence of robot-assisted gait training (RAGT) using the THERA-Trainer e-go on self-experienced gait stability and self-efficacy, as part of a post-market clinical follow-up evaluation.

Methodology

From several inpatient neurological rehabilitation facilities, a total of 26 patients with impaired mobility, age 65.3 (± 11.1), 15 strokes (58%), 4 multiple sclerosis (15%), 3 Parkinson's disease (11%), 2 cerebral haemorrhage (8%), 1 encephalitis (4%), 1 spinal cord injury (4%) were recruited and included in the case series intervention study.

Frequency distribution of the diseases



Inclusion criteria

- at least three-week hospital stay
- neurological disease with impaired walking ability
- cognitive requirements to participate in the therapy and testing procedures and to follow the instructions of the investigator
- interest and motivation to participate

Exclusion criteria

- lack of initial walking ability (FAC <2) or unrestricted ability to walk indoors and outdoors (FAC >4)
- health condition, not to be able to train in the submaximal range
- pain during therapy using the THERA-Trainer e-go

Intervention

As part of the rehabilitation program, the patients were given a 30-minute task-specific gait training with the THERA-Trainer e-go to complement conventional physiotherapy and ergotherapy (average 2.8 ± 1.6 training sessions per week) up to five days a week. The intervention period was 3 weeks.

Measurement variables

A key element was the collection of Patient Reported Outcomes (PROs) at the end of the intervention phase (T1). In addition, standardised motor assessments were performed at the beginning (T0) and at the end (T1).

The individual fall risk of the patients was assessed by means of the Functional Reach Test (FR). The FR is a dynamic balance test that is easy to use in practice and uses a continuous score system. It measures in centimetres how far a patient with a secure stance can reach forward with an extended right arm. Patients with neurogenic movement disorders may lose their balance or even fall. The degree of uncertainty and the associated risk of falls can be derived from the measurement results.

Subjective gait stability or the fear of falling was recorded using the Falls Efficacy Scale (FES). Since fear is a latent variable that can not be directly operationalised, FES (based on question items) helps to record fall-associated self-efficacy in a standardised manner. The person to be measured estimates the individual competencies in successfully coping with certain actions associated with the risk of falling.

Recording the PROs was designed to investigate the patient's perspective, which is not captured by the clinical measurement variables in that form, but is important to the patient and compliance with the therapy. Of course, treatments must be clinically and cost effective, but they should also deliver acceptable and desirable results for patients. Measures of clinical efficacy typically do not provide information about how a patient feels or works or what he or she believes is achieved through treatment. Measuring this element of acceptance requires patient-based evidence that includes measures of well-being. The PRO was recorded in four dimensions. At the end of the intervention period, patients were able to subjectively evaluate the influence of training on walking ability, gait stability, balance and their independence in everyday life on a five-point Likert scale (1 not true to 5 true).

Statistics

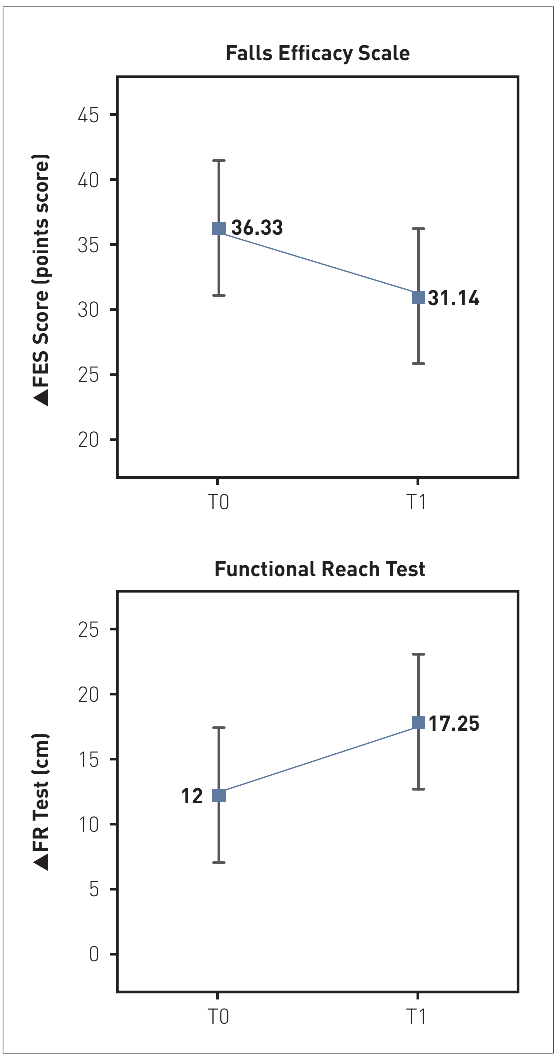
Data collection and descriptive statistics were performed using Microsoft Excel (version 16.14.1). The inferential statistical analysis was carried out using the statistics program JASP (Version 0.9.0.1).

The paired samples for variable walking speed, walking distance, FES and FR were evaluated non-parametrically using the Wilcoxon test for paired samples, because all test variables did not meet the requirements for the use of parametric test procedures. The significance level was set to $\alpha < 0.05$ on two sides.

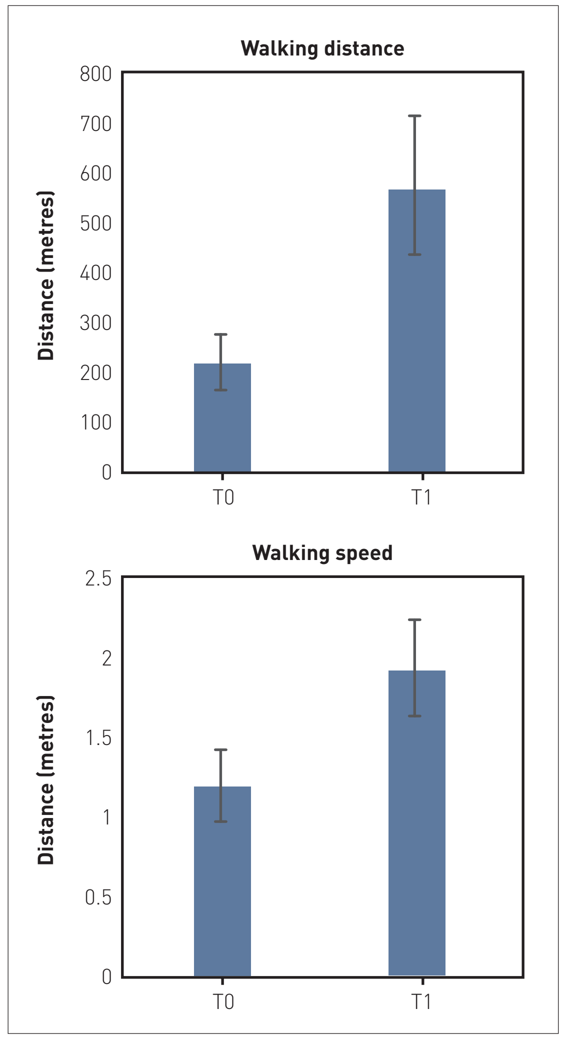
Results

A total of 26 patients, age 65.3 (± 11.1), were included in the evaluations. The data sets from a total of 209 training sessions were analysed. Each patient completed an average of 8.58 (95% CI: 6.05, 11.11) training sessions within the three-week intervention period.

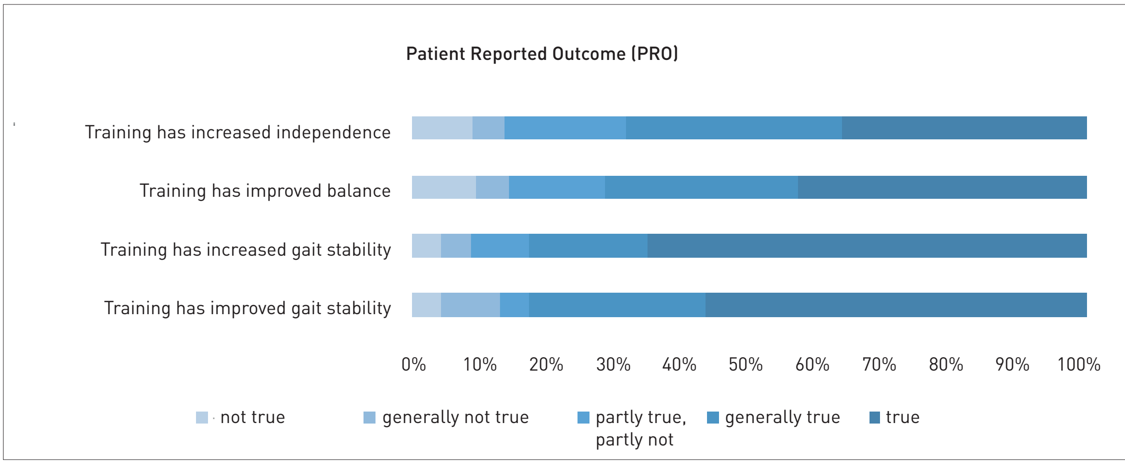
In the FR, patients improved their reach by an average of 5.25 cm (95% CI: 2.09, 8.4; p=.004). Fear of falling decreased by an average of 5.19 (95% CI 2.12, 8.25, p = .003) points on the FES.



The pre-post analysis of the training data shows a significant increase in walking distance of 353.92 metres (95% CI: 251.4, 456.43; p=<.001) and in walking speed of 0.73 km/h (95% CI: 0.54, 0.92; p <0.001) in the course of therapy.



The PROs show that the training with the THERA-Trainer e-go had a positive influence on the ability to walk and gait stability from the perspective of the patients, and led to improvements in the area of balance and independence in everyday life.



Measurement variables	Average value	95% confidence interval		Significance
		lower	upper	p
Walking distance T0	218.88	162.67	275.09	
Walking distance T1	572.81	432.21	713.4	<.001
Difference	353.92	251.4	456.43	
Speed T0	1.19	0.97	1.41	
Speed T1	1.92	1.62	2.22	<.001
Difference	0.73	0.54	0.92	
Falls Efficacy Scale T0	36.33	31.38	41.28	
Falls Efficacy Scale T1	31.14	25.76	36.52	0.003
Difference	5.19	2.12	8.25	
Functional Reach Test T0	12	8.54	15.45	
Functional Reach Test T1	17.25	13.47	21.02	0.004
Difference	5.25	2.09	8.4	

Conclusion

The objective was to investigate the influence of robot-assisted gait training (RAGT) with the THERA-Trainer e-go on the self-experienced gait stability of patients with acquired brain damage. The evaluations show that the patients' balance improved significantly and the fear of falling decreased significantly. More than 80% of patients attributed these improvements to the task-specific training with the THERA-Trainer e-go, amongst other things.

Gait training using the THERA-Trainer e-go therefore represents a practical addition to conventional gait therapy in neurological rehabilitation. Through training, patients experience an improvement in gait-specific parameters and benefit at the level of participation from increased self-efficacy.

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Is progressive strength training in Parkinson's effective?

A recent study by Santos and colleagues provides answers to this question.

Researchers divided 28 akinetic-rigid Parkinson's patients into intervention (13) and control (15) groups. While the subjects in the control group followed their usual daily activities during the study period, the subjects in the intervention group additionally completed 16 training sessions in eight weeks. A training session comprised 60 to 70 minutes, and each included a short warm-up phase, strength training with knee flexion and extension exercises, chest press, lat pull, rowing and, finally, stretching exercises.

The training results and progress were determined by the researchers during the course. The effects of the training were determined using standardised test procedures and questionnaires. Testing and measurements were taken at the beginning of the intervention, at the end, and at the follow-up four weeks after the end of the training.

The results show that progressive muscle training in akinetic-rigid Parkinson's patients has a positive effect on balance and walking ability and leads to improved quality of life in those affected.

Key definition: Progressive muscle training is a type of training in which the training load is gradually increased. The skeletal muscle reacts to a training stimulus in the normal instance with an increase in strength. In order to keep this constant and, if possible, to increase it further, the load must be permanently increased and adapted to the increasing capabilities. This constant adaptation is called progressive muscle training.

LITERATURE

Santos L, et al. Effects of progressive resistance exercise in akinetic-rigid Parkinson's disease patients: a randomized controlled trial. Eur J Phys Rehabil Med 2017 Mar 13. DOI: 10.23736/S1973-9087.17.04572-5

Gait trainer customer survey

How satisfied are customers with the THERA-Trainer lyra? An evaluation as part of post market surveillance

Jakob Tiebel; Otto Höbel; Petra Frankenhauser; Marcus Scherl; Christian Branz

Background

In business administration and in sales and commercial psychology, customer satisfaction refers to an abstract construct in social research that is usually described as the difference between customer expectation and satisfaction of needs, if the confirmation/disconfirmation model is used. Customer satisfaction can be considered a result of a complex comparison process in which the consumer, after using a tangible item or service, compares subjective experience (actual performance) with a comparison value (target performance). If the performance exceeds expectations, the customer is very or even extremely satisfied (delighted). If both are the same, then the customer is satisfied (which is not enough for long-term customer commitment/loyalty). If customer expectations are not met, the customer is somewhat or very dissatisfied (annoyed).

Objective

The aim of this work was to determine customer satisfaction among existing customers in relation to using the electromechanical gait trainer THERA-Trainer lyra.

Methodology

Methodologically, customer satisfaction was assessed by means of a quantitative survey using a standardised questionnaire. In the context of impact research, the quantitative survey represents a key survey method by means of which the inner processes of satisfaction can be verbally mapped. The underlying standardised questionnaire, by its design, enabled an objective, reliable and valid determination of individual customer satisfaction.

Results

A total of 32 customers were surveyed regarding their satisfaction with the THERA-Trainer lyra gait trainer. Figures 1 and 2 show the distribution of the sample in terms of occupational group and length of customer affiliation in months.

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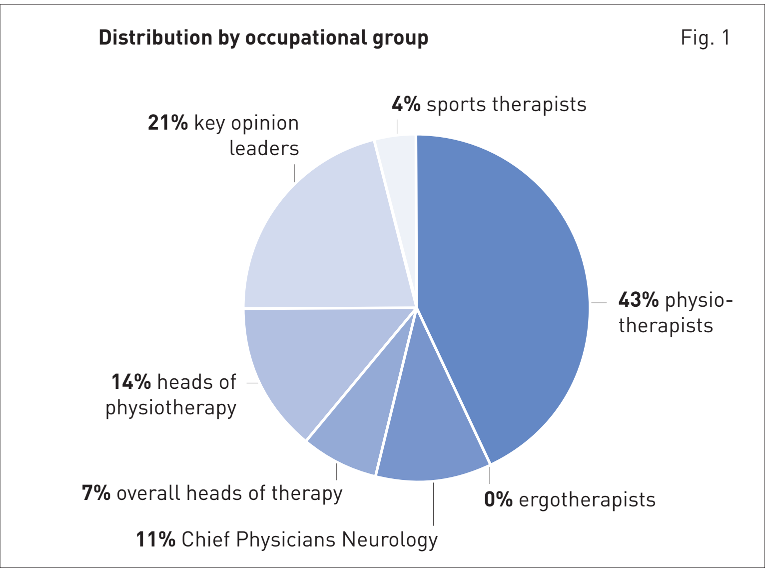
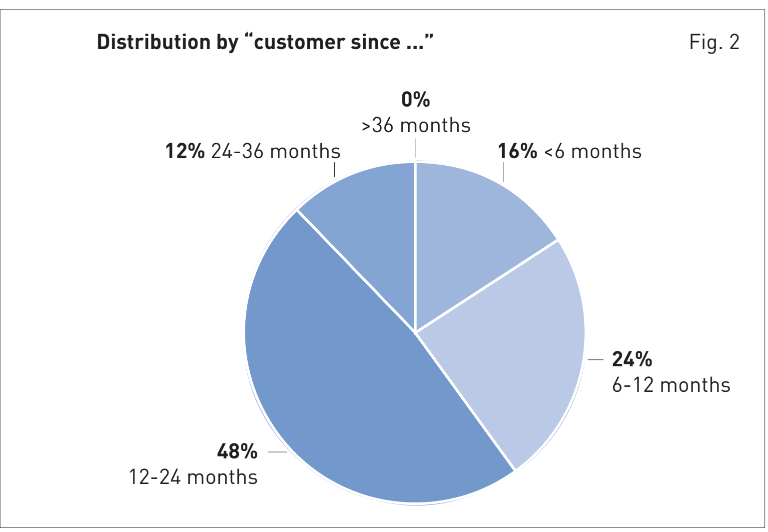
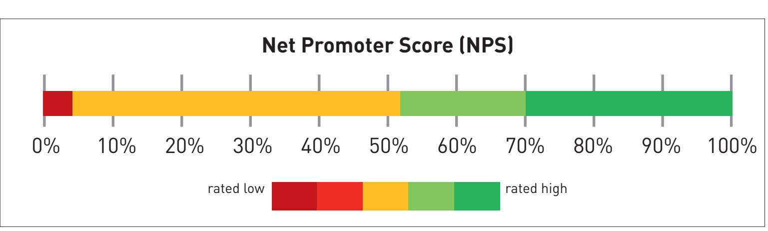


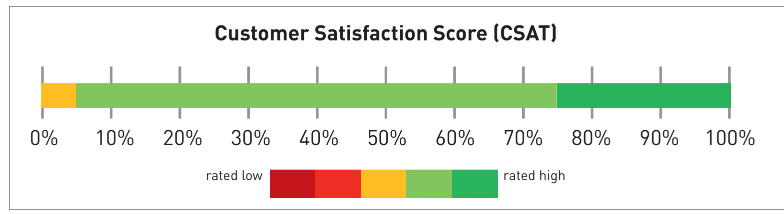
Most of the customers had been using the THERA-Trainer lyra for 12 to 24 months at the time of the survey.



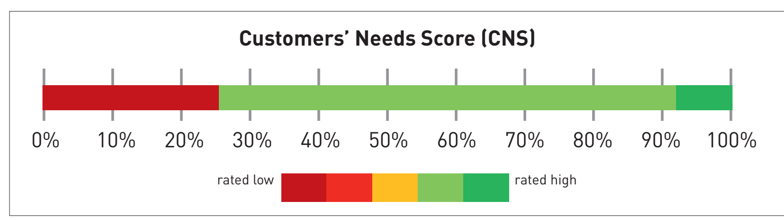
The Net Promoter Score (NPS) is a figure that correlates with business success (in specific industries). The method was developed by Satmetrix Systems, Inc., Bain & Company and Fred Reichheld. The evaluation of the results indicates a net promoter score.



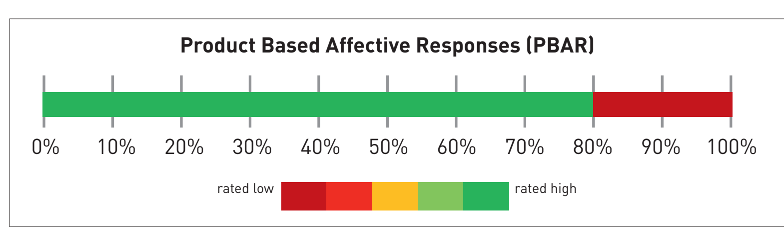
The Customer Satisfaction Score (CSAT) is a value designed to measure overall customer satisfaction. It can relate to the evaluation of both services or products. The CSAT is often used in conjunction with or as an alternative to the other key performance indicators (KPIs) such as the NPS. The CSAT also reflects above-average customer satisfaction.

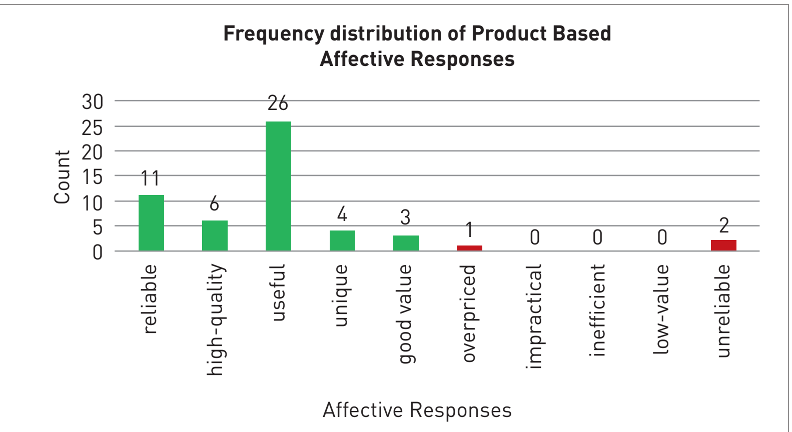


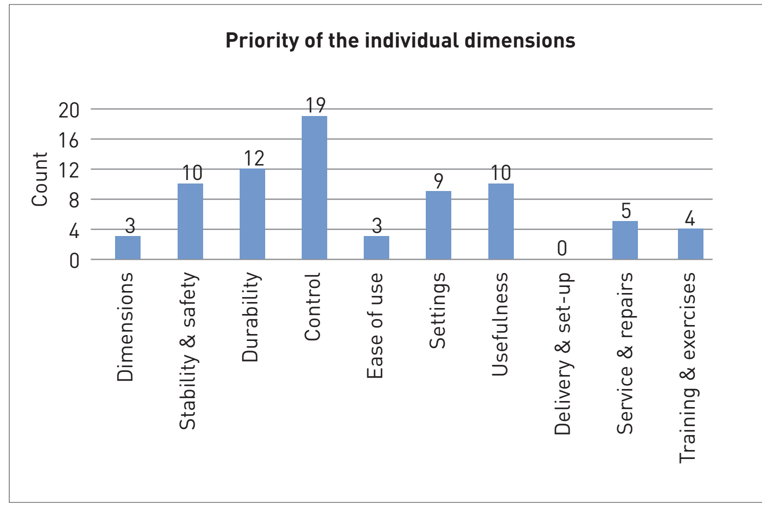
The Customers' Needs Score (CNS) determines how well a product or service meets customer needs. The results of the CNS indicate that the THERA-Trainer lyra meets the needs of the customers very well. This item has also largely been rated highly.



The Product Based Affective Responses (PBAR) allow easy and quick qualitative analysis of customer satisfaction. The PBARs were gathered in conjunction with the NPS or the CSAT to find out which qualitative characteristics are associated with customer satisfaction. This shows that the THERA-Trainer lyra is mainly linked with positively-associated quality characteristics. The usefulness of the gait trainer, followed by its reliability and quality, clearly stand out for many customers.
The Advanced Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST) is a



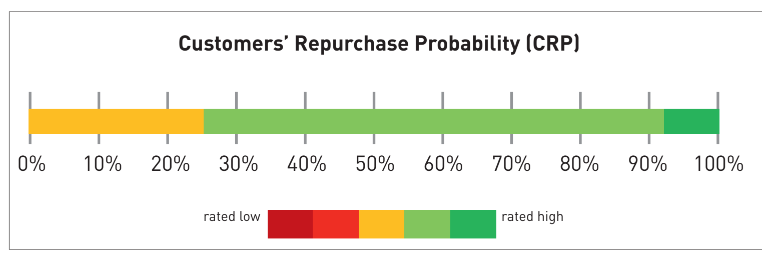


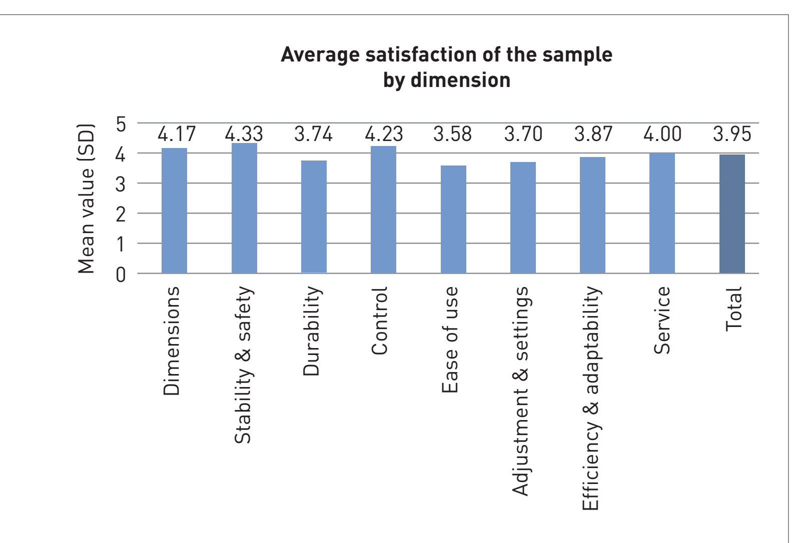


survey methodology designed to record user satisfaction in using technological tools. The concept of satisfaction in the sense of the QUEST relates to the positive or negative evaluation of different dimensions. The aim is to find out how satisfied people are with specific functions and how particular features and services are evaluated in relation to the technology used.

Here, the results show above-average satisfaction in all evaluation dimensions. Particular importance is given to operating the system, its durability, safety and stability, together with its usefulness. In terms of ease of use, the survey shows that there is enormous scope for further improvement.

The Customers' Re-purchase Probability (CRP) determines how likely a customer will be to buy a product or service again the next time or how much a customer is willing to purchase the next product from the same manufacturer. Again, the results reflect an above-average willingness to buy again.





Conclusion

Overall, the results represent a high level of customer satisfaction. On average, the performance of the product at least meets the expectations of the customers and in most cases even exceeds them, which leads to long-term customer commitment and loyalty.

Acknowledgements

We would like to thank all those taking part in the survey for their friendly support and honest feedback!

SCIENCE

How the environment can influence genes

Tübingen scientists are on the track of an interface between the environment and genes which could lower the risk of Parkinson's

“People who move a lot, participate in community life and try to keep their brains fit are less often affected by Parkinson’s.”

“Move extensively, enjoy time with friends and revel in the delights of nature! Not only will you feel well physically, it also seems to be good for your brain!” This advice could serve as the summary of the results of a study recently published by a team of scientists from the Institute of Medical Genetics and Applied Genomics at the University Hospital Tübingen and the Hertie Institute for Clinical Brain Research (HIH). In the respected journal Frontiers in Cellular Neuroscience, the scientists working under Julia Schulze-Hentrich demonstrate how movement, social interaction and cognition largely prevented changes in the cell caused by the alpha-synuclein gene. The gene plays a key role in Parkinson’s disease.

Parkinson’s is a degenerative disease of the brain that predominantly affects the elderly. After Alzheimer’s, it is the second most common disease of its kind. It is currently estimated that there are around 400,000 Parkinson’s patients in Germany alone, with an expectation that these numbers will rise in line with progressive demographic shifts. The disease appears to result from a complex interaction of genes, aging and environmental factors. Certain environmental factors seem to increase the risk of disease, while others counteract the risk.

“People who move a lot, participate in community life and try to keep their brains fit are less often affected by Parkinson’s. We are intrigued to understand how these environmental conditions positively impact our genes,” says Schulze-Hentrich, the initiator of the study: “While we know there is a protective influence from certain environmental factors with regard to Parkinson’s, we still know far too little about how that influence works at the molecular level.” An understanding of the underlying cell mechanisms could potentially be used to mimic the effect of a protective environmental factor on key genes involved, in a targeted therapy.

For their studies, the scientists used mice carrying the human alpha-synuclein, and studied changes in gene activity throughout the genome under the influence of what is termed an enriched environment, which refers to a stimulating environment for the animals in terms of movement, social interaction and cognition. “The latest technologies, which we use and offer in our central research facility in Tübingen, make it possible to ask such questions,” adds Professor Olaf Riess, Director of the Institute of Medical Genetics and Applied Genomics in Tübingen.

Using this technology to understand the environment-gene axis in Parkinson’s better than ever before is central to the BMBF (German Federal Ministry of Education and Research) funded decipherPD project, which Schulze-Hentrich is coordinating and which involves a collaboration between six research teams from Germany, France and Canada. “In decipherPD, we are attempting to put together individual phenomena at different

levels in the cell, like in a jigsaw puzzle, and to understand which signalling pathways environmental factors use in the cell, which traces they leave behind on the packaging structure of our DNA and how these, in turn, influence the activity of genes in Parkinson's," says Philipp Kahle, Professor of Functional Neurogenetics at HIH and one of the scientists involved, outlining the core task of the project. It is highly motivating to see that even in diseases such as Parkinson's, we do not seem to be completely at the mercy of our genes, Schulze-Hentrich said. Her team is already working hard on follow-up studies to identify potential new avenues for much-needed new therapeutic approaches in Parkinson's.

PUBLICATION

Wassouf Z, Hentrich T, Samer S, Rotermund C, Kahle PJ, Ehrlich I, Riess O, Casadei N, Schulze-Hentrich JM (2018): Environmental Enrichment Prevents Transcriptional Disturbances Induced by Alpha -Synuclein Overexpression. Frontiers in Cellular Neuroscience. doi: 10.3389/fncel.2018.00112

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Steep learning curve with a long-term learning effect

Acoustic balance training

Interview: Melanie Grom | Photos: Andrea Sommer

The University of Applied Sciences Kempten is intensively involved in various research projects using digital systems in care and rehabilitation. With medica Medizintechnik GmbH, feo Elektronik GmbH and Schön Klinik Bad Aibling, Prof. Dr.-Ing. Petra Friedrich from the Faculty of Electrical Engineering and her research assistant Dominik Fuchs have been working on BalThaSAR - a project to optimise balance training for neurological patients.

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Ms Friedrich, what is behind BalThaSAR?

Friedrich: The abbreviation stands for balance therapy with automated sonification and drive technology for rehabilitation. BalThaSAR is designed to support neurologically-impaired individuals in restoring reactive balance and somatosensory function. Training options for the sense of balance in a fall-safe environment already exist. The basic idea of this project, however, was firstly to build a prototype with motors, to optimise the balance training, and secondly, not only to train the sense of balance with the help of visual feedback, but to guide the patient acoustically. The patient is thus in a training environment which is as free as possible, in which the therapist also has the opportunity to introduce forms of interference. So if the patient has reached a certain level of training, for example, he or she is given a little push from behind or from the side and has to react to it.

What part did the university take on in this project?

Friedrich: Our part related to sonification: developing a sonification system including acoustic guidance and suitable training games. The system integration of all modules and components, together with the control unit, was then taken on by medica.

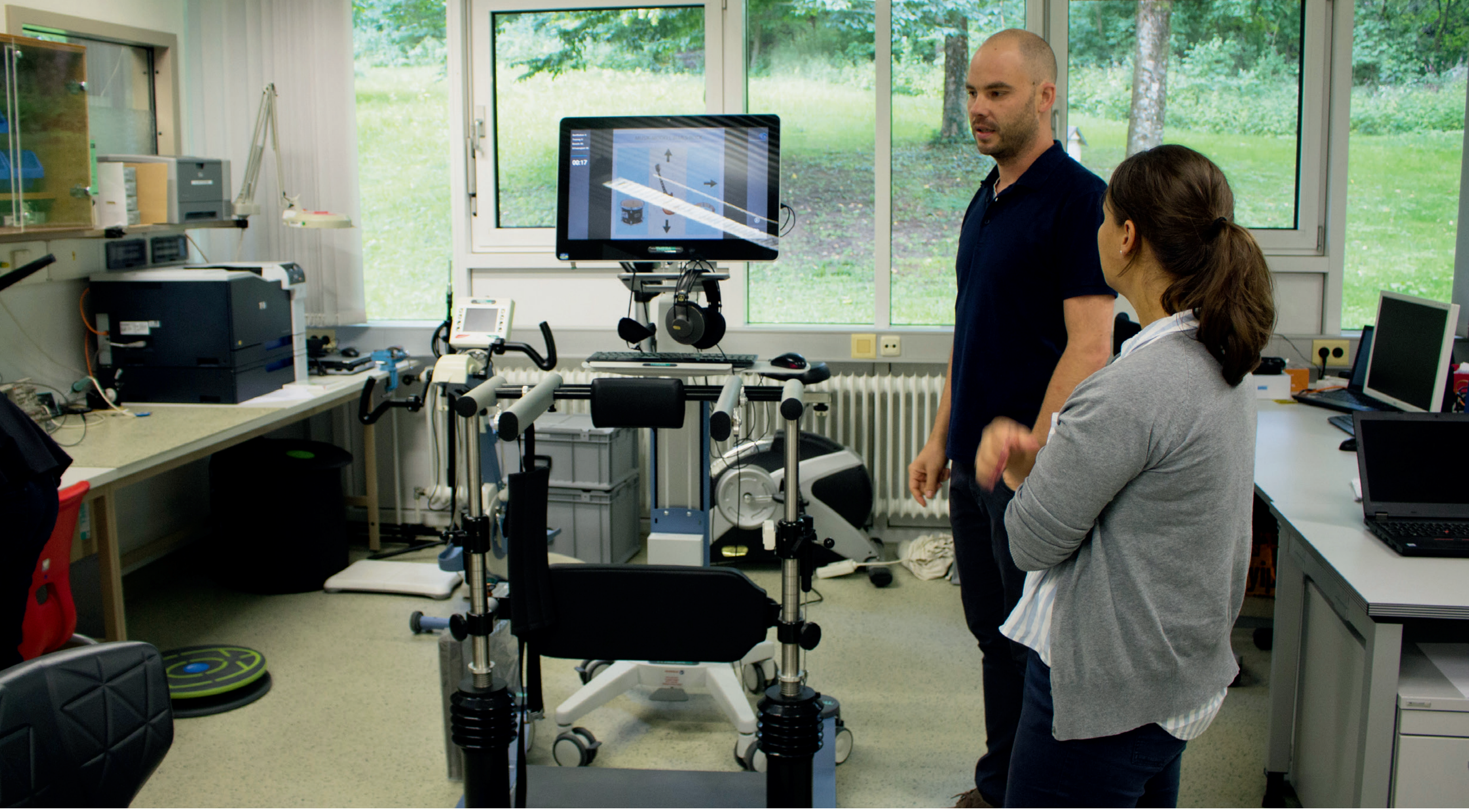
Why does it make sense to combine balance therapy with acoustic stimuli?

Fuchs: With a balance disorder, many patients develop a visual dependency – they are looking for fixed points by which they can orient themselves. But especially in large crowds, with fast movements or in the dark, these fixed points are not there. That's why it is helpful to reduce visual dependence.

Friedrich: The literature and our preliminary work suggest that acoustic stimuli are more effective than visual ones, especially for balance training. That was the hypothesis we had set. The idea was to gradually remove visual acuity from the patient, so that he or she is only guided acoustically and still trains those activities relevant to daily life. The body movements are then sonified, i.e. sound is added, meaning that the patient is acoustically made aware of his or her current position and the target position. If visual acuity is deliberately removed, then the organ of balance and the body's own perception, in turn, are forced to assume more tasks for spatial orientation.

How effective is the new training concept compared to "conventional" balance training, Mr. Fuchs?

Fuchs: In test series with healthy subjects, we have seen that with purely visual feedback the route navigation is quickly recognised and learned. But after that, hardly anything changes in the learning effect. You learn fast, but then it does not necessarily get better. There is also something known as the guidance effect: strong feedback, such as visual feedback, even dominates the body's own perception, i.e. proprioception, for example. If this feedback is missing, patients often cannot do much more than before the training. The auditory element is not so dominant, and is processed largely in parallel with the intrinsic feedback.

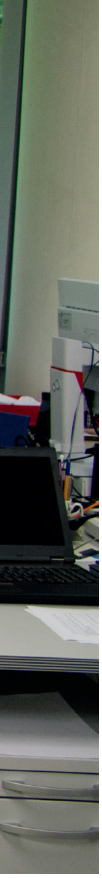


At first, the patients are much slower, because it is more exhausting and more difficult to learn. You have to involve all of the body's own perception. But there is much to suggest that, compared to training using visual acuity, the learning curve increases more steeply and the learning effect lasts longer – meaning that the training is more effective. This now remains to be confirmed in larger studies.

Are the research results being translated into real products?
Friedrich: BalThaSAR was a very appealing and fruitful project. The advantage was that we had a really new topic, and were able to develop a prototype. What is missing from BalThaSAR, before it can be developed into a product, includes the clinical tests. Without these efficacy studies, there is no approval. Whether the project can go into series production is a matter for the industrial partner.

Are you continuing your research in this direction?
Friedrich: Things are moving more and more in the direction of digitisation and technology in care and rehabilitation. At the moment, this is the topic that is really taking off, you could say. And that affects us too. We at the university have decided to continue looking into this area – balance training and sense of balance – and to continue combining this with acoustics. There are also many new questions. On the one hand from the therapeutic side, and on the other hand from the musical-acoustic side. And, of course, when it comes to implementation, including from a technical point of view.
Fuchs: Of course, the software can be further developed and made much more dynamic and more intelligent, so that the patients feel at best neither under nor overwhelmed and train in a state that can be described as "flow". Maybe this will result in further cooperation with medica.
Friedrich: My concern in research is to develop assistance systems for the aging population, with the

goal of being able to stay as long as possible in one's own home. There is the problem of a shortage of skilled therapists, and old people in particular are often not able to come to a practice several times a week. And the credo in rehabilitation is "Repetition, Repetition, Repetition", as I have learned. So it makes perfect sense to do the exercise training also – indeed, above all – at home. Ideally, this is under therapeutic supervision or using a telemedicine assistance system, with which the therapist puts together the training sessions, which are then uploaded onto the patient's training device at home. In combination with IT, entertainment and smart home technology, much will happen in this field in the years ahead. It's an aspect that was not realised in the BalThaSAR project.



How does the university benefit from the project?
Friedrich: Personally, I enjoy working on an interdisciplinary level and broadening my focus, looking at the system as a whole. For us as a university, the research itself is important, as are the methods, the technical questions and the solutions to them. And, of course, it's also essential that we can use this in teaching – the combination of research and teaching. As a result, students in the more advanced stages of their studies become more interested in doing their final thesis here at the university. It's application and industry-oriented. As a university, we also had the added value of having to align ourselves to industrial development processes. There were telephone conferences every two weeks, there were shared drives on which we uploaded the documents. It was very informative and helpful to us to use these things for ourselves or for our students, who were involved in the project for their final thesis, and to have to adhere to certain processes. And that is our core focus – as a university of applied sciences – and I think such projects are indispensable for that.

Thank you for this interesting interview.

Dominik Fuchs

Dominik Fuchs graduated in 2015 with a Master of Arts in Music Therapy from the SRH University of Heidelberg. He then worked for the welfare association Arbeiterwohlfahrt (AWO) Rhein Neckar, before moving to Kempten University of Applied Sciences in November 2016 as a research assistant. In July 2018, Fuchs officially began his doctoral studies. to qualify as Dr. rer. biol. hum. in cooperation with the Ludwig Maximilian University Munich. His doctoral project is building thematically on a joint project with medica Medizintechnik GmbH, and is being supported by the company with equipment.

Petra Friedrich

Prof. Dr.-Ing. Petra Friedrich graduated in 1991 from the RWTH Aachen with a degree in electrical engineering, specialising in communications engineering. In the following 13 years, she worked as an engineer in various posts in information and communication technology at Siemens AG in Munich. From the end of 2004 to August 2011, she worked as a scientific assistant and obtained her doctorate from the Heinz Nixdorf Chair of Medical Electronics at the Technical University of Munich. In September 2011, Dr. Friedrich took up a post at the University of Applied Sciences Kempten, in the Faculty of Electrical Engineering. She is currently head of the AAL Living Lab and CoKeTT Centre in Kempten and chair of the South Bavaria Association of German Engineers, VDE Südbayern e. V.

Need assistance! Can assistants relieve the burden on therapy professions?

As our society ages, hospitals today are not usually lacking in patients, but in skilled professionals. Without exception, healthcare facilities face the challenge of having to do more with ever scarcer resources. A contradiction in itself? Not necessarily. But the changes require innovative care concepts and new structures in hospitals.

Jakob Tiebel

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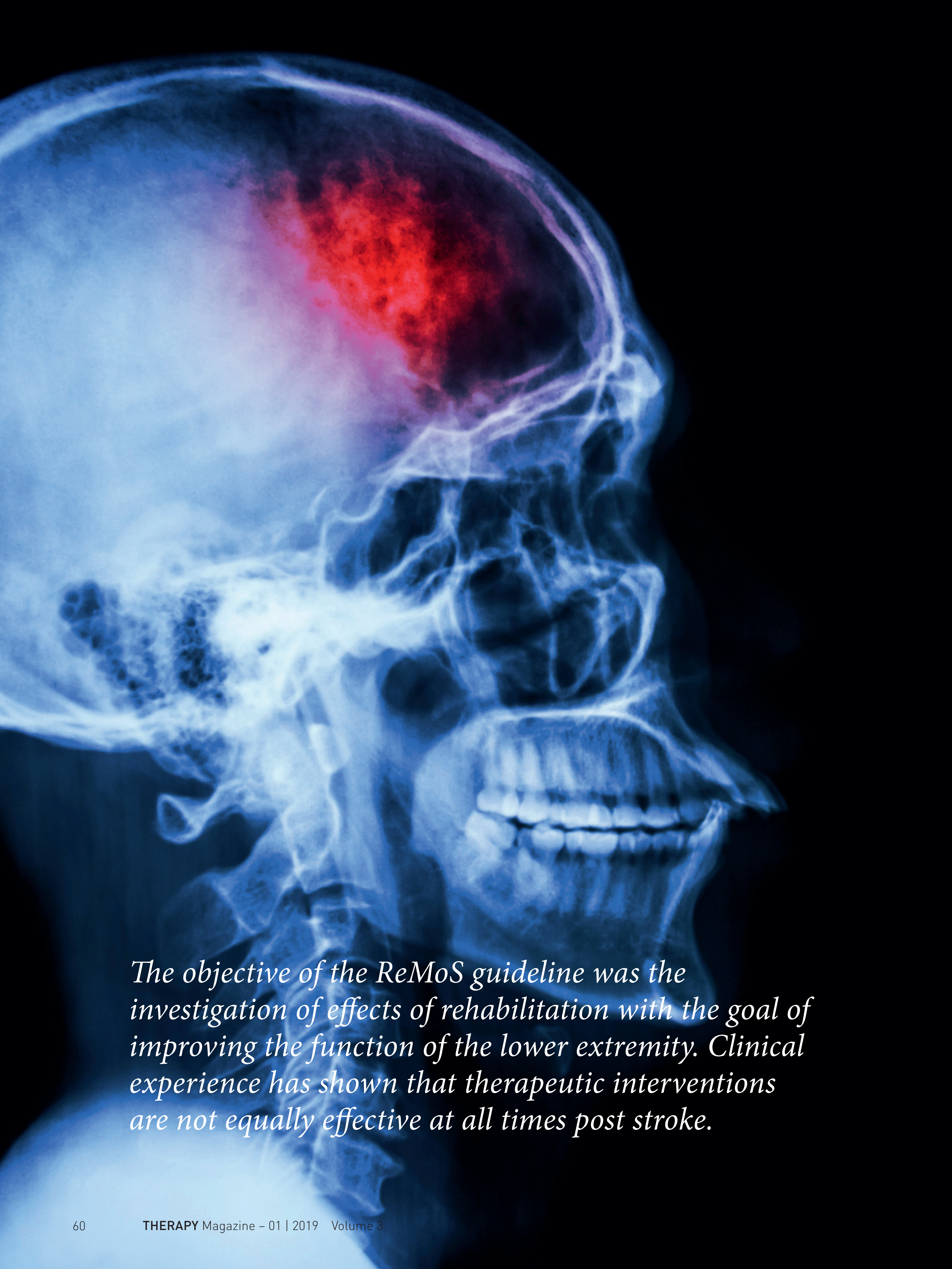
It is increasingly reported in specialist journals that sometimes entire task areas in hospitals are relocated. Physiotherapists who yesterday were still encouraging patients to exercise are today taking on more and more management and coordination tasks, while therapy assistants are getting the patients moving. Of course, this is according to a predetermined plan, which the specialist has previously created on the basis of a diagnosis.

Is this the future of inter-professional collaboration in rehabilitation? At the very least, a lot of indicators are pointing to this, because the fact is that the increasing complexity of care cannot be met by employing more skilled workers. They are simply not out there, and even if they were, there would be clear limits from a health economics point of view. The solution therefore really seems to lie in a new distribution of tasks.

However, such restructuring also arouses ambitions and can create resistance. Change processes are therefore by no means trivial. It requires a lot of tact, and precise planning. The interfaces between doctors, nurses, therapists and therapy assistants must be freshly and, above all, very precisely coordinated. Assistants can then be a great asset – not least for patients, as they in particular can be given the attention they need as a result.

When things work out, everyone benefits in the end. The burden on doctors is eased, because they can focus on medical care. Therapists take on more responsibility for the rehabilitation process, and the assistants are satisfied because they play an exciting and interesting role between the therapist and the patient.

A model without risks? Assuming that implementation is right, there are certainly far more opportunities than risks. For therapists, however, an extension of competence and greater responsibility are based on a clear requirement: measures to be taken must be evidence-based, and scientifically proven in their effectiveness! Otherwise there is a risk of being deemed unreliable and open to criticism.



The objective of the ReMoS guideline was the investigation of effects of rehabilitation with the goal of improving the function of the lower extremity. Clinical experience has shown that therapeutic interventions are not equally effective at all times post stroke.

Recommendations from the German Guideline for „Rehabilitation of Mobility after Stroke"

Guidelines reflect the state of the art and generate a high degree of confidence that their recommendations support optimal treatment. Since 2015 the German Neurorehabilitation Society (DGNR) provides an evidence-based guideline for "Rehabilitation of Mobility after Stroke" (ReMoS). Unfortunately, until now it is available exclusively in German. To overcome the language barrier this article covers main recommendations of the guideline in English.

Jakob Tiebel

Background and key issues

The ReMoS guideline was jointly developed by neurologists and physiotherapists working in the field of neurorehabilitation. It is the first stroke rehabilitation guideline that is strictly oriented on target criteria and in which authors make differentiated recommendations for patients in the subacute or chronic stage after stroke and for initially non-ambulatory and ambulatory patients (ReMoS Working Group, 2015 at 355).

The guideline focuses on the following key issues:

1. What rehabilitation measures for patients with a stroke or hemiparesis after stroke have been proven to lead to an improvement in

   a) walking ability
   b) risk of falling and balance
   c) walking speed and/or walking distance?

DOI: 10.6084/m9.figshare.7000397

2. What rehabilitation methods can be recommended for improving the target criteria mentioned above?

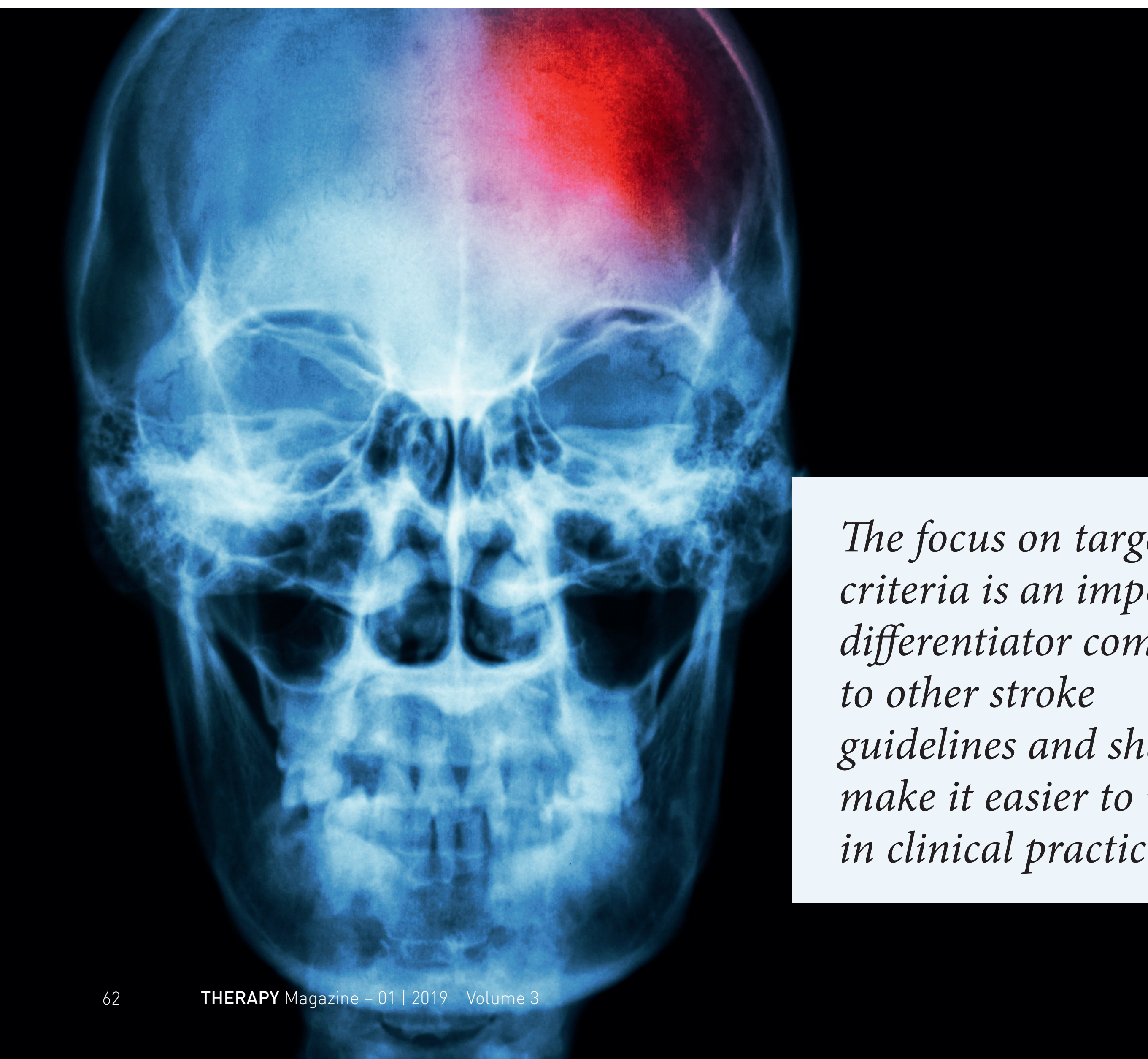
In the developing process also other national and international guidelines in the field of stroke rehabilitation have been taken into account, provided that these guidelines were devoted to the same interventions. But a direct adoption of recommendations was not possible, since ReMoS gives recommendations for interventions with regard to specific target criteria, whereas in the other guidelines reviewed recommendations are not differentiated according to that. Thus, the focus on target criteria is an important differentiator compared to other stroke guidelines in the world and shall make it much easier to use it in clinical practice (ReMoS Working Group, 2015 at 355-57).

Classification of different stages post stroke

Clinical experience has shown that therapeutic interventions are not equally effective at all times post stroke. In order to better assess the differential efficacy of interventions, the authors investigated their efficacy in the acute, subacute or chronic stages after stroke.

However, the acute, subacute and chronic phases are defined differently in the field of neurological rehabilitation. Time windows normally range between 3 weeks and 12 months post stroke.

For the purposes of the ReMoS guideline the researchers defined the time-windows of 3 weeks and 6 months as boundaries between the acute, sub



The focus on target criteria is an important differentiator compared to other stroke guidelines and shall make it easier to use it in clinical practice.

acute and chronic phase of rehabilitation (ReMoS Working Group, 2015 at 356-57).

General approach

The following approach was adopted for the development of the ReMoS guideline (ReMoS Working Group, 2015 at 358):

1. Systematic literature search using defined criteria
2. Evaluation of individual papers
3. Summary of individual papers relating to a question and evaluation of the baseline quality of the evidence
4. Critical summary while considering the appropriateness and clarity of the evidence, resulting in the final quality of the evidence (GRADE scheme)
5. Practical consideration (e.g. risk of the therapy procedure) and development of a recommendation from this.

The systematic search was based on the following PICO key question (ReMoS Working Group, 2015 at 358):

Patients:
In-patients with a stroke or a hemiparesis after stroke…

Intervention:
… specific rehabilitation therapy (physiotherapy, occupational therapy, acupuncture, electrical stimulation, robot-assisted gait therapy, treadmill training, biofeedback therapy, implantation of medical devices, botulinum toxin injection, orthotic supplies and other rehabilitation therapy)…

Comparison:
… with varying doses or different contents…

Outcomes:
… lead to improvement in strength or mobility in the lower extremities or improvement in balance, walking, mobility or reduction in number of falls?

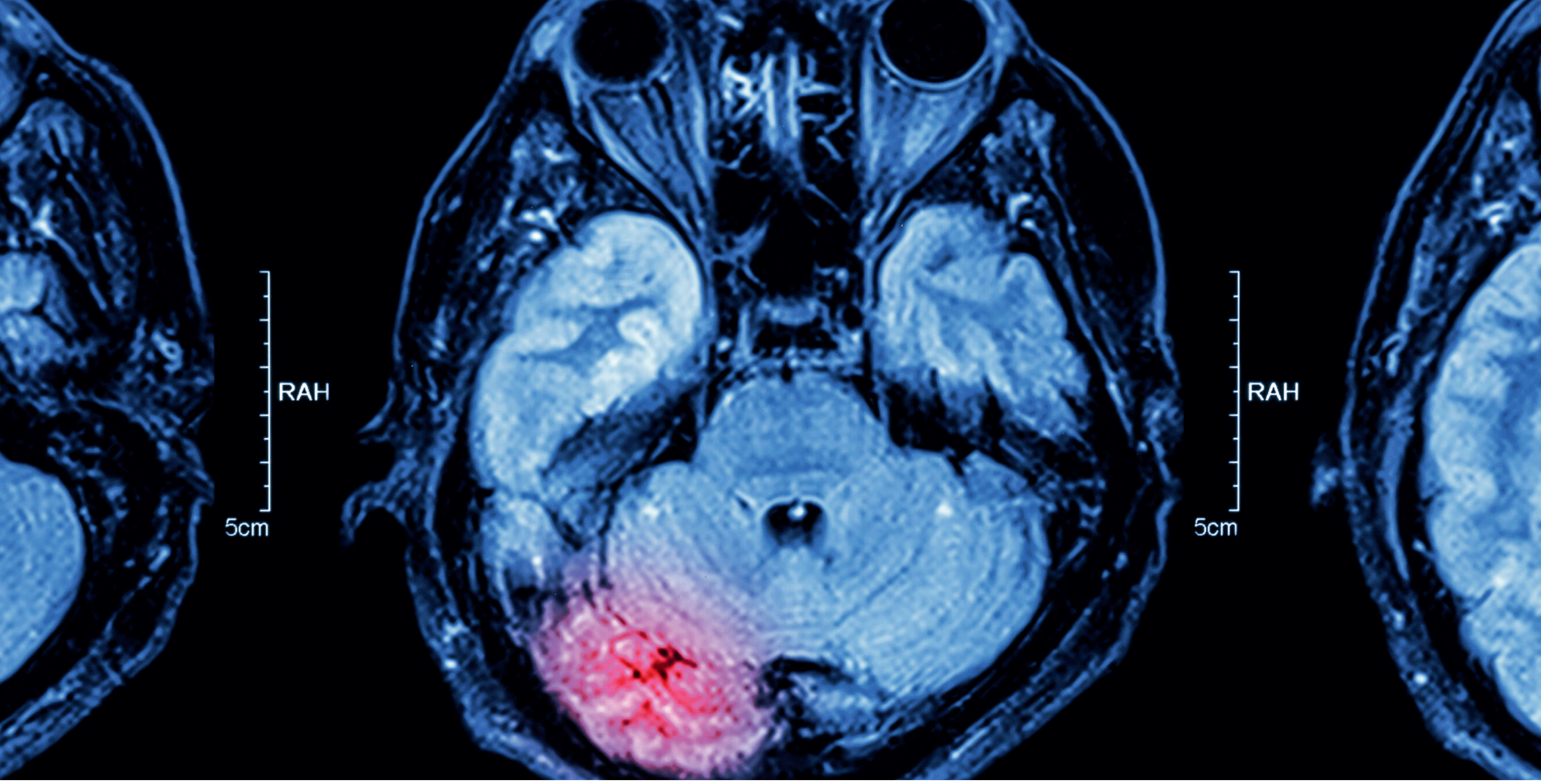
Literature search

The literature search was done with the program Reference Manager in the Medline (Pubmed) and PEDro databases. The last systematic search took place in June 2012. The PICO search algorithm included the same terms for all specified databases, but a syntactic change of the search terms was necessary depending on the version of the internet database. Particularly in the case of Medline (Pubmed) the authors stated, that during the process of literature search the internal search algorithm changed considerably a number of times. Therefore, before each literature search they ran several test searches with an orientation triage of the results and an adjustment of the search algorithm (ReMoS Working Group, 2015 at 358).

Interventions included

The researchers carried out an open literature search with regard to interventions that selected references according to target criteria and patient cohort only. As a result, also studies were found in which one of the target criterion was not primarily intended and a plausible, specific effect mechanism was not directly established (ReMoS Working Group, 2015 at 359).

However, the objective of the ReMoS guideline was the investigation of effects of rehabilitation (such as physiotherapy, occupational therapy, acupuncture, electrical stimulation, assisted gait therapy, biofeedback therapy and medication) with the goal of improving the function of the lower extremity. Tests were being carried out to determine whether there was at least one study in which this intervention was investigated as a primary intervention. In case of this, the effect of the intervention was also considered in studies where this intervention was treated as a control intervention. Studies that included purely acute medical aspects therapy were not taken into account (ReMoS Working Group, 2015 at 359).



Studies included

The researchers included only randomized controlled trials, randomized crossover studies, systematic reviews and meta-analyses. In case of inclusion of cross-over studies always only the first phase of the intervention was considered. And exclusively articles published in English or German on adult stroke patients were included (ReMoS Working Group, 2015 at 359).

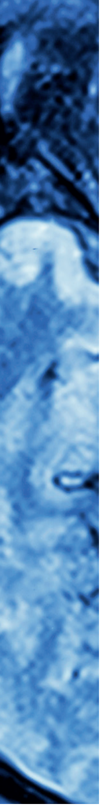
Additionally, sample sizes were decisive for the inclusion of a study in the guideline, as small case numbers could easily lead to an inappropriate distortion of the results. Therefore, randomized trials with less than 10 included patients per group were not considered. Studies with fewer than 20 patients included per group were generally downgraded in the quality ranking even if the quality was otherwise good (ReMoS Working Group, 2015 at 359). Nevertheless, as not enough studies with the desired quality were available for all interventions, the researchers made exceptions to this rule. If there were several "small" studies with less than 10 patients per group, but a meta-analysis with more than 10 patients per group, the meta-analysis was evaluated. If there were no "larger" studies with more than 10 patients per group for an intervention available, but one or more smaller studies with less than 10 patients per group, the "smaller" studies were considered in the work of the guideline (ReMoS Working Group, 2015 at 359).

Target criteria

The classification of the target criteria was limited to the following clinically most relevant points by Consensus of the guideline working group (ReMoS Working Group, 2015 at 360):

- Walking ability
- Walking speed
- Walking endurance (in relation to distance)
- Risk of falling (Balance)

This classification forms the structure of the guideline according to these target criteria. General motor scales such as the Fugl-Meyer Assessment, Rivermead Motor Assessment or total ADL scales such as Barthel Index and FIM are disregarded explicitly. Papers whose endpoints were exclusively physiological parameters, e.g. muscle strength or kinematic parameters, were also not included in the guideline (ReMoS Working Group, 2015 at 360-62).



Number of studies included

The Researchers included a total of 199 papers, of which 188 were clinical trial papers and 11 were systematic reviews (ReMoS Working Group, 2015 at 362).

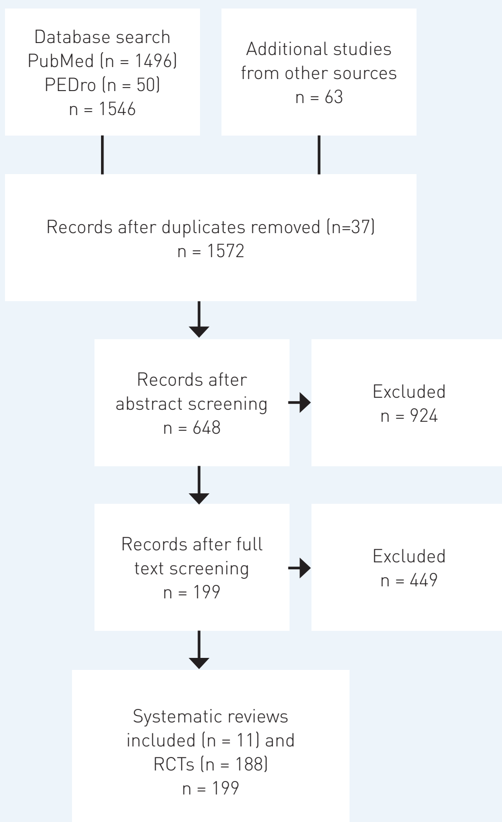


Fig. 1: PRISMA flow diagram (from Moher et al., 2009)

Evaluation of individual papers

All studies were initially evaluated irrespective of the guideline question.

By rating the methodology the authors determined the validity of studies and classified them according to the Oxford classification, (Version 1 of the CEBM classification of March 2009) (ReMoS Working Group, 2015 at 363-64).

In order to produce a practical recommendation, studies were allocated as far as possible to overarching therapeutic approaches, for example (ReMoS Working Group, 2015 at 364):

- Conventional gait training
- Treadmill training with patients in the subacute stage
- Treadmill training with patients in the chronic stage
- End-effector-based devices (e.g. Gait Trainer)
- Exoskeleton-assisted devices (e.g. Lokomat)
- Training for improved strength and endurance ergometer training
- Specific balance training
- Sensory feedforward stimulation without feedback (except electrical stimulation)
- Cognitive therapy strategies
- Comprehensive physiotherapy treatment concepts
- Electrical stimulation
- Aids
- Central stimulation
- Drug therapy
- Positioning

This type of structuring directly affected evidence assessment and recommendations. In the case of different device-based procedures, for example, the researchers did not look at every industry model in isolation. They examined the overall principle of treatment (e.g. end-effector versus exoskeleton). It should be remembered that this type of classification is subject to a certain degree of subjectivity. But the structure makes much sense and helps therapists to better find recommendations for different intervention types. The selected classifications were agreed in the hole guideline working group (ReMoS Working Group, 2015 at 364).

In addition, therapy organization concepts were evaluated as follows (ReMoS Working Group, 2015 at 364):

- Organization of the therapy sessions
- Training intensity, additional physiotherapy
- Training organization
- Circuit class training

- Cross-organizational concepts
- Early supported discharge with multidisciplinary rehabilitation in the domestic environment
- Organisational concepts in the domestic environment based devices (e.g. gait trainers)

This structure also enabled a comprehensive discussion of possible principles of treatment.

In the summary evaluation, the formal baseline quality of the evidence for an intervention has been determined in the four-stage GRADE classification, starting with the methodological quality of the individual papers (ReMoS Working Group, 2015 at 365).

Table 1: GRADE System – Strength of Recommendation (Guyatt et al., 2008, and GRADE Working Group)

Quality of Evidence	Definitions
High	Further research is very unlikely to change our confidence in the estimate of effect.
Moderate	Further research is likely to have an important impact on our confidence in the estimate of effect.
Low	Further research is very likely to have an important impact on our confidence in the estimate of effect.
Very low	Any estimate of effect is uncertain.

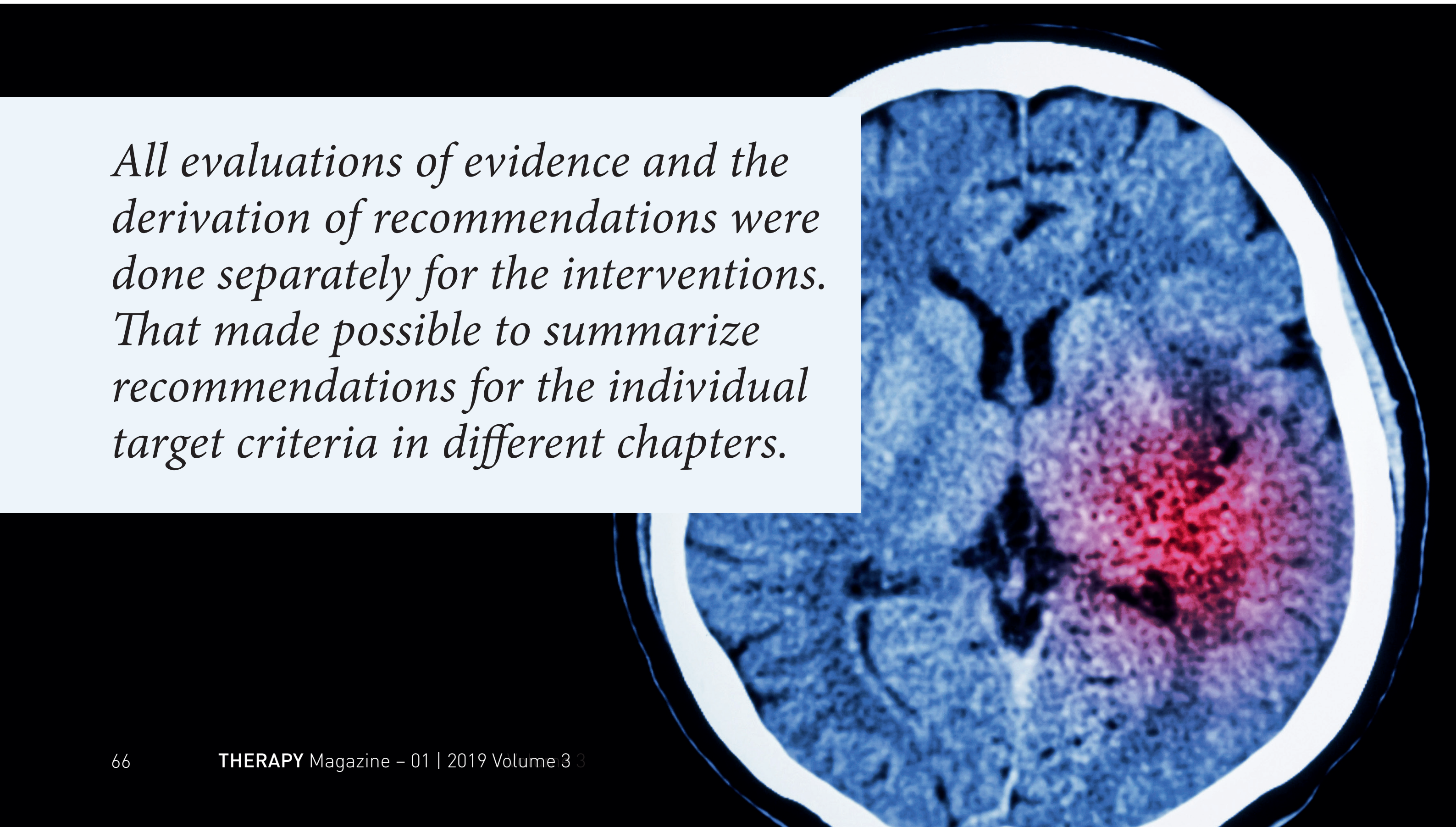
The recommendations are formulated on the basis of the evaluation of the quality of the evidence in the consensus procedure while taking into account potential risks and clinical benefits. Similar to other DGNR guidelines (for example the guideline for the rehabilitation of the upper extremities post stroke from Platz et al.) the following recommendation levels are used, which can be formulated both positively and negatively (ReMoS Working Group, 2015 at 365):

Table 2: Recommendations

Recommendation level	Positive formulation	Negative formulation
A	ought	ought not
B	should	should not
C	can be carried out	"cannot be recommended"
No recommendation		

In the formulation of the open recommendation, a distinction was made as to whether the recommendation takes effect on the basis of insufficient strength of evidence, for example a very small study, or due to lack of effects, including larger studies. Only in the first case is a "can" recommendation (0) expressed. In the second case, always a "no recommendation" was expressed by the authors

All evaluations of evidence and the derivation of recommendations were done separately for the interventions. That made possible to summarize recommendations for the individual target criteria in different chapters.



without specifying a recommendation grade (ReMoS Working Group, 2015 at 365).

Summary evaluation of interventions

As shown above, all evaluations of evidence and the derivation of recommendations were done separately for the interventions. That made possible to summarize recommendations for the individual target criteria in different chapters. The following overview should enable the selection of suitable interventions in a concrete case under a specific question (ReMoS Working Group, 2015 at 366).

Walking ability

A high number of steps carried out (number of repetitions) is a significant principle of treatment to improve walking ability. When selecting the therapies to use, a decision must be made when therapy is initiated as to whether the patients are able to walk or not. In the case of non-ambulatory patients, the following recommendations can be expressed (ReMoS Working Group, 2015 at 481):

Table 3: Attainment of walking ability in non-ambulatory patients (ReMoS Working Group, 2015 at 482)

	Subacute	Chronic
B (should):	– Intensive gait training, if available and feasible, including end-effector-based devices (e.g. Gait Trainer)	
0 (can):	– Intensive gait training, if available and feasible, including treadmill or exoskeleton-assisted devices (e.g. Lokomat) – Cyclical multichannel stimulation to generate gait-similar leg movements in the paretic leg when lying – Additional electroacupuncture – For patients with neglect : Specific neglect training	

Especially in the subacute stage, the high number of repetitions achieved, if available, including a training on an end-effector device (e.g. gait trainer). Alternatively, gait training can also be performed with an exoskeleton (e.g. Lokomat) or treadmill (ReMoS Working Group, 2015 at 481). Compared to the treatment of non-ambulatory patients, the device-support can no longer be seen as as preferential for at least assisted ambulatory patients (ReMoS Working Group, 2015 at 481):

Table 4: Improvement in walking ability in (restricted) ambulatory patients (ReMoS Working Group, 2015 at 482).

	Subacute	Chronic
B (should):	– Intensive gait training: conventional or including treadmill (possibly progressive)	– For patients with spastic equinovarus deformity: injection of botulinum toxin to reduce the use of aids
0 (can):	– Task-related training with movement imagery – Use of walking aids – Combination therapy of end-effector-based gait training (e.g. Gait Trainer) with functional electrical stimulation – Needle acupuncture including electro-acupuncture during intensive rehabilitation	– Support of treadmill training with VR
– B (should not):		– For patients with spastic equinovarus deformity: Thermo-coagulation of the tibial nerve

In these patients, conventional or device supported training (in this case usually with the treadmill) can be made relatively freely dependent on the possibilities of the facility, without significant differences in the result. If the treadmill is used, it should be used as progressively as possible (increasing the speed) (ReMoS Working Group, 2015 at 481).

Walking speed

If the aim is to improve the walking speed in ambulatory patients, progressive aerobic treadmill training can be considered as a gold standard. Also intensive walking practice with and without treadmill or an intensive supervised home exercise program can be strongly recommended. The same also applies to gait training with acoustic feedback (ReMoS Working Group, 2015 at 482).

For patients with initial (limited) walking ability, a step-synchronous stimulation of flexoreflex- afferent nerve pathways during walking training can be recommended in order to achieve a higher walking speed (ReMoS Working Group, 2015 at 482).

However, the use of a gait trainer or acoustic stimulation can also improve the effects of gait training in severely affected patients (ReMoS Working Group, 2015 at 482).

Table 5: Improvement in speed in (restricted) ambulatory patients (ReMoS Working Group, 2015 at 482)

	Subacute	Chronic
A (ought):	– Task-related progressive endurance training (in implementation treadmill or progressive circuit training)	
B (should):	– Intensive gait training without treadmill or – Intensive gait training including treadmill or – Intensive supervised home exercise programme (strengthening, endurance, balance) with progression – Gait training with stimulation of flexor reflex afferents	– Orthosis with electrical stimulation of the peroneal nerve (indirect effect)
0 (can):	– Intensive progressive task-related training – Task-related training with movement imagery – Walking training with gait trainer or Lokomat if device is available – Strength/endurance training – Isokinetic strength training – Strength/endurance training – Gait training with acoustic stimulation – Acoustic feedback while walking – Feedback/reinforcement (daily time measurement while walking with reinforcing feedback) – Combination therapy of gait trainer with functional electrical stimulation – Electroacupuncture – Ankle brace – Early orthopaedic shoe (4.10) – In case of severe arm paresis: arm sling	– Intensive progressive task-related training – Task-related endurance training, e.g. progressive aerobic treadmill training – Combination of treadmill training and variable gait training on the ground – Gait training with gait trainer if device is available – Additional backward walking training – Task-related strength training – Additional balance trainer – Strength feedback training – Additional VR-based training – Additional dual-task training – Movement observation – TENS on tendon transition of the spastic medial gastrocnemius – TENS on acupuncture points before task-oriented training – Ankle brace – Orthosis with electrical stimulation of the peroneal nerve (direct effect) – Toe separator with/without shoe – Repetitive magnetic stimulation in combination with task-oriented training
– B (should not):		– For patients with spastic equinovarus deformity: Thermocoagulation of the tibial nerve

Walking Distance

The following recommendations can be expressed to improve distance:

Table 6: Improvement in distance in (restricted) ambulatory patients (ReMoS Working Group, 2015 at 482).

	Subacute	Chronic
A (ought):	– Task-related progressive endurance training	
B (should):	– Intensive supervised home exercise programme (strengthening, endurance, balance) with progression – Task-related aerobic treadmill training – Intensive gait training including treadmill	– Task-related endurance training, e.g. progressive aerobic treadmill training – Orthosis with electrical stimulation (indirect effect)
0 (can):	– Task-related training with movement imagery – Gait training with gait trainer or Lokomat if device is available – Strength/endurance training – Additional strength/endurance training – Multichannel functional electrical stimulation during gait training	– Intensive progressive task-related training – Combination of treadmill training and variable gait training on the ground – Gait training with gait trainer if device is available – Ergometer training – Task-related strength training – Strength feedback training – Movement observation – Orthosis with electrical stimulation (direct effect)
– B (should not):		– Functional electrical stimulation with percutaneous wire electrodes

Improving the walking distance in walking patients requires in particular an increase in cardiopulmonary performance. The gold standard for this is aerobic endurance training, which should be carried out in relation to the task at hand, e.g. as progressive aerobic treadmill training (ReMoS Working Group, 2015 at 483).

Here, as well, an intensive supervised home exercise program can be highly recommended, as well as an intensive progressive task-oriented training or an isolated strength endurance training. Also in this case additional effects can be achieved through electrostimulation procedures, especially for severely affected patients (ReMoS Working Group, 2015 at 483).

Risk of falling, balance

The following recommendations can be expressed to improve balance:

An improvement in balance and a reduction in the number of falls cannot be achieved by specific walking training alone. The principle of treatment is a balance and mobility training in the subacute and in the chronic stage after a stroke (ReMoS Working Group, 2015 at 484).

Author's exclusions:

This article is a personal written summary of an official open access publication. This article is not an official document of the guideline working group. It can differ in parts from the original and may contain own interpretations of the author.

Table 7: Improvement of balance (static, dynamic, falls) (ReMoS Working Group, 2015 at 484).

	Subacute	Chronic
B (should):	– Intensive gait training without treadmill or – Intensive gait training including treadmill or – Intensive supervised home exercise programme (strengthening, endurance, balance) with progression – Motor relearning programmes	
0 (can):	– Gait training with end-effector or exoskeleton gait trainer, treadmill, if available – Additional ergometer training – Strength/endurance training – Trunk activities on unstable support surface - Additional biofeedback platform with advanced tasks – Acoustic feedback while walking – Needle acupuncture including electroacupuncture during intensive rehabilitation – Additional electroacupuncture – Early orthopaedic shoe	– Gait training with gait trainer or Lokomat if available – Task-related strength training – Exercises on unstable support surface – Exercise programme with systematic reduction of support surface and progression of perturbation – Customised exercise programme (balance, coordination) – Ai Chi (aquatic tai chi) – Movement observation – Additional biofeedback platform with advanced movement components – Additional VR-based training – Combined dual-task-based exercise programme
– B (should not):		– Functional electrical stimulation with percutaneous wire electrodes

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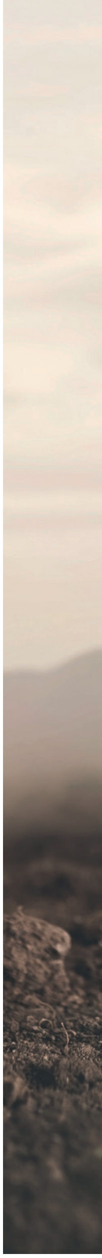
[4] **Guyatt Gordon H, Oxman Andrew D, Vist Gunn E, Kunz Regina, Falck-Ytter Yngve, Alonso-Coello Pablo et al.** GRADE: an emerging consensus on rating quality of evidence and strength of recommendations BMJ 2008, 336:924.

The original full text version and short version of the guideline, written in German, can be downloaded at http://www.dgnr.de/.

When mobility rehabilitation guidelines get smart

Jakob Tiebel



The first version of the S2e guideline on rehabilitation of mobility following stroke (ReMoS) was published in 2015. Today, almost four years later, implementation in clinical practice continues to be sluggish. For practitioners, it appears to be difficult to extract relevant core statements for daily practice from around 150 pages of continuous text with more than 250 abstractly-formulated recommendations. Thus the question arises as to how such weakly-structured data can and must be processed in order to enterclinical practice.

The aim of the "ReMoS-Mining" project, which began in the middle of last year, was to process the existing ReMoS guideline as a text, in order to make the knowledge contained in it accessible to a wider public in condensed form.

Using a bundle of partly algorithm-based analysis methods, significance structures were initially extracted from the text data of the guideline and summarised into key messages and recommendations.

The document editing was followed by the actual exploitation of the content, which included methods of classification, segmentation and dependency analysis. The aim was to summarise the content according to the problem or objective, to group it and to analyse it in terms of informative value and level of recommendation. Relational structuring in a data matrix allowed for further quantitative and qualitative analyses, as well as the application of dedicated filter logic to select units of information.

The processing and analysis was performed using the statistical software R and current packages downloadable for it online. R, as a well-known and powerful tool for the statistical analysis and evaluation of structured data, proved to be equally suitable as a tool for processing weakly-structured textual data in this context.

One extraction from the ReMoS mining project, as of now, is a dynamic web application that presents the contents of the guideline in a concentrated form and also reflects the results of exploratory data analyses that even remain hidden from readers of the full text.

The objective, of obtaining clinically-relevant guideline information in less than ten seconds which succinctly summarises the body of research on rehabilitation of mobility after a stroke, looks to have been achieved. Now we wait to see if, and to what extent, the efforts bear fruit. The project is, however, still in its infancy. In the long-term, the application is intended to evolve into a tool that optimally supports clinical decision-making for evidence-based rehabilitation of post-stroke mobility and, in addition to guideline recommendations, also generates concrete exercise and therapy suggestions, based on specific algorithms.

DOI: 10.6084/m9.figshare.7315355

Further information about the project at https://osf.io/cpdbw/

Key definition: Text mining deals with the processing and analysis of text data in order to use linguistic and statistical methods to develop patterns and unknown information from documents or natural language sources and to prepare them for users. The automated processing of textual data is not trivial, as that data is unstructured and highly dimensional. As a result, the text data in the process must first be structured and the dimensional characteristics reduced. For this purpose, text normalisation and dimensional reduction methods are usually applied. In order to be able to analyse text data, it needs to be transformed into a document matrix, in a second stage. From this, vectors are generated with which similarities are calculated. This allows the data to be clustered and classified, in a third stage, to identify topics, groupings or patterns. In the final stage, data mining, the data is analysed and visually processed. The findings, data relationships or patterns derived from these can then be used for further purposes.

Stroke Quiz

The therapies for treating neurological diseases such as stroke are continuously being optimised. Nevertheless, it is of course better not to suffer a stroke at all. As an expert, you are bound to be well-acquainted with the topic. Test your knowledge with our quiz.

Question 1:
The main risk factor for strokes is considered to be

☐ M | Alcohol abuse
☐ B | Anaemia
☐ S | High blood pressure

Question 2:
Which statement is one of the biggest mistakes concerning stroke?

☐ A | A cerebral vascular occlusion is more commonly the cause of stroke than a brain haemorrhage.
☐ T | Stroke cannot be prevented.
☐ X | There are warning signs that can announce a stroke.

Question 3:
Which of the following numbers, dates, facts are correct?

☐ L | Strokes generate around EUR 100 million in treatment costs in Germany annually.
☐ W | Over 50% of strokes are fatal.
☐ R | Even a reduction in elevated systolic blood pressure by 10 mm Hg and increased diastolic pressure by 5 mm Hg reduces the risk of stroke by 20%.

Question 4:
Which preventive measure is most effective?

☐ O | Adequate treatment of hypertension
☐ J | Regular brain training exercises
☐ F | There is no prevention.

Question 5:
Which warning signs can indicate a stroke?

☐ K | Sudden vision or speech problems, confusion, numbness or discomfort on one side of the body that fade away again
☐ P | Sudden facial pain
☐ U | Drooping eyelids of both eyes

Question 6:
How can you prevent a stroke in a practical way?

☐ R | It is possible to undergo a preventive brain operation.
☐ E | Medicines for lowering blood pressure and promoting blood flow can have a positive influence on the risk of stroke. Sometimes a blood vessel intervention is needed to improve the blood supply to the brain.
☐ L | A healthy diet with lots of fruit and vegetables is the only way to avoid a stroke.

Solution:

Quiz Answers

1) Correct answer: S
High blood pressure is and is likely to remain risk factor 1 until further notice. Untreated hypertension increases the risk of stroke by as much as twenty times. Although sickle cell anaemia, a hereditary form of anaemia, can lead to vascular occlusions, it is not among the leading risk factors.

2) Correct answer: T
It is no mistake that there are warning signs, and that a cerebral vascular occlusion is more often the cause of a stroke than a cerebral haemorrhage (80% versus 20%). One accelerator of cerebral vascular occlusions is arteriosclerosis. It affects the larger vessels supplying the brain and is closely linked to high blood pressure, but also to diabetes mellitus. This, in turn, tends to damage the smaller cerebral vessels.

3) Correct answer: R
In fact, the risk of stroke decreases with every millimetre of mercury (which is the unit of measurement of blood pressure) by which increased blood pressure decreases. It is therefore incredible that so many strokes still happen. Around 30% to 40% of strokes are fatal. Experts estimate that in the next 20 years around 3.4 million Germans will suffer a stroke if situations do not improve. That alone means annual treatment costs of over EUR 5 billion.

4) Correct answer: O
Brain training exercises the memory. However, it has not been proven that this would prevent strokes. With regard to lowering high blood pressure, medicine has certainly proved its efficacy. Therefore, lowering blood pressure is a substantiated medical treatment.

5) Correct answer: K
When symptoms of stroke that are generally recognised as warning signs recede, it is called a transient ischaemic attack (TIA), meaning that there was a transient disruption in blood supply to the brain. Only immediate diagnosis and therapy can prevent worse, and even be life-saving.

6) Correct answer: E
A healthy diet with less meat, but more fish and daily fruit and vegetables promotes vascular health. The diet should include more vegetable and less animal fats. The ideal is a healthy diet combined with sufficient physical activity.
A healthy lifestyle can lower blood pressure, but it is usually not enough if certain vascular risks or damage to the cardiovascular system are present. Untreated high blood pressure increases the risk of stroke considerably. Depending on the risk situation, comprehensive drug treatment is necessary; possibly also vascular surgery to improve blood supply to the brain.

Solution: STROKE

Source: Apotheken-Umschau pharmacy magazine
www.apotheken-umschau.de/Schlaganfall/
Quiz-Schlaganfall-17036.html#riddle

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