01 | 2022 VOLUME 6

THERAPY

THE MAGAZINE FROM THERA-TRAINER

Brain moving too slowly? Exercise helps.

THERAPY & PRACTICE

Back on your feet again – state-of-the-art technology restoring the ability to walk

SCIENCE

Annual Science Review

Free

"Only those on the move can change direction."

Martin Gerhard Reisenberg

FOREWORD

Does exercise make you clever?

Dear readers,

As experts in the field, they know only too well that exercise helps to regain and improve motor functions. But does exercise also help to improve mental, i.e. cognitive, abilities? Does exercise even make you clever, or in other words, can exercise actually help delay the ageing process?

We want to explore these questions and, through the focus articles in this issue, we want to demonstrate to you that exercise even has a strong influence on the cognitive motor skills of older people.

This makes appropriate rehabilitation procedures, which we will present to you, the key to having a stable gait in old age. As well as this, these procedures inspire those who take part in them in a playful way. They have a mood-lifting effect and positively influence perceived exertion.

In addition to the topics and issues surrounding "healthy ageing", the issue again offers some exciting insights into the field of modern walking therapy, including lively and patient-focused examples from clinical practice.

In Technology and Development, we talk to CTO Otto Höbel about implementing a user-centered design approach at THERA-Trainer and the challenges of hunting for new features.

I hope you enjoy this edition.

Jakob Tiebel

Contact the editorial team therapy@thera-trainer.com (tell us what you think!)

The brain cells are reminded how to walk.

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SCIENCE

Annual Science Review

This is what drove science in the field of neurorehabilitation in 2021

What exciting news has the past year brought from the field of research and development in terms of evidence-based therapies for walking rehabilitation? To kick off the new year, we have compiled some studies that we found interesting here. This, and of course much more, was the driving force behind the researchers in 2021. Here's a brief overview by month.

Jakob Tiebel

January **Impact of rehabilitation start time on functional outcomes after stroke.**

When should rehabilitation be started after having an acute stroke? Right at the beginning of the year, Otokita et al. published an interesting paper with findings on how the start time of rehabilitation influences the outcome. In a retrospective database study, they analysed the courses of 140,655 patients who had had a stroke. In general, they found no significant difference in the outcome between starting rehabilitation immediately on day 1 or day 2 after the event. That being said, in a subgroup of patients who had had a haemorrhagic stroke, starting rehabilitation on day 2 resulted in a better outcome than starting on day 1. However, for haemorrhagic strokes, starting rehabilitation

Starting rehabilitation after a stroke on the day of admission or the second day of hospitalisation could be the optimal time for functional outcomes.

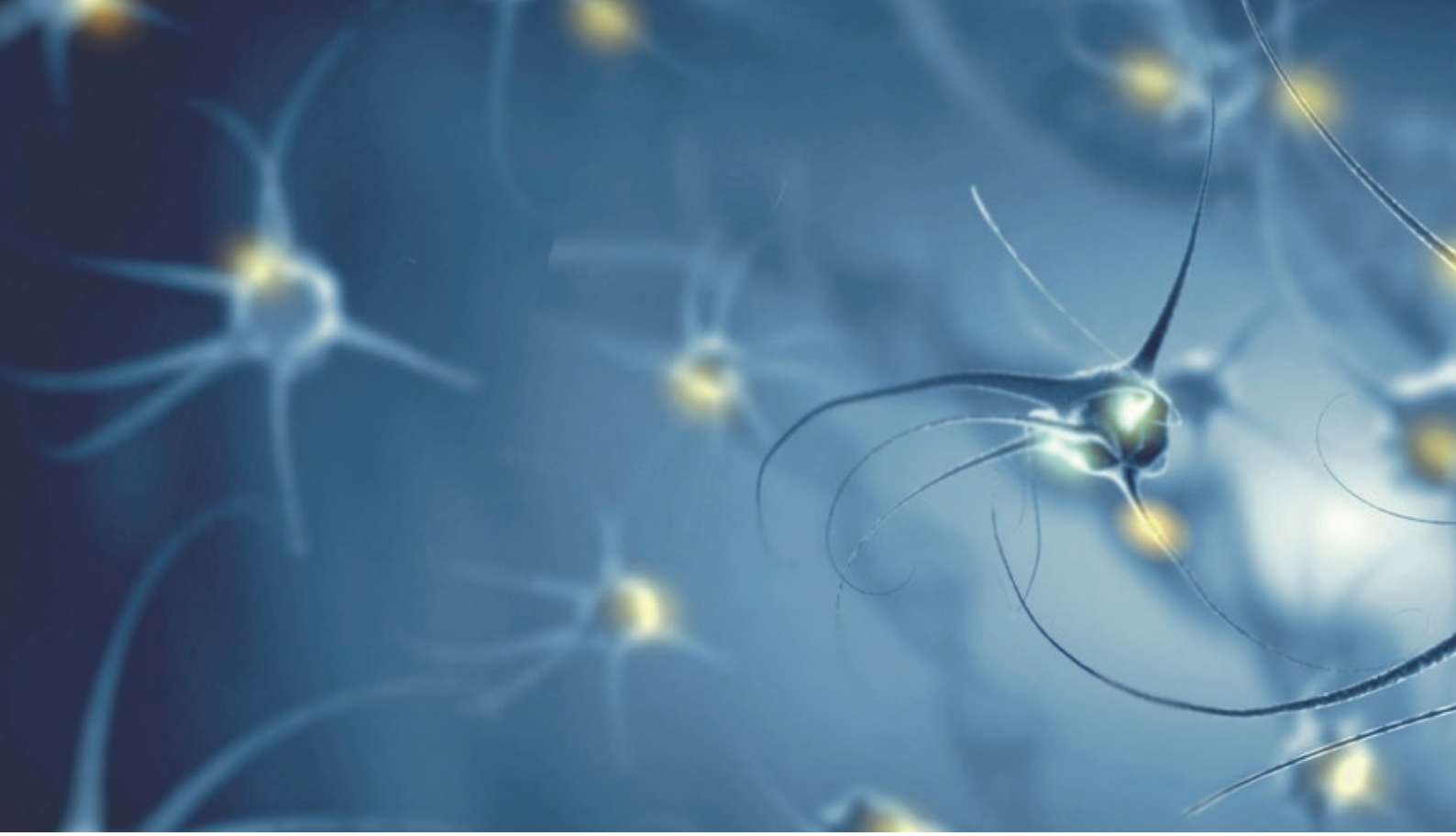
on the second day of hospitalisation may be more effective than on the day of admission.

Otokita S, Uematsu H, Kunisawa S, et al. Impact of rehabilitation start time on functional outcomes after stroke. J Rehabil Med. 2021 Jan 13;53(1):jrm00145. doi: 10.2340/16501977-2775. PMID: 33284355.

February **Effects on walking performance and lower body strength by short message service guided training after stroke or transient ischemic attack (Results of the STROKEWALK Study)**

In February, Vahlberg et al. published their results on the STROKEWALK study. The researchers investigated the extent to which daily mobile phone messages with exercise instructions over a period of three months increase physical activity and general mobility in patients shortly after having a stroke or a transient ischaemic attack. The intervention group received standard care and daily text message instructions via mobile phone to encourage them to go on regular outdoor walks and do functional leg exercises. The control group received standard care, i.e. follow-up by their general practitioner. The results: Three months of daily mobile phone text messages and guided exercise instructions improved combined mobility measures, i.e. walking performance and lower body strength.

Vahlberg B, Lundström E, Eriksson S, et al. Effects on walking performance and lower body strength by short message service guided training after stroke or transient ischemic attack (The STROKEWALK Study): a randomized controlled trial. Clin Rehabil. 2021 Feb;35(2):276-287. doi: 10.1177/0269215520954346. Epub 2020 Sep 18. PMID: 32942914; PMCID: PMC7874373.



March **Understanding the therapeutic alliance in stroke rehabilitation.**

The quality of the therapeutic alliance between a patient and the therapist is considered to play an important role in health care, but there is little research on this concept when it comes to stroke rehabilitation.

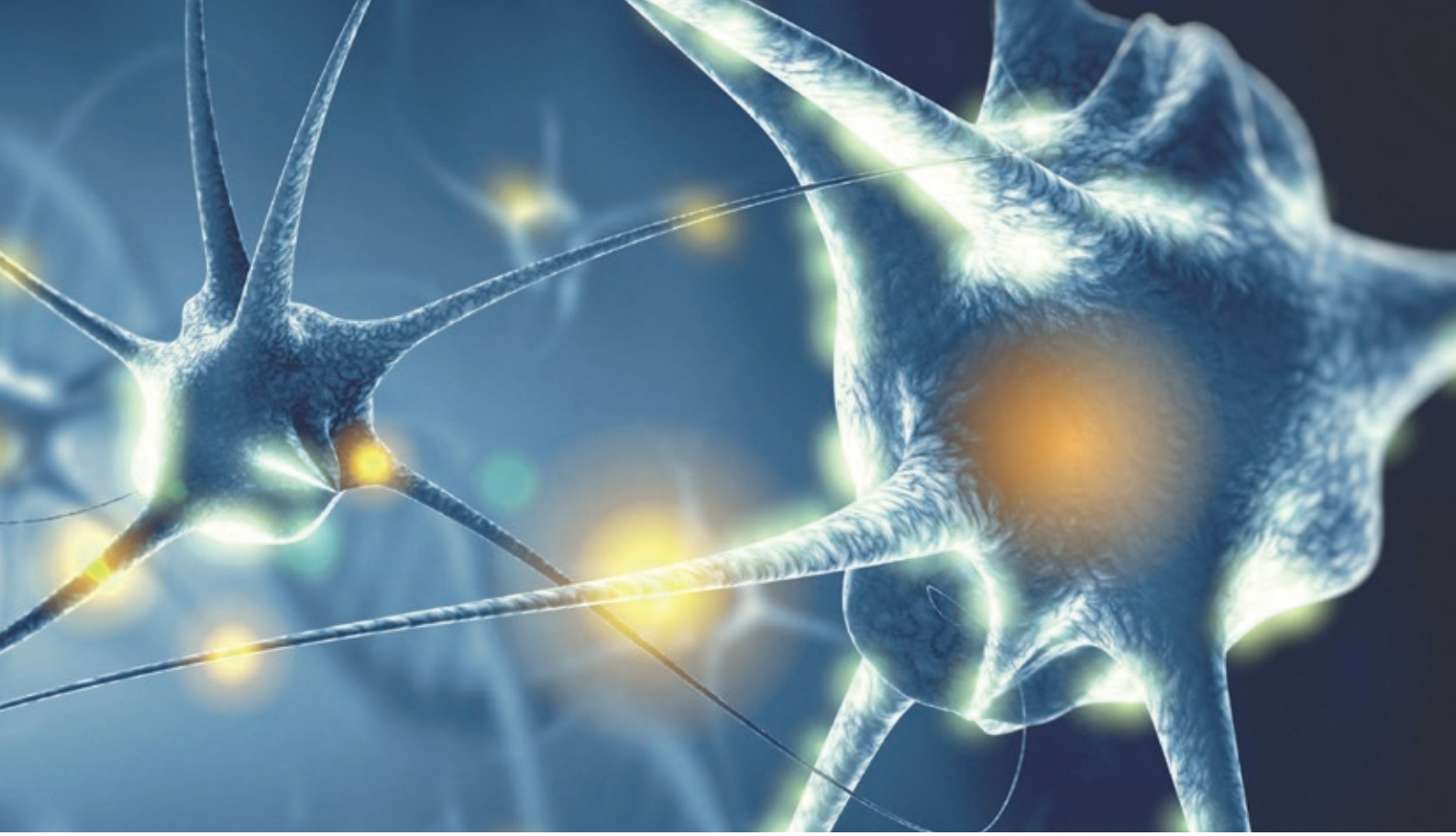
The study by Bishop et al., published in March, showed that a therapeutic alliance in stroke care consists of three overlapping core components: a personal connection, a professional collaboration and a family collaboration. The researchers found that building and maintaining a therapeutic alliance appears to be an individual and complex process. The ability of a clinician to use their own personal qualities therapeutically and to use their professional skills flexibly seems to be an essential part of the quality of the relationship.

This means the development of therapeutic relationships requires a person-centred and sometimes family or relative-centred approach. The prudent use of self-disclosure can achieve emotional closeness while still maintaining professional boundaries.

Bishop M, Kayes N, McPherson K. Understanding the therapeutic alliance in stroke rehabilitation. Disabil Rehabil. 2021 Apr;43(8):1074-1083. doi: 10.1080/09638288.2019.1651909. Epub 2019 Aug 21. PMID: 31433673.

April **What is the impact of robotic rehabilitation on balance and gait outcomes in people with multiple sclerosis? A systematic review of randomized control trials**

In April, Bowman et al. published their findings on the use of equipment-based gait training in patients with multiple sclerosis. For this purpose, they conducted a systematic literature review and evaluated randomised control trials. Searching through databases resulted in 336 entries and in the end 12 studies were included. The researchers found moderate evidence that robotics-assisted gait training has positive effects on the ability to walk in people with multiple sclerosis. In the available RCTs, balance and gait outcomes improved in a way



that was clinically meaningful. After considering the multiple advantages in terms of safety, motor support and intensity of training, the researchers recommended device-assisted gait training be used to improve motor skills, especially in patients with severe disabilities in a multimodal rehabilitation context.

Bowman T, Gervasoni E, Amico AP, et al. What is the impact of robotic rehabilitation on balance and gait outcomes in people with multiple sclerosis? A systematic review of randomized control trials. Eur J Phys Rehabil Med. 2021 Apr;57(2):246-253. doi: 10.23736/S1973-9087.21.06692-2. Epub 2021 Feb 4. PMID: 33541044.

May Core Stability Exercises in Addition to Usual Care Physiotherapy Improve Stability and Balance After Stroke: A Systematic Review and Meta-analysis

In May, Gamble et al. presented their findings on balance training. They had carried out a review using meta-analysis. This included eleven randomised controlled trials comparing usual physiotherapy with usual physiotherapy alongside additional core stability exercises in people who had had a stroke. They found that adding core stability exercises to the usual physiotherapy after a stroke lead to an improvement in core control and dynamic balance. This means that additional core stability exercises should definitely be included in rehabilitation if improvements in these areas help patients to achieve their goals. The researchers report that future studies should consider body kinematics outcomes in functional tasks to assess movement quality and participation outcomes.

Gamble K, Chiu A, Peiris C. Core Stability Exercises in Addition to Usual Care Physiotherapy Improve Stability and Balance After Stroke: A Systematic Review and Meta-analysis. Arch Phys Med Rehabil. 2021 Apr;102(4):762-775. doi: 10.1016/j.apmr.2020.09.388. Epub 2020 Oct 22. PMID: 33239203.

June Effects of robot-assisted gait training on postural instability in Parkinson's disease: a systematic review

The systematic review that was published by Picelli in June provides the reader with a complete overview of the current literature and evidence base on the effects

of robotic gait training on problems with postural instability (static and dynamic balance, freezing of gait, falls, confidence in activities that are part of daily life and gait parameters related to balance ability) in patients with Parkinson's disease. A total of 18 articles (2 systematic reviews, 9 randomised controlled trials, 4 uncontrolled trials and 3 case series/case reports) were included.

"We found a high level of evidence on the effects of robotic gait training on balance and freezing of gait in patients with Parkinson's disease", the researchers explain.

On the one hand, they found that robot-assisted gait training both after treatment and during the course of treatment (up to one month after the end of treatment) can lead to significant improvements in postural control and gait parameters related to balance ability compared to baseline assessment or non-specific conventional low-intensity training methods. On the other hand, there is evidence that robotic gait training is not necessarily superior to conventional balance training and treadmill training of the same intensity when it comes to improving postural instability and gait parameters related to balance control in patients with Parkinson's. For this reason, it's necessary to evaluate when the intervention makes sense and what advantages it has over comparable training methods.

Picelli A, Capecci M, Filippetti M, et al. Effects of robot-assisted gait training on postural instability in Parkinson's disease: a systematic review. Eur J Phys Rehabil Med. 2021 Jun;57(3):472-477. doi: 10.23736/S1973-9087.21.06939-2. Epub 2021 Apr 7. PMID: 33826278

July **Factors associated with time to independent walking recovery post-stroke**

So far, studies have inconsistently identified factors associated with independent walking after having a stroke. In July, Kennedy et al. published new results from their study in which they examined the relationship between pre-stroke factors and factors collected acutely after stroke, and related these to the number of days to independent walking of 50 m using data from "A Very Early Rehabilitation Trial" (AVERT). A total of 2,100 participants who had has a stroke were included. It took an average of 6 days for them to walk 50 m unassisted, 75% achieved independent walking after 3 months. Therefore, the analysis provides robust evidence of important factors associated with regaining independent walking. The researchers highlight the need for customised mobilisation programmes targeting subgroups, as all patients are individual and respond differently to interventions. This is especially true for people with haemorrhagic and severe strokes (cf. results from January by Otokita et al.).

Kennedy C, Bernhardt J, Churilov L, et al. Factors associated with time to independent walking recovery post-stroke. J Neurol Neurosurg Psychiatry. 2021 Jul;92(7):702-708. doi: 10.1136/jnnp-2020-325125. Epub 2021 Mar 17. PMID: 33737383.

August **SWEAT2 Study: Effectiveness of Core Training on Muscle Activity after Stroke. A randomized controlled trial**

In August, there was news on core training for stroke patients, published by Criekinge et al. Whether the core holds the key is debatable. However, it is undisputed that core training after a stroke is an effective way to improve core control, balance while standing and mobility. Core training primarily improves selective control and endurance of the core muscles after a subacute stroke. The SWEAT2 study sought to explore the underlying mechanisms that lead to these observable mobility transfer effects after core training. What the field of

clinical rehabilitation has recently discovered is that core training does not alter muscle activation patterns and the amount of muscle synergies over time, and a decrease in fast-twitch motor recruitment in the erector spinae muscle during walking can be detected after core training. In this way, core training seems to primarily increase the fatigue resistance of the back muscles and allows greater isolated activation, which is important for dynamic movement in high starting positions and mobility.

VAN Criekinge T, Saeys W, Hallemans A, et al. SWEAT2 study: effectiveness of trunk training on muscle activity after stroke. A randomized controlled trial. Eur J Phys Rehabil Med. 2021 Aug;57(4):485-494. doi: 10.23736/S1973-9087.20.06409-6. Epub 2020 Nov 9. PMID: 33165310.

September Ankle-foot orthoses improve walking but do not reduce dual-task costs after stroke

Cognitive-motor interference, as measured by dual-task walking (performing a mental task while walking), occurs in many clinical patient groups. Ankle-foot orthoses (AFOs) are lower leg splints prescribed to stabilise the foot and ankle and prevent drop foot – a gait deficit that often occurs after a stroke. In the study published by Drake in September, the use of AFOs is shown to improve gait parameters such as speed and step time, which are often negatively affected when walking with two tasks.

"Our aim was to determine whether AOFs can improve the cognitive-motor skills of patients with stroke-induced hemiplegia as measured by dual-task gait exercises", explain the researchers. Their results support the use of AFOs to improve certain gait parameters in post-stroke hemiplegia. However, AFOs do not seem to protect against cognitive-motor dysfunction when walking with dual tasks (see also our main articles on cognitive-motor training).

Drake R, Parker K, Clifton KL, et al. Ankle-foot orthoses improve walking but do not reduce dual-task costs after stroke. Top Stroke Rehabil. 2021 Sep;28(6):463-473. doi: 10.1080/10749357.2020.1834271. Epub 2020 Oct 16. PMID: 33063635.

October Prevalence of Walking Limitation after Acute Stroke and its Impact on Discharge to Home

While some are concerned with the question of when to start training after an acute stroke and what the time frames should be, depending on which predictors, improvements can be achieved, Louie and colleagues looked at the prevalence and impact of walking disability after stroke. The aim of their study, which was published in October, was to provide current estimates of the prevalence of lower limb motor impairment and walking disability following a first-time stroke and to characterise the predictive nature of early walking ability for discharge to home after an acute hospital stay. Around half of patients with a first-time stroke are found to have lower limb weakness and walking limitations. Early walking ability is, in their view, a significant predictor of returning home after an acute hospital stay, regardless of the severity of the stroke. Based on their findings, the researchers recommend early assessment of walking ability, in particular to also improve discharge planning for patients. "Early assessment of walking ability within a few days after suffering a stroke can help to optimise discharge management", the researchers say.

Louie DR, Simpson LA, Mortenson WB, et al. Prevalence of Walking Limitation after Acute Stroke and its Impact on Discharge to Home. Phys Ther. 2021 Oct 23:pzab246. doi: 10.1093/ptj/pzab246. Epub ahead of print. PMID: 34718796.

November Passive leg cycling increases activity of the cardiorespiratory system in people with tetraplegia

People with a spinal cord injury (SCI) are at increased risk of cardiovascular disease and exercise is known to be a proven way to prevent these conditions. However, there are few simple and safe training methods that can increase cardiorespiratory system activity after a cervical spine injury. The aim of the study, published in November by Soriano and et al., was therefore to investigate the cardiorespiratory response to passive leg cycling in people with cervical SCI. The results

Passive leg cycling increases cardiorespiratory system activity and improves markers of cardiovascular health in cervical SCI.

were exciting: Therefore, the researchers conclude that passive leg cycling is an effective, inexpensive and practical alternative exercise method for people with SCI of the cervical spine.

Soriano JE, Romac R, Squair JW, et al. Passive leg cycling increases activity of the cardiorespiratory system in people with tetraplegia. Appl Physiol Nutr Metab. 2021 Nov 5. doi: 10.1139/apnm-2021-0523. Epub ahead of print. PMID: 34739759.

December **Motor imagery and gait control in Parkinson's disease: techniques and new perspectives in neurorehabilitation**

Motor imagery (MI), which is defined as the ability to mentally imagine an action without actual movement, has been used to improve motor function in athletes and more recently in neurological disorders such as Parkinson's disease (PD). Several studies have investigated the neural correlates of motor imagination, which also change depending on the imagined action. Despite a manageable number of included studies, the end-of-year literature review by Coumo et al. supports the potential positive effects of motor imagination interventions in PD that focus on moving forward. The researchers discuss that the development of new technologies could improve the delivery of training based on motor imagery in the future, and the application could lead to new rehabilitation protocols aimed at improving the walking ability of patients with Parkinson's disease. It will be exciting to see what further insights these and other working groups will provide this year!

Cuomo G, Maglianella V, Ghanbari Ghooshchy S, et al. Motor imagery and gait control in Parkinson's disease: techniques and new perspectives in neurorehabilitation. Expert Rev Neurother. 2021 Dec 28:1-9. doi: 10.1080/14737175.2022.2018301. Epub ahead of print. PMID: 34906019.

SCIENCE

Hello Again!?

The importance of movement quality for functional recovery after having a stroke.

Martin Huber

Recently, in the context of modern, evidence-based stroke rehabilitation, the question of quality of movement has been raised in relation to functional recovery. Wasn't this issue settled ages ago? Wasn't this once important in empiricist approaches to therapy, but now it's given way to the primacy of goal achievement and functional improvement in evidence-based approaches to therapy?

Movement quality was considered secondary, compensation was seen as the best possible way to control movement after CNS damage. But now publications by reputable and internationally renowned neuroscientists are causing a renaissance in the study of movement quality.

A working group led by Gert Kwakkel, Carolee Winstein and John Krakauer is providing a major impetus for this. How have they come up with this?

In the next issue of THERAPY magazine, we'll talk about this with physiotherapist and Master of Science in Neurorehabilitation, Martin Huber.

Martin Huber Physiotherapist and Master of Science in Neurorehabilitation

SCIENCE

Brain moving too slowly? Exercise helps.

Unfortunately dementia diseases, such as Alzheimer's dementia, are widespread and feared. They not only limit thinking performance (memory, for example), but also have an impact on everyday life and independence. This also applies to mobility: people with dementia are more likely to fall than people without dementia.
The affected people themselves and their family members suffer. People are still waiting for the big breakthrough in the medication industry, year after year large sums are invested in research into dementia treatment. However, one thing is already clear and has been proven by many study findings: exercise helps!

ETH Zurich | Dividat AG

Game playing to fight dementia

Cognitive-motor training helps fight Alzheimer's and dementia: An international team of researchers, along with ETH, was able to prove this for the first time in a study. The training platform used comes from an ETH spin-off. Training with the Senso platform strengthens cognitive abilities such as attention, concentration, memory or orientation in patients with dementia. Being diagnosed with dementia turns both the life of the person affected and that of their relatives upside down: Gradually, brain functions deteriorate. Those affected lose the ability to plan, remember, or behave appropriately. At the same time, their motor skills also degrade. In the end, dementia patients are no longer able to manage their daily lives on their own and require comprehensive care. In Switzerland alone, more than 150,000 people share this fate, and around 30,000 new cases are added every year.

So far, all attempts to find medication to counteract the disease have failed. Dementia and Alzheimer's disease, the most common of several forms of dementia, are still not curable. But a clinical study conducted in Belgium, along with ETH researcher Eling de Bruin, now shows for the first time that cognitive-motor training improves both the cognitive and physical abilities of severely impaired dementia patients. A fitness game, also called "Excergame", developed by the ETH spin-off "Dividat" was used for the study.

Better cognitive performance thanks to training

A team of scientists led by ETH researcher Patrick Eggenberger already proved in 2015 that older people who exercise body and mind simultaneously perform better cognitively and, in this way, can prevent cognitive impairments. But this study was conducted exclusively with healthy people. "There has long been the assumption that physical and mental training also has a positive effect on dementia", explains de Bruin, who works together with Eggenberger at the Institute of Human Movement Sciences and Sport at ETH Zurich. "But until now, it has proved difficult to motivate dementia patients to engage in physical activities over longer periods of time."

ETH spin-off combines exercise and fun

To change this, Eva van het Reve founded the ETH spin-off Dividat together with her brother Joris. "We wanted to improve the lives of older people with a customised training programme", says van het Reve. Using playful exercises, people who are already physically and cognitively impaired should also be encouraged to exercise. This is how the Senso training platform was born. This platform consists of a screen including game software and a floor plate with five fields that measures steps, weight shifts and balance. Users try to use their feet to reproduce a sequence of movements given on the screen. In this way, they're carrying out physical movements and cognitive functions at the same time. The fact that the fitness game is also fun for the study subjects makes it easier to motivate them to exercise regularly.

Dementia patients train for eight weeks

For the study, an international team led by Nathalie Swinnen, who holds a doctorate from the Katholieke Universiteit Leuven and is supervised by ETH researcher de Bruin, recruited 45 study subjects. They live in two Belgian nursing homes, were on average 85 years old at the time of the survey and all showed severe dementia symptoms. "The participants were randomly divided into two groups", Eling de Bruin said, explaining the study design. "The first group trained with the Dividat Senso for 15 minutes three times a week over a period of eight weeks, while the second group listened to and watched music videos of their choice." After the eight-week training programme, the physical, cognitive and mental performance of all subjects was measured in comparison to the beginning of the study.

Playing regularly has an effect

The results can give hope to dementia patients and their relatives: Training with the Senso platform actually strengthens cognitive abilities such as attention, concentration, memory or orientation. "For the first time, there is hope that we can not only delay but also mitigate dementia symptoms through targeted play", de Bruin emphasises. It's particularly noteworthy that the control group continued to deteriorate during the eight weeks, while the training group showed significant improvements. "These are very encouraging results, which are also in line with the expectation that patients with dementia are more likely to deteriorate without training", de Bruin points out. But the playful training doesn't just have a positive effect on cognitive performance. The researchers were also able to measure positive effects on physical abilities such as reaction time.

This meant the study subjects in the training group reacted significantly faster after only eight weeks, while the control group also deteriorated here. This is encouraging in that the speed with which older people react to impulses is crucial to whether they can prevent a fall.

Better understanding processes in the brain

De Bruin's research group is currently working on replicating the results of this pilot study in people with mild cognitive impairment – a precursor to dementia. Therefore, the neuronal processes in the brain, which underlie the observed cognitive and physical improvements, will also be investigated in more detail using MRI images.

LITERATURE

Swinnen N, Vandenbulcke N, de Bruin ED, Akkerman R, Stubbs B, Firth J, Vancampfort D: The efficacy of exergaming in people with major neurocognitive disorder residing in long-term care facilities: a pilot randomized controlled trial. Alzheimer's Research & Therapy. March 30 2021

SOURCE

ETH Zurich (ETH News > Contributions > April 2021)
www.ethz.ch/de/news-und-veranstaltungen/eth-news/archiv
in cooperation with Dividat AG
Neuhofstrasse 14, Schindellegi 8834, Switzerland
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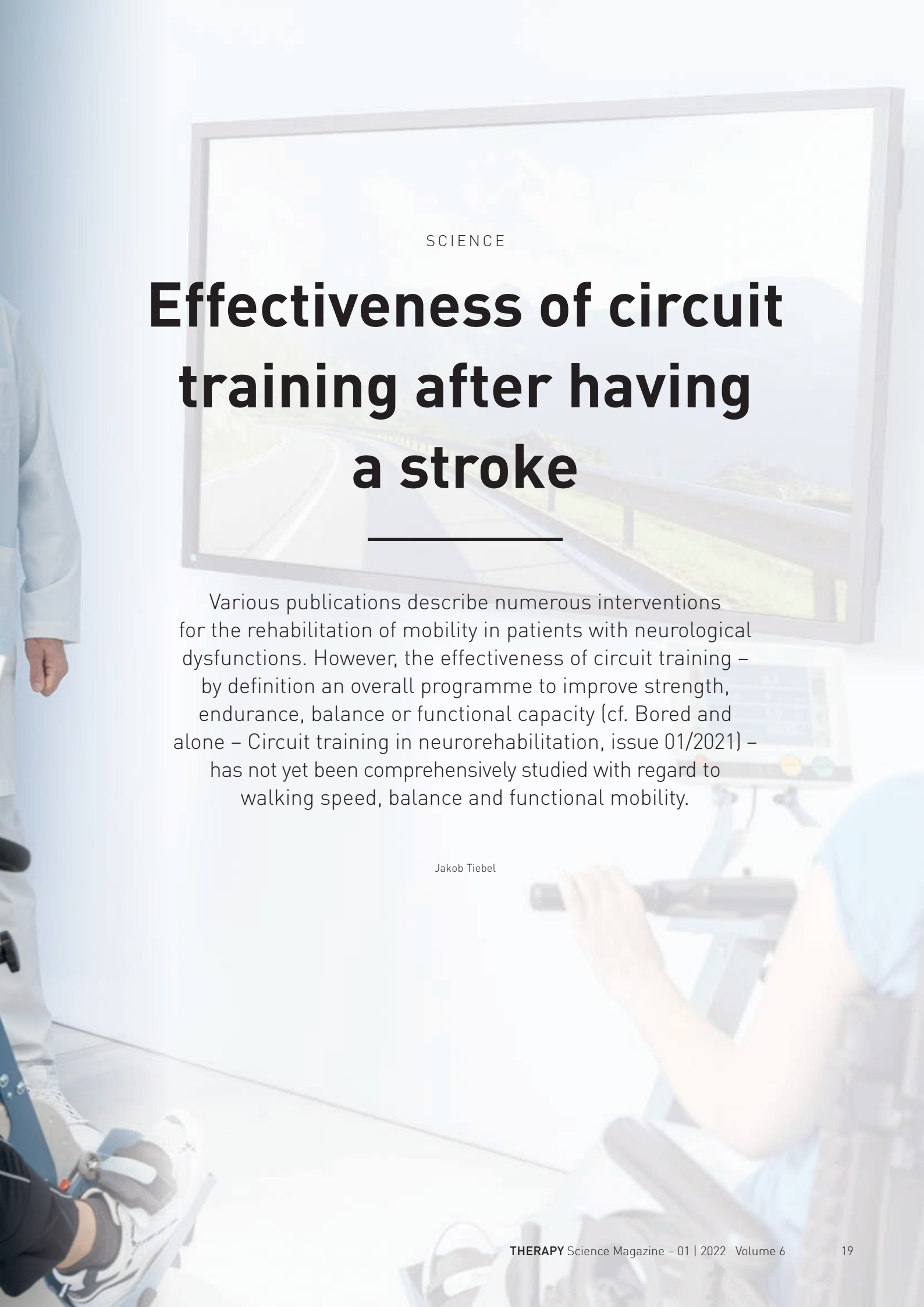


SCIENCE

Effectiveness of circuit training after having a stroke

Various publications describe numerous interventions for the rehabilitation of mobility in patients with neurological dysfunctions. However, the effectiveness of circuit training – by definition an overall programme to improve strength, endurance, balance or functional capacity (cf. Bored and alone – Circuit training in neurorehabilitation, issue 01/2021) – has not yet been comprehensively studied with regard to walking speed, balance and functional mobility.

Jakob Tiebel

The aim of the systematic review by Bo-nini-Rocha et al. from the School of Physical Therapy at the University of Brazil was to evaluate the effectiveness of circuit training for treating people who have had a stroke.

The researchers searched the PubMed and Embase databases and the Cochrane Library for controlled clinical trials. The search was carried out without language or date restrictions. While extracting the data, mean differences between intervention and control groups were calculated for all outcomes, each with their 95% confidence intervals. Two independent experts assessed the risk of any possible bias.

Eleven studies met the inclusion criteria and eight presented suitable data to perform a meta-analysis. The quantitative analysis showed that circuit training is more effective than conventional intervention when the goal of the therapy was to improve walking speed (mean difference of 0.11 m/s), and that circuit training is at least as effective as conventional intervention when the goal of therapy was to improve balance and functional mobility.

The results demonstrate that circuit training has similar, and in some cases even more positive effects on crucial walking parameters than conventional comparative therapy. According to the recommendations of the Agency for Healthcare Research and Quality (AHCPR), the results of the meta-analysis correspond to evidence class I.

ORIGINAL WORK

Bonini-Rocha AC, de Andrade ALS, Moraes AM, Gomide Matheus LB, Diniz LR, Martins WR (2018). Effectiveness of Circuit-Based Exercises on Gait Speed, Balance, and Functional Mobility in People Affected by Stroke: A Meta-Analysis. PM R. 2018 Apr;10(4):398-409. doi: 10.1016/j.pmrj.2017.09.014. Epub 2017 Oct 27. Review. PubMed PMID: 29111465.

Jakob Tiebel studied applied psychology with a focus on business in the health sector in Bremen. His clinical expertise is based on his previous work as an occupational therapist in neurological and neurosurgical early rehabilitation. On behalf of THERA-Trainer, he was instrumental in the development of evidence-based robotics-supported therapy concepts as a specialist for clinical applications and head of product management at the interface to marketing, sales and research. He now lives in Switzerland, where he was most recently involved in the digital expansion of one of the largest Swiss eHealth platforms for healthcare professionals for two years in a strategic management role. Since the end of 2021, he has been working in a consulting capacity for medtech, life science and ICT companies in the areas of business development, marketing and sales. As the main editor, he takes responsibility for the content of the THERAPY magazine.

THERAPY & PRACTICE

Physiotherapy for Covid-19

Insights into work in the intensive care unit

Interview: Jakob Tiebel

When it comes to the specialised field of physiotherapy in intensive care, everyday life has been massively shaped by Covid-19 for almost two years. Tobias Giebler is a physiotherapist at Tübingen University Hospital. His focus is on the area of intensive care therapy. During the "coronavirus period", he and his colleagues faced many challenges. The interview sheds light on what this means from a physiotherapy perspective. Therapy options will be shown using case studies and experiences from everyday life.

Editorial: Thank you for agreeing to do this interview, Tobias. You're a physiotherapist at Tübingen University Hospital. What is the current Covid situation from a physiotherapy perspective?

Tobias Giebler: I can answer this question specifically for the area of intensive care units. In any case, it must be said here that it is a huge interdisciplinary challenge to implement early mobilisation.

Especially with these very severely affected patients, the whole thing thrives on interdisciplinary cooperation.

Early mobilisation also seems to be a key to successful rehabilitation and a positive long-term outcome. Especially with these very severely affected patients, the whole thing thrives on interdisciplinary cooperation. By this, I deliberately mean all the professional groups that care for the patient.

How does it work? Together, the patient and the situation are considered. Therapy options are evaluated taking into account the latest findings, and treatment goals and priorities are set. If possible, the patient is involved at this stage. It's important to know that Covid patients are kept in the prone position for 16 hours a day while the lungs are still massively affected. Then they are turned back to the supine position and sedation is reduced as much as possible. Patients should be awake and if there are no contraindications, this phase is then used for mobilisation. If a break from sedation is not possible, our only options are respiratory therapy in bed in different starting positions, and passive movement of the patient. Most of the time, these are severely affected patients. Not only the lungs, but many other organs, such as the central nervous system, the kidneys, the liver and the intestines are affected. As a result, the patients have many inputs and outputs, such as ventilation, infusions, possibly ECMO cannulas (extracorporeal membrane oxygenation, "artificial lung") and dialysis tubes. Offering an adequate therapy programme to cardiopulmonary unstable patients is challenging. We have to be incredibly vigilant and attentive. We've also found over the past two years that managing exercise intensity in these patients is a challenge. The condition and prerequisites associated with it change quickly. It's important that we do not overburden them in any way. Metabolism seems to be very catabolic in Covid patients. They lose muscle mass quickly and strongly, so they need a lot of support from us. For this reason, we are mainly dealing with severely affected adynamous patients who demand maximum attention in early mobilisation and respiratory therapy. What makes it even more difficult for us is that the whole intervention takes place in full PPE. You sweat and quite often find you have limited vision due to fogged up protective goggles – an exhausting undertaking.

Editorial: This sounds like a very high demand on body and mind on behalf and in the sense of the patient. How does this affect teamwork and what does it do to the atmosphere?

Tobias Giebler: This is a really complex and personal question. Especially in the early days, when we didn't know exactly what we were dealing with, it was incredibly stressful. No one knew how the situation would develop or how well your own family would be protected. Uncertainty was a constant companion during this time. In addition, we were shown again and again how the situation presents itself and can develop, that the general condition of these people who are affected can deteriorate massively in a short time and sometimes they also die. Being constantly confronted with the topic of death, even in young, previously healthy people, was and is a burden. Even without Covid, we are dealing with severely affected patients and tragedies in the intensive care unit.

Another point is that early mobilisation, as I mentioned before, only works successfully when there is a team effort and so close cooperation is necessary.

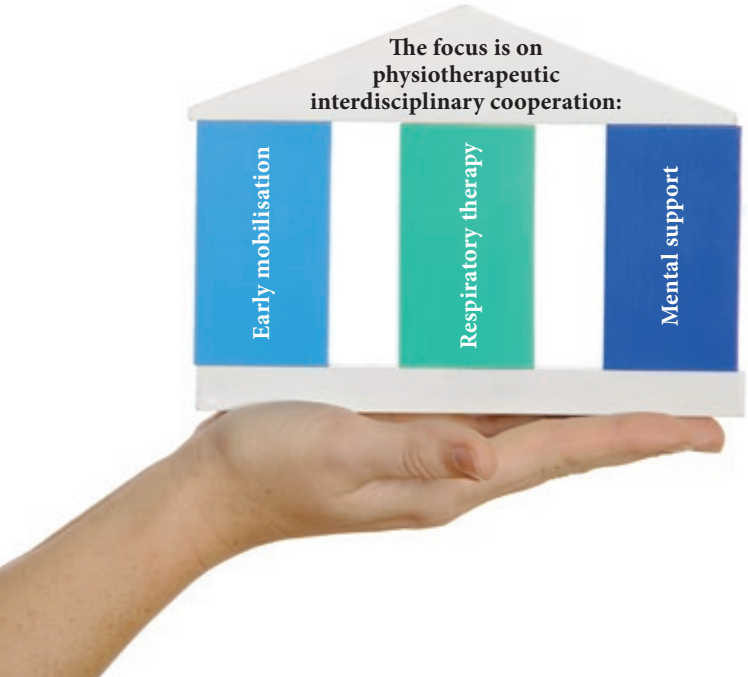
Time and again, however, we also have a sense of achievement when we get patients through a critical illness or a post-operative course and we see how they get better again over time. That motivates us. When it comes to Covid, we see this less often, and when we do, it is with trade-offs in terms of permanent limitations. Another point is that early mobilisation, as I mentioned before, only works successfully when there is a team effort and so close cooperation is necessary. At the end of the day, this good cooperation is decisive for success from my point of view. The physical strain and the mental demands are high. I think it's clear that this constellation brings stress points with it and therefore creates friction – especially in an interdisciplinary context, since everyone wants to get their tasks done. Among physio colleagues, you can say that we have moved quite a bit closer together. Due to the adynamous patients, most of the time mobilisation is not possible alone. That means that usually it takes two therapists, sometimes three. We also combine the units again and again with occupational therapy and speech therapy. More often than not, nursing aspects are included too. This close cooperation in small teams with changing partners leads to situations being mastered together, solutions to problems being developed together and a lively exchange taking place. That connects us all together, of course.

Editorial: We're just talking about the intensive care unit where you work. You find Covid a lot at intensive care units, since many patients require intensive care. What is the situation on the normal wards?

Tobias Giebler: Since I don't work in this field, I can't answer this from my own experience.

Editorial: If we look back at the patient and go even deeper here, what are the focal points in the physiotherapeutic activity but also in the interdisciplinary cooperation with the other professional groups that work with the patient? What are the interventions that you do?

Tobias Giebler: Physiotherapy is divided into three pillars here. **One pillar is early mobilisation** from the first exercises in bed to gait training. This often takes place under ECMO therapy. We know that early mobilisation, with its many positive effects, has a huge influence on the development of complications, the length of stay in the intensive care unit and, most of all, on the outcome. **Respiratory therapy, the second important pillar**, is usually integrated into early mobilisation. Here, our experience is that in Covid patients we need to look at maintaining thoracic mobility and lowering breathing resistance to improve breathing work over tissues and muscle techniques. On top of this, reducing the coughing stimulus is an issue. We take care of secretion in the lungs and the management around it. This also includes various positions that help to improve the ventilation-perfusion ratio in the lungs. We treat ventilation disorders (atelectasis/dystelectasis) and try to prevent them. While doing this, we then support the weaning process – and by that I mean the path of weaning from ventilation and ECMO therapy. We strengthen the respiratory muscles and then work to help patients learn to breathe again as effectively as possible and reacquire a physiological breathing pattern. This is a particular issue for those with Covid disease. Again and again it seems as if the patients have forgotten how to breathe physiologically, as if their central coordination has also been affected. **Finally, the third pillar is mental support, the psychological aspect.** You have to realise that the patients are in an extreme state of emergency. Visits are only possible to a limited extent; at the beginning of the pandemic visiting was not allowed at all. We become the patients' close confidant and contact person, because we spend a lot of time with them.



Editorial: A summary of all these descriptions: What are the biggest challenges in working with patients who have Covid-19?

Tobias Giebler: When I look at the patients, quite a lot of the time they come to us in panic, with fear of death and shortness of breath. They are often in a situation where they can no longer breathe properly by themselves and have to be anaesthetised and ventilated. They are not well and they are alone, separated from their loved ones. They notice

What she wanted most of all and what motivated her daily to keep at the hard struggle back into mobility was to see her child for the first time.

how quickly they physically break down. They are uncertain about how and if life will continue. This is an extreme situation to be in. Coping with this situation is the central challenge, for the patients and for us. And by us, I mean all the people who care for Covid patients. This seems to me to be the biggest challenge for the future as well. To look at the whole thing with professional distance, to reflect well on the situations and to allocate your own resources in the best possible way. Because that is incredibly draining – both mentally and physically. Our task in early mobilisation is to transform this panic and fear that the patients have into motivation to participate in therapy and to show perspectives day by day. We have to manage the necessary energy well. No one knows how much longer we have to hold out.

Editorial: In conclusion: Do you maybe have a nice or positive anecdote from everyday life?

Tobias Giebler: Time and again, we also have patients who are particularly memorable and stories that are especially touching. For example, I just remember a pregnant patient who came to us in the intensive care unit. It became clear that the patient needed ECMO therapy and and the baby had to

be delivered as early as 28 weeks gestation. This woman was lying with us and was badly affected. Finally, after about 7 weeks, she was able to walk a few steps again and sit in a wheelchair regularly.

What she wanted most of all and what motivated her daily to keep at the hard struggle back into mobility was to see her child for the first time. From the intensive care unit, it was organised that an ambulance with incubator went to the neonatology unit and together with a paediatrician the baby was brought to us in the intensive care unit. The overjoyed mother and her child could then be reunited in a separate room. These are moments that everyone can naturally draw a lot of energy from!

Editorial: Thank you for this exciting insight!

Photo credits: Tübingen University Hospital/Tobias Wuntke

Tobias Giebler graduated as a physiotherapist at the University Hospital of Freiburg in 2013. Due to his several years of working as a paramedic in the emergency services, he already brought knowledge in dealing with patients in the intensive care unit into his physiotherapeutic training. He has been working intensively on the topic of early mobilisation for eight years now. He works at the Tübingen University Hospital in the Therapy Centre and has been the deputy area expert for intensive care medicine and neurosurgery since the middle of last year.

SCIENCE

Therapeutic Gamification and rehabilitation technologies in use

How MossRehab and Moss Rehabilitation Research Institute (MRRI) are using Therapeutic Gaming and technology to Improve Recovery after neurological injuries

Laurel J. Buxbaum, Dylan J. Edwards and Amanda Rabinowitz

Rehabilitation is critical after a stroke or brain injury to improve an individual's chances of regaining functional and cognitive abilities. Studies show that intensive therapy with highly repetitive and task-oriented practices offers the most benefits after neurological injuries. "After a stroke or brain injury, the neural pathways involved with the brain are interrupted," explains Amanda Rabinowitz, PhD, institute scientist and director of the Brain Injury Neuropsychology Laboratory at the Moss Rehabilitation Research Institute (MRRI).

„Repetitive therapy exercises help to strengthen that pathway in the brain or develop a new one to restore function."

Maintaining patient interest and enthusiasm in traditional therapies over time is difficult. While therapists help engage patients in exercises, individuals often lose their drive in completing the same routines repeatedly. Therapeutic gaming provides the stimuli to keep patients engaged in rehab exercises with therapy equipment that features computer-based and/or virtual reality images. In addition, gaming therapy helps individuals to understand and visualize exercise goals.

"If somebody is working on their arms with a reaching exercise, therapy equipment with gamification can project an image, such as a fruit, to frame how to retrieve it," Dr. Rabinowitz states. "Using this type of visualization helps patients to master the right movement for more natural motions. It would be hard to duplicate that motion by following a worksheet that outlines the exercise."

Therapeutic gaming also provides immediate, robust feedback. Flashing lights and sounds triggered when a patient makes the correct movement encourages them to keep going. At the same time, therapists get information on patient progress to determine if they should level up or move to another activity.

Therapeutic gaming at MossRehab

MossRehab has more than 25 robotic devices that clinicians can use for rehabilitation inpatient and outpatient rehabilitation. Many feature gamification. The diversity of MossRehab's equipment enables therapists to concentrate on various body functions and patients with different capacity levels.

For example, Armeo Therapy robots support different levels of arm rehabilitation. Other robots that focus on the upper limb include the Amadeo for hand-finger rehabilitation and the Diego for training arm-shoulder. These devices have interactive games.

"I used the therapy devices with a youngster diagnosed with acute flaccid myelitis that caused difficulties with finger extension. Through therapeutic games the patient seemed to view therapy as less of a chore and more of a video game," says Casey McKee, OTR/L, who treats patients at MossRehab Elkins Park. Most of her patients have neurological deficits caused by stroke, traumatic brain injuries, multiple sclerosis, and Parkinson's Disease that require occupational therapy to overcome impairments that limit their ability to complete everyday tasks. "This patient benefitted from the engagement prompted by the high-repetition movement patterns experienced in the various games. I am not certain he would have tolerated such repetitions if not motivated through therapeutic gaming."

The Myro is another therapeutic technology with gamification features for upper extremity rehabilitation available at MossRehab. The Myro offers a sensor-based surface much like a large touch screen computer, with force control and tactile applications.

"I use this extensively in occupational therapy to improve arm range of motion and cognitive skills," remarks Stephanie Farm, MS, OTR/L, who works with adult and pediatric persons with brain injuries and serves as the occupational therapy team leader at the MossRehab Drucker Brain Injury Center. "The Myro has various fine motor attachments so patients can use a joystick to work on gross grasp skills, a pencil for writing activities, or a piece to promote grasp. Cognitive games also prompt patients to scan the screen and identify items that don't belong or find missing components or use colors to complete a sequence."

Gaming therapy for gait rehabilitation

MossRehab is the only rehab facility with two Lokomat devices, a THERA-Trainer lyra and a G-EO at one site that offers robot-assisted gait therapy for patients who experienced neurological injuries. For the Lokomat, the patient is supported by a harness above the treadmill, while an exoskeleton assists the legs to improve walking. Various game-like exercises help patients to meet their goals. MossRehab also recently added the C-Mill, a high-tech treadmill that features a large LCD screen and an overhead projector for gait rehabilitation. The C-Mill device offers augmented and virtual reality games that replicate real-life activities to prepare patients for the outside world.

"One application requires a patient standing at an intersection of two crossing roads to lift their leg if a car approaches from the right or left to avoid it," says Matthew Vnenchak, PT, MS, NCS. "The high-tech treadmill gives visual and auditory feedback if a patient successfully or unsuccessfully completes the task for immediate feedback and reinforcement."

Researching the future

MossRehab continues to evaluate new technologies and conduct research to develop new therapeutic gaming technology. One study led by Dylan Edwards, PhD, Director of MRRI and the Human Motor Recovery Laboratory, is testing a new therapeutic gaming system for motor recovery after a stroke that uses immersive digital gaming to create an environment in which patients control a dolphin swimming through the water. The engaging exercises will help people with impaired arm function to improve their recovery.

Another study using virtual reality gamification focuses on reducing phantom limb pain. Laurel Buxbaum, PsyD, Associate Director of MRRI and Director of the Cognition and Action Laboratory, is working on a virtual reality treatment based on the theory of providing alternative feedback to the brain in the form of a visual image of a missing limb to eliminate a sensory mismatch to reduce pain.

Wearing a VR headset, patients with limb amputations will perform a series of activities such as scooting around a maze on a virtual chair while kicking down barricades and typing on a virtual keyboard with the legs to surf the Internet. The VR system fills in an image of the missing limb so that amputees see themselves complete. "Visualizing and moving limbs simultaneously provides a corrective signal to the brain that reduces phantom limb pain," explains Dr. Buxbaum.

Creating VR patient assessments

Dr. Bauxbaum also developed a Virtual Reality Lateralized Attention Test (VR-LAT) that assesses the severity of a stroke on attention, visual search, and multi-tasking. Typically, pencil and paper tests diagnose this problem where patients bisect lines or cross out specific items in a listing. However, these tests are not sensitive enough to detect subtle deficits and are not strong predictors of performance in the real world.

The VR-LAT creates a virtual environment where individuals travel a path while naming trees and statues of animals and ignoring auditory distractions. Using test results, clinicians can assess spatial neglect and the disposition to visual and auditory distraction to determine patient safety in navigating environments. The assessment also provides a baseline measurement for therapy.

The Virtual Reality Non-Use Test (VR-NU) is another assessment tool developed by Dr. Bauxbaum team that uses gaming theory to evaluate arm function after a stroke. Wearing a VR head-mounted display equipped with headphones and motion tracking sensors affixed to the wrists, patients reach for objects on different virtual shelves. The VR-NU test tracks accuracy, trajectory, response time in the completion of tasks under different conditions. The ten-minute assessment

„There is a great deal of technology available to assist with patient mobilization in a way that is safer for both the patient and clinician. One of the challenges with technology is how to keep the patient engaged for the entire time the equipment is being utilized to allow for increased intensity and frequency of use. The THERA-soft software used in conjunction with the Balo makes it fun and interesting for patients when we are working on dynamic standing balance tasks. THERA-soft can be tailored to the patient's specific needs so they can easily appreciate gains being made"

Naomi Greenberg, DPT, ATP, FSOAE, PT Team Leader, Spinal Cord Injury and Acute Care Units, MossRehab

tool will help clinicians determine the severity of arm limitations after stroke.

Home therapies

Home-based therapy devices help those having transportation or resource challenges or needing to supplement outpatient rehabilitation. That's the premise behind a portable gaming console for homes use that assists patients in recovering upper extremity functions after a stroke. Dr. Edwards was a principal investigator for a pivotal trial of the home-based therapy equipment that features arcade like computer-based and cognitive games.

Dr. Rabinowitz is working with a Rehabilitation Engineering Resource Center (RERC) on developing mobile rehabilitation interventions and therapies for home-based use in persons with TBI. Currently, she is leading the development of a chatbot for personalized interactions with patients to track activities, plans, and goals between therapy sessions, all via text message. Designed to support outpatient brain injury treatment, the chatbot provides encouraging messages, activity updates, and other feedback to help patients meet therapy goals.

Another research program is evaluating feedback received from sensor-based neurorehabilitation devices offered by FlintRehab to determine how people use different gamification features during therapy. Findings will enable developers to design more effective and engaging applications. In addition, Dr. Rabinowitz is working to integrate home-based rehab devices (one is a sensorized glove worn while performing hand and finger exercises to music) with an application called PT Pal to create a platform that collects data and identifies trends to monitor and track patient progress between clinical visits.

With the help of MRRI researchers, MossRehab remains on the pulse of therapeutic gaming in research and developing new innovative technologies for both clinical and home-based use. Our goal is to provide patients and therapists with the best tools and clinical programs to boost the effectiveness of rehabilitation in achieving long-term recovery goals.

For more information using robotics-assisted rehabilitation solutions to assess and treat neurological deficits, visit **www.mossrehab.com/technology.**

Laurel J. Buxbaum, PsyD, is Associate Director of the Moss Rehabilitation Research Institute (MRRI) in Elkins Park, PA, Director of MRRI's Cognition and Action Laboratory, and Professor of Rehabilitation Medicine at Thomas Jefferson University in Philadelphia. She has authored more than 100 peer-reviewed articles and book chapters, and has served as Associate Editor of the scientific journals Cognition, Cortex, and Journal of Neuropsychology. She has received grant funding from the National Institute of Health, National Institute of Disability and Rehabilitation Research, and the James S. McDonnell Foundation. Dr. Buxbaum is the recipient of numerous professional awards, including the International Neuropsychological Society's Arthur Benton Mid-Career Award, the Widener University Graduate Award for Excellence in Professional Psychology, the American Society of Neurorehabilitation's Viste Award, and the British Neuropsychological Society's Freda Newcombe Prize. Her laboratory focuses on understanding how complex skilled action is represented in the brain, how action representations influence manipulable object knowledge, relationships between action and language processing, spatial neglect, and phantom limb phenomena in persons with amputation. Her work spans a translational "pipeline" from basic cognitive neuroscience to neurorehabilitation.

Dylan J. Edwards, PhD, is Director of the Moss Rehabilitation Research Institute (MRRI) and Director of MRRI's Human Motor Recovery Laboratory which aims to understand the basis of motor symptoms and motor recovery in order to inform and develop rehabilitation treatment strategies. He is also Professor of Neuroscience and Director of the NeuroRehabilitation and Robotics Laboratory at Edith Cowan University which has several lines of research addressing recovery of functional movement in humans following neurological damage caused by stroke, spinal cord injury, or other neurological conditions. He was awarded his PhD in clinical neurophysiology from the Centre for Neuromuscular and Neurological Disorders at the University of Western Australia (now the Perron Institute for Neurological and Translational Sciences). Before coming to MRRI in 2018, Dr. Edwards served as Director of the Non-Invasive Brain Stimulation Laboratory at Burke Neurological Institute, and he was Associate Professor of Clinical Neurophysiology at Weill Cornell Medicine in New York. While in New York, he led a long-standing collaboration between Harvard Medical School and Massachusetts Institute of Technology in Boston, as well as Burke-Cornell Neurological Institute in New York, to bridge engineering, neurology, and rehabilitation medicine. This cross disciplinary collaboration led to over a decade of extramural funding in studies of human motor recovery. Dr. Edwards is recognized internationally as a leader in the field of Neurorehabilitation, and his work has resulted in scientific advancements in rehabilitation outcome predictors, non-invasive brain stimulation techniques, and rehabilitation robotics, in method as well as application.

Amanda Rabinowitz, PhD, is an Institute Scientist and Director of the Brain Injury Neuropsychology Laboratory at the Moss Rehabilitation Research Institute (MRRI), as well as a Research Assistant Professor of Rehabilitation Medicine at Thomas Jefferson University. In addition, Dr. Rabinowitz leads the Moss Traumatic Brain Injury (TBI) Model System, a world class center of excellence providing state-of-the-art research, innovative treatment, and valuable programs for people with Traumatic Brain Injury which has been continuously funded since 1997. Dr. Rabinowitz is a clinical neuropsychologist, and her research examines chronic brain injury outcomes across the spectrum of TBI severity. In particular, Dr. Rabinowitz's work focuses on the psychosocial factors that confer resilience after brain injury, with an interest in self-regulation as a key mechanism. A number of Dr. Rabinowitz's projects leverage mobile technology to augment brain injury assessment and intervention. She works with local and national collaborators on studies of long term brain injury outcomes. Dr. Rabinowitz has authored or co-authored more than 100 publications in academic journals, and she is internationally regarded as an expert in TBI neuropsychology. Dr. Rabinowitz received her BA in Cognitive Neuroscience and Psychology from the University of Pennsylvania and her MS and PhD in Clinical Psychology from The Pennsylvania State University. During graduate school, she completed her Residency in Neuropsychology at the Warren Alpert Medical School of Brown University. Prior to establishing her research laboratory at MRRI, Dr. Rabinowitz completed a postdoctoral fellowship at the University of Pennsylvania.

SCIENCE

Interactive cognitive-motor training with the Dividat Senso

Influence of the level of difficulty of different training games on motivation, emotional gaming experience and physical and cognitive demands.

Manuela Adcock, Rebecca Birchler and Jakob Tiebel

Older people have been shown to have an increased risk of falling due to age-related changes in the body and brain. These changes influence their independence and ability to participate in everyday life. This is because everyday human life is predominantly based on action requirements that involve a second motor task and/or a cognitive task in addition to a motor task. For this reason, training recommendations point to a necessary combination of these requirements also in the training context.

With the help of challenging dual tasks, it's possible to train both physical performance and cognition (specific brain functions). This can effectively counteract age-related changes and maintain and even improve the functional fitness, balance, steady walking and walking speed of older people.

Therefore, in therapeutic practice, it makes sense and is useful to couple forms of movement with coordinative and cognitive tasks in order to train the skills as close as possible to everyday life. It's crucial that the trainee's attention is focused evenly and simultaneously on the physical as well as the cognitive task.

Today, technology-based training systems are often used for dual task training. They make it possible to mitigate the consequences of under-straining or overstraining and provide exercisers a safe framework for training at their individual performance limits. The computer game, which represents the cognitive elements of the intervention, is specifically coupled with the movement task. The level of difficulty of the training game is modelled by a progression algorithm depending on the trainee's performance.

The attractive training environment is intended to promote motivation in particular, as this is an essential condition for frequent use of the equipment and training.

Training in virtual realities has a high impact on motivation per se. Ultimately, the play instinct flows into the training when computer games are used. In order for motor learning to be successful, however, it is crucial to keep the trainee's motivation as constant as possible during the course of an exercise session and throughout the entire training process. In this context, preventing under-straining and overstraining as well as getting rewards through learning successes can be seen as essential determinants for maintaining motivation and optimising the training process.

The "Dividat Senso" forms the basis for such computer-supported interactive cognitive-motor training. The training system consists of both hardware and software. Sensors mounted on a base plate record the body's centre of gravity, targeted forces and steps in a highly dynamic way. In combination with the intelligent software "Dividat Play", gross motor movements are playfully linked to personalised cognitive tasks. The video games (exergames) interact with the pressure-sensitive plate. The software is designed to provide an optimal level of challenge; individually tailored to the trainee's abilities. Even without previous computer experience, the video games are easy to use; they bring excitement and fun to training and are designed to increase motivation.

The effectiveness of cognitive-motor training with the Dividat Senso has already been proven in various studies in different fields of application in recent years (cf. van het Reve et al. 2014, Eggenberger et al. 2016, Schättin et al. 2016, Oku-bo et al. 2016, Schwanenburg et al. 2018, Rebsamen et al. 2019, de Bruin et al. 2019, Morat et al. 2019). However, the influences on, and relationships between, the level of difficulty, motivation, emotional experience, and physical and cognitive demands have not yet been investigated.

What influence does the level of difficulty of different game applications for interactive cognitive-motor training with the Dividat Senso have on motivation, emotional game experience and physical and cognitive demands? And what are the connections between the level of difficulty and motivation, the emotional experience of playing, and the physical and cognitive demands?

Jakob Tiebel, Rebecca Birchler and Manuela Adcock recently investigated this in an explorative field study, which is the first of its kind. "The starting point of our investigation was the observation and analysis of characteristics observed and collected in practice, their features and interrelationships. We wanted to find out what possible influence the level of difficulty of different game applications of interactive cognitive-motor training with the Dividat Senso has on motivation, emotional play experience, and physical and cognitive demands, in order to understand the relationships between the variables a little better." This pilot study is the first to address this question. Evaluating the results first showed that the interactive cognitive-motor training with the Dividat Senso was overall experienced as exciting and motivating by the participants, which confirms the results of previous studies. "This can be seen as a predictor for continuing training in the future", the authors said. "The high level of intrinsic motivation and self-regulation further suggests that the study participants found the activity interesting on its own merits and that they self-directed their behaviour towards the target activity."

The most striking results were found in the product-moment correlations, which were used to examine the linear relationships of pairs of variables. Here, there were highly significant correlations between average and maximum heart rate and between motivation and emotional playing experience. The more a study subject was motivated to do a training game, the more positively they described the emotions felt during training. "While the correlation between average and maximum heart rate can be explained on its own, the correlation between motivation and emotional gaming experience supports our hypothesis that the gaming fun associated with exergaming has a motivational effect", Jakob Tiebel explains.

It is particularly interesting that higher cognitive effort correlated positively with the participants'

motivation. "This could mean that the "mental challenge" had a motivation-enhancing effect." Qualitative feedback supports this hypothesis. "Some of the study participants commented positively that the training game felt like brain training. Furthermore, for some games, a significant correlation between the variables of cognitive load and motivation could also be demonstrated."

Due to the numerous limitations of this study, the results must be considered preliminary. They serve as a first impulse in the ongoing project to better understand the influence of the level of difficulty of different training games of interactive cognitive-motor training with the Dividat Senso on motivation, emotional play experience as well as physical and cognitive strain and to investigate correlations between the constructs. "Larger, methodologically more complex studies are needed to determine the direction and strength of these relationships more precisely. In particular, the relationships between cognitive effort and motivation and their influence on the subjective perception of stress should be researched further", the authors say.

Manuela Adcock is Head of Research at Dividat AG and has a PhD from ETH Zurich. Manuela Adcock is a neuropsychologist with many years of clinical experience at the Zurich University Hospital.

Rebecca Birchler graduated from ETH Zurich, majoring in exercise science and sport. As part of her Master's dissertation, she evaluated solutions for home-based cognitive-motor training together with Dividat. In her current role at Dividat, she supports clients in the practical implementation of cognitive-motor movement concepts.

Jakob Tiebel studied applied psychology with a focus on business in the health sector in Bremen. His clinical expertise is based on his previous work as an occupational therapist in neurological and neurosurgical early rehabilitation. On behalf of THERA-Trainer, he was instrumental in the development of evidence-based robotics-supported therapy concepts as a specialist for clinical applications and head of product management at the interface to marketing, sales and research. He now lives in Switzerland, where he was most recently involved in the digital expansion of one of the largest Swiss eHealth platforms for healthcare professionals for two years in a strategic management role. Since the end of 2021, he has been working in a consulting capacity for medtech, life science and ICT companies in the areas of business development, marketing and sales. As the main editor, he takes responsibility for the content of the THERAPY magazine.

Dividat AG is a spin-off company of ETH Zurich that uses digitalisation in healthcare to promote independence and health in all phases of life. Dividat puts the knowledge gained from research into practice and generates new findings, including through its own studies with research partners at home and abroad. www.dividat.com

SCIENCE

Dementia Care Using Advanced Rehabilitation Technology

Accelerated Care Plus (ACP)

According to the CDC (Centers for Disease Control and Prevention are an agency of the U.S. Department of Health and Human Services, headquartered in Druid Hills.), dementia affects one's ability to remember, think, and make decisions that impact daily activities and safety. Alzheimer's disease (AD) is the most common type of dementia accounting for 60-80% of cases. As dementia progresses to increased levels of memory loss and confusion, the individual becomes more sedentary and frail. Rehabilitation in this population should be tailored to patient needs addressing cognition, strength, gait, balance, endurance, and function.

OmniStand® assists the therapist by providing the patient with an appropriate level of support to challenge and progress balance, improve patient's sense of security while performing activities, and it can be combined with virtual reality exercises.

Research:

- Promoting lifestyle changes to include regular exercise in pre-symptomatic individuals may have the potential for delaying one-third of dementias worldwide. (De la Rosa et al., 2020)
- A systematic review found strong evidence for the use of physical exercise in people with mild cognitive impairment (MCI) or mild-to-moderate dementia to improve strength, sit-to-stand, step length, balance, walking speed, and endurance. (Lam et al., 2018)
- Individuals with AD who performed six months of aerobic exercise (progressing from 60 to 150 minutes/week) had increased cardiorespiratory fitness resulting in improved memory performance. (Morris et al., 2017)
- In community dwelling older adults with MCI, 12 weeks of VR-based physical and cognitive training using biofeedback improves cognitive function and was superior in improving IADLs compared to traditional physical and cognitive training. (Liao et al., 2020)

OmniCycle® includes upper and lower extremity cycling to improve strength, endurance, and coordination. Participation is increased with biofeedback activities that are selected based on patient performance.

Advanced Rehab Technology can play an important role in the rehabilitation of individuals with dementia.

OmniVR® engages and challenges cognitive and physical abilities within a virtual environment. Exercises can be simplified to allow for less visual stimulation, as needed for patients with dementia.

Accelerated Care Plus (ACP) | www.acplus.com

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TECHNOLOGY & DEVELOPMENT

Sometimes less is more – on the hunt for new features

User-centred development of robotic and therapeutic devices for neurorehabilitation requires interdisciplinary cooperation.

Interview: Jakob Tiebel

The use of robotic and technology-assisted therapies in neurorehabilitation is booming. The development of new therapy equipment must be preceded by a thorough examination of customer needs. In fact, manufacturers are prone to overengineering. They spend a lot of time on development projects and want to make their products as "perfect" as possible. No one knows better than the therapists who work with the equipment in practice what is important, explains Otto Höbel (CTO THERA-Trainer) in an interview. It's important to interview them in a structured way and to focus on their needs.

Avoiding overengineering and focus on customer benefits

Promoting evidence-based robotic therapies as well as technology-based therapies in neurorehabilitation has triggered a veritable surge of innovation and transformation in recent years. This is an important step forward, because the use of new technologies helps therapists to expand their treatment spectrum and make complex therapies more efficient and safer. However, the spirit of innovation and the search for sophisticated solutions also has a dark side. Manufacturers sometimes forget that the focus should not be on the product, but on the requests and needs of the users. A therapy device that is perfect from the developer's point of view does not necessarily have to be perfect for everyday use.

The constant search for more, better, trendier is increasingly leading to a phenomenon in medical technology that is referred to in specialist circles as overengineering. A therapy device is equipped with as many features and functions as possible. True to the motto: More is better. "In reality, it's the second best choice", says Otto Höbel, Managing Director for Technology and Development at THERA- Trainer.

"Never fall in love with your product, always fall in love with your customers"

Editorial: Mr. Höbel, with the phenomenon described in mind: As the main person responsible for technology and development at THERA-Trainer, how do you face the problem of overengineering?

Otto Höbel: What I often hear are statements such as: "Our competitor has this or that new feature. We need that too. Only better!" (grins). That makes my ears prick up. On the one hand, of course it's important to know what the competition is doing. But on the other hand, because in such cases my developers are quickly put to work on a subject that has never been questioned and analysed more closely. So if you ask me where I stand on this, I say: I'm increasingly critical!

Editorial: Isn't it the job of development to deal with problems around new features and functions?

Otto Höbel: No. What the engineers then end up doing is developing a desired feature on the basis of vague statements and missing specifications. The end of the story is usually a product that may be adorned with good-sounding advertising claims, but has essentially been developed completely past the customer's needs. The question was missing at the beginning: "What benefit should the feature provide for which customers?" Only then does it make sense for the development team to address it. And then you also find good solutions.

Editorial: So would you say that it doesn't necessarily have to be a lot of features and functions, but most importantly it's the right ones that should end up in a product?

Otto Höbel: Yes, exactly. For example, if you get into a modern car with full equipment you'll encounter features and functions that you never need. That only

The use of a therapy device only pays off if it runs as uninterruptedly and error-free as possible in clinical operation and the users are happy to keep on using it.

makes it harder to find important functions quickly and operate them intuitively. In therapy, these kinds of "usability issues" are serious. A therapy device intervenes in a sensitive area of application. It must support treatment on humans. The focus must not be on the operation of the device, but 100 percent on the patient. Just as you should always keep your eyes on the road when driving a car and not on any controls in the car.

Editorial: What negative influence does overengineering have on the development process?

Otto Höbel: Overengineering means that products are given properties that were not requested by customers and this means, in a narrower sense, they do not correspond to the company's goals. So it's a waste of resources. You have to remember that therapy devices are medical devices that must be developed in a strictly regulated process. That's a good thing, because it ensures safety in clinical use. A lot of time is lost in planning, designing and testing unnecessary functions and features, which can cause delays in market introduction.

Editorial: The fully equipped cars you mentioned are also usually quite expensive. To what extent do superfluous functions influence the price development of therapy equipment?

Otto Höbel: Therapy equipment is always expensive. People are often shocked by this, especially users. The high prices result from the quality and safety requirements placed on medical products. However, in cases of overengineering, the more functions a new product has, the more costly the development, production and assembly becomes. As a result of unnecessarily high product complexity, the profit margin decreases and this naturally drives up the price.

Editorial: Does this mean that an unnecessarily high range of functions is more likely to break the price-performance ratio than to bring demonstrable benefits?

Otto Höbel: Of course, you have to be balanced here. Not every new feature is bad per se. Quite the opposite. But if it doesn't prove useful in practice later, then it is what it is. The development costs are not even the biggest evil. Product complexity also always leads to greater susceptibility to errors and therefore higher service costs. The use of a therapy device only pays off if it runs as uninterruptedly and error-free as possible in clinical operation and the users are happy to keep on using it. Here, overengineering can lead not only to frustration but also to financial "side effects", since in addition to impairments in usability, sometimes considerably high follow-up costs can occur.

Editorial: Consequently, searching for what's more, better, trendier alone does not lead to success. But to what extent is innovation slowed down by such strict pragmatics?

Otto Höbel: In colloquial language, the word innovation is often used in the sense of new ideas and inventions and their economic implementation. In the narrower sense, however, innovations only result from ideas when they are translated into new products, services or processes that are actually successfully applied and penetrate the market. In my opinion, there's often an error of interpretation here.

Editorial: How much do additional features and functions determine the degree of innovation of new products these days?

Otto Höbel: Many medical technology companies today determine the degree of innovation of their products by the presence of additional features that often don't even have a proven additional therapeutic benefit. As a result, as already mentioned, there are high development costs. But to remain competitive market prices must remain at an attractive level. Then this quickly comes at the expense of quality. In practice, overengineered products usually prove to be unstable and prone to errors. This is actually good for the manufacturers. In this way, they can subsequently improve their margins through repairs and service orders. The ones who suffer in the end are the customers. That's why at THERA-Trainer we don't do that. Maybe we're just too "Upper Swabian" for that. No, joking aside: As in medicine, we have imposed on ourselves the imperative of economic efficiency and expediency. And according to this principle, we do everything every day to develop the best therapy devices. That's what sets us apart. And we've been doing it for 30 years now. And that by no means closes the doors to our innovative spirit. Quite the opposite.

Editorial: How do you create cooperation within the company that makes "real innovation" possible in the area of tension between what sounds good and what actually makes sense?

Otto Höbel: It may sound boring now. But it's through a user-oriented design process that is lived in interdisciplinary teams consisting of engineers and application specialists. A profession on its own can never succeed in developing a useful product. A software developer, for example, can write good source code, but how is he supposed to know how to maximise customer value by doing so? This requires close cooperation between development, product management and, last but not least, the users in practice. The exciting thing is that in medical technology, this development process is actually mandatory. But I find that it's only really lived by a few. This was also a challenge for THERA-Trainer to establish the process. But we've done it and we're getting better at it.

Editorial: That means therapists are at the centre of the development process at THERA-Trainer?

Otto Höbel: You could say that. At the very least, together with the users, we consistently focus on the benefit that a medical device should provide and, based on this, look for ways to generate this benefit with consistent ease of use.

If a feature offers no added value in this context or makes only a minor contribution, it is put under the

Keep it simple!
The products do not have to offer more solutions than required.

critical microscope. In the increasingly complex and specialised health sector, it's often difficult to balance the diverse interests and requests of all stakeholders. Returning to the benefit for the customer and to the priority features is especially important then. Every feature must be consistently and repeatedly checked for usability and the degree to which it fulfils the user's needs, even during its creation. This sometimes requires many iteration loops to get from the usage requirement through different ideas to a final solution. Sometimes it's necessary to ask the customer several times. This is because you have to understand the customer's processes in the context of the application and have the work steps, and the associated requirements, described in as much detail as possible. And in the end, the product should not offer more than a fulfilment of these requirements. We've been pursuing this concept very consistently and with proven success for several years now. But along the way, of course, we also paid our dues.

Editorial: What have you learned and what is the most important aspect to consider when developing new therapy devices?

Otto Höbel: Keep it simple! As already described: The products do not have to offer more solutions than required. That's why we always reduce it to the essentials. But as I said, this does not rule out our innovative spirit. In order to remain fit for the future, we have been building modularly for many years, for example. This allows us to plan expansion options for a product exactly when we can assume that they will be needed in the future. That's innovation. The same applies to the fact that we can usually even offer our customers these kinds of innovations for retrofitting existing therapy equipment. This is sustainable and allows us and our customers to keep up with the times and remain at the cutting edge of technology throughout the entire product life cycle.

Editorial: Did you just say: along the way, of course, we also paid our dues? What did you mean by that?

Otto Höbel: Of course, we have allowed ourselves slip-ups along the way. With our therapy software THERA-soft, for example, we introduced far too much complexity at the beginning. We thought we were doing everything right at the time because we wanted to give the therapists every opportunity to individualise exercises. Then we realised that no one was able to operate it in practice. It was far too complicated. So we started listening closely to users and gathering feedback. By doing this, in combination with findings from the scientific literature, clear patterns suddenly emerged and we developed very simple and intuitive treatment algorithms. This allowed the performance spectrum and functionality to be retained, but the complexity was significantly reduced. We took the same approach with our new bemo bed trainer.

The search for an optimal solution was long and tedious, but the result speaks for itself today. And our end-effector walking trainer lyra, which was developed at the ETH in Zurich, also impresses with its simplicity. For some, the device looks spartan at first glance. But in the end, therapists love our end-effector walking trainer because it's easy to use and they don't have to be afraid of the technology. It's important to not forget that aspect too. Therapists did not choose their profession to mess around with complex technical systems, but to be able to concentrate on their service to people.

Editorial: How do you effectively avoid these kinds of "slip-ups"?

Otto Höbel: Thanks to modern development methods, the properties and behaviour of a therapy device can nowadays be simulated and tested at a very early stage. This makes it possible to continuously check whether we've taken the right path to fulfil the product requirements. Early feedback from customers and users also makes it possible to assess

whether product development even makes sense or not, or where adjustments still need to be made.

Editorial: So the conclusion is "less is sometimes more"?

Otto Höbel: Sometimes, exactly (laughs). When it comes to listening to customers, it's more a case of "more is better" in order to understand their requests properly. When it comes to development, you're right: Then less is usually more. Product development is an intelligent translation, a condensation of requests into structured, definable usage requirements. Development should never serve the goal of creating a particularly trendy product with as many functions as possible. It should be a reduction to the essentials. You can solve almost any complex hardware problem with lots of steel and thick screws and solve any software problem with many thousands of lines of source code and umpteen sliders. That's no longer an art today. Rather, the art lies in creating efficient solutions. We will continue to focus on this in the future and inspire our customers with optimal solutions.

Editorial: I wish you every success in this and thank you for the interesting conversation.

Otto Höbel, a graduate engineer (FH) in medical technology, trained as a mechatronics technician and paramedic and was already involved in rehabilitation medicine as part of his diploma dissertation back in 1996. Since completing his diploma dissertation, he has been employed as a development engineer at medica Medizintechnik GmbH and is responsible for the development of THERA-Trainer. In 2011, Mr. Höbel became a shareholder and member of the management board of medica. In particular, he is intensively involved in the design of efficient and sustainable development processes in his role as CTO. Since the end of 2021, Mr. Höbel has been a board member of the association GMDRC e.V. The Group for MDR-Concerns is an association of several medical technology companies that regularly exchange information regarding a practicable implementation of the MDR.

A persistent vegetative state to working capacity thanks to verticalisation – A case study

The importance of verticalisation of people in a vegetative state in home care is shown below in the case of a nurse for the elderly, S.S., whose neurologist at the time said to her husband during his first and only home visit: "The child has fallen into the well, there is nothing more to be done – I won't come back here again and won't be prescribing any therapies".

Karin Neidhard

Long-term out-of-hospital care of severely neurologically affected patients in the home environment requires competent interdisciplinary cooperation and a high level of professional expertise. Only in this way can those affected be supported in the best possible way and their caring relatives be informed as much as possible and guided to integrate the progress made in therapy into everyday life.

It can be read in the international literature that verticalisation brings the following benefits in particular:

- vigilance and consciousness are positively influenced.
- the 7 remission stages (according to Gerstenbrand) are passed through more quickly.
- consequential complications such as spasticity, pressure ulcers, contractures, dysphagia, ventilator dependence, etc. can be avoided or reduced by early mobilisation.
- the vegetativum (unconscious nerve system), including circulatory stability, lung ventilation, urinary flow and digestion are positively influenced.
- osteoporosis prophylaxis is also practised.
- spatial and positional sensation, depth sensitivity and body schema are significantly improved.

In December 2015, the nurse for the elderly, who was also ward manager, S.S., suffered a subarachnoid haemorrhage during boxing training due to the rupture of an aneurysm of the posterior right communicating artery. A right decompressive hemicraniectomy and endovascular coiling were performed and a shunt was placed.

Complications that developed in the following weeks were symptomatic of epilepsy following hydrocephalus malresorptivus, meningitis, postoperative haemorrhage with haemorrhages and repeat shunt implantation. As well as this, a PEG was inserted for parenteral nutrition and the patient was fitted with a suprapubic catheter.

S.S. was discharged home in February 2016 in a state of wakefulness; her husband and an outpatient care service looked after her. The patient received physiotherapy twice a week via home visit – she carried out passive movements in bed. During this period, the only home visit by the neurologist in private practice, quoted above, took place with his scathing verdict.

In March 2017, I met the then 42-year-old mother of two school-age children in her owner-occupied attic flat in an apartment building where her parents and siblings also live with families:

Tetraplegic, left half of the body flaccid, right half of the body spastically paralysed, with flexion contracture of the right knee, malpositions due to flexion contractures of both ankle joints, also aphasic but breathing independently and not tracheotomised. All that was possible was unreliable communication via winks to her husband. The patient's disturbed sense of space and position was also noticeable, which manifested itself in her constant searching for a foothold / bumping against the foot end of the nursing bed, which in turn led to a worsening of the poor posture of both ankles and an increase in bending contractures on both sides.

Due to my many years of experience with neurologically impaired patients with impaired consciousness, I recognised my patient's potential

The two children of puberty age were very distraught, the husband completely overwhelmed with household management, child rearing, care and the alleged lack of prospects for his beloved wife, whom he also sorely missed as a partner.

This resulted in the following occupational therapy treatment goals:

- training and improvement of yes / no communication
- daily mobilisation in the existing multifunctional wheelchair
- contracture treatment using a Johnstone pressure cuff
- initiation of own active movements
- prescription of durable medical equipment after they have been trialled
- contact and referral to a speech therapist
- education and guidance for relatives

The following durable medical equipment help to mobilise people in a coma and prepare them for verticalization:

- OrthoTech therapy boot with insertable stabilisers at the ankle and flip-up toe caps with Velcro closure so that spasm-prone, clenched toes can be loosened more easily from the outside and placed physiologically.
- Headmaster neck brace to support head control and improve eye contact when sitting and standing.
- inflatable Johnstone pressure cuff to improve cognition and for contracture prophylaxis or treatment.
- thanks to a change to another neurologist, S.S. was able to be provided with a THERA-Trainer tigo arm and leg trainer on loan after a few weeks. The approval by the health insurance company only took place after objections and justifications / advocacy by the neurologist and by me. The husband exercised daily with S.S. on the tigo arm and leg trainer, and she became increasingly alert and motivated to exercise on her own.
- in December 2017, the patient underwent verticalisation for the first time as part of testing the THERA-Trainer balo standing and balance trainer. Due to her painful flexion contractures and malpositions, the patient was initially only able to stand for 5 minutes despite the therapy boots. The existing contractures and ankle deformities improved with verticalisation so that she could stand for 15-20 minutes at a time until undergoing the corrective surgeries. Despite her pain, my patient kept wanting to stand. Sometimes 3 x 5 minutes in a row, with sitting breaks in the wheelchair, because standing gave her a new perspective and courage to face life. Thankfully, the balance trainer could be borrowed over Christmas and the turn of the year, so that S.S. was given a long trial period. Unfortunately, the approval procedure by the health insurance company again took many months. I have instructed family members and physiotherapy colleagues in the use of the balance trainer to maximise its use.

In March 2018, my patient began to speak spontaneously without errors.

In April 2018, she started eating and drinking. After initial swallowing, this also normalised through logopaedic training.

In June 2018, her skull was surgically covered with an artificial dome. This optical correction was extremely important for her self-image as a woman. Now her children could look at her again "without being horrified" at her injuries.

This was followed in August 2018 by the surgical correction of the flexion contractures of both ankles and the fabrication of lower leg orthoses with special boots. With her physiotherapist, our patient practised walking on a rollator on her balcony.

Durable medical equipment

OrthoTech therapy boots

Headmaster neck brace

Johnstone pressure cuff, inflatable

With the help of the balance function of the balo trainer, we practised improving balance – for example, by catching a balloon while standing.

In October 2018, she trained climbing stairs for the first time with the help of her physiotherapist and her husband using a forearm crutch and lower leg orthoses.

The PEG was removed in November 2018, followed by the removal of the suprapubic catheter in December 2018. We had gradually trained continence with bladder training by disconnecting the catheter.

During a six-week inpatient rehabilitation period in January 2019, S.S. learned to walk on her own without orthoses.

When she returned home, she received occupational therapy training, including fine motor exercises in combination with concentration and visual-spatial perception training. In addition, Mrs. S. practised her sense of space and position according to Prof. Perfetti under the exclusion of eye control.

In November 2019, the patient successfully completed an internship in a geriatric internal medicine department of the hospital where her current neurologist, who prescribed all necessary durable medical equipment, operations and rehabilitation measures, had worked as head physician.

As of December 2019, S. S. was taken on in a six-month employment contract with 17 hours per week in shift work.

In January 2020, she took some driving lessons and also received specialist neurological permission to drive again – she is able to compensate well for the remaining discrete visual field impairments.

Since December 2020, Mrs. S. has been working in a permanent job on a gerontopsychiatric ward in another hospital, her desired field of work, and she was even boxing again. In 2021, she successfully completed further palliative care training and is now a certified hospice worker.

The last meaningful activity still to be practised by Mrs. S. is learning to wear 10 cm high heels again without any accidents!

In retrospect, the patient describes herself as severely depressed and suicidal after being discharged from the clinic – for months in her own flat, in the living room, lying in a nursing bed.

THERA-Trainer balo

THERA-Trainer tigo for arms and legs

For example, she tried to get her husband to give her high doses of pain medication by crying constantly, in the hope that overdosing would cause multiple organ failure and ultimately death.

It was only through mobilisation with the tigo arm and leg trainer, which increasingly offered her the possibility of self-active movements, that she regained her courage to face life. She found the verticalisation with the balo balance trainer to be crucial for her rehabilitation. According to her own statement, seeing herself at eye level with her family and the therapist again made Mrs. S. want to fight for herself and make progress.

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Karin Neidhard is a graduate occupational therapist (FH) with over 40 years of professional experience. From December 1981 to June 1988, she was employed as an occupational therapist at the BG Accident Clinic in Frankfurt/Main in the specialist areas of spinal cord injuries, general surgery, hand surgery, neurosurgery and orthopaedics. Since 1991 she has been working as an employee at the occupational therapy practice Christa Middendorf in Essen (since 01/01/22 under the new management of Andrea Klomfaß) and specialises in the treatment of neurologically severely ill adults, including people in out-of-hospital ventilation and in a vegetative state. K. Neidhard has been a member of the German Association of Occupational Therapists (DVE) for over 30 years. She has participated in various further and advanced training courses with a focus on neuropsychological and neurological-rehabilitative treatment methods and concepts such as Bobath, Perfetti, basal stimulation, orofacial regulation therapy according to Castillo Morales, Kinaesthetics and much more. Karin Neidhard has worked part-time and voluntarily as a speaker and lecturer for the German Association of Occupational Therapists (DVE), among others, most recently in March 2019 for the "After-Work Lecture Therapy" series at Münster University of Applied Sciences. Her publications, including Ergotherapeutische Untersuchungsreihe neuropsychologischer Störungen – EUNS are published by Schulz-Kirchner Verlag. In November 2021, she completed her further training as a specialist therapist in out-of-hospital intensive care (VeRegO/DiGaB).

SCIENCE

Risk of falling in seniors – What effect do multimodal training programmes have?

Jakob Tiebel

In keeping with the focus of this issue, we're going to explore an exciting study by Rosado et al. from last year. The Portuguese research team investigated the effects of two multimodal exercise programmes on reaction time, mobility and dual-task performance in seniors at risk of falls in a randomised controlled trial.

For this purpose, 51 study subjects were divided into two experimental groups (units: three times a week for 24 weeks) and a control group. Group 1 carried out a psychomotor intervention, group 2 a combined programme (psychomotor intervention plus whole body vibration). The control group maintained their usual daily activities.

The study participants were evaluated before the start of the study, after the intervention and after a further twelve weeks for follow-up. The comparisons showed significant improvements in mobility and dual-task performance after the intervention in group 1, while there were improvements in reaction time, mobility and dual-task performance in group 2. The magnitude of the clinical effect was average (group 1) to significant (group 2). The comparisons also showed a reduction in the rate of falls in both groups. However, the effects of the interventions on reaction time, mobility and dual-task performance were no longer detectable after the 12-week follow-up period without intervention.

The results suggest that multimodal psychomotor programmes in older adults at risk of falling contribute to fall prevention as well as to the prevention of cognitive and physical functional decline. However, the interruption of the programmes apparently leads to a rapid reversal of the effects.

ORIGINAL WORK:

Rosado H, Bravo J, Raimundo A, Carvalho J, Marmeleira J, Pereira C. Effects of two 24-week multimodal exercise programs on reaction time, mobility, and dual-task performance in community-dwelling older adults at risk of falling: a randomized controlled trial. BMC Public Health. 2021 Nov 10;21(Suppl 2):408. doi: 10.1186/s12889-021-10448-x. PMID: 34758759; PMCID: PMC8582089.

Activation through digital memory work in the TagesOase Bruchsal care facility

Daniela Benz (Facility Manager) reports on the use of virtual bike tours in the Caritas TagesOase Bruchsal, which are used to encourage the guests – a great change, especially during the pandemic period.

Anke Kunze, Interview 03/02/2021

Would you please introduce yourself briefly?
My name is Daniela Benz. I've been working at the Caritas TagesOase (CTO) Bruchsal as a Facility Manager for nine years.

Do you already use innovative durable medical equipment in the CTO for more active participation in life?

We hardly use digital durable medical equipment at all here in the CTO at the moment. The Bike Labyrinth was the first digital medium we ever tried here. Of course, we have a radio and music on CD, but we don't do anything with computers for seniors at the moment.

When our CTO was closed in spring 2020 due to the pandemic, the staff were deployed in the Caritas homes. In Oberhausen, I helped the seniors to use Skype so that they could see their relatives on a tablet. This was very touching for me because I'm used to it from the CTO that the visitors go home again and then don't get to see their loved ones for weeks like in the home.

Ms. Benz, how do you encourage your seniors to exercise every day?

Most of the guests have a walking disability. A lot of them use a rollator or a walking aid. They are

physically encouraged by daily seated gymnastics and a walk through the city, as we are fortunately centrally located near the Bruchsal weekly market. This walk is between 30 to 45 minutes daily with rollators, wheelchairs and walkers. We also enjoy taking part in events organised by the city of Bruchsal. It's not digital, but it is fun! For example, in October 2020 there was the Bruchsal Hope Run, where our day guests marched 80.7 km.

That really sounds like a lot of fun! Despite your great trips out, what brought you to Bike Labyrinth? And what was the incentive to actually try out Bike Labyrinth with your seniors?

Dr Schoch is our gerontologist from the Caritas Association. She does a lot of training and actively looks for projects and durable medical equipment that might be of interest to us. Since I'm a very open-minded person and like to try out a lot of things, she asked me if I would like to try out a trim bike with our guests, where they can cycle and see where they're going on a monitor. I couldn't really imagine it myself to be honest. Nevertheless, I immediately agreed, as we're not allowed to do much at the moment because of Covid. We usually had musicians come visit us: dancing and swaying three times a week. And all that has now fallen through because of the pandemic. Now it's a matter of keeping a metre

and a half distance from each other and no hugging. And the Bike Labyrinth was just a nice change from all that.

The incentive was actually the TV with the lifelike images. Our guests were able to cycle in a city they had been to before. It wasn't so much about the mountains or the snowy landscapes, but really about the cities that our guests know. They were totally into it, because they cycled through streets they could recognise.

But they were also excited about seeing places they would like to visit. One of our guests, who has apoplexy, really wanted to go to the Copacabana, to see the young girls in bikinis. That was funny for all of us.

Why are these lifelike images so important for your guests, Ms. Benz?

They're memories from the past. People with dementia in particular still remember everything that happened in the past. For example, one guest was born in Heidelberg. He lived there, worked there and of course he knew every alley and the castle! He had such fun riding his bike through Heidelberg. He told us during the bike tour through Heidelberg where he did his training. He has dementia, so it's insanely nice to see that everything from the past is still in there and resurfaces when you give a little nudge. Knowledge comes out of nowhere from one minute to the next.

Please explain briefly (in your own words) what Bike Labyrinth is.

The Bike Labyrinth is a trim bike connected to a large monitor. Our guests can select which city or country they would like to cycle to with two buttons. The (rolling) chair on which you sit is secured beforehand with an anti-tilt device. Because the guests sometimes push off so hard or step in so firmly that they tip over backwards. This anti-tip device is actually very important for us. The pedals with foot and leg supports are also useful for guests to set up their legs properly, especially for the hemiplegic users who have no feeling in their legs.

What opportunities does Bike Labyrinth offer for seniors?

1. Something new to do and a change from everyday life

The advantages are quite clear. For example, not all day visitors can take part in our city walks. These guests, who stay in the CTO, have a lot of fun using the Bike Labyrinth. That went down very well. Some guests even insist on walking AND cycling. We put some time aside for this again at lunchtime. There was a lot of interest because everyone raved about it. From the bike routes,

to the guessing games and the sound of a bike bell at the beginning of each route.

2. Bike Labyrinth contributes to the sense of community

Everyone sat together and enjoyed the beautiful landscapes. For example, we were in Austria in the snow – because unfortunately there's none here in Bruchsal. Of course, the cities also were a big hit, especially if the guests knew them. Our puzzle fans liked the guessing games.

The whole group sat in on the quiz! With us, there's no shame in not being able to say something. There was a lot of discussion and the person who was at the wheel then decided for the group.

3. Autonomy for restricted seniors

It was really nice to see how a guest who had already had a stroke and could no longer walk could decide for himself where to go. Precisely because this isn't an option for him in normal life.

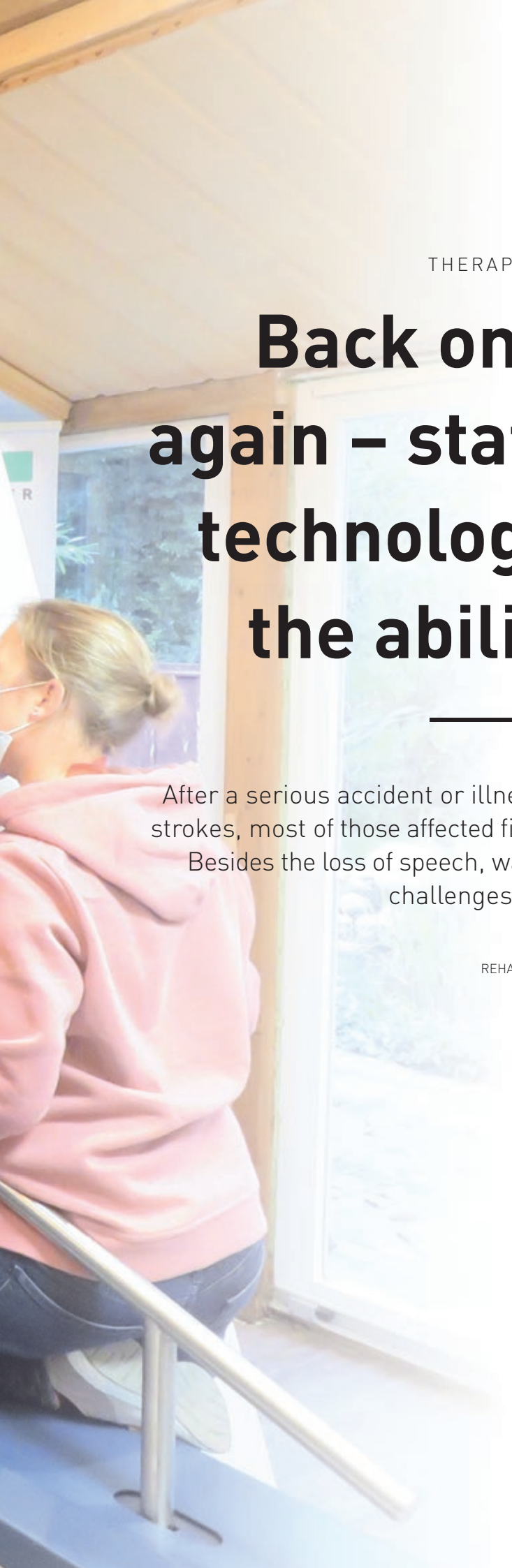
4. Bike Labyrinth promotes mental function

To become physically fitter, the guests would have to ride more. Many only cycle for 15 minutes once or twice a week, which is not enough. But it definitely gives our guests a mental boost. Deciding and remembering are important: being able to choose for themselves which city they want to go to and then also remembering that they have already been there. It's just a pity that Bruchsal or Calw, for example, were not yet on the system. Cities where people come from or live. That would be best for the memory work. People then know exactly where they have been shopping or in which street their aunt or cousin lives.

In your experience, what are the decision-making criteria for buying something like this?

When our guests and the residents of the homes feel comfortable with Bike Labyrinth and there is so much joy every day, then the purchase of Bike Labyrinth pays off. As management, we see whether a product is well received by our seniors. And if we endorse Bike Labyrinth, then buying it already makes a lot of sense. We plan to purchase at least one system after the trial orders and have it rotate between the homes and the Day Oases on a quarterly basis.

Anke Kunze received her Bachelor of Science in Teaching, Learning and Training Psychology in 2012 and her Master of Science in Health & Social Psychology in 2014. After some experience in the private and university sector, she has been working as a product consultant at Bike Labyrinth B.V. since November 2018 and offers free and non-binding trial orders for interested facilities. The company also co-operates with clients for public relations and evaluations to draw attention to the issue of encouragement and exercise for older people.



Back on your feet again – state-of-the-art technology restoring the ability to walk

After a serious accident or illness such as brain haemorrhages and strokes, most of those affected first have to learn to walk and talk again. Besides the loss of speech, walking upright is one of the biggest challenges in rehabilitation.

REHA-HAUS Buchholz

But the latest technology can help here. With this in mind, the "Physiotherapie am Sakura-Bad" has purchased the THERA-Trainer lyra in cooperation with the REHA-HAUS. With the end-effector walking trainer, intensive training at the performance limit is aimed for in every phase of rehabilitation. The main goal of the training is to enable those affected to find their way back into a self-determined everyday life.

Specifically, it's all about:

- regaining the ability to walk,
- increasing walking speed,
- improving stamina and gait.

The device generates the human walking pattern through a patented mechanism that can be individually adapted to each patient. Training should feel like natural walking.

The natural but mechanically supported walking movement is intended to recall the resident's "muscle memory". This increases the chance of rehabilitation of the ability to walk.

The number of repetitions is also important for the effectiveness of the training. In this area, the THERA-Trainer lyra is clearly superior to conventional treadmill or manual gait training.

The direct ground-level access allows quick and easy transfer, even for patients with severe disabilities. The settings, such as step length, height of the handrails and weight relief, can also be adapted to the respective resident in no time at all. After the

Left: THERA-Trainer bemo
Right: THERA-Trainer balo –
a dynamic standing or balance trainer
to improve core stability, train balance,
promote walking ability, etc.

gait trainer has been adjusted to the patient, all of the important training parameters are displayed on the touch screen and can be configured accordingly.

Training from bed with the THERA-Trainer bemo

In addition to the THERA-Trainer lyra, REHA-HAUS has also purchased the THERA-Trainer bemo. A movement exerciser for circular passive, assistive or active movement of the arms and legs. The device can specifically promote mobility in bedridden and severely affected patients. In this device, the resident's feet are fixed in a special foot-rest. The legs are set in motion by a motor, just like when riding a bicycle.

The goals of this therapy are:

- to stabilise pulmonary functions,
- to reduce complications in intensive care,
- to activate the metabolism and
- to improve the resident's functionality.

In principle, this is also intended to optimise the degree of alertness in order to rehabilitate the affected person as quickly as possible after the acute phase – i.e. shortly after the accident or illness.

SOURCE:

Der Buchholzer. Mitteilungen des REHA-HAUSES Buchholz, Dithmarschen, Ausgabe Dezember 2021, S.1f.

Out of the wheelchair and into the mushroom forest

After postoperative complications, the diagnosis was incomplete transverse section. Thanks to his unlimited willpower and the intensive exercise therapy, Leo R. made it back to the mushroom forest on crutches.

Home4Motion

During a routine gastroscopy in 2018, Leo R. was diagnosed with stomach cancer. The doctors advised an operation, which went off without a hitch. However, his condition deteriorated during his stay in the normal ward. He suffered a burst stomach as well as pneumonia and had to be intubated. Leo was then in intensive care for 47 days. After waking up, he could no longer sit, walk or stand. Diagnosis: incomplete transverse section, the cause of which has not been clarified to date. This was followed by nine months of inpatient treatment in hospital and intensive rehabilitation and mobilisation in various rehabilitation facilities. However, the last stint in rehab did not produce any more significant improvements – Leo was confined to a wheelchair. Doctors also did not predict good future prospects, as at his age neurological recovery from movement limitations was unlikely. "But I didn't want to settle for that", says Leo. When reading a brochure, he became aware of the robotics-assisted therapy centre HOME4MOTION in Graz. He started his therapy there in August 2019 as well as conventional physiotherapy in Leoben.

Being able to look for mushrooms again

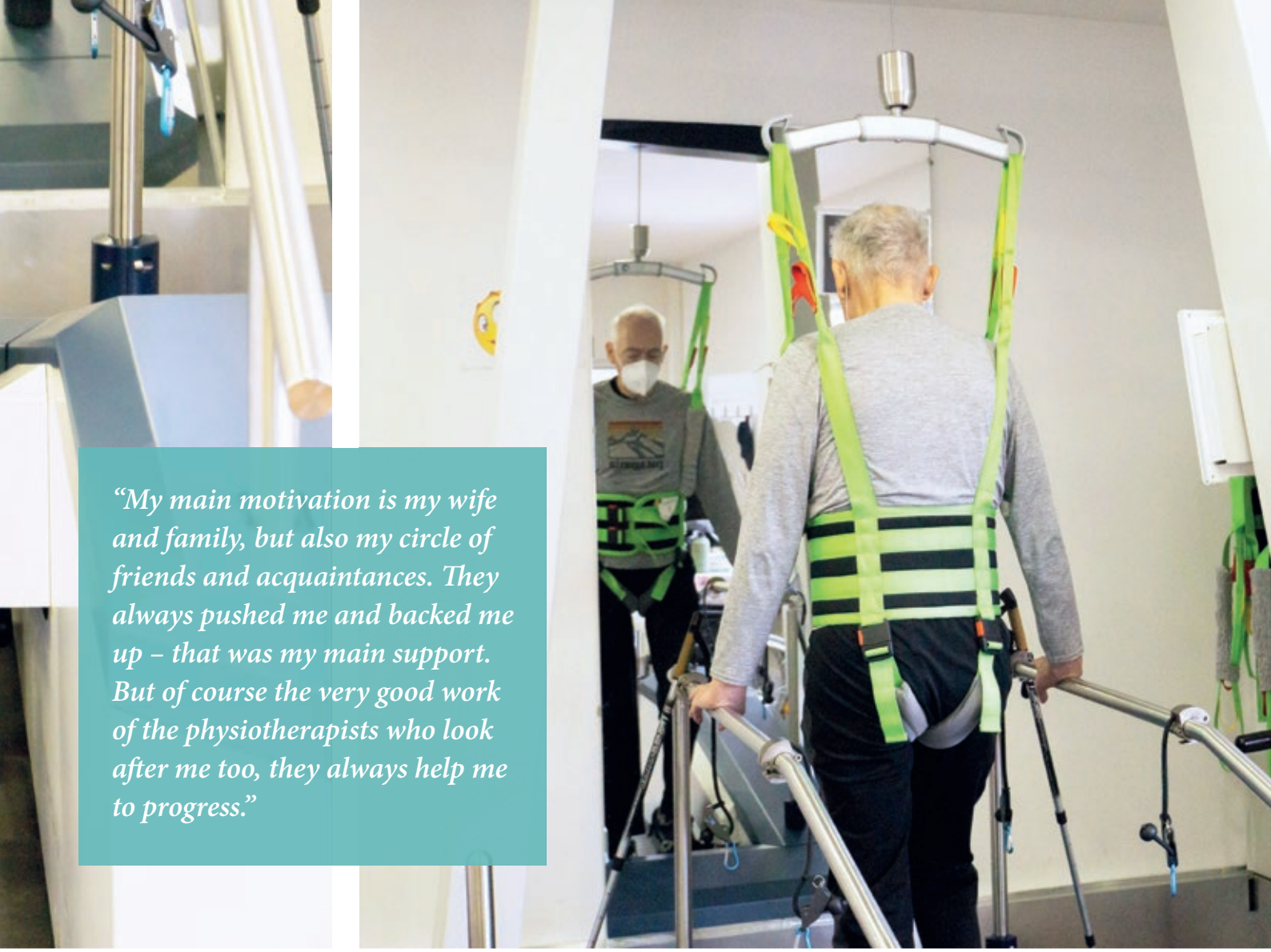
"I'm a very nature-oriented person. Even as a child, I enjoyed spending time in the forest picking berries or looking for mushrooms. Or in spring, when the pine or spruce forest is in bloom, the most beautiful thing for me was to lie down there in the moss and just enjoy life. I would love to be able to do that again", he says enthusiastically. Leo's support and motivation are his wife and family. "I don't want to be a burden for anyone and I also wanted to get back on my feet myself. For me, but also for my family", Leo continues.

That is why HOME4MOTION focuses on improving or re-learning how to walk. Walking is a complex process and requires strength, endurance and coordination of the leg muscles as well as sufficient stabilisation of the core. This is intensively trained by our gait trainer lyra as well as our gait phase trainer Omego. Through rhythmic walking and cyclical activation and relaxation of the leg muscles, adequate active movement of the legs, as well as endurance and strength of the leg muscles are improved. At the beginning, Leo still had to be pushed to the gait trainer with the wheelchair and a large part of his own weight had to be relieved. This is where the great advantage of our gait trainers comes into play, namely to perform a physiological gait pattern with partial or full weight relief. Over time, Leo could take more and more

of his own weight and his general health also gradually improved so that by September Leo was already noticing improvements in his thighs and knees. Towards Christmas, he was already able to cover somewhat longer distances with the rollator. In February 2020, the first attempts at walking with crutches followed, and in the summer with walking sticks. “But it’s not like I can do without the wheelchair all together. It’s still necessary for long distances. But when I look at the difference from spring 2019, when I was wheelchair-bound, to today, the progress for me is significant”, Leo says with enthusiasm. The Omego gait trainer, which specifically addresses the gait phases of the stance and free leg phases, has also contributed to this. Exercises such as the leg press or the stepper enable the targeted training of the extensors and flexors of the knee and hip through varying demands in different games.

Never give up

Leo’s biggest weaknesses are still balance or standing for long periods of time. “I always try to set myself small goals. At the beginning I wanted to get out of the wheelchair for short distances, when that worked I wanted to walk further distances with the rollator and so on. Today, my next goal is to be able to walk freely for short distances and stand freely for longer”, Leo reports. Essential for improving balance is core stability, which is trained by reducing the supporting activity of the arms on the gait trainer lyra. While Leo swings his arms next to his torso or raises his arms outstretched, the challenge is to keep the torso stable so as not to lose balance. Leo masters these therapy exercises better and better and for a longer time. And how does he stay so motivated? “My main motivation is my wife and family, but also my circle



"My main motivation is my wife and family, but also my circle of friends and acquaintances. They always pushed me and backed me up – that was my main support. But of course the very good work of the physiotherapists who look after me too, they always help me to progress."

of friends and acquaintances. They always pushed me and backed me up – that was my main support. But of course the very good work of the physiotherapists who look after me too, they always help me to progress. We also have a large garden, which I get a lot of enjoyment from. If you can't work there, that's a problem for me. This was also a motivation".

Into the forest on crutches

Leo wants to encourage others who are affected. "You also have days where things don't go so well, or you regress, but as long as you have a positive attitude and your body naturally allows it, then something keeps going and it improves – you have to want it! I can only advise everyone to do what they can to get out of their own personal mess", he says. Not giving up has paid off for Leo. In August of the previous year, he was able to walk a short distance with his wife and on crutches in the very forest where the couple used to spend time together. They were even able to collect chanterelles and porcini mushrooms. "Six months earlier, I would never have imagined that I would come to the forest again. That in itself means a lot to me", says Leo.

SOURCE:

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THERAPY & PRACTICE

Patients in intensive care should be mobilised as soon as possible

Early mobilisation can reduce medical complications and is associated with improvements in respiratory function, reductions in delirium, increased functional independence, cardiovascular fitness and psychological well-being. In practice, however, early mobilisation is often a major challenge.

Dividat AG

"Many studies show the effectiveness of early mobilisation in the ICU."

Mobilisation in the intensive care unit: Interview with Ticino professionals by Eva van het Reve and Damiano Zemp, Dividat AG

The Swiss company Dividat AG already presented the new bed trainer THERA-Trainer bemo to specialists from the intensive care units of the Ticino hospitals at the end of 2020. It quickly became clear that this kind of product would make their work in the intensive care unit much easier. In the following interview they tell us about their experiences.

Dividat: Hello Giuseppe and Christian. Thank you very much for taking the time to be interviewed! What advantages do you see in the THERA-Trainer bemo for early mobilisation?

Giuseppe de Pasquale: We had been looking for a device that met our needs in terms of quality, comfort and manageability for some time. It was not an easy search. The few products in this area were not convincing. When the bemo was introduced to us, we were immediately enthusiastic and this only increased when we started to use it in our everyday life. The exerciser is easy to disinfect, offers a wide range of functions as both a leg ergometer and an arm ergometer, in passive, assistive and active modes. In addition, a feedback system enables active participation of the patient. Many studies show the effectiveness of early mobilisation in the ICU. Patients leave the unit in a better condition and show better motor recovery. As well as this, it has a positive effect on the mental state and results in a faster reduction of the administered medication.

Dividat: Why is early mobilisation so important from a medical point of view?

Christian Nicole: Many patients suffer from Post Intensive Care Syndrome (PICS) after their stay in the ICU. These are health problems (physical, psychological, cognitive) that remain after a critical illness. PICS appears as general muscle weakness (better known as ICU-Aquired Weakness). Efforts should be directed towards preventing PICS. This involves trying to minimise sedation and maximise early mobilisation during the stay in the ICU. The benefits of early mobilisation are undisputed: it affects the severity of PICS, ventilation time, risk of delirium and rehabilitation time.

Dividat: Which kinds of patients used the bemo? Which patients benefit most and what are the results?

Christian Nicole: In Mendrisio, the THERA-Trainer bemo was used in both ventilated and non-ventilated, sedated and non-sedated patients – with very good results. In the awake patients, it was found that in the next training session, the exertion force and the training time could be increased. As we weren't used to it yet, we only used the movement exerciser on stable patients for safety reasons. When working according to the early mobilisation protocol, which includes restrictions and safety criteria, all patients could benefit from the bemo. I think the only limitation is respiratory instability in patients who need continuous pronation – those we are treating during this pandemic period.

Dividat: How are patients mobilised without the THERA-Trainer bemo?

Christian Nicole: It was well received by the patients who used it and they felt the benefit – this especially in terms of their strength. As carers, we noticed how from one training session to the next, both the intensity and the duration of the exercise increased. This applied to the arms as well as the legs. Thanks to bemo, transfers from bed to chair, as well as vice versa, were possible earlier without a lifting device, and patients regained functional and muscular abilities more quickly.

Dividat: Have you also been able to mobilise Covid patients? Can you envisage this device also having positive effects on Covid patients?

Christian Nicole: Early mobilisation is also carried out at the Covid Hospital in Locarno. However, logistics and resources only allow for respiratory physiotherapy and active-passive mobilisation such as transfer from bed to chair. However, Covid patients, just like all other patients, could also benefit from the new THERA-Trainer bemo, because it's a device that, if used daily, can certainly lead to better outcomes and a reduction in the length of stay in the intensive care unit. For this reason, we have shared the experience we gained on the wards of the other three cantonal hospitals with the Covid Hospital in Locarno.

Dividat: Do you think that the bemo should also be used for patients from other departments? Which ones?

Giuseppe de Pasquale: The only disadvantage of the bemo is its size. It's adapted for an ICU room, so it would be difficult in a standard ward room. If there are no logistical restrictions, the range of applications is very broad: Geriatrics, oncology, rehabilitation – all could benefit. After 15 years as a physiotherapist in intensive care, I can safely say that it is really worth trying out the bemo to be convinced of its efficiency. When the exerciser was introduced to us, we were immediately enthusiastic and this only increased when we started to use it in our everyday life.

Dividat: Thank you very much, Christian and Giuseppe, for making yourselves available for the interview!

SOURCE

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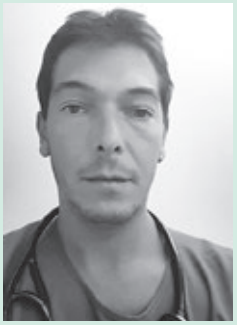

Christian Nicole is a clinical specialist in the intensive care unit in Mendrisio.

Giuseppe de Pasquale is a physiotherapist for intensive care medicine and a member of the IG Physiotherapy of the SGI.

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Publishing details

Issue No. 01/2022 | 10th Edition | Volume 6

Publisher & media owner: THERA-Trainer by medica Medizintechnik GmbH | Blumenweg 8 | 88454 Hochdorf

Photo credits: phonlamaiphoto / beerkoff / Wordley Calvo Stock / sveta / sudok1 / Syda Productions / Gorodenkoff / and.one / Photographee.eu / pomupomu / magicmine – stock.adobe.com

Sales: The magazine is published twice a year and is free

A008-761 | 04/2022