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THERAPY

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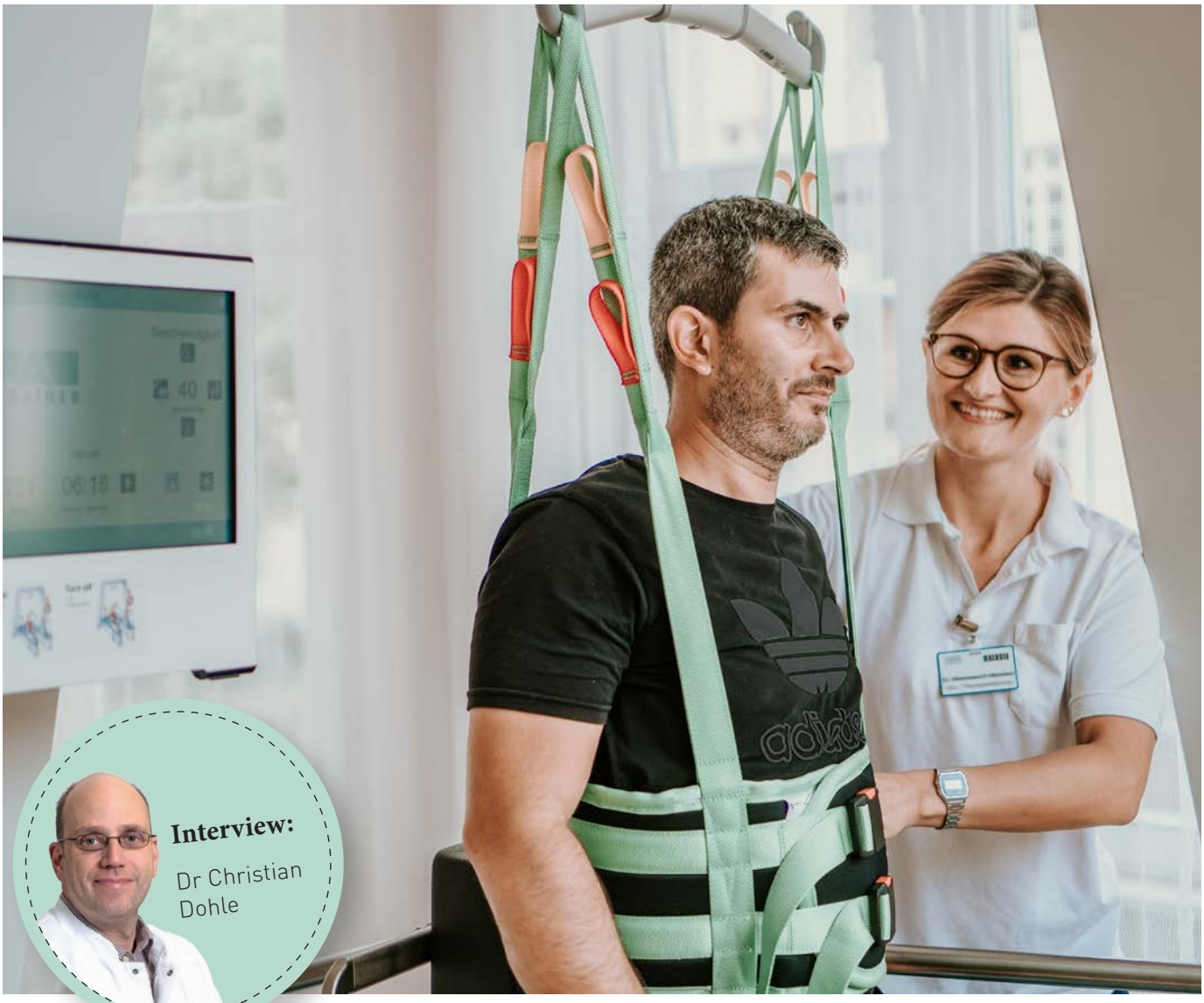

Training in neurorehab

INTERVIEW

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"In neurological rehabilitation, it is currently assumed that therapies have a dose-effect relationship. And for good reason!"

Editor Jakob Tiebel

FOREWORD

Dose and effect

Dear Readers,

At present, neurological rehabilitation is based on a dose-effect relationship which seems to be of central importance for the success of treatment. Numerous scientific studies in recent years have indicated that high-intensity therapies in particular are effective.

To this day, however, this topic has not received enough attention in day-to-day therapy. I am therefore pleased that, in his interview, Dr Christian Dohle, on behalf of the DGNR guidelines group, comments on the dose-effect relationship in the rehabilitation of mobility after a stroke.

In addition, Sabine and Hans Lamprecht provide a pragmatic and, at the same time, scientifically and clinically valid guideline for training design in neurorehabilitation.

I hope that you enjoy this issue and that these and all of the other articles will give you some ideas.

Jakob Tiebel

Contact the editorial team: therapy@thera-trainer.de

(Tell us what you think!)

The art of therapy is to take patients to their performance limits.

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Step by step – that's how it's done!

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COVER STORY

Constant repetition is the most important thing

Which therapies are particularly effective in gait rehabilitation? Dr Christian Dohle explains the current state of knowledge and the most important recommendations in an expert interview.

Interview: Mario Leisle

In order to provide doctors and therapists with professional orientation and to provide patients with optimal care, medical associations develop guidelines for treatment. In autumn 2015, the German Society for Neurorehabilitation published its guideline "Rehabilitation of mobility after a stroke". Dr Christian Dohle is one of the authors.

He is Medical Director of the Median Clinic Berlin-Kladow and member of the board of the German Society for Neurorehabilitation.

Mario Leisle spoke to him about the current state of knowledge and the most important recommendations.

Dr Dohle, why is it so difficult for many stroke patients to learn how to walk again?

With a therapist at their side, most patients in rehabilitation are able to get back on their feet very quickly. But often the necessary stability is lacking. I have to keep my balance, I have to be mobile, I have to be able to react to obstacles on the ground and I have to be able to turn my head when someone speaks to me. Walking is a complex process.

If you were to take a key lesson from the guideline, would it be "practice makes perfect"?

Exactly, the constant repetition is the most important thing. I need to keep practising what I'm trying to achieve. The important thing is to define the goal precisely: do I have to learn to walk, or can I already do it and would like to improve walking speed? This results in the optimal therapy.

To improve walking speed, you recommend task-based, progressive endurance training. What does that involve?

Progressive training means that we always adapt to the current performance level. The better the patient gets, the faster I set the treadmill so that they can improve further. Therapists call that "shaping". And, of course, they must have a gait-like movement. The treadmill is a device that combines these two approaches well.

The training should be intensive. Is there such a thing as "too much"?

Yes, there are clear criteria for endurance training in particular. We are guided by the heart rate, among other things. This is the art of therapy, to bring the patients to their performance limits and to keep them there, while not over- or under-straining them.

What can the use of modern technology achieve?

Robot-assisted training has been a domain of gait rehabilitation for quite some time. It is true to say that technology in itself has no value for rehabilitation. But for the therapists and the patients it would be much more expensive to achieve the same result by conventional therapy. The intensity and this high repetition rate would be very difficult to achieve conventionally.

Does this make successful gait rehabilitation a realistic possibility even long after a stroke?

Improvements are also documented in the chronic stage, only the effects are usually smaller. But if there is a certain ability there that can be trained, there will also be improvements. However, the training must then be intensive and high frequency. As an outpatient this will be difficult to achieve due to limited resources.

As a scientist in gait rehabilitation, where do you still see potential for further development?

We have taken an important step with this guideline by evaluating the current procedures. Interestingly, medication seems to be of little help to the lower extremities. We now have to differentiate even better between the methods we use for individual patients. Personally, I also believe that electrostimulation has much more potential. How best to use it will become clear in the coming years.

Can you explain the development of such a guideline to a layman?

It was a lengthy process, we worked on it for several years. We sifted through thousands of works and finally evaluated 188 studies from all over the world. There are meta-analyses for the common methods in which the results of several studies are summarised. The study situation is now quite good, so rehabilitation no longer has to hide behind acute neurology.

Dr Dohle, thank you very much for the interview!

SOURCE

Stiftung Deutsche Schlaganfall-Hilfe,
Thala – Das Gesundheitsmagazin, issue 3/2016.

Dr Christian Dohle is Medical Director and Chief Physician of the Special Clinic for Neurological Rehabilitation at the Median Clinic Berlin-Kladow and is also a member of the Executive Board of the German Society for Neurorehabilitation. As a member of the Guidelines Commission of the German Society for Neurorehabilitation, he played a leading role in the development of guidelines for the rehabilitation of the lower extremities after a stroke.

SCIENCE

Review of Physiokongress Germany

In January, the physiotherapy conferences "Physiokongress" and "Süddeutsche Verbände-Symposium" kicked off the year in Stuttgart. As in previous years, the TheraPro therapy and rehabilitation trade fair offered visitors a varied supporting programme.

Jakob Tiebel

As part of the neurorehabilitation day, the medical journal "neuroreha" celebrated its tenth anniversary and attracted physiotherapists and occupational therapists to the lecture halls of the Stuttgart trade fair centre with interesting, interdisciplinary topics. The opening event on the subject of digitisation and physiotherapy was a particular highlight of the congress.

Opening by Susanna Freivogel

Susanna Freivogel, neuroreha co-editor from the very beginning, looked back on the title topics of previous years in her keynote lecture "10 years of neuroreha – what has happened in this time and what are the next steps" and placed them in

a well-founded professional context in relation to current findings from science and research.

She emphasised the need to focus on the practice of activities in central motor disorder therapy. She referred to basic mechanisms of neuronal reorganisation, Hebb's learning rules and essential principles of motor learning, such as repetition and shaping. She also made it clear that compensatory phenomena can be tolerated without concerns in the context of active practice and must not be equated with spasticity or the pathological increase of a plus symptomatology.

Last but not least, Freivogel asked that we do away with phrases like "standing before walking" and "core is more". Postural control and walking are two completely different categories of motor learning which are equally important for the success of mobility rehabilitation and should be practised in a targeted manner. No single therapy method is superior here, but rather an intelligent combination of several specific measures.

Freivogel ended her lecture with a personal conclusion. From her point of view, evidence-based physiotherapy has become established over the past ten years particularly in the clinical field. She criticised the quality of outpatient aftercare. There is still a lot of potential here, although the first results of an ongoing study fail, not so much due to the will of the therapists as to the framework conditions set by the healthcare system.

Plea for more sport in neurology

In the talk "Sport and exercise in neurology", Prof. Dr Jan Mehrholz demonstrated his own physical condition. In his 30-minute speaking time, he sprinted through a broad range of topics in his usual casual manner. He had already announced an "evidence update" in the programme booklet – and there certainly was one! First, he presented some basic research findings on the topic of fitness and the influences of a healthy lifestyle. From this it could be deduced that endurance sports not only improve physical fitness, but also mental fitness. "If you want to be smart, do some endurance sports," he summarily told the auditorium.

He then focused on the topic of endurance sports for stroke patients. Stroke patients have decreased fitness reserves, muscle atrophies, a higher intramuscular fat percentage, increased signs of tissue inflammation and often glucose intolerance. Endurance sports can effectively counteract this, but unfortunately cardiovascular training is still far too little considered in the context of rehabilitation after a stroke.

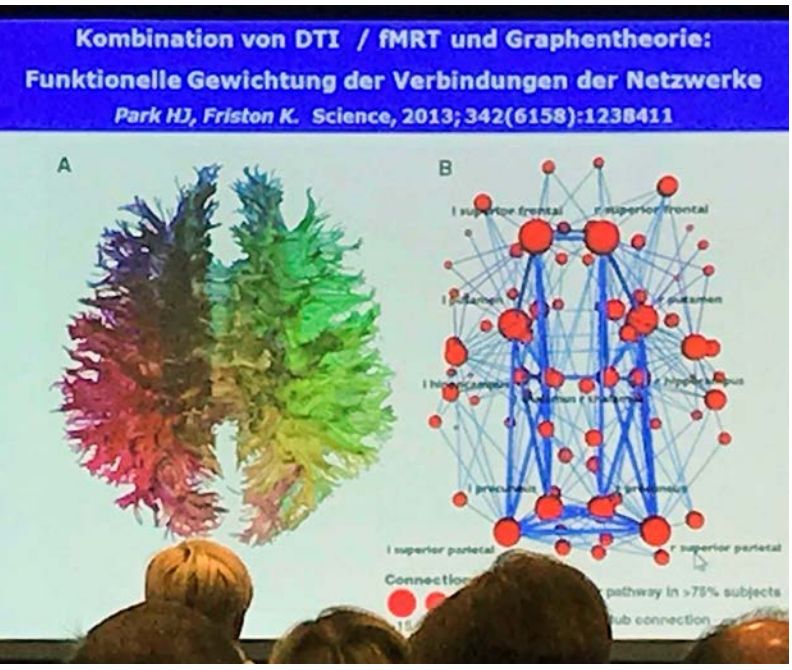
It is well known that a paradigm shift requires knowledge transfer. Mehrholz explicitly described to the audience how endurance training with patients can be structured – from performance measurement and training principles to concrete application protocols for the different phases of rehabilitation. He used the "FITT" criteria (cf. article on p. 56 in this issue) to describe the intervention and referred to the guidelines of the American Heart Association and the FAME Guideline of the Canadian Heart and Stroke Foundation with regard to training recommendations.

In the discussion that followed, the question arose as to whether cardiovascular fitness could be "caught up" if one was negligent in the past. According to Mehrholz, this is only possible to a limited extent. Another problem is that even after a stroke a couch potato will not turn into a fitness fanatic. The audience contributed that, for example, apps could have a stimulating effect and that under certain circumstances "psychological tricks" had to be used to motivate patients to be more active.

Participation is the goal

Occupational therapist Christina Janssen focused on the individual everyday life of patients. She said that ultimately participation is the goal and ICF, the International Classification of Functioning, Disability and Health, is the basis for neurorehabilitation. The editor of the magazine ergopraxis took up the ideas of previous speaker Susanna Freivogel and confirmed that pure functional improvement does not necessarily mean improved participation. An activity-oriented approach should be favoured. She focused on the idea of "enriched environments" and used experiments conducted by John Krakauer's research group to explain "why it is better to be a rat". In an entertaining way, she alluded to the high inactivity times of patients in rehab: the test rat in the laboratory has it better today with regard to activity than the patient in rehabilitation.

Janssen convincingly described how the transfer into everyday life – of which there is always much talk in therapy – actually succeeds by means of a patient example. From an occupational therapy point of view, the context factors according to ICF are of great importance. Environmental and personal factors can have beneficial and detrimental effects and should be consistently taken into account in therapy planning.



The idea of movement can complement motor learning

Martin Lotze, neurologist and neuroscientist at the Institute for Diagnostic Radiology and Neuroradiology at the University of Greifswald, described the advantages of mental strategies in the context of rehabilitation. On the basis of research results from his own and other research groups, he showed how mental strategies used professionally by athletes and musicians can be used in rehabilitation and what benefits result from this. In his conclusion, he presented mental training strategies as an effective addition to training. For example, by observing and imagining movement without the risk of physical overtraining, an increase in dosage can be achieved in therapy.

Music is effective in neurorehabilitation

Josephine Geipel, music therapist and research associate at the Faculty of Therapy Sciences of the SRH University Heidelberg, and Stefan Mainka, music therapist at the Beelitz-Heilstätten Parkinson's Centre, reported on the multifaceted application possibilities of music therapy in the context of neurorehabilitation. Using numerous patient videos, Mainka demonstrated the effect of music on the walking ability of Parkinson's patients and regretted that in many studies on rhythmic acoustic stimulation, music was reduced to the use of a metronome. In addition, he presented new methods of music therapy. An acoustic app developed by him, for example, improves the arm swing of Parkinson's patients.

When Siri and Alexa say what's what

Karmen Krewer, movement scientist and motor skills researcher at the Schön Clinic in Bad Aibling, reported on the REACH project, in which the Bad Aibling clinic is involved as a clinical partner and where sensors and wearables are central components. According to Krewer, the EU-funded research project is dedicated to topics such as motivation for more exercise in old age, the combined use of portable and environment-integrated sensors, data analysis for early detection and prevention (e.g. of falls) and personalised interventions, including maintaining mobility in old age.

Circuit therapy

Meta-analysis confirms effectiveness of circuit training to improve mobility and balance in stroke patients

Jakob Tiebel

Background

Various evidence-based interventions are proposed for the treatment of neurological dysfunctions in stroke patients. However, there is hardly any clear evidence for the effectiveness of exercises in a training circuit. By definition, circuit training is to be understood as an overall programme to improve strength, endurance, balance and other bodily functions.

Goal and methods

The aim of a review with meta-analysis published in 2018 by Ana Clara Bonini-Rocha's working group at the School of Physical Therapy, University of Brasilia was to investigate the effectiveness of circulatory circuit training for the treatment of mobility disorders in stroke patients. The scientists conducted a systematic literature search to identify controlled clinical trials. The standardised mean value differences (SMD) of the point estimators with their 95% confidence intervals were determined. The studies were evaluated by two independent experts.

Results and conclusion

Eleven studies met the inclusion criteria and eight presented suitable data to perform a meta-analysis. According to the analysis, circuit training is more effective in terms of walking speed than conventional therapy (mean difference of 0.11 m/s). With regard to balance and functional mobility, no significant advantages of circuit training compared to conventional therapy could be demonstrated. The researchers evaluate the results with evidence level I.

Comments

Although clinically relevant benefits of circuit training have only been demonstrated in terms of walking speed, it can also be considered as a proven intervention in terms of other outcome parameters (balance, mobility). Experience has shown that the required increase in therapy intensity can be better implemented in such a setting than in conventional forms of therapy. It is therefore essential to pay more attention to circuit training, which can also be carried out effectively in a group, in order to improve the mobility of stroke patients in the long term.

ORIGINAL WORK

Bonini-Rocha AC et al. (2018). Effectiveness of Circuit-Based Exercises on Gait Speed, Balance, and Functional Mobility in People Affected by Stroke: A Meta-Analysis. PM&R, 10: 398-409 doi:10.1016/j.pmrj.2017.09.014

Modern gait rehabilitation – where are we and where are we going?

After a short critical examination of the traditional strictly formalised therapy concepts, this article illuminates the essential cornerstones of modern gait rehabilitation. Here, the latest research results increasingly point to the fact that a comprehensive implementation of device-supported procedures is unavoidable, even in the outpatient aftercare sector. The paradigm shift in neurology is not yet complete – we are in the middle of it!

Jakob Tiebel

Are traditional methods still effective?

Traditional physiotherapeutic schools such as Bobath, Proprioceptive Neuromuscular Facilitation or Vojta hardly differ from each other in their effectiveness. Supporters of these schools assume a transfer from one learned motor task to the next. A monocausal chain is postulated which, according to the Bobath concept, regards sitting and standing, for example, as an essential prerequisite for walking.

Against the background of current findings on motor learning and functional recovery in central motor movement disorders, however, these views are hardly tenable. Despite all the criticism, however, the traditional methods still enjoy a good reputation today and sometimes determine the treatment routines, even though they hardly stand up to the increasing demand for evidence-based treatment.

DOI: 10.6084/m9.figshare.7756619

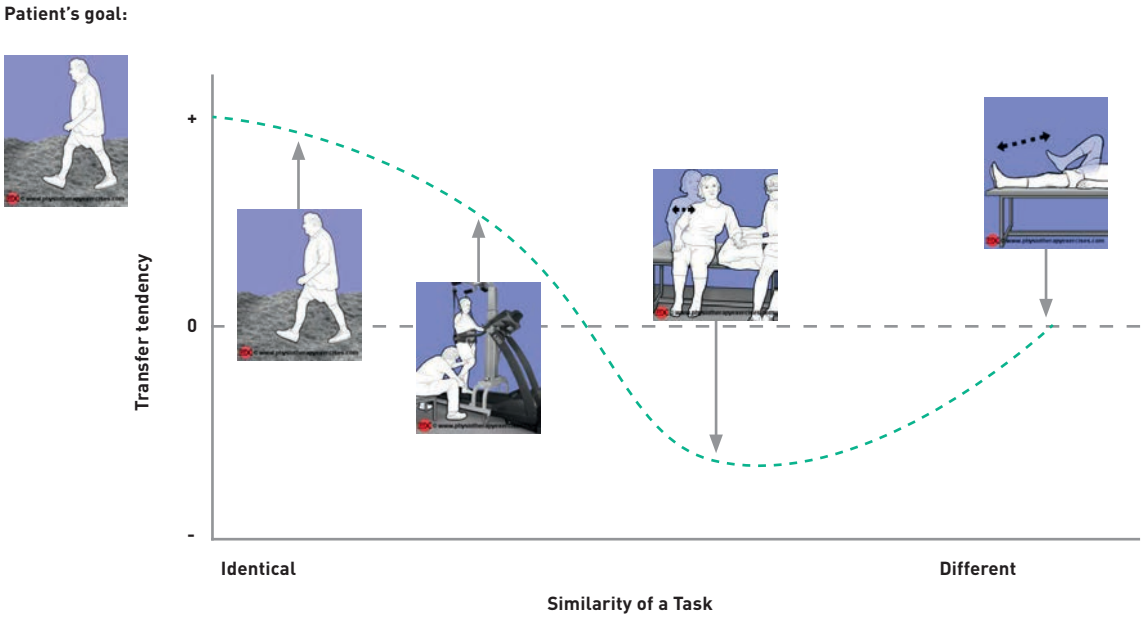


Fig. 1: The Skaggs-Robinson curve is derived from the hypothesis of the same name formulated by American psychologists Ernest B. Skaggs and Edward S. Robinson to describe the effects of similarity of presented learning content on retention performance. The more similar tasks are, the greater the learning transfer between them. The more different they are, the lower the transfer of learning. Similar tasks whose requirements diverge with regard to the learning objective can even have a negative effect on learning success (negative transfer). If there is a complete deviation from the learning objective, there is no transfer (zero transfer).
(Exercise pictures © by www.physiotherapyexercises.com).

Development of modern locomotion therapy

Fortunately, stance and gait rehabilitation has undergone a change in recent decades. In contrast to the strictly formalised therapy concepts, a task-specific repetitive approach has increasingly prevailed, in which the motor task to be learned is practised through the maximum repetition of the same task.

Modern locomotion therapy includes repetitive walking exercises even using modern gait machines and treadmills with safety belts. Where once the emphasis was on tone reduction and the practice of gait-preparation skills while seated, standing and walking are now practised in function as early as possible.

Phase classification in gait rehabilitation

Three essential transition phases with different objectives can be distinguished over the course of rehabilitation, according to the patient's limitations:

1. Mobilisation of the patient from the bed
2. Restoration of walking ability
3. Improvement of endurance (walking distance), walking speed and gait stability

Since stroke patients mobilised at a very early stage show significantly better functional recovery, the roughly formulated demands "wake up and move", "out of bed" and "learn walking by walking"

should generally be followed. Patients with haemodynamic instability naturally require a sensitive approach in the early phase of rehabilitation. However, exceptions should not become the rule. Experience has shown that this leads to the failure of all good intentions due to the demonstrably intense urge for individualisation of the therapy by the therapist.

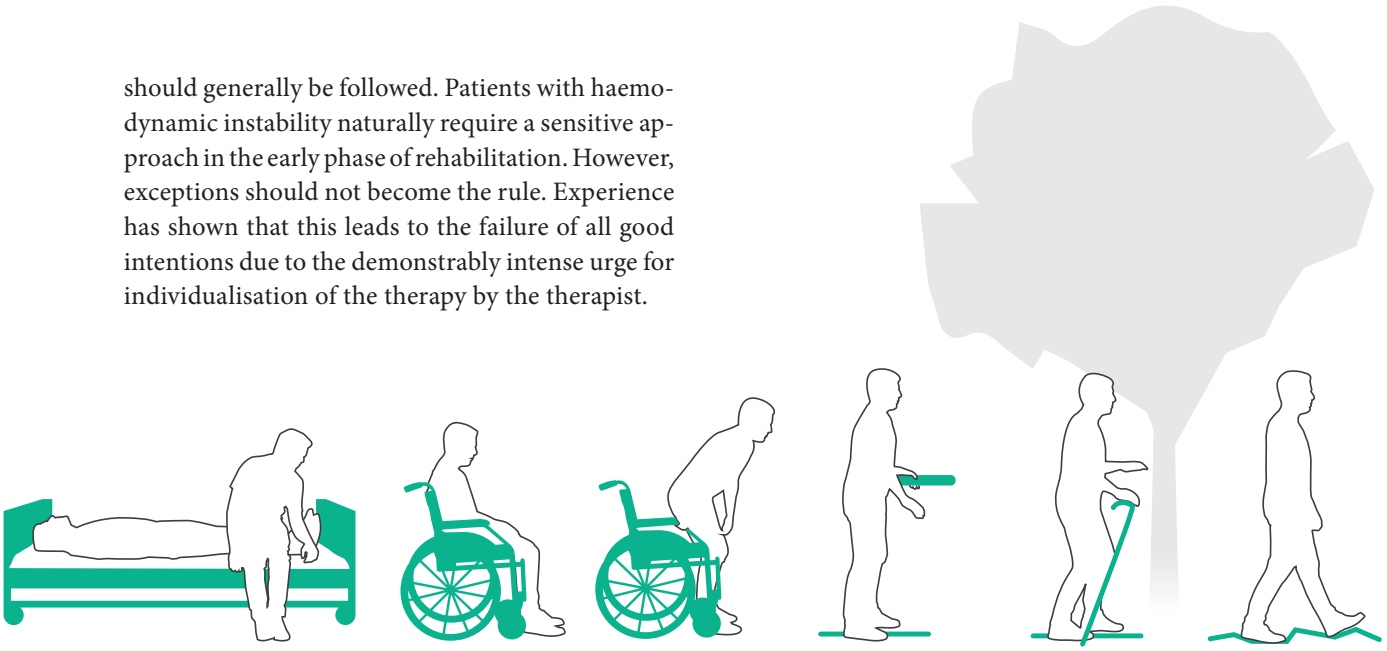


Fig. 2: The diagram shows the phases of rehabilitation of walking. According to current knowledge, however, these can no longer be regarded as rigid and formalised. Rather, the patient is in a continuum between the poles. With today's possibilities of modern locomotion therapy, the increasingly informative data situation and the easy access to monitoring possibilities, the boundaries are becoming increasingly blurred. The future will no longer be characterised by the inhibition of activity and movement, but will increasingly call for bold and confident therapeutic action, providing state-of-the-art, individualised services. Specifically, this means at the latest when a wheelchair-mobilised patient is able to sit at the edge of the bed and tolerates a verticalisation of at least ten minutes, then locomotion training should be seen as the next logical step in the treatment chain.

Robotics simplifies high-frequency therapy

If walking is practised by walking, the number of steps per training session seems to be essential for the success of the treatment, regardless of the technique used. However, the physical exertion associated with manual procedures is hardly tolerable for therapists. According to current guidelines, patients who are unable to walk should achieve 800 – 1000 steps per day. Therefore, it is always recommended to use a gait trainer to achieve the required therapy intensity. The gait trainer, with which the patient can practise walking repetitively while wearing a safety belt, does not replace the therapist. The use of a gait trainer as a supportive basis is more effective, so that according to current studies every fourth to seventh inability to walk can be avoided.

Prediction of walking ability after a stroke

The probability of being able to walk independently again after a stroke is vitally important for patients and their relatives. The ability to move independently determines the degree of independence in everyday life after rehabilitation and thus the necessary steps in hospital discharge planning.

Already in the first week after a stroke, the "TWIST" algorithm can be used to make a fairly accurate prediction as to whether and how well stroke patients can walk again after six to twelve weeks of rehabilitation. All that's needed is two simple motor tests, which can be carried out by the therapist at the patient's bed.

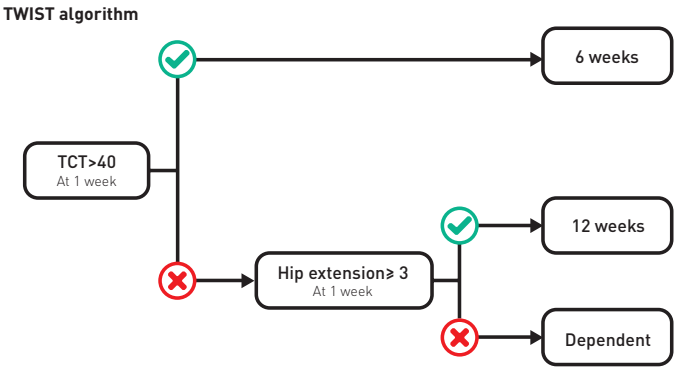


Fig. 3: The figure shows the TWIST algorithm. Patients with a TCT score >40 in the first week after a stroke are 95% likely to walk independently again after 6 weeks. In patients with a TCT ≤40, it is muscle strength in the hip extensions that is critical for the outcome after 12 weeks. Patients with a muscle strength ≥3 in the first week after a stroke can walk independently after 12 weeks. The remaining patients require assistance even after 12 weeks. They are unable to walk independently.

Marie-Claire Smith and her colleagues investigated numerous predictors for the recovery of walking ability after a stroke in a study conducted in 2017. Based on their analyses, they came to the conclusion that a fairly accurate prediction is possible on the basis of simple assessments (the trunk control test and the MRC hip extension force levels). The TWIST algorithm derived from the test results can support clinical decision-making and provide an outlook on the expected functional recovery (see THERAPY 2/2018, p. 27).

In addition, Mahendran and colleagues report in their 2019 publication that, in stroke patients, endurance at the time of discharge from hospital in particular can be regarded as a predictor of activity behaviour in the first 6 months (see article p. 56 in this issue).

New findings on the use of the gait trainer

According to experts to date, treadmill training is particularly suitable for patients who are already able to walk to improve walking distance and walking speed, and electromechanically assisted walking training is particularly suitable for patients who are not able to walk to restore walking ability.

The German working group headed by Jan Mehrholz and Marcus Pohl brings this into focus in its systematic review work with network meta-analysis published at the end of 2018 and produces some new findings. The evaluation included 95 randomised controlled trials with a total of 4458 patients after a stroke. Mehrholz and his colleagues state that "What is special about this network meta-analysis is that, for the first time, competing approaches to improving walking after a stroke were jointly evaluated and made statistically directly comparable, so that their effects could be assessed in a differentiated way." The work can thus be seen as a supplement to the previous Cochrane Reviews and meta-analyses.

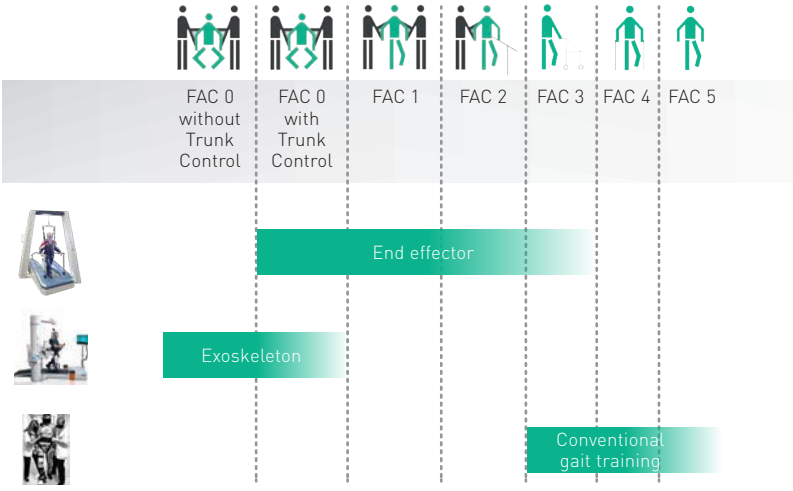


Fig. 4: As early as 2012, Mehrholz and his colleagues reported for the first time within the framework of a systematic review with meta-analysis on the possible advantages of end effector-based gait training compared to exoskeleton and conventional gait training. The results of the network meta-analysis from 2018 underline these findings, whereby end effector systems in the continuum of gait rehabilitation offer a broad spectrum of therapy options. They can be used sensibly, from restoring walking ability to improving walking speed and gait endurance.

In their results section, the researchers come to the conclusion that, compared to conventional gait therapy, end-effector-assisted gait training in particular significantly and clinically improves gait speed and gait endurance after a stroke. In contrast, treadmill therapy with partial body weight relief achieves significant and clinically significant improvements in gait endurance compared to conventional therapy.

Furthermore, the analyses, as well as earlier publications of this and other working groups, again point to the advantage of gait training with end effector devices compared to exoskeletal systems. However, there are still no controlled studies that directly compare the different device-specific approaches.

Clear recommendation in the direction of device support

In practice, the results mean that electromechanically assisted gait therapy, due to its demonstrable advantages, is currently probably the best therapy option for improving the various dimensions of walking.

According to Mehrholz and colleagues, the research results have significant effects on neurological rehabilitation. A comprehensive implementation of device-based therapy procedures in neurological gait rehabilitation is required. These demands have a particularly strong impact on the outpatient sector and its financing. A rethink is inevitable: away from traditional physiotherapy on a neurophysiological basis towards modern methods of device-based gait rehabilitation.

The dose brings success

In addition to the task orientation, a "dose-effect" relationship in neurological rehabilitation is assumed according to current findings in therapy science. It describes the relationship between exercise frequency, duration and intensity and the treatment result. The motto here is "more is better...". Reconcile this with the demand for task specificity and we can postulate: "...and a specific more is the best!".

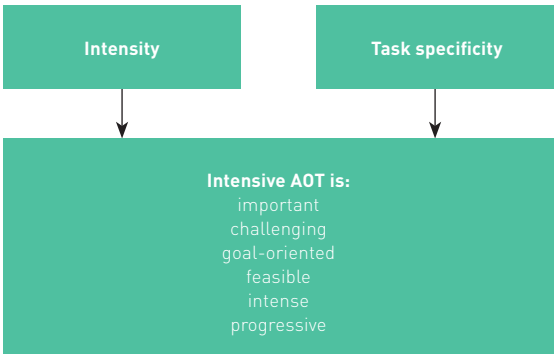


Fig. 5: Some important general requirements can be derived for the design of therapy in general and gait therapy in particular. It must be meaningful and challenging for the patient and correspond to their individual goals. Tasks must not be too easy or too difficult (i.e. feasible) and must be sufficiently intensive and progressively increased over time.

Standardised measurement methods in gait rehabilitation

The Functional Ambulation Categories (FAC) are particularly suitable for determining walking ability. With their help, therapists can quickly and intuitively assess walking ability in five steps in clinical everyday life. The result is decisive when, for example, it comes to dividing patients into subgroups for gait therapy according to their ability level (see THERAPY 2, 2017 p. 16).

The 6-minute walking test (6-MWT) is suitable for measuring the walking distance and endurance. Over a period of six minutes, the patient walks as quickly as possible on a flat track. A circuit that prevents abrupt changes in direction and tempo is most suitable for this. The distance travelled is measured by the therapist using a distance measuring wheel or the distance marked out.

The walking speed at self-selected speed or if necessary at high speed can be determined by means of a 10-metre walking test (10-MWT). The test is also very simple. Four points are marked on level ground. The first marking is the starting point (0 m). The second marking is at 2 m. The measuring person uses this as the time measurement starting point. The third marking is at 8 m: This is where the time measurement ends. The fourth marking is the end point for the test person (10 m). A distance of 10 m is marked, but the time is only measured

for a distance of 6 m. The time is measured with a stopwatch, the walking speed is measured in seconds and tenths of a second and then converted to metres/second.

For balance, the Berg Balance Scale (BBS) remains the gold standard, although the BEST and other specific assessments to determine the individual fall risk should not be completely ignored. The decision for or against a measuring instrument can vary depending on the evaluation.

Suggestions for further research

Future gait rehabilitation studies should focus on the dose-effect relationship (number of repetitions) and therapy intensity. According to Mehrholz and colleagues, systematic reviews should include individual patient data in order to be able to describe the effects of gait training even more precisely.

Furthermore, as already mentioned, there are still no controlled studies that directly compare the different device-specific approaches. This aspect, too, should be the subject of future research in order to back up previous findings regarding which systems provide the greatest benefit for gait rehabilitation and when.

In order to answer all research questions, multicentre studies with a sufficiently large number of cases will usually be necessary. This should be seen as a challenge and not as an insurmountable hurdle and should be well considered and calculated in the preliminary planning phase.

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Walk again despite Multiple Sclerosis

How Sharyn trains tirelessly and thus brings more activity into her life again – a field report.

Amali Perera

Sharyn has Multiple Sclerosis and has been engaging in physiotherapy at home through Advance Rehab Centre (a specialist neurological rehab centre in Sydney, Australia) intermittently since April 2016. Unfortunately, in December 2017, Sharyn had a fall that resulted in a right knee injury. Up until then she had been mobilising with a stick or a wheeled walker independently. However, since her fall, Sharyn experienced an exacerbation of the spasticity in her legs, particularly in her hamstrings. It was initially affecting her right side but later also affected her left side. The spasticity caused Sharyn to be more flexed in her posture and made it difficult to straighten her knees, with the knee being bent to 90 degrees at their worst. With increased spasticity, inability to straighten the knee and right knee pain, it caused Sharyn to require maximal assistance for a transfer and she was unable to walk.

Sharyn completed daily stretches to increase the knee range of movement, however this did not prove to be very effective in improving her knee extension. Due to limited capacity for standing at home, Sharyn attended Advance Rehab Centre to make use of the THERA-Trainer balo.

This device provided an opportunity for Sharyn to stand and weight bear safely with adequate support. As it comes with a harness, sit to stand power assist function, hip supports and a wide table for upper limb supports, Sharyn was able to gradually increase her standing tolerance.

Along with regular standing practice on the THERA-Trainer balo, Botox treatment, exercise physiology, physiotherapy and commitment to home exercises and stretches, Sharyn is now mobilising for distances greater than 60 meters with intermittent rests with minimal assistance and a forearm support frame.

The THERA-Trainer balo has been an important tool for Sharyn's recovery. It enables Sharyn to gradually build her standing tolerance safely and with adequate support. The posterior supports, knee guards and table for upper limb supports and the sit to stand function has been particularly useful to ensure that Sharyn was able to weight bear for a period of time to gain adequate stretch in her hips, knees and ankles. The foot straps effectively secure her feet in place given that Sharyn could have involuntary spasms that could move her feet out of place.

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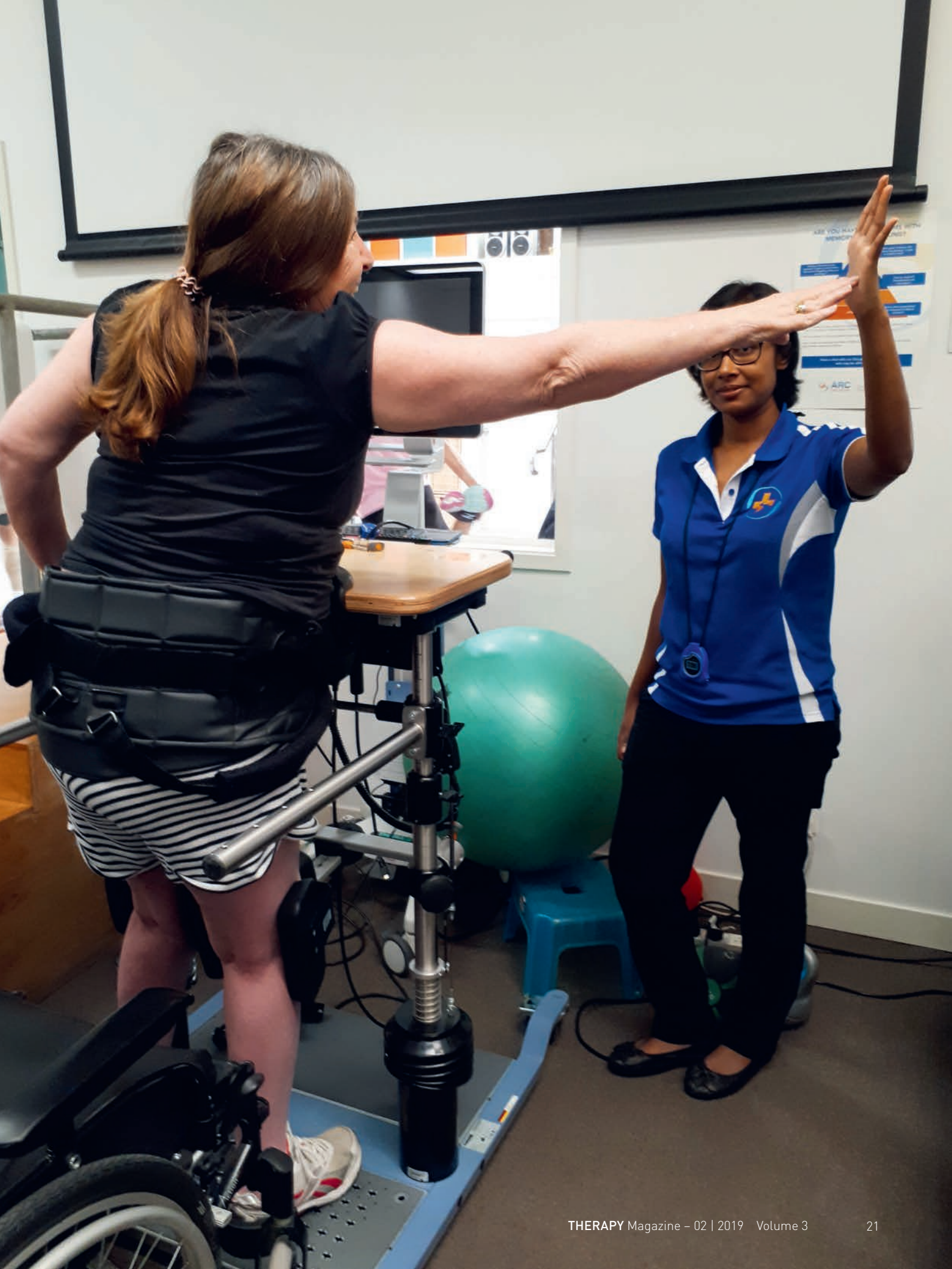

Sharyn has now progressed to the point that she is not heavily reliant on her upper limb support for standing. Therefore, she has been completing reaching and back strengthening exercises whilst standing in the THERA-Trainer balo. Sharyn has been able to focus on more functional upper limb training in standing.

The adjustable knee guards not only enabled comfortable positioning in the THERA-Trainer balo, but as Sharyn built her tolerance for standing, we have been able to gradually reduce the support, so that Sharyn can complete squatting exercises while being supported.

I would like to take this opportunity also to commend Sharyn for her commitment and positive attitude towards her recovery. Sharyn is always up for trying new exercises and pushing herself to her limits. Sharyn has been truly inspirational and never afraid of hard work.

A special mention should also go to Jim, Sharyn's husband, who is always there to back her up, help with exercises daily and cheer her on every step of the way! This year we will be working towards increasing walking endurance even further, improving independence with walking and turning with the long-term goal of weaning off the forearm support frame to use a 2-wheeled walker.

Congratulations Sharyn!

Amali Perera completed a BSc (Honours) specialising in neuroscience and her project investigating biochemical causes of Parkinson's disease and results were later published in Neurochemistry International. She then went on to qualify as a physiotherapist from Auckland University of Technology in New Zealand.
Amali has worked as a physiotherapist in New Zealand and across Australia within various settings and different specialties of rehab. She is passionate about optimising function, achieving goals and independence for her clients. She has now specialised as neuro physiotherapist and works at Advance Rehab Centre in Sydney – a leading multidisciplinary neuro rehab practice.

Theory-practice transfer in physiotherapy

In memory of the outstanding neurorehabilitation scientist Professor Dr Stefan Hesse

Jakob Tiebel

Do specialist papers on evidence-based physiotherapy contain implications that are sufficiently practically relevant? What about the exchange between researchers and practitioners? And how is the transfer of new theories into clinical practice structured? How much theory does evidence-based physiotherapy need in order to be practical? Opinions, attitudes and behaviour can vary widely on these issues. A look at the extreme positions paints a picture of a complete demarcation between theory and practice on the one hand, through to a targeted exchange between the disciplines on the other.

Some practitioners perceive the reality of neurological rehabilitation to this day as so complex that there is no theory for them that even comes close to doing justice to what they have experienced. Similarly, there are theorists for whom the purpose of research lies more in the theory itself and less in what exists outside. While some believe transfers from theory to practice only satisfy to a completely inadequate extent, others definitely do not believe that practical experiences could also have implications for research.

Still others assume that nothing can be more practical than a good theory and nothing more theory-winning than a well-functioning practice. The university professor Dr Stefan Hesse, who during his scientific life endeavoured to combine basic research with applied research, can be regarded as the scientific model of such an exemplary theory-practice transfer in neurorehabilitation. He thus rendered outstanding services to the development of new therapeutic methods for the treatment of stroke patients. He contributed ground-breaking work above all in the field of device-supported motor rehabilitation. He introduced innovations in locomotion therapy into practice very early on, sometimes even against resistance from the specialist field.

Professor Dr Stefan Hesse has had a decisive influence on neurorehabilitation nationally and internationally for more than 20 years. To this day, he is regarded as a pioneer for many therapy methods that are now established in day-to-day neurorehabilitation. On the third anniversary of his death on 6 August, we thank him for his outstanding work.

Cycling successfully in a team

How can patients be treated optimally in neurological rehabilitation? With conventional or device-based therapy? In individual treatment sessions or better in group settings? Therapists from the Sauerland hospital in Hachen have found that device-based training in the group has positive effects, especially on MS patients.

Melanie Schmitten and Lara Baum

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The Sauerland hospital with 125 beds is an acute hospital in the hospital plan of the state of North Rhine-Westphalia. Over time, the Sauerland hospital has become one of the most important neurological special clinics for multiple sclerosis patients in Germany. Around 2,800 patients from all over Germany are treated in the Sauerland hospital every year.

The hospital's recipe for success lies in the combination of many years of experience and current know-how in a multidisciplinary treatment team. Over the years, doctors, nursing staff and therapists have developed into specialists in the treatment of multiple sclerosis and form an interdisciplinary team.

At the Sauerland hospital in Hachen we treat multiple sclerosis patients in specialised teams of doctors, nursing staff and therapists. The disease symptom spasticity can only be treated optimally and effectively in such a team. It would not be sufficient to treat pronounced spasticity in the legs with medication alone.

At a glance

Summarised

1. Software-based cycling group training for MS patients is evidence-based, can be precisely controlled and motivates patients to train while having fun.
2. Positive aspects of group training are fun, togetherness, the promotion of social contacts and thus more motivation, which often leads to higher repetition rates.
3. Both therapists and patients benefit from device-based group training.

One of these therapies from the multidisciplinary treatment concept is medico-mechanical training in a group, also known as cycling. Since December 2017 we have been using the cycling equipment in combination with new THERA-Trainer software. Evidence-based, exact training control and playful motivation are just a few of the key words and reasons why therapists and patients alike enjoy working with it.

The therapy is structured in such a way that four patients practice simultaneously on movement exercisers connected to a computer. The devices can be used as arm or leg trainers and the level of difficulty can be individually adapted to each patient, so that even severely affected patients are able to participate in the training. You can also train in competition mode against each other or as a team.

"Fun games where you forget the time."

As therapists, we can choose from three different biofeedback games in the software. You can also work with different settings for the severity levels. The "Helicopter" game, for example, goes above and beyond. The aim is to move the helicopter up or down by changing the rotational speed in order to keep a floating balloon in the air.

On a bicycle tour through the hilly Sauerland, patients have to pedal purposefully, evenly, rhythmically but also quickly. Patients can explore the most beautiful corners of Holland together. The computer calculates the average speed at which the video route is played.

Particularly positive aspects of the training for those affected include having fun and working together with others, which also encourages social contacts. Through this unconscious training, patients often achieve a higher number of repetitions than when they sit alone at a seat bicycle and mindlessly pedal. The games can be designed to be fair thanks to the individual adjustment possibilities and the patients are often positively surprised by what they were able to achieve while their focus was on something else. This often comes to light in particular after 20 minutes at the end of the group training when the patients can see their own evaluation. This also often motivates them to become more even, faster or stronger in the next session and to get further.

The games are not only easy to understand for fit patients, but also for people with cognitive deficits. In addition to promoting cognition, motivation and coordination, they also promote various muscle groups. The tasks can be performed in both forward and backward motion.

By training as a group, we can achieve high patient coverage in the therapy session. This makes it particularly attractive for us as a clinic. Due to the simple operation of the hardware and software, the workload for the therapist running the session is manageable.
A survey of a patient selection showed that cycling leads to more motivation due to the high fun factor. Many patients reported an improvement in pain, spasticity and range of motion over time.

In the evaluations one could often see an increase of the driven distance and an improvement of the symmetry. Regular use has become very important for our patients.

All in all, cycling at our hospital is a therapy that no one wants to do without anymore.

"It's nice to do something in a group and forget you're doing something. It stimulates and motivates."

Lara Baum and **Melanie Schmitten** are physiotherapists. Since 2016 and 2007, respectively, they have been employed at the Sauerland hospital in Hachen with a focus on multiple sclerosis treatment. They work together in a team of 30 physiotherapists, occupational therapists, medical pool attendants, masseurs and speech therapists. In addition to Bobath, PNF and Vojta treatments, they also carry out robot-assisted training and therapeutic climbing. In recent years, they have specialised in neurological forms of therapy through various further training courses.

Across the living room without support

The rehabilitation centre MOTIONrehab has been incorporating the lyra into its intensive rehabilitation programmes. MOTIONrehab's client Avais has been happy to share his experience or how the lyra in combination with balo, other devices as well as 'hands-on' therapy has helped him regain the ability to walk.

Sarah Daniel

In May 2018 MOTIONrehab opened a high intensive rehabilitation centre augmented by robotics and virtual reality, the first of its kind in the UK. MOTIONrehab incorporated the THERA-Trainer balo and the end effector gait trainer lyra into the robotics suite. This remains the only facility in the UK to have the lyra.

Avais was born with Cerebral Palsy. He has always been dependent on a wheelchair. From the age of 4 Avais could walk short distances with the aid of a walker. However, as he grew and got older, he developed a crouched gait. This resulted in shortening of his hamstring muscles and his walking became increasing challenging. At the age of 9 he lost all ability to walk.

In 2015, aged 12, Avais underwent hamstring lengthening surgery. He found the recovery and postoperative rehabilitation period very difficult. He was prescribed gaiters to wear for stretching and intermittent therapy. Unfortunately, the therapy provision was not sufficient for Avais to regain his lower limb strength. Consequently, he was unable to stand or walk with his walker and became completely wheelchair dependent.

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Avais started therapy with MOTIONrehab on 1st October 2018. Avais' family brought him for an assessment for MOTIONrehab's Intensive Neurological Rehabilitation Programme. At the time, it was felt that Avais was too weak to complete the intensive rehabilitation programme (80 hours over 4 weeks) and it was decided that the team would start to work with Avais slowly, focusing on building up his strength.

Initially, Avais came to MOTIONrehab for two sessions a week and he has quickly developed his strength enough to increase to three sessions a week.

Avais has spent time working on improving his balance and control along with building up his strength using lyra and balo. Just four weeks later, Avais was able to walk for six minutes with his walker at home. Avais has continued to attend sessions on the lyra and balo with MOTIONrehab. He is now 5 months into his therapy. Avais is now able to stand independently. He can walk with his walker for 40 minutes with a few short rests. Avais has increased his mobility at home and he now uses his walker all the time around the house. Avais is very happy using his walker and feels his walking is now controlled and is no longer the struggle it used to be.

However, his greatest achievement to date is that for the first time in his life he can walk independently across the living room (approximately 10 steps), without the use of a walker or support from a family member!

MOTIONrehab are so proud of his achievements. Avais is a very strong and determined young man and he will only continue to improve. The lyra has provided Avais the opportunity to undertake high repetition training to increase his strength, stamina and walking abilities. He is one of many clients MOTIONrehab have been able to help with the THERA-Trainer lyra.

Sarah Daniel is the owner and director of MOTIONrehab. She qualified at St George's Hospital Medical School, London, with a 1st Class Honours Degree in Physiotherapy in 2001. She completed her Master's degree with a Merit in Neurological Physiotherapy at Coventry University in 2006. In April 2018 Sarah Daniel opened the UK's first intensive outpatient neurological rehabilitation facility augmented by robotics and virtual reality technology in Leeds.

About MOTIONrehab: The clinic provides intensive rehabilitation incorporating specialist 'hands-on' therapy with the robotic gait trainer lyra and the balance trainer balo. The centre was awarded two European grants for business development in April 2018 recognising the business innovation, employment creation and technological healthcare advancements that would benefit the local population. In November 2018 MOTIONrehab won an international business award for digital innovation from Google and The Financial Times, who recognised the innovation MOTIONrehab brought to the industry of neurological rehabilitation. Sarah and MOTIONrehab have collaborated with universities across the North of England to provide under-graduate and post-graduate training, external audit and research. MOTIONrehab have had two abstracts published to date and continue with a research in progress. The centre has been operating with great success and significant interest across the rehabilitation industry within the UK.

Therapy 4.0

Rapid growth in digital healthcare

Jakob Tiebel

Digitisation in the healthcare sector is progressing relentlessly. The influence of digital technologies and big data on patient care is high. The increasing understanding of the use and evaluation of complex data creates innovative application scenarios that will be of great importance for the therapy of the future.

To this day, traditional therapy control and patient monitoring are based on proximity between the patient and the therapist. Due to the increasing lack of resources in therapy and the increasing complexity of data collection, a complete collection of health-related data will only be possible in the future with digital support.

Against this background, continuous patient monitoring is becoming increasingly important. The consulting firm Frost & Sullivan expects wearables, remote rehabilitation and patient engagement to become established in industrialised countries by 2025. This is supported by the results of the market study "Patient Monitoring Industry – Analysis of Investment and Trends 2018".

Remote digital patient monitoring data, combined with simultaneous currents of modern measurement sensors, will drive digital change in patient care. Clinically relevant data will be captured around the clock and expand the possibilities of therapeutic decision-making. Patients and therapists will together be able to make better decisions, which will lead to a better use of existing health resources and ultimately allow therapists to spend more time with their patients.

Digitisation in therapy obviously has great potential. It could improve patient outcomes and treatment quality, optimise access to care and reduce costs. To illustrate the effect on the interaction between therapist and patient, a practical example illustrating the benefits:

Mobility recovery

According to current guidelines for the rehabilitation of mobility after a stroke, patients in neurological rehabilitation should cover at least 1000 steps per day in order to increase the chance of mobility recovery. But who can prove this at the end of the day? Movement sensors, which record the movement behaviour and the distance walked or the number of steps taken by patients, could in future detect a deviation from the target at an early stage and signal the need for intervention to the therapist.

TECHNOLOGY AND DEVELOPMENT

Robotics in rehabilitation

The development of robotics systems has changed the daily practice of neurological rehabilitation since the 1990s. Modern gait robotics systems support therapists in their daily work and patients in achieving their goals – but they cannot completely replace therapists and conventional therapy.

Martina Betschart

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For several decades now, patients with neurological complaints have received support from equipment. Robotics in rehabilitation can be explained as a system that can independently perform movements without the patient having to initiate them. The therapist's control over the specific settings of the movement, such as movement speed or duration of the training, is essential.

Development of gait robots

In the 1990s, researchers at the Swiss Federal Institute of Technology (ETH) Zurich developed a gait robot. With an "exoskeleton", attached to legs and feet, and a treadmill, paralysed patients could experience gait movements again. The patients are secured to the exoskeleton by therapists and supported with belt suspension. The number of steps, step speed and movement settings are specified by the therapist or researcher. This system and similar versions are still used today in rehabilitation and are being further developed in research.

Rapid further development

Since then, the field of robotics has experienced rapid growth. There are now different versions of robots in rehabilitation settings around the world for training patients to walk, learning to move their arms again or learning to communicate again after nerve damage to the speech system. The robots support the therapy, but cannot replace the work of the therapists. In physiotherapy and occupational therapy, movement is re-learned, for example, after a stroke, craniocerebral trauma or paraplegia. The consequences of the damage can be so severe that movements such as sitting, standing or walking are no longer possible independently.

The nervous system is adaptive

If certain nerve cells and connections are still present, intensive training can lead to partial or almost complete regaining of independence. Science has repeatedly confirmed the insight that intensity, repetition and early start of rehabilitation are the alpha and omega for the greatest possible recovery and learning of movements [3, 5]. High motivation and support by robots optimise the learning process [4].

Important role: motivation

Patient motivation is another confirmed factor that plays an essential role in rehabilitation. The use of robotics devices can motivate patients to regain a sense of movement. The recording of certain training parameters such as the number of steps, the effort required for strength or the coordination of movement provides direct feedback. Unfortunately, robotic devices can also deter and create fear. The patient is often fixed with straps and/or cuffs during training. Since the robot executes the movement, large forces act on the patients. If there is an existing fear of the robot, robot-assisted therapy is therefore contraindicated.

At a glance

Summarised

1. Modern gait robotics systems support patients in achieving their goals, and also support therapists in their daily work – but they cannot replace them.
2. Science confirms that intensity, repetition and early onset of training are essential when learning movement skills. The motivation of the patient is another important factor.
3. The manner, duration and frequency of robotics use should be adapted depending on the clinical picture. No general statements can be made on the superiority of robot-assisted therapy. What is certain, however, is that patients must be motivated and robotics help to mobilise patients earlier and more intensively.

Learning effect through repeated resistance

Knowledge of our musculoskeletal system and its control by the nervous system has shown that repeated resistance in movement processes – specifically and systematically applied – can also have a learning effect. Robots therefore "disturb" the movements of the arms or legs of stroke patients in order to trigger a "correction" of the movement. In addition to this supporting factor, robots also contribute to regaining the feeling for and knowledge of our motion system.

It is still important to discuss which complaints or complications require the use of robots, how, when and how often. For example, a combination of robot-assisted training and conventional physiotherapy is recommended for stroke patients. Accelerated work with robot-assisted therapy, on the other hand, is suitable for training gait speed and endurance [3].
In the field of paraplegia (incomplete paralysis) this topic is still being discussed [1, 2]. Here the assumption exists that conventional training on bars (on the ground) is rather advantageous.

The superiority of robot-assisted therapy has neither been proven nor completely rejected. There are no general statements and rules. It is important to understand our musculoskeletal system and how it learns and adapts to limitations and changed situations. This is the only way to consider whether robotics can support patients and therapists during rehabilitation. Research, medicine and therapy are still required here, and motivated patients are needed.

Armeo®Spring
(Hocoma, Switzerland)

Robotics at REHAB Basel

At REHAB Basel we work with patients who suffer various deficits in movement, speech and cognition due to an injury of the nervous system. Many of them can no longer make everyday or relevant movements independently. Robotics supports our therapists in mobilising severely affected patients at an early stage in order to stimulate the damaged structures such as the nerve tissue, stabilise the cardiovascular system and intensively promote learning of movements. In physiotherapy, we currently use three robotics-based devices. These are used for gait rehabilitation and stabilisation of the cardiovascular system. The devices have different support levels, so that different devices can be used for therapy depending on the degree of our patients' complaints. For example, patients on the monitoring ward who require permanent monitoring of the cardiovascular system can be safely vertically positioned and trained with the "Erigo". With the gait robot "lyra" from THERA-Trainer, patients who can otherwise only walk with the support of two therapists can train their walking ability and endurance. Thanks to the gait robot, the patient achieves many more steps than conventional training would allow. Early mobilisation and constant repetition promote the re-learning of movements.

Application of robotics remains a challenge

Simple walking with the therapist is indispensable, however, and supports the learning effect. The research findings are confirmed in practice at REHAB Basel: The use of robotics helps us to mobilise patients earlier and more intensively.

In combination with everyday exercise situations, this type of therapy gives our patients the chance to regain lost skills. The greatest challenge for us therapists is to define which robotics-based device is suitable for each individual patient, and who would benefit more from conventional therapy.

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Martina Betschart attained bachelor's and master's degrees in physiotherapy in Switzerland and has been working as a physiotherapist since 2010. In addition, she completed a PhD in Rehabilitation Science at the University of Montreal, Canada, from 2012 to 2016. Martina Betschart has been head of physiotherapy at REHAB Basel in Switzerland since 2016. She is involved in several projects and pilot studies and has already written publications for various scientific journals, mainly in the field of gait rehabilitation.


3.0
START
STOP

SCIENCE

PAD – arm training for the legs?

Peripheral artery disease (PAD) is an increasingly common disease in today's society. The current gold standard in physiotherapeutic PAD treatment is gait training on a treadmill or bicycle ergometer training [1, 6]. However, new findings show that training on an arm ergometer can have at least the same positive effects on walking distance and quality of life without triggering ischaemia-related claudication pain in the legs [8 – 11].

Raphael Weidmann, Erik Willems

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Theory

Peripheral artery disease is preceded by arteriosclerotic changes in more than 95% of cases. Even the smallest damage to the inner wall of the artery leads to chronic inflammatory processes, resulting in deposits of arteriosclerotic plaques. This reduces the arterial diameter and thus causes reduced blood circulation in the extremities. Classic risk factors are smoking, high blood pressure, diabetes mellitus, fat metabolism disorders and being overweight [3, 5].

The disease manifests in the lower extremities in over 90% of cases. Asymptomatic PAD has a prevalence of 15 %, and symptomatic PAD of 5 %, among the German population [3].

At a glance

Summarised

1 Peripheral artery disease (PAD) is becoming increasingly common. It affects the lower extremities in over 90 % of cases and is usually treated with bicycle ergometer or treadmill training.

2 In the disease, plaque is deposited on the inner wall of the artery, causing blood circulation to deteriorate. The disease is facilitated by smoking, high blood pressure and obesity, among other factors.

3 Several studies have investigated the effects of arm ergometer training on the maximum and pain-free walking distance of patients. Compared to treadmill or bicycle ergometer training, patients with arm ergometer training achieve similar or better results with regard to walking distance and subjectively perceived quality of life.

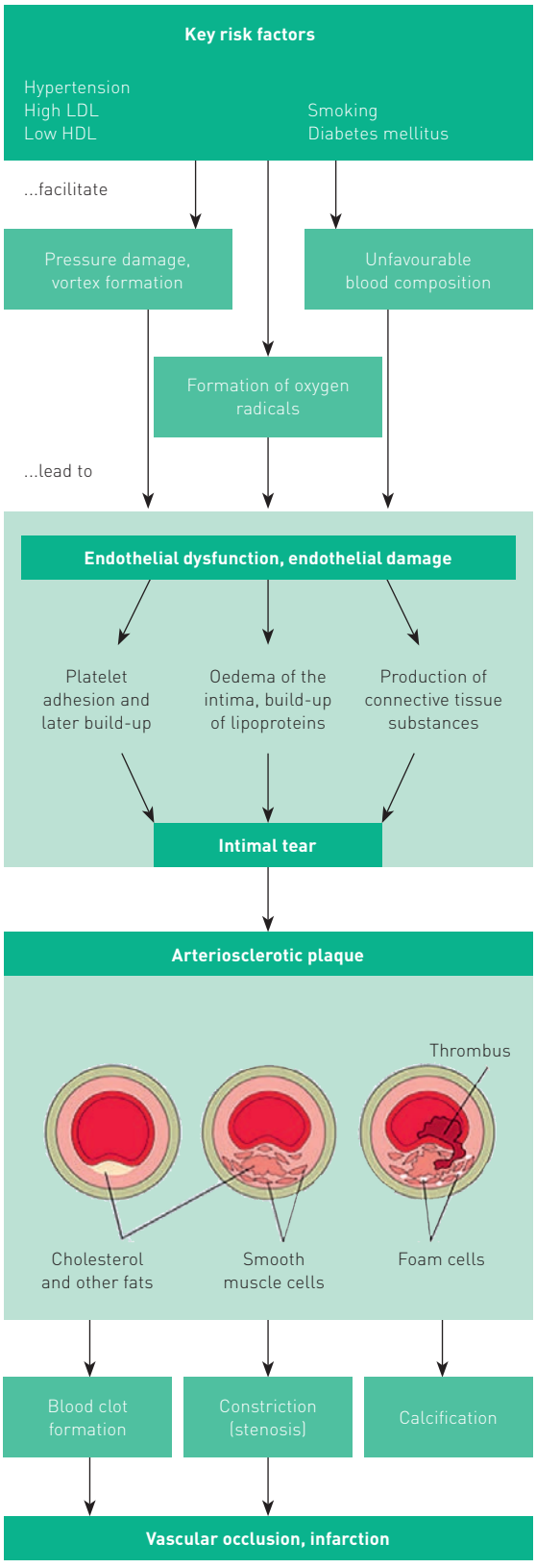

Figure 1: Risk factors, pathogenesis and consequences of arteriosclerosis [5]

The condition is most often categorised according to Fontaine's staging scheme [3]:

Table 1: Stages according to Fontaine

Stage	Symptoms
I	Freedom from complaint
II a)	Stress pain with a pain-free walking distance > 200m
II b)	Stress pain with a pain-free walking distance < 200m
III	Ischaemic rest pain
IV	Additional necrosis/gangrene/ulcer

Methodology

A literature search carried out on various health-specific databases yielded four relevant studies [8 – 11]. All four studies examined the effects of arm ergometer training on maximum and pain-free walking distance. In addition, one study investigated the effects on subjective quality of life, and another investigated the effects on oxygen saturation in the calf muscles. In order to assess the quality of the four studies, the PEDro score and an assessment grid for quantitative studies by Law et al. (1998) were used [2, 7].

Two studies can be rated as high quality and two as mediocre.

Discoveries

In the different intervention groups, arm ergometer training was compared with treadmill training, bicycle ergometer training and the combination of arm ergometer and treadmill training. In addition, a control group was present in each study. All intervention groups trained in a form of interval endurance training in which the intensity was adapted to the maximum personal performance of the subjects. Training took place either twice a week for 40 minutes or three times a week for 60 minutes under supervision.

After the interventions, significant improvements in walking distance were observed in the arm ergometer groups. In comparison with the treadmill or bicycle ergometer groups, similar or even better results were revealed. Based on the initial value, the pain-free walking distance in the arm ergometer groups could be increased by 33 to 83 % and the maximum walking distance by 29 to 53 %.

An astounding change in quality of life could also be observed. Patients who trained on the arm ergometer showed a significant improvement in their subjective quality of life after only six weeks. By contrast, fewer improvements were measurable in the bicycle ergometer group, and these could only be recorded 24 weeks after the start of training. The arm ergometer group was also better able to maintain this increased quality of life in the follow-up measurement after 72 weeks.

The researchers of one study wanted to use the oxygen measurement in the calf musculature to draw conclusions about blood circulation. The time to minimal oxygen saturation in the blood was measured by infrared sensors on the skin. After 12 weeks of training on the arm ergometer, the time to minimum oxygen saturation had been demonstrably increased by 65 %. This improvement could be due to increased blood flow to the lower extremity, but also to improved endothelial function or an increased ratio of capillaries to muscle fibres. Based on these facts, the question cannot be answered definitively – only further hypotheses regarding the effect on peripheral blood circulation can be made.

Practice transfer

In conclusion, a positive recommendation can be given for arm ergometer training for patients with stage II PAD according to Fontaine for improving pain-free and maximum walking distance, as well as for improving subjective quality of life. The 40-minute training model is recommended for implementation in everyday practice. It has a similar effect to the 60-minute model, but is less time-consuming to perform.

Arm ergometer training could also have great potential for patients with stage III PAD according to Fontaine. Due to the ischaemic rest pain, training of the legs is contraindicated and the patients are often bed-bound. Patients confined to bed only rarely have the opportunity to undergo training to prevent thrombosis and increase cardiopulmonary endurance, even though suitably adapted endurance training has been proven to have positive effects on the cardiovascular system and the associated mortality risk. Here, many patients could benefit from suitable arm ergometer training devices and actively improve their prognosis.

Arm ergometer training is thus an effective alternative and could increase the compliance of those affected [8 – 11].

Table 2: Structure of the 40-minute training model

Training structure	**Arm ergometer**
Frequency	2 times per week
Time	40 minutes total
Intensity	60 - 70 % of the previously determined maximum performance
Cadence	50 revolutions per minute
Interval	2 minutes training/2 minutes break
Special	Adjust intensity during intervention period

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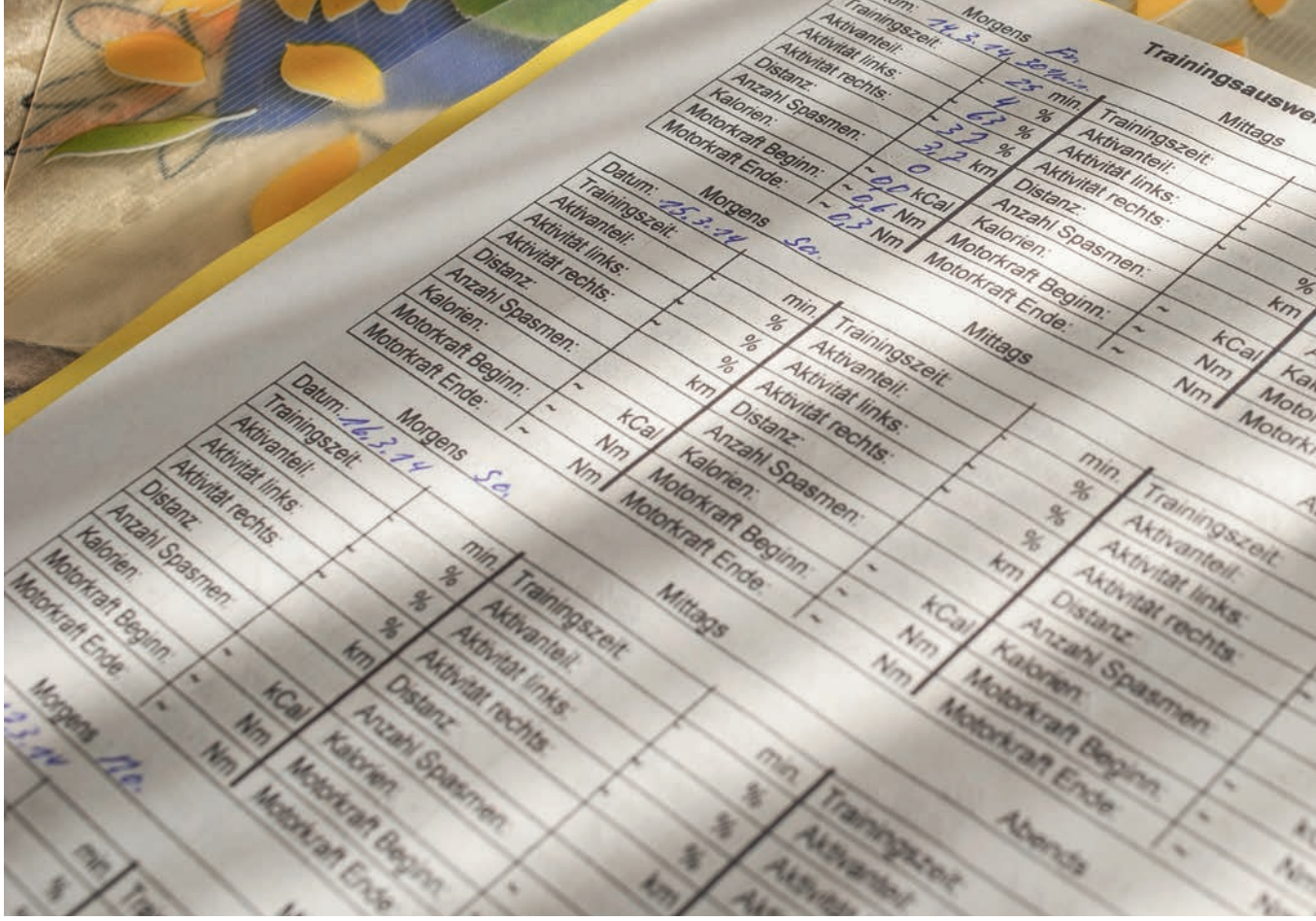


THERAPY & PRACTICE

Step by step – that's how it's done!

Jakob Tiebel

Mr Grunow is in a hurry this morning. The nursing service, here to help him care for his wife, came later than expected. Usually that's not a problem. The couple is now retired and the days when they needed to be punctual are long past.

It was different during their working lives. Both of them had a demanding job which kept them busy and gave them little time for each other. The couple had made preparations for the sudden disappearance of this pillar of stability in their lives – they didn't want their well-deserved retirement to end in boredom. Together they had decided to travel the world once more.

When they boarded the Orient Express three years ago to travel from Paris to Istanbul, on their way to discover Europe's most fascinating

At a glance

Summarised

1. After severe headaches, dizziness and unconsciousness, the patient is found to have suffered a stroke.
2. Despite her struggles, she does not lose her ambition to regain her old life and trains with a movement exerciser to avoid muscle loss and movement restrictions. She is enthusiastic about the intensive group training.
3. Even years after a stroke, patients can still achieve motor improvements.

metropolises, it was like a dream come true. They had been enamoured with the nostalgic long-distance train since long before the film adaptation of Agatha Christie's "Murder on the Orient Express" reached the silver screen.

The journey began, as Mr Grunow recalls, on a sunny day in late summer. When they had boarded the train's gold-lettered carriages in Paris that afternoon, his wife had still felt as fit as a fiddle. Everything seemed to be going just as they had long envisioned it. Who could have guessed that Mrs Grunow's journey would end shortly afterwards on the threshold between life and death?

After a wonderful dinner in one of the train's elaborately restored dining cars, decorated with Lalique reliefs, the two retired to their compartment for the night at the end of their first day of travel. They talked and laughed a little longer, and the only danger they thought they had to fear that night was a restless sleep after eating so much at the evening's sumptuous dinner.

It must have been in the early hours of the morning when Mrs Grunow suddenly awoke with a terrible headache. When she turned on the light, she was overwhelmed by dizziness. She closed her eyes, fell back into the bed and lost consciousness shortly afterwards. When she regained consciousness, her life had abruptly changed. The right side of her body was as heavy as lead. She was shocked to find that she had completely lost control of her limbs. When, shortly afterwards, two paramedics pushed her in a wheelchair through the station to the waiting ambulance, she was already starting to fear that she would never recover. Mr Grunow had arranged for the train to stop at the nearest station after noticing in the morning that something was clearly wrong with his wife.

At the hospital, the doctors explained to them that a blood clot had blocked one of the important brain-supplying arteries in Mrs Grunow's head. The nerve tissue of her left brain had therefore been deprived of oxygen for an extended period,

and had been destroyed. Mrs Grunow had suffered a stroke. The brain areas responsible for movement control were particularly affected. The right side of her body was completely paralysed, and this also caused the corner of her mouth to sag, as if fixed in an expression of grief and resignation. But what she felt inside couldn't have been more different – she was more determined than ever. The more Mrs Grunow found herself relying on the care of others, the stronger her ambition to win back her old life became. The next few months taught her just how laborious the way back into society was to become for her. Many times, she might have preferred simply to give up, had her husband not been there to keep inspiring her with new courage.

Unlike most cells in the human body, the brain is unable to heal itself. Mrs Grunow had to accept that the functions located in the damaged part of her brain had been erased. Her fate was more or less in her own hands. It was only through intensive training, she had been told, that she could ensure that her condition would gradually improve again. For weeks, she put all her efforts into rehabilitation. She underwent countless treatments in which she tried, by way of targeted movement exercises, to stimulate intact nerve cells in her brain to take over the tasks of destroyed brain areas and to return to her paralysed limbs at least a part of their original function. The clinic even employed a gait robot to help her get closer, step by step, to her ultimate goal of independent walking.

Even today, three years after the acute stroke, the paralysis in the right half of her body has not completely disappeared. However, thanks to the intensive therapy and with the support of her husband, Mrs Grunow can take a few steps around her apartment. But most of her life is still tied to the wheelchair. Her resolve to get back on her feet remains unbroken. The agonising feeling of only existing on the fringes of society, and no longer being part of it, spurs her on to something new each and every day. But this does not make the fight to find funding for further therapies any easier for her. As a chronic stroke patient, Mrs Grunow is often treated as if she will never be able to return to a normal life, and the progress she has been making has indeed diminished. But it is still there, and still measurable. Mrs Grunow meticulously keeps a therapy diary. Every day she trains with a movement exerciser, which she can now operate herself, and which helps her to avoid muscle loss and restricted movement in her limbs. In addition, she has physiotherapy and occupational therapy sessions several times a week.

Therapy is also the reason why everything needs to happen faster than usual this morning. After a lengthy dispute with her health insurance company, Mrs Grunow finally received approval for a long-awaited intensive therapy a few weeks ago. Not in a rehabilitation clinic, but in an outpatient therapy practice specialising in the treatment of stroke patients. Mrs Grunow's main goal is still to improve her ability to walk. Thanks to a special exercise program, which consists of modern robot-assisted therapy methods and intensive training focused on the challenges of daily living, there is now hope of getting even closer to that goal.

The conventional therapy that Mrs Grunow usually receives had lately been limited to short exercise sequences, mainly performed while sitting down, which had not improved her walking ability in the last few months. The intensive stroke rehabilitation programme is quite different.

Mrs Grunow's agenda now contains daily gait training at the limit of her performance. As the therapist explained to her during the consultation, "walking is practised by walking". This is confirmed by scientific studies. Another exciting aspect is that Mrs Grunow isn't simply treated on her own. The exercise programme takes place three to five days a week, and consists entirely of group sessions. Mrs Grunow was sceptical at first, but now she is enthusiastic. The achievements of the other stroke patients training alongside her help to spur her on. She knows all too well how difficult it can be to overcome one's weaker self. Training in a group makes everything so much easier. In addition, the group members all know each other well by now, and the well-deserved breaks between individual treatment sequences give them an opportunity to share their experiences.

After only two weeks of intensive therapy, Mrs Grunow has already made a great achievement on her way towards her goal. She walked a proud ten metres through the clinic without any help at all. Only her therapist accompanied her as a "guardian angel", while her fellow patients, the rest of the team of therapists and her husband – who is always at her side – clapped and cheered her on. Mrs. Grunow's motto ever since has been: one more step every day!

STEP BY STEP – THAT'S HOW IT'S DONE!

Expert opinion

Jakob Tiebel, occupational therapist

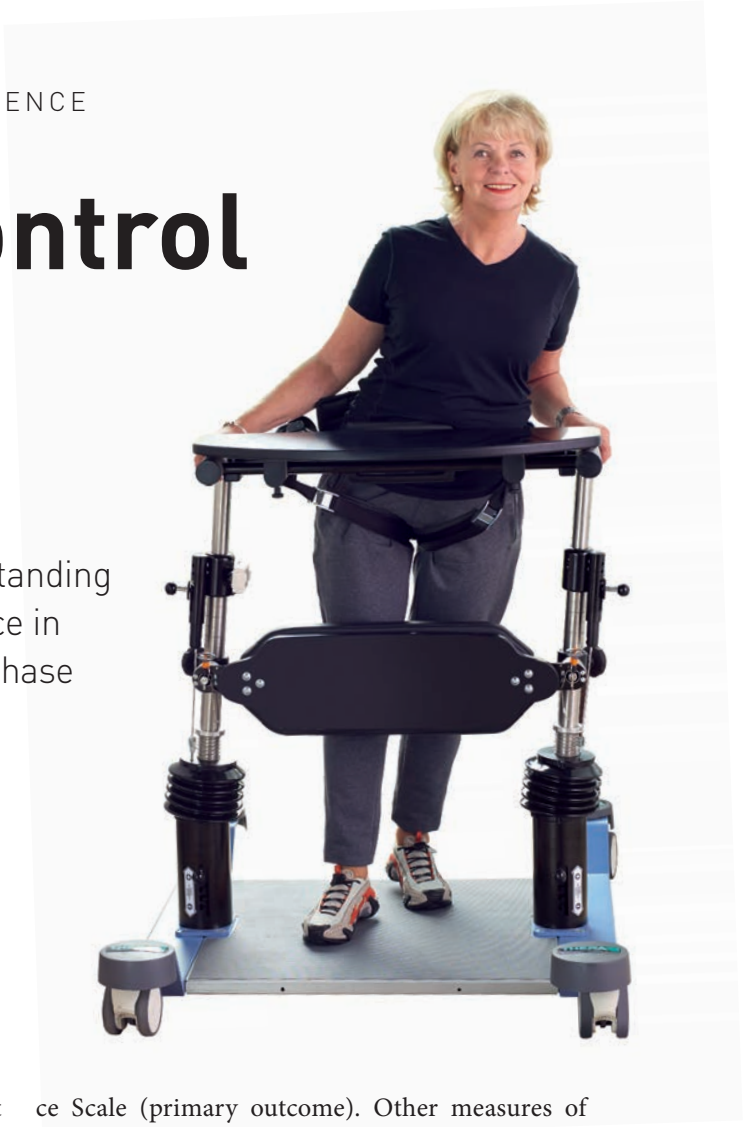
Along with traumatic brain injury, multiple sclerosis, Parkinson's disease and cross-sectional syndromes, stroke is one of the most common diseases in neurological rehabilitation. In Germany, the care of neurological patients is structured using the phase model of the Federal Association for Rehabilitation (BAR). In this model, outpatient rehabilitation and aftercare to promote participation in society is part of stage E. And there are plenty of difficulties here:

Traditional therapy strategies continue to be of great importance and make up a large part of the interventions defined in the catalogue of treatments. But given the lifelong plasticity of the nervous system, such strategies have long since ceased to be the most effective approach. Research results on the post-lesional reorganisation ability of the nervous system show that motoric improvements in therapy can still be expected years after a stroke. However, this requires that the affected persons are provided with suitable therapies that are consistently oriented to learning-theory models, and that focus is placed on intensive, task-oriented practice at the activity level.

Traditional therapeutic approaches only inadequately meet these requirements. Physiotherapy and occupational therapy on a neurophysiological basis and treatments according to the Bobath concept are clearly inferior to such evidence-based interventions in terms of effectiveness and efficiency. Nevertheless, they are preferred because they are billable, whereas the catalogue of treatments simply lacks reimbursement regulations for demonstrably effective therapy procedures. This dilemma is also relevant from a health economics perspective. Rising costs for treatment, rehabilitation and care are an enormous burden on the healthcare system. Care services must become more efficient in order to mitigate the consequences of neurological diseases, achieve the best possible integration into the workplace, everyday life and society, while at the same time keeping costs within reasonable limits. Legislation even explicitly requires, in Section 12 of Book V of the German Social Security Code (SGB V), that therapies used for this purpose must be expedient and economical. But today, most of them are not.

There is an urgent need for thorough optimisation in terms of effectiveness, transparency and economic efficiency in order to be able to guarantee a high quality of outpatient aftercare in the future despite the difficult framework conditions. An essential prerequisite is the implementation of evidence-based action and quality assurance measures. What are we waiting for?

Postural control training



Effects of training with a dynamic standing table on sitting and standing balance in patients after CVA in the subacute phase

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Abstract

Background and objective

One of the most common physical limitations that patients experience after stroke are balance problems. Serious balance problems due to stroke lead to dependency in daily activities and limited walking ability of the patient. At the moment the treatment options for balance training with severely disabled stroke patients are limited. The purpose of this study is to evaluate the preliminary effect of dynamic supported standing practice on sitting and standing balance by severely disabled stroke patients in the sub-acute phase.

Method

The study design is a quasi-experimental pilotstudy, the intervention consisted of usual care that includes either balance training in a dynamic standing frame (intervention group, n = 7) or conventional balance training (control group, n = 7) for 6 weeks. The preliminary effectiveness was assessed with the Trunk Control Test and the Berg Balance Scale (primary outcome). Other measures of physical functioning are Barthel Index, Motricity Index of lower extremity and the Functional Ambulation Category.

Results

In total there are 14 patients whose data was analyzed. Both groups were comparable at baseline. Between-group changes tended to be higher for the intervention group, but did not reach a significant level except for the Trunk Control Test (P = 0,014).

Conclusion

There are indications that a dynamic support standing table is an aid that can be used safely for practicing sitting and standing balance with severely disabled stroke patients. A large multi-center study would be needed to prove the preliminary effectiveness found in this study.

Part 1
stroke

COVER STORY

Training in neurology and geriatrics

Using various neurological and geriatric clinical pictures and symptoms, we want to show how an effective training scheme can be designed. In this series, we will consider stroke, multiple sclerosis (MS) and Parkinson's disease as the three most common diseases in neurology and, with the exception of MS, also in geriatrics. In a further instalment, we will deal with the importance of training for older people.

Sabine and Hans Lamprecht

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An important finding in recent years in the field of neuro- and geriatric rehabilitation is that training and training principles should be applied to achieve sustainable success.

Training does not always have to take place with devices – training without equipment can also be effective. Devices help to make the training easier to compare and to present objectively, as well as allowing patients to train at their individual performance limit. Increases in performance can be clearly documented and often help motivate the patient to continue training.

If the devices are additionally combined with visual or acoustic feedback, the training effect is often clearer and motor learning is easier. The training motivation is increased if the devices have games in which the patients can earn points, for example. In such cases, patients often do not notice that they are training on the device for much longer periods, and therefore reach a significantly higher performance.

Everyone likes to play – whatever their age

When patients achieve success, the important neurotransmitter dopamine is also released, which brightens their mood and helps with motor learning.

These effects can also be achieved without equipment, but therapists or relatives must then provide the necessary framework conditions. A fun and encouraging atmosphere, plenty of praise and a little competitive spirit are all helpful for the motivation of neurological and geriatric patients. The therapists should offer a lot of praise to the patients undergoing training, and report back to them clear improvements based on figures. [6]

The first instalment in this series deals with stroke, the most common neurological disease in our society.

The prevalence of patients with stroke (CVI = cerebrovascular insult) will continue to rise in the future due to demographic developments and will thus remain a very common clinical picture in both neurology and geriatrics. [3]

At a glance

Summarised

1 Sustainable and effective training in neurological and geriatric rehabilitation should be based on certain training principles in order to achieve long-term success. With the help of equipment, training at the patient's performance limit is easier to achieve and more convenient to compare.

2 Praise, a certain competitive spirit, and success during training all help to elicit feelings of happiness, increase patients' motivation and aid motor learning. Games also provide more motivation and significantly better performance during training.

3 Stroke patients, in particular, should undergo intensive training as early as the acute rehabilitation stage – preferably with the use of aids. Both endurance and strength should be trained – at the patient's performance limit if possible.

The cause of a stroke is either ischaemia, which can often more easily be treated medically – the stroke units provide a valuable contribution in such cases – or, in a significantly lower proportion of patients (approx. 15 to 20%), bleeding, in which case lysis treatment is not possible and more severe progressions can often be seen.

Since the site of the damage is often located in the bend of the middle cerebral artery, hemiplegia of the contralateral side occurs, mainly affecting the arm. It is important to mention this here, because we have stroke patients who cannot move the arm, or can hardly move it, due to the damage site alone. A stroke causes damage to the upper motor neuron (upper motor neuron syndrome, UMNS). This means that patients show a more or less pronounced weakness, while spasticity only develops

over the course of time. [4] The more patient activity can be achieved in the early phase, the less spasticity will develop. In the upper extremity, however, flaccid paresis can persist for years.

Effective training for stroke patients

Intensive walking exercises should be started as early as the acute phase [2]. Aids such as walking frames or rollators (with lower arm rests on which the affected arm can be easily supported if necessary) should be used. Often acute wards and stroke units have no gait trainers, but are instead equipped with movement exercisers or a bed bicycle. These should be used for intensive cardiovascular and endurance training. Since a stroke immediately leads to negative symptoms of upper motor neuron syndrome (UMNS), it is absolutely necessary – if possible – to begin training with resistance. In the case of the upper extremity, the arm should be fixed with appropriate aids so that it can be moved.

If weakness occurs when subluxation is present, the patient must be fitted with a shoulder orthosis [5]. Unfortunately, the guidelines state that stroke patients only need a shoulder orthosis if they are able to walk, but this does not correspond to everyday life. If the patient has a painful shoulder or the therapist notices pronounced subluxation, the stroke patient must be provided with a shoulder orthosis at least during training and, if the shoulder is painful, also while in a wheelchair.

In summary, stroke patients need to walk intensively with the help of aids, even in acute rehabilitation, and must also intensively practice gripping. Mobilisation should not only take place in the wheelchair, and patients should not practise while sitting – and certainly not while lying down – if they are able to walk.

More intensive training is necessary in rehabilitation. This is where gait trainers and treadmills come in. For the upper extremity, movement exercisers such as tigo or balance trainers – including those with balancing and step triggering functions – can be used in addition to training of the distal functions.

Stroke: general training principles

There are many indications in studies that training in the aerobic range, for example, improves the cardiovascular situation. The load control should be based on the training control for heart attack patients.

The guidelines of the American College of Sport Medicine and the American Heart Association recommend:

- –> Training 3 to 5 times/week for 20 to 40 minutes
- –> Training with 50 to 80 % of the maximum heart rate
- –> Documentation of the results (10-metre walk test, 6-minute walk test, force test)
- –> Strength training always with one leg
- –> 10 to 12 repetitions, 3 series each with pause

The training should always be at the limit of the patient's performance and be carried out for at least 4 weeks before success can be measured. Many studies have shown that strength training in stroke patients leads to an improvement in the functions trained, with no increase in spasticity or pain. Even high-intensity strength training leads to an improvement in strength and functional abilities.

Training principles with the lyra gait trainer

Speed

At the beginning of rehabilitation, a high number of step repetitions is the goal. International guidelines recommend at least 800 steps. [1] For severely affected patients, these repetition rates can actually only be achieved with a gait trainer. The walking speed must be set to as quick as possible. Often only a higher speed makes it possible to find the right gait rhythm, improving symmetry and thus making walking easier for the patient. The training is therefore more relevant to everyday life and walking becomes automatic. Even severely

affected patients should reach a speed of around 1 km/h in the first sessions. Of course, this depends on the individual – but faster is easier!

Later on, specific attention must be paid to an increase in speed. The higher the speed, the easier it is to walk. For more experienced patients, the minimum speed can be increased to 2.6 km/h. Even the 4 km/h that the lyra goes up to is slower than we would normally walk, but is entirely sufficient for the patients. In general, the patient should not be assisted in any way, as this disturbs motor learning. Remember: if the focus is on speed, the patient can of course hold on to something for support. The patient may and should also look at their feet, as they can learn more effectively from the visual feedback.

Endurance

In addition to speed, the time for which the patient can walk is also a focus. It is important that the patient walks for as long as possible. They can also be allowed to sit briefly on the lyra to rest. The recommended endurance training is interval training at the fastest possible pace, but most importantly for the longest possible time. The metres walked are noted as the target parameter [7]. Step length can also be considered, but this is less important. The most important aspects of gait training are speed and endurance.

Even balance can be trained in the lyra. In this case, the patient should no longer hold on to anything – or only onto mobile objects such as Thera bands. Focus can now be placed on the patient

looking right, left and upwards. This will help them train sensory balance. Of course, motor and cognitive dual-task training can also take place.

Weight relief should be minimal and should take place only when necessary, and should be dynamic so that the relief can adapt to the patient's gait. This enables the patient to support their own weight as far as possible.

Training principles with the movement exerciser

Upper limbs

During movement training with the arms, the focus can be either on endurance in the sense of cardiovascular training or on strength with appropriate resistance. The affected hand should always be moved along with the arm, even if it has to be supported or fixed. If the therapist has concerns about the shoulder, a shoulder brace should be used. If the shoulder is painful, exercise should be carried out on a raised seat or while standing up, so that the arm is not flexed more than 60 degrees. If the focus is on strength, appropriate resistance must be used. In this case, instead of taking a hesitant approach, it is important to determine the patient's performance limit. This is the individual reference point for controlling the strength requirement.

Strength training

Yes. We know that strength is also essential in the upper limbs in order to reduce evasive movements and make activities possible. Damage to the upper motor neuron leads to negative symptoms, which can and must be alleviated with strength training. The DGNR guideline for "Motor Therapies for the Upper Limbs in the Treatment of Stroke" classifies arm pareses according to strength values and recommends strength training.

... even with spasticity

That's right – because the positive symptoms are sustainably reduced by activity or strength training. Functionally, the positive symptoms of UMNS are reduced to the extent that activity or strength is improved. Even with severe arm pareses, activity and individually adapted resistance


THERA

loosen the arm both temporarily and permanently. If the arm gets tired, a temporary increase in the positive symptoms may be observed.

Limits of tigo training for arm motor skills

As therapists who focus on functional ability and everyday activities, we know that distal function is what makes arm activity possible in the first place. The grasping function must be accorded central importance in therapy of the upper limbs. Training with the tigo does not reach this function – however, the proximal musculature can be usefully trained.

Lower limbs

A movement exerciser allows targeted endurance and strength training of the lower limbs. It is up to the therapist to decide whether targeted endurance training is performed with the upper limbs to achieve the above effects or whether activation of the lower limbs is preferable. Since endurance training requires as much resistance as possible, as quickly as possible and – most importantly – for as long as possible, short breaks should be planned and exercises repeated up to three times.

For example:
-> 5 minutes upper limbs
-> break (1-2 minutes)
-> another 5 minutes upper limbs
-> then 5 minutes lower limbs

Note: For all parameters, the patient's performance limit should first be determined and the training should then be individually adapted.

Strength training with the movement exerciser

During training with the tigo, the lower limbs as well as the muscles important for walking (dorsal flexors, calf, quadriceps and hip flexors) are activated. For this reason, resistance training with the tigo is a very sensible supplement to gait training for patients who have suffered a moderate to severe stroke. Here too, it is important to train at the patient's performance limit and to make sure that the affected leg is activated.

The tigo movement exerciser can generally be used for targeted endurance and strength training of both the upper and lower limbs.

Training principles with the balance trainer

The balo balance trainer can simply be used as a standing frame for severely affected patients. It is especially important for severely affected patients to stand during the early phase when walking is not possible.

We know that alertness plays a major role for patients with neglect, so it is better to carry out optical stimulation, gripping exercises or mirror therapy to treat the neglect while the patient is standing up, as they will have a higher degree of alertness than when sitting.

With pusher syndrome, the best approach is to move forwards and backwards with the balo along with visual feedback and games, and then gradually switch from the sagittal to the frontal plane.

Balance training

The patient can practice actively shifting their balance at all levels and thus train proactive balance.

Thanks to the spring resistance, the right side is activated more when moving to the left side and vice versa. If a patient has a hemiparesis on the right side, there should be more movement to the left side. The balance must be actively shifted by the right side. It is also important to work with the spring resistance. If lower spring resistance is set, the balance shifting must be adjusted more finely. This means that the demand on the patient's coordination is higher.

Strength training

And it is thanks to spring resistance that the balo provides an effective and targeted means of training strength.

Exercise	Musculature trained
1. Standing up	Quadriceps and more
2. Standing	Moving upward from a bent posture – extensor chain
3. Movement in dorsal direction	Ventral chain and in particular dorsal flexors
4. Straightening posture while standing	Extensors, back
5. Active resistance training for the arms	Targeted activation of upper body/ torso
6. Step triggering	The calf muscles, which are very important for walking, can be trained effectively without knee support

Generally speaking, step triggering also needs to be trained more frequently during balance training. The balo, when appropriately secured, provides the ideal opportunity for this. Its spring resistance also enables heavier patients to use it for active strength training on a regular basis.

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Sabine Lamprecht passed her physiotherapy exam in Berlin in 1982. Since then, she has completed various further training programmes. In 2006 she obtained her Master of Science degree 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.

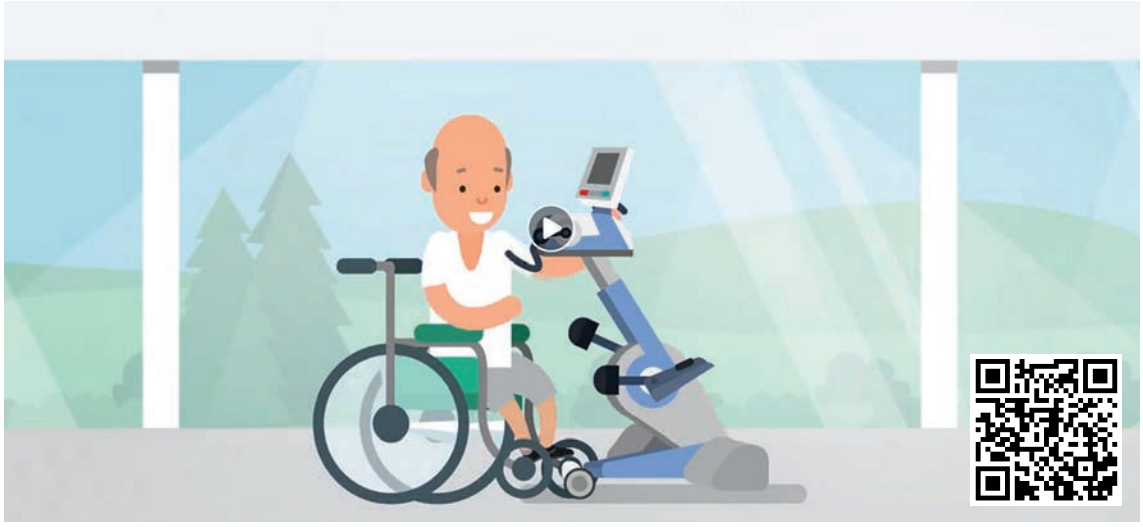
Hans Lamprecht has also been working as a physiotherapist since 1982. He founded the Kirchheim regional group in the Baden-Württemberg Association of Physiotherapists.

In 1987, Sabine and Hans Lamprecht opened their own practice together.

Just stay FITT!

The FITT criteria and their specific application in neurological rehabilitation

Jakob Tiebel



Due to their central motor disorders, neurological patients often suffer from physical weakness and have reduced muscle strength and endurance. Numerous high-quality studies and reviews with different focuses are now available on the topic of strength and endurance performance training in neurological rehabilitation. The FITT criteria help therapists to pace and manage the training effectively.

Endurance training

Aerobic endurance training is becoming increasingly important in neurological rehabilitation. In other indication areas, such as cardiological and orthopaedic rehabilitation, this form of training has been established for a long time. It is used to improve cardiopulmonary resilience, endurance and coordination, and to positively influence somatic risk factors such as arterial hypertension.

Aerobic endurance can be trained in different ways depending on the patient's ability limitations. These include task-specific training, e.g. by walking on a treadmill or outdoors, or by targeted training with a movement trainer such as the tigo.

Strength training

Specific strength training has also gained in importance. After a stroke, secondary muscular changes occur, which often lead to a weakening of the musculature. Strength training is primarily carried out in the form of dynamic muscle training. The main goal is to avoid muscular atrophy and to improve the innervation ability.

Strength training can be carried out in a function-oriented manner with the help of weights or equipment. A special form of dynamic strength training using equipment is isokinetic training, which is characterised by a constant resistance over the entire range of motion. Such training is device-specific and can also be carried out with a movement exerciser.

Training control with FITT

Strength and endurance training recommendations are given for neurological patients according to the FITT (frequency, intensity, time and type) criteria. Where possible, untrained persons should start with the lowest FITT specifications suggested here.

Progression is crucial in both forms of training. However, no more than one FITT criterion should be gradually increased at a time in order to prevent overloading.

The training intensity depends on the heart rate or the so-called "one-repetition maximum" (1-RM). The 1-RM is the maximum weight with which exactly one repetition of an exercise can be adequately performed. The RPE (Borg scale) is suitable for training and load control (for further information, see THERAPY 2/2017 p. 58).

The table below shows how training to improve endurance and strength should be structured according to FITT criteria.

FITT criterion	Cardiorespiratory endurance training	(Isokinetic) strength training
Frequency	3-5 x per week	2-3 x per week
Intensity	50 % - 80 % HR-max 40 % - 60 % 1-RM 12 - 14 RPE (Borg scale)	70 % - 90 % HR-max 60 % - 80 % 1-RM 15 - 17 RPE (Borg scale)
Time	20 - 60 minutes*	15 - 30 minutes*
Type	Movement exerciser, gait training (rapid – fast contraction speed)	Movement exercisers, weights, strength training equipment (slow – rapid contraction speed)

* For patients with low load-bearing capacity, multiple 10-minute units can be distributed throughout the day

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Sample-size recommendations for robot assisted gait training research

Jakob Tiebel (1, 2)

Introduction

When planning a new RAGT study, power analysis is an important step, as it helps to specify how many participants are required to determine replicable effects. However, these analyses require the researcher to input an expected effect size. A new app visualizes an effect size distribution and determined effect size percentiles, representing small, medium and large effects extracted from robot-assisted gait training (RAGT) studies. Based on prevalence assumptions for the exposure in a control intervention and an expected odds ratio (OR) the app allows to specify how many participants a study requires to determine a replicable effect.

Background

Electromechanical assisted gait training is a popular intervention, used to restore walking ability in patients who suffered from stroke. Current research results suggest that people who receive electromechanical-assisted gait training in combination with physiotherapy after stroke are more likely to achieve independent walking than people who receive gait training without these devices. Further research should address what frequency or duration of walking training might be most effective and how long the benefit can last. Also, it is still not clear how such devices should be used in rehabilitation routine.

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Fig. 1: Picture of a robot-assisted gait trainer, THERA-Trainer lyra. The gait trainer offers a safe, intensive and repetitive locomotion therapy and thus an ideal and cost-efficient training for heavily affected patients post stroke.

When planning a new RAGT study power analysis is an important step, as it helps to specify how many participants are required to determine replicable effects. However, these analyses require the researcher to input an expected effect size.

Cohen's guidelines from 1988 are typically used for that. Cohen's d is the standardized mean difference between two group means, the effect size underlying power calculations for the two-sample t-test. Cohen's d = 0.2, 0.5, and 0.8, often is cited as indicative of a small, medium, and large effect size, respectively. However, in RAGT studies the odds ratio (OR) is the most widely used index to quantify the prevalence of exposure amongst experimental and control. The OR is proposed to determine whether the probability of an event (e.g. independent walking) is the same or differs across two groups, generally an experimental group and a control group. The range of OR is from 0 to infinity: A value of 1 = no association with the specified intervention (that is, the event is equally likely in the experimental and control group); as the value of OR increases or decreases away from 1, the association grows increasingly stronger.

The question that arises is whether Cohen's assumptions are also appropriate for the interpretation of OR in RAGT studies. Guidelines such as those from Cohen were originally proposed only as a fall back for when the effect size distribution (ESD) is unknown. Using these guidelines, which are intended to represent an average across research fields, may quickly lead to an underestimation or overestimation of a true distribution.

Methods

To interpret Cohen's guidelines in the context of RAGT research we used a converting method developed by Borenstein et al. (2009) which relates a Cohen's d to a corresponding OR. On the basis of this method our calculations indicated that OR = 1.44, 2.48 and 4.27 are equivalent to Cohen's d = 0.2 (small), 0.5 (medium), and 0.8 (large) effect. A total sample of 36 RAGT trails involving 1472 participants was taken from a most recent Cochrane Review, to construct an effect size distribution and determine effect size percentiles, representing small, medium and large effects.

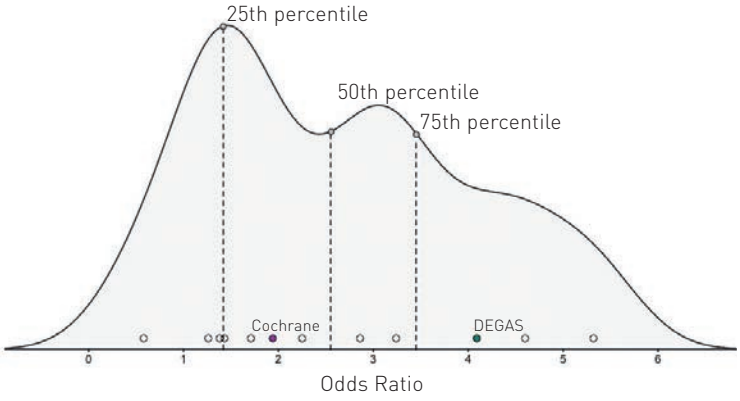

Fig. 2: The distribution of effect sizes from RAGT studies. The 25th, 50th, and 75th percentiles (dashed lines) represent the calculated thresholds for small (1.42), medium (2.55), and large (3.45) Odds Ratios. Colored in purple and green the overall effect size of the 2017 Cochrane Review (OR 1.94) and the DEGAS Study from Pohl et al. 2007 (OR 4.09).

Additionally, a one-sided contour-enhanced funnel plot, in which the effect sizes are plotted against their standard errors with added contours representing key levels of statistical significance (p = .1, p = .05, p = .01 was constructed to examine the representation of significant findings in RAGT research. In the funnel plot log odds ratio values were used as a measure of effect size.

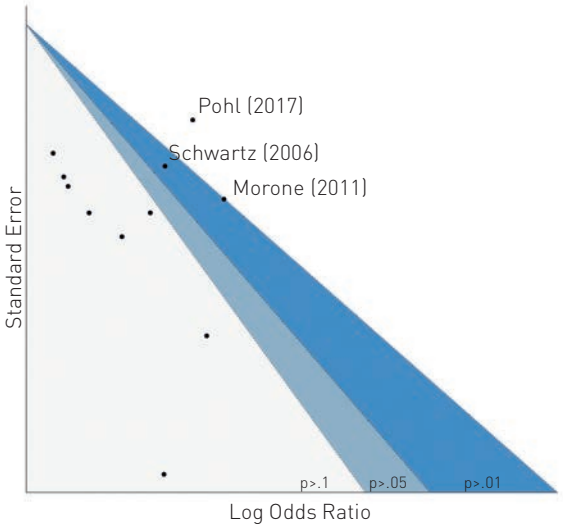

Fig. 3: A one-sided contour-enhanced funnel plot, whereby the effect sizes (Log Odds Ratios) are plotted against their standard errors, constructed to explore the representation of statistically significant effects in RAGT research. (Significance level of = 0.05, two-sided).

The dataset and script to perform the reported analyses using R statistical software packages is available at https://osf.io/w6c7y/.

Results

The small, medium and large effect size percentiles for RAGT research are presented in Table 1 and Figure 2. A notable deviation from Cohen's guidelines is the reduced 75th percentile in RAGT studies, which is significantly smaller than the generally cited guidelines. That means Cohen's guidelines overestimate the distribution of a large effect size that can be constructed based on today's available RAGT research findings whereby the small and medium effect sizes are comparable.

	25th	50th	75th
Cohen's d	.2	.5	.8
Cohen's d (RAGT)	.19	.52	**.68**
Odds Ratio	1.44	2.48	4.27
Odds Ratio (RAGT)	1.42	2.56	**3.45**

Tab. 1: Shown in the table are the Cohen's guideline based .25, .5 and .75 percentiles for Cohen's d, their corresponding ORs (Odds Ratio) and the estimated Cohens d (Cohen's d RAGT)) and OR (Odds Ratio (RAGT)) percentiles from RAGT research. Deviations from Cohen's guidelines d > ±.1 are indicating a significant deviation and are marked bold.

A limiting factor is that the RAGT effect size distribution only bases on a moderate number of 36 ORs. But the here described approach may help to overcome a bit the difficulty of interpreting ORs in RAGT studies, that troubles clinical researchers since long time. And it may lead to more realistic planning of sample sizes in RAGT studies, intended to get more reproducible study results in future.

Conclusions

Cohen suggested effect size guidelines, intended to use only as a fallback for when effect size distributions in a research field are not available. Aim of this research was to construct an effect size distribution of RAGT studies to compare these with widely used guideline recommendations and to determine whether an empirically derived distribution better

represent RAGT studies. The data suggest that Cohen's guidelines appear to overestimate the magnitude of large effect sizes in RAGT studies.

The analyses also revealed that RAGT studies are generally underpowered to detect such effect sizes that can be found in the literature until now, due to small sample sizes. This indicates that the reported effects of most of the studies are less likely to replicate.

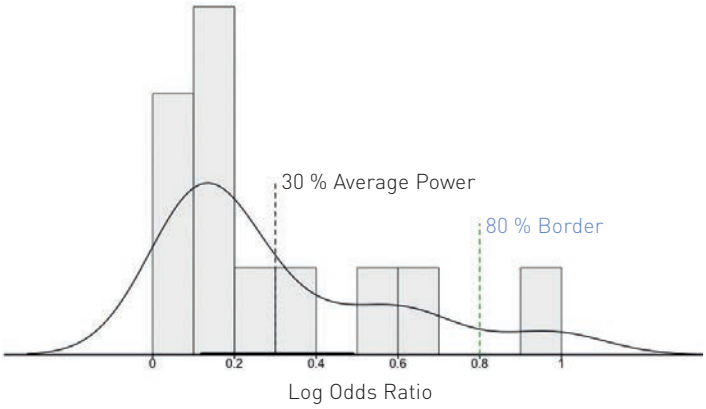

Fig. 4: A histogram with density curve visualizes the distribution of statistical power in RAGT studies. In average RAGT studies have a statistical power of 30 %. Only two studies of the Cochrane Review are sufficiently powered (>80 %).

By referring to the here provided sample sizes, researchers can perform appropriately powered RAGT studies with outcomes that are more likely to replicate in future. For example, to achieve a statistical power of 0.8 to detect a medium effect size, 82 participants are required in each group. This is more than three times the median sample size of RAGT research at present.

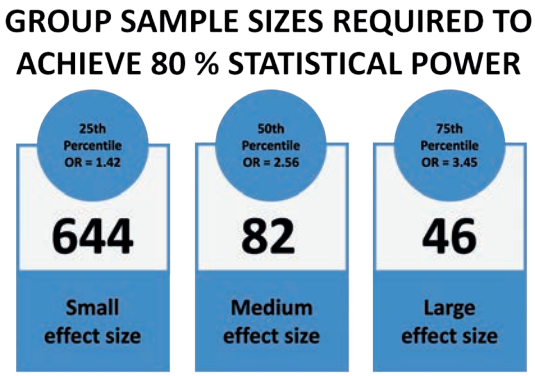

Fig. 5: Info chart with recommendations for group sample sizes required to achieve 80 % statistical power in RAGT studies based on the calculated effect size distribution.

However, it needs to be considered that there are limitations to the present investigation. Results from 36 RAGT studies of which in 20 studies the OR were not estimable, are far not enough to construct an effect size distribution that can be fully believed. Another limitation could be that underpowered studies that discovered an effect are more likely to over- or underestimate a true population effect. These effect size estimation errors may influence the observed effect size distribution and may also be a possible reason for distortions.

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News on the prediction of walking ability after a stroke

Which impairments, activity restrictions and personal factors reliably predict walking activity in the first 6 months after a stroke upon discharge from hospital? A longitudinal study published in early 2019 by Niruthikha Mahendran and colleagues from the Physiotherapy School of Health and Rehabilitation Science at the University of Queensland in Brisbane, Australia, provides new insights into this issue.

Jakob Tiebel

Question

In their study, the researchers investigated which impairments, activity restrictions and personal factors can predict the extent, frequency and intensity of walking activity of patients 1, 3 and 6 months after stroke when they are discharged from hospital.

Methodology

As part of a prospective longitudinal study, a total of 36 stroke patients aged 71 ±14 years were recruited at the time of discharge. 69% of the subjects were male. Data on possible predictors such as fatigue, mood, executive functions, walking speed, walking endurance, age, prestroke activity, self-efficacy, perceived stroke recovery and health were collected. After 1, 3 and 6 months, the researchers investigated the walking activity of the subjects as part of the follow-up using movement and activity profiles, which they recorded using portable sensors.

Results

The results of a regression analysis showed that after one month, walking endurance was the sole predictor for walking activity ($R2 > 0.29$, $p < 0.01$). After 3 months, walking endurance in combination with pre-stroke activity level predicted the extent and intensity of activity ($R2 = 0.46\text{-}0.61$, $p < 0.001$). In addition, activity behaviour before the stroke

was a meaningful predictor of activity frequency (R2 = 0.31, p = 0.004). After 6 months, age in particular predicted the extent and frequency of walking activity (R2 = 0.34-0.35, p < 0.003), whereas activity levels before the stroke, walking endurance at discharge, and executive functions predicted intensity (R2 = 0.79, p < 0.001).

Conclusions

The authors conclude that endurance in particular has an influence on the activity level of stroke patients in the first 6 months after hospitalisation. After one month, factors such as pre-stroke activity behaviour, age and executive functions also contribute to the results and should be taken into account in the orientation of physical activity after a stroke.

Implications for clinical practice

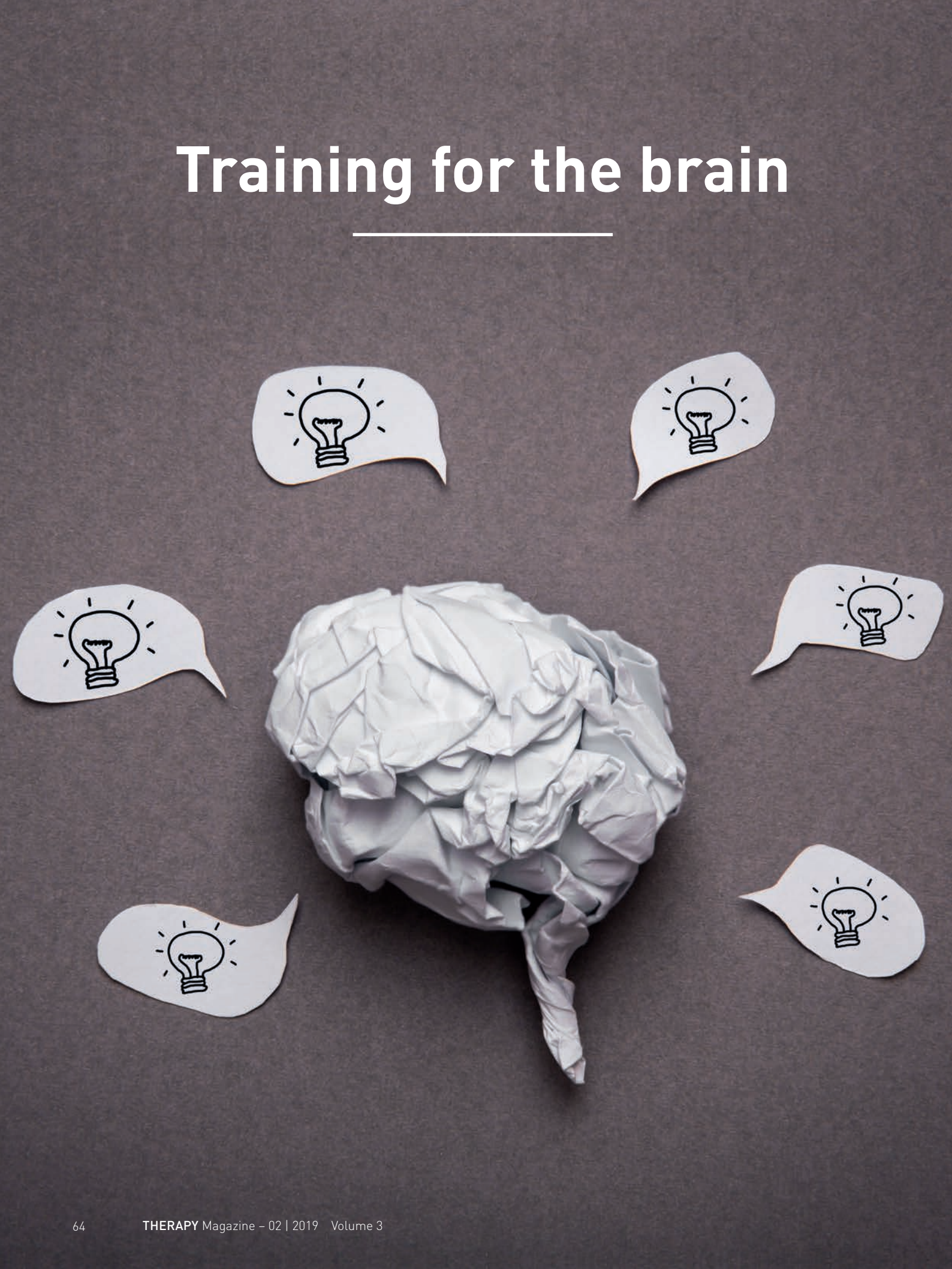
The results of this study provide important information for clinical practice. Therapeutic activities in the context of stroke rehabilitation should aim in particular at improving walking endurance, as higher values are associated with higher walking activity in the first month after discharge. Factors such as a low pre-stroke activity level and a higher age predict reduced walking activity after the stroke. They represent fundamental barriers, and creative approaches are required to overcome them.

Physical activity measures should always be tailored to the individual, their environment and relevant context factors, while taking into account the individual's pre-stroke activity behaviour.

ORIGINAL WORK

Mahendran N, Kuys S, Brauer S (2019). Which impairments, activity limitations and personal factors at hospital discharge predict walking activity across the first 6 months poststroke? Disability and Rehabilitation, DOI: 10.1080/09638288.2018.1508513

Training for the brain



Can you find the 15 terms we've hidden in the jumble of letters below? All of the words can be found in this issue of THERAPY. They can be read horizontally, vertically, forwards, backwards or diagonally.

Q	D	X	Y	E	Y	M	O	Z	K	U	V	U	U	X	J	O	T	V	Y	Y	H	W	W	Q	T	J	F	P	B
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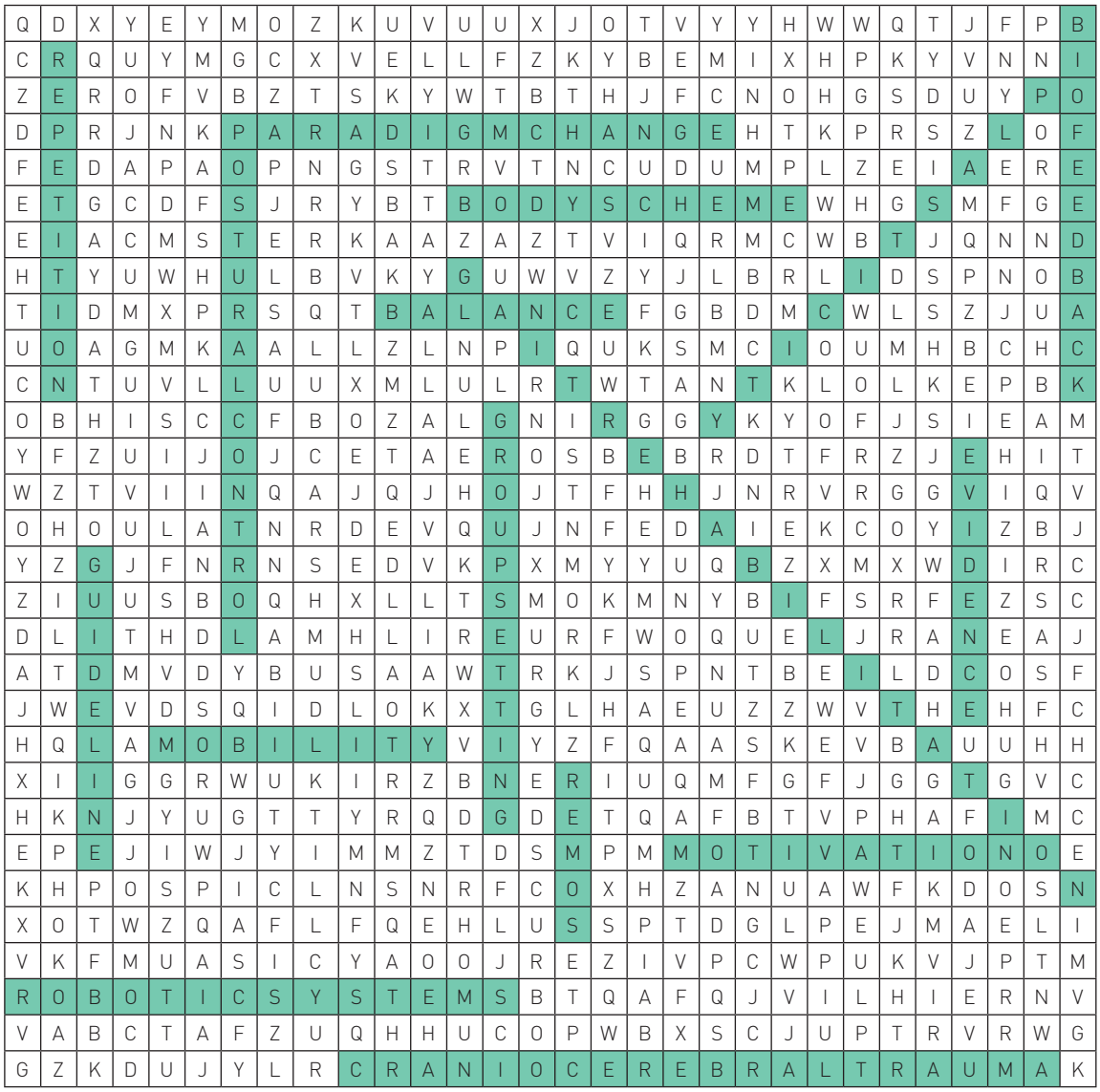
The solution is on the next page.

Quiz solution



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