The scooter trick

INCOMPLETE PARAPLEGIA: A CASE REPORT

A stroke of luck

Robert Göthner when he had an accident while bobsleighing. Despite a fracture of the 7th cervical vertebra, he is now fully reintegrated into student life in Leipzig. Together with physiotherapist Renata Horst, he explains how and why concentrating on the plantar flexors in particular has brought him a big step forward.

My name is Renata Horst and I have been a physiotherapist for 24 years. When Robert joined my N.A.P. course at the NOZ Leipzig as a test subject, his accident was a year ago. I immediately noticed that he was a very athletic guy and had a lot of potential, both physically and mentally. I was immediately sure that he would make the best of his fate.

" My name is Robert Göthner. I have been completely paraplegic since a bobsleigh accident in December 2009. The accident happened during a European Cup training run on the Altenberg bobsleigh track. After a driving error, the bobsleigh tipped over at high speed and skidded on its side. I couldn't quite get my head into the protective chassis of the sled and after a heavy blow to the head, I realized that I had lost control of my legs in the still sliding sled. I could do what I wanted - my legs were no longer doing anything at all. The feeling was also suddenly completely gone. When the sled came to a standstill, I grabbed my legs, stomach and chest in a panicked reaction and realized that only my hand could still feel my body parts - but not the other way around. I told my teammates in the bobsleigh that something serious had probably happened and moved as little as possible. The ambulance came, and after a CT scan at Dresden University Hospital, the suspicion was confirmed. The doctor told me that the 7th cervical vertebra was fractured and that I needed to be operated on quickly to relieve the pressure on my spinal cord. The operation was successful and the spine was stiffened in the affected area. However, the consequences remained.

When I was transferred to the Bavaria Clinic in Kreischa shortly before Christmas, I still didn't feel any sensation or movement below my chest. "Spinal shock", I was told. We would have to wait and see how things developed. I hoped, feared, tried and at the same time realized how incredibly limited you are without legs, without abdominal and back muscles. I couldn't even sit freely or turn from side to side in bed. My head and arms were sitting on what felt like a mountain of clay, which was supposed to be my own body. "

The big goal: to be able to run again > Robert was lucky that he already had very competent and committed therapists at the NOZ Leipzig, which is a training center and therapy center in one - Stefan Srugies and Silvia Borgmeier. Stefan was initially very surprised at how much functional capacity Robert had eight months after the accident, even though the fracture was at C 7. His assumption was that the spinal cord had only been injured from about Th 2/3 due to the massive flexion posture of the trunk in the bob at the time of the spinal shock.

In his medical history, Robert stated that neither motor nor sensory functions were present at first. Sensitivity was the first thing to return after around two weeks, followed shortly afterwards by the first motor signs in his legs. In the rehabilitation clinic, Robert was put on a treadmill after about two weeks. At first with almost complete weight relief and then with less and less help. Three months later he was able to walk on the walking frame and after four months on crutches. When Robert presented for therapy at the NOZ eight months after his accident, he was able to walk but fell very frequently.

" Legs that are just a dead mass - that was hard for me to imagine. Especially as a former sprinter and bobsledder, I was passionate about running. For me, running is a kind of basic need that I wish and strive to regain to this day. I was lucky in misfortune - as the saying goes. Over the course of the following months in the rehabilitation clinic, I experienced some recovery effects. First I felt a few touches on my feet again, then came tiny motor activities. Maximum effort and full control by the head led to minimal movement. Thanks to the good and dedicated care at the clinic, I was soon able to stand again and then try to take one step at a time - always secured by my arms, which were supported by bar rails and later by the rollator. I hoped that it would go on and on - just like toddlers gradually walk, then run and become more and more skillful. But it wasn't that easy. Although I made significant gains in strength in certain muscle groups

One week before his accident, Robert Göthner (front right) was still competing in the European Cup race in Winterberg.

in my pelvis and legs, walking remained an uncertain, uncoordinated activity that always required awareness. I had to think through every step and every movement.

I was often told that the foot lifts were my problem. They were too weak. During rehab in Kreischa, I was constantly given electricity to strengthen them, and I also spent a lot of time working on them afterwards. But despite a significant increase in strength, there was hardly any improvement in my stumbling and falling in everyday life.

It was the time when I had to find my way around at home again. In my search for a suitable physiotherapy practice, I came across NOZ. After just a few weeks, I knew that these were the right people for me. Stefan and Silvia took it in turns to treat me. I was also given the opportunity to receive therapy as part of the further training courses organized there. This is where I met Renata. "

Recruitment problem of the plantar flexors > When we analyzed Robert's gait in the first module of the N.A.P. course, we were all initially of the opinion that he had trunk instability and foot lift weakness. This was an obvious assumption as we could clearly see how he initiated his swing leg phase by using his trunk. We also heard his feet dragging on the ground. At

On closer inspection of a video recording, however, we noticed that he was able to get his foot up very well in the mid-swing leg phase. He even had a clearly recognizable heel contact (initial contact) when touching down on the ground. During the strength test of his dorsiflexors, he scored 5s on both sides. However, he was only able to stand on his toes with difficulty and showed a clear outer edge load (a **Fig. 2, p. 30**). His peroneal and toe joint flexors had a

Racing is a kind of basic need for me, which I am still trying to regain today.

Robert Göthner

MFT value of 1, especially the flexor hallucis longus seemed to be affected (a **Fig. 3, p. 30**). I suspected that Robert was using his trunk because he could not push his feet off the ground. It was not the trunk that was the problem, but his potential, which he used to bring his swing leg forward. This realization triggered heated discussions in the classroom.

However, a brief excursion into the current literature showed us that flexor synergy is not required to move the free leg.

Fig. 2 Toe stance with outer edge loading. Robert lacks the peroneal activity to stabilize the ball of the big toe. It is not possible for him to stand on one leg.

Fig. 3 The strength value of the flexor hallucis longus muscle is MFT 1. As a result, Robert does not pre-stretch the tibialis anterior muscle in the push-off phase and therefore recruits it too late.

Fig. 4 On the scooter, Robert activates the toe flexors and peroneal muscles with the help of his therapist in order to propel the scooter forward.

Fig. 5 Participation: The scooter is an enrichment for Robert as a means of locomotion. His dynamic spiral orthoses promote pronatory push-off activity.

but rather the extensor synergy of the same leg. Only the foot strike with the help of the flexors brings the foot lifters into the necessary pretension in order to be lifted reactively - like a spring. In addition, anatomically speaking, there are fewer connections between the brain and distal body musculature than between the brain and proximal musculature. In the course of evolution, humans have had less experience with the dexterity of distal body parts than with their trunk muscles. Consequently, Robert uses his trunk as a functional reserve to bring his leg forward. Under healthy conditions, it is the other way around. The foot pushes off the ground to propel the trunk, which is not consciously controlled, forward.

In Robert's case, it became apparent that his structures had adapted to the functional requirements. The compensation strategies that we observed in him proximally were the reserves that he drew on in order to be able to cope with the verticalization at all. This was necessary because he lacked the foot as a stable base. Therefore, our aim should not be to inhibit these compensations and support flexion synergy, but to promote the weak points: We started with of the stretching chain - building up from the distal so that verticalization could take place.

" Renata let me ride her scooter during a lesson (a **Fig. 4***). After that, I was suddenly walking around relatively well for a few hours. And as long as the route wasn't too long, I didn't even need any aids. I bought my own scooter - also enthusiastic about this speedy way of getting around (a* **Fig. 5***). Whenever I use it a lot, my gait and safety when walking are significantly improved. "*

Training with the scooter in everyday life > Robert came to my courses in Leipzig every four to six weeks. We also met again in the evenings and practiced together. Together with Stefan and Silvia, we coordinated the therapy process. I came up with the idea of the scooter because I use it a lot myself and notice how much muscle soreness I sometimes have in the soles of my feet. You can't make any progress without working your toes. I thought that we could train the explosive strength that Robert needs in his toes and especially in his big toes. Stefan and

Fig. 1-4: R. Horst, Fig. 5: R. Göthner

Silvia took up this basic idea in her therapies and was very creative in her choice of exercises. In addition to trampolining and jumping off chairs, we practiced descending stairs to strengthen the peroneal muscles. We made sure that Robert walked cross-legged so that he was forced to stabilize the ball of his big toe (a **Fig. 6**). This made it easier for him to trigger protective steps in everyday life. To improve peroneal activity, Robert was also given a tape application. I placed the kinesiotape in a spiral so that all the bases of the metatarsal bones and all the tarsal bones, especially the cuboid bone, were stimulated on the plantar sole. As the tape progressed, I rotated the skin over the talus from the back of the foot

inwards. The aim of this system is to activate the peroneals and promote eversion in the lower ankle joint (for the shock absorber phase). We also did a lot of structural work. For example, we activated the back extensors eccentrically to ensure better postural control. Figure 7 shows how Robert slows down the therapist's pressure in order to lower his right leg in a controlled manner. He then uses this elasticity to powerfully activate his extensor synergy (including the toe flexors). The flexor activity of his left leg prevents him from generating extension from his back during the exercise (a **Fig. 7**). To awaken the old motor programs in Robert, Stefan had him push a bench (on which he was sitting) through the practice, just as Robert used to have to push his bobsled (a **Fig. 8**).

" It's fascinating to see and feel the progress I can make in one hour of physiotherapy when I do the right exercises. Sometimes it's "little things", such as manually supporting pronation and stabilizing the foot, that immediately give me much more confidence. Some are very demanding exercises that I often dislike. It drives me half crazy when I fail at skills whose movement program I know exactly from before. I know what my body is supposed to do and what it can do. But it doesn't work. Fast movements, in particular, turn into tiny, fleeting twitches and increase the spastic activity in my legs and torso. Stefan and Silvia sometimes have to put up with a few of my whims. But what I notice after every session is that the movements become more harmonious afterwards. The coupling of trunk and legs seems easier.

The main focus is always on optimizing my walking. What I particularly like is the therapists' willingness to take me to the limits of what is possible for me in terms of coordination. In my experience, I have always found that the most difficult thing is to walk.

The most important thing is that the most strenuous and strenuous exercise ultimately - even if only for the day in question - brings the most significant gains in the coordination of my legs. Running and jumping were almost unimaginable and dangerous for me back then. Most physiotherapists probably wouldn't have even put me on the tampolin or pushed me off chairs.

jump. But I have the impression that this is exactly what

brings me forward. I have learned that strength is not the decisive factor at all, but rather the targeted activation of the muscles and the rapid change between agonists and antagonists. Even outside of therapy, I try to focus on where my potential lies that I haven't yet discovered. "

Getting through everyday life with orthoses

> The torso was not the problem, but its potential to move the swing leg forward.
>
> *Renata Horst*

Somehow I couldn't rest, that Robert kept getting stiff during his therapy-free periods, especially when he spent long days at university. I was looking for a way to help him walk faster and more safely and perhaps even jog easily. I contacted the Stolle company in Hamburg, which manufactures spiral orthoses that are similar in design.

are how I had taped Robert's feet. It was important to me that he a practicable solution for the times between therapy sessions. he gets his orthoses. Robert collected his orthoses himself in Hamburg, and when we compared his walking speed over ten meters with and without orthoses, it became clear that he could walk much faster with the spiral orthoses. Without orthoses he walked 8.35 seconds, with orthoses he only needed 7.1 seconds. This motivated him to wear them regularly, and after six weeks he was able to reduce his time to 6.5 seconds. Other tests also showed improvements in his balance and gait. At the end of November 2011, Robert scored only 11 out of 24 points on the Dynamic Gait Index (DGI). Below 21 points, there is an increased risk of falling. At this time, he also scored only 44 points out of a possible 56 points on the Berg Balance Scale (BBS). Three months later, during which we concentrated on plantar flexor therapy, Robert scored 17 points on the DGI and 54 on the BBS. After a further six weeks, during which he had walked for around two hours a day with his new spiral orthoses in addition to the therapy, we calculated 54 points on the BBS and 20 points on the DGI. He hardly fell on a daily basis and wore the orthoses regularly from then on.

" When Renata asked me whether I would be interested in orthoses that would provide the long-term effects of taping, I immediately said yes. Because even if it hadn't worked, I wanted to take the chance

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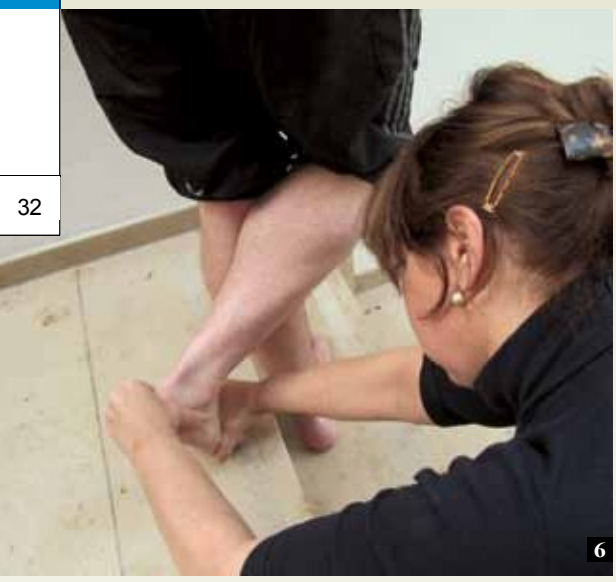

Fig. 6 Robert is forced to stabilize the ball of his big toe when descending stairs sideways with a crossed step. The therapist supports the biomechanical situation by rotating the metatarsal bones inwards along the Lisfranc joint line.

Fig. 7 The therapist promotes the elasticity of the extensor synergy through eccentric activation.

Fig. 8 To strengthen the plantar flexors, Robert should push a bench as he used to do with his bob.

*I didn't want to miss out on a useful aid. But I was skeptical because the spiral orthoses look very delicate (*a **Fig. 5, p. 30***).*

With regard to my walking and safety of movement However, the orthoses have really taken me a big step forward. Firstly, they turn the foot more inwards so that the ball of my foot no longer bends outwards. Secondly, they absorb energy during the push-off phase thanks to their spiral shape and thus support my propulsion. For me, the orthosis is a supportive spring that brings back some of what used to be natural. Unfortunately, it remains difficult and exhausting for me to move around in public, on changing surfaces and among many people. But thankfully, my body and brain are constantly adapting and I'm getting a little better at coping with it all. This means that I fall much less often and on good days I can think about something other than just running. The quality of my movement depends most on the weather and the exercise I've already done.

On a cold, rainy day, it is virtually impossible to walk freely. Is If, on the other hand, it is warm and I have been to therapy or have done sports, I may be able to walk almost normally and move safely in everyday life. I still go to physiotherapy twice a week for an hour and a half each time. It is essential for me to improve my well-being, reduce spasticity and regain other skills. I still find it difficult to walk, climb stairs and carry things - even though everything is getting a little better.

There is still a long way to go in terms of running. Every week in therapy or on my own when training on the treadmill, I try to find a to run a little. When I'm well warmed up, have the orthoses on and practise for a few runs, what I'm doing feels good and actually feels a bit like running. "

Regular food for the brain > I have learned a lot from Robert. His feedback has always encouraged me to reflect on where and what support could be useful for him. Not every patient is so willing to learn. Physiotherapy is a necessary part of his life. He needs regular therapeutic support for the movements that he cannot perform on his own and to be able to train safely enough himself. If he did not have this, he would become stiff and possibly develop contractures. His participation in life would be limited, and he would simply lack the necessary nutrition for his brain. And as he says so well himself: "My brain needs input, input, input - to know where my legs are." *Renata Horst and Robert Göthner*

Robert Göthner studied business mathematics at the University of Leipzig. Until his accident, the then trainee teacher was a competitive bobsleigh pilot and sprinter.

Renata Horst, MSc (Neuroreha) and physiotherapist (OMT), runs her own training institute and private practice in Ingelheim. She works as a lecturer for N.A.P. and PNF and also treats patients at other institutions in Germany and abroad.

Illustration: R. Horst