SilverFit Rephagia

Intensive therapy is effective for many forms of dysphagia. However, the challenge many therapists face is explaining the exercises to the patient. The SilverFit Rephagia makes this easier by providing visual and immediate feedback in the form of games while performing functional and motor swallowing training. Exercises to improve frequency, strength and coordination (e.g. through the Mendelsohn Maneuver) during the oral or pharyngeal phases of swallowing become entertaining, motivating and rewarding with the SilverFit Rephagia.

SilverFit Rephagia

Swallowing training

Consequences of dysphagia

Oropharyngeal dysphagia has far-reaching medical consequences and a severely negative influence on the social wellbeing of the patient.

It often leads to dehydration, malnutrition, weight loss, dyspnoea, respiratory infections, or pneumonia ***(Lim et al., 2009)***.

In addition, even mild forms of oropharyngeal dysphagia can cause social isolation. Research shows 36% of people with oropharyngeal dysphagia avoid eating with other people ***(Ekberg et al., 2002)***.

Current treatment of dysphagia

Generally, three therapeutic solutions for dysphagia treatment are recommended: dietary texture adjustments, postural changes/compensatory maneuvers, and interventions with devices using neuromuscular stimulation. This does not cure the disease, nor its consequences. In order to directly improve the swallowing function, intensive training is necessary. Therapists rarely undertake training with their patients because of the extreme difficulty of explaining precisely what to do and what the outcomes of the exercises should be.

Benefits of SilverFit Rephagia

The SilverFit Rephagia offers support to both therapists and patients by providing:

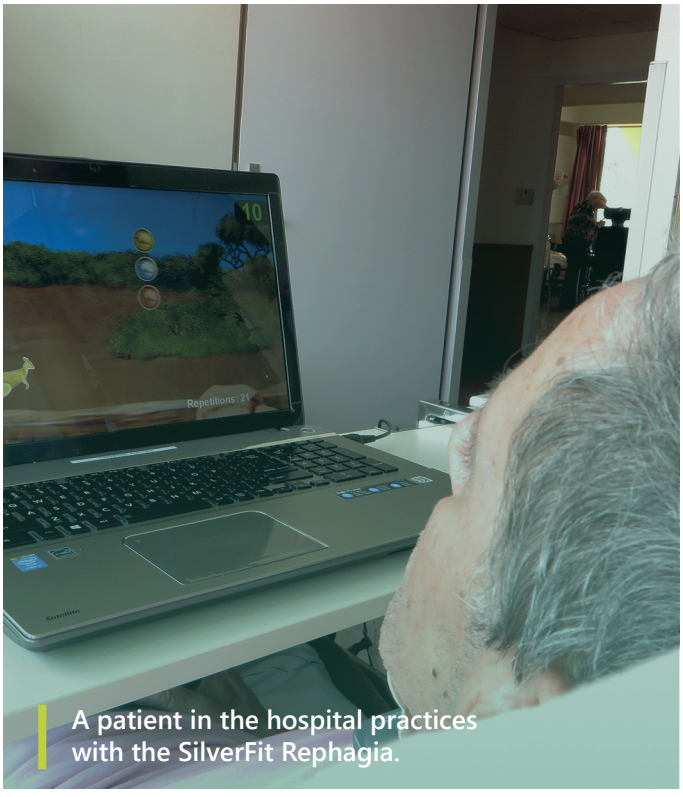
- Immediate feedback of the swallowing movement, giving a better foundation to explain the goal of the exercise.
- Assistance in deciding the choice of exercise, method and visualisation based on the individual patient's case.
- Valuable insight into the patient's progress.
- Greater motivation to train, thanks to the interactive exercises and the user-friendly interface.
- A large patient demographic. People with impaired cognitive ability and/or a mental disability will understand the exercises and goals better due to the visual feedback and easy-to-follow games.

Applications

The SilverFit Rephagia can be used by speech therapists with different specialties. It can also be applied to patients in many different settings.

In Intensive Care Units, it can be used for post-extubation dysphagia. Combining an adapted diet and early-initiated swallowing training increases the overall condition and recovery of the patient ***(Spronk et al., 2017)***. Once the patient is discharged from the hospital, the training can continue in an outpatient setting.

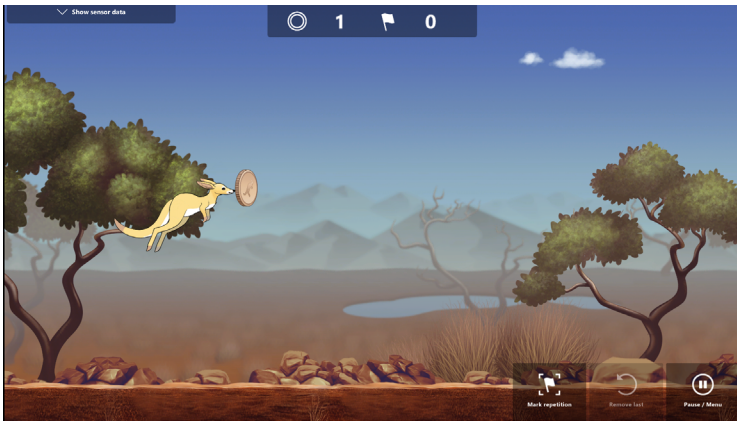
Nursing home residents with and without neurological impairments often suffer from different forms of dysphagia. Currently, the main treatment is a texture-modified diet. In addition to this, speech and language therapists can provide a patient with a fun and high-intensity training program using the SilverFit Rephagia.

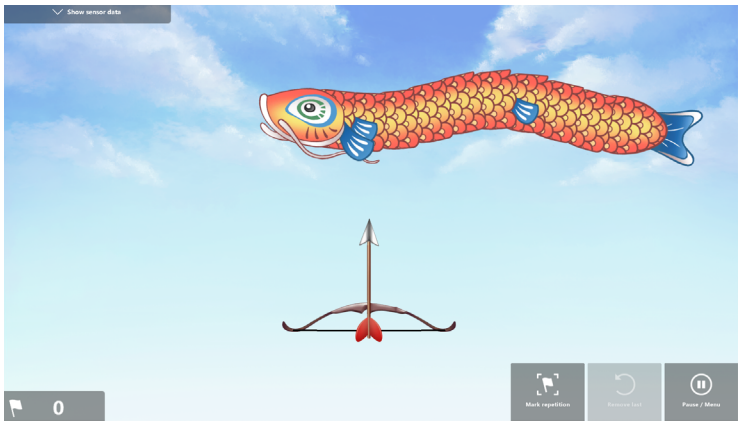


A patient in the hospital practices with the SilverFit Rephagia.

SilverFit Rephagia

Overview of the exercises





The SilverFit Rephagia offers exercises aimed at the pharyngeal phase and the oral phase of swallowing. An advisory assistant helps therapists select appropriate exercises for their patient.

- **The pharyngeal range of exercises** consist of four categories: Typical swallow, Effortful swallow, Timing (control of the swallow initiation) and Mendelsohn maneuver (coordination). The exercises are selected to be performed consecutively during a treatment session. The therapist might start with strengthening with repetitions, followed by timing exercises and coordination training.

- **The oral exercises** are aimed at treating different disorders during the oral phase of swallowing. These exercises help to improve the mobility and strength of the muscles involved in food manipulation, chewing and lip closure. Examples of these exercises include moving tongue against resistance, pulling the tongue back, sucking a straw and jaw grading.

- **The assessment** is used for demonstration and to familiarize the patient with the system. The therapist will also get an impression of motor activity and control. The assessment is therefore predominantly used to provide insight.

Select exercise

Swallow exercises

- Typical swallow
- Effortful swallow
- Timing
- Mendelsohn Maneuver

Oral exercises

- Tongue against resistance
- Tongue pull-back
- Straw sucking
- Jaw grading

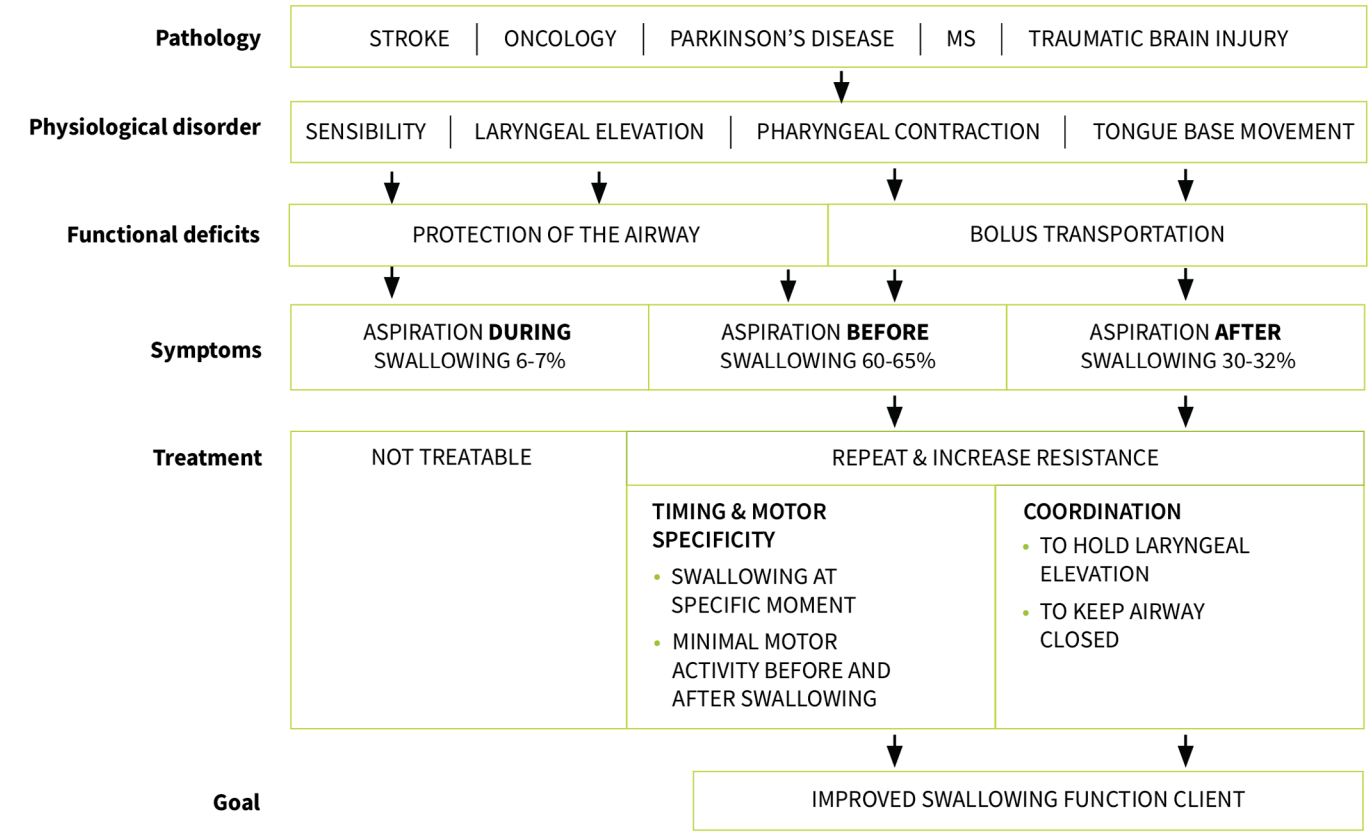
Assessments

- Assessment

Which exercise should I select?

The set-up assistant is a step-by-step-tool for finding and configuring the right exercise.

Set-up assistant



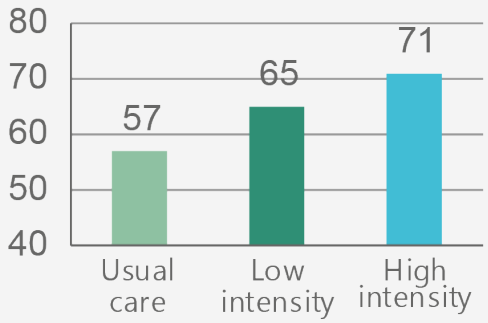
Clinical care pathways developed by SilverFit in collaboration with Scholten (2014, not published)

SilverFit Rephagia

Scientific background

High intensity swallowing therapy achieves best outcomes

Patients having a normal diet after six months (in %)



Source : Carnaby et al. (2006)

71% of 102 patients who immediately followed an intensive swallowing therapy after a stroke could eat again normally within 6 months.

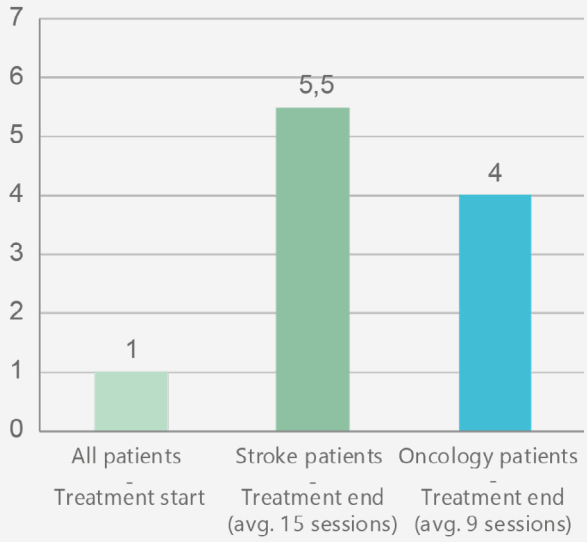
Usual care - Treatment, if offered, consisted mainly of supervision for feeding and precautions for safe swallowing
Low intensity - Swallowing compensation strategies, mainly environmental modifications; safe swallowing advice; and appropriate dietary modification
High intensity swallowing - Direct swallowing exercises (eg, effortful swallowing, supraglottic swallow technique) and appropriate dietary modification

N = 3x102; Treatment for three months, measurement 6 months later;
p = 0.04 so we speak of a trend and not a significant result

The effect of sEMG on the oral food intake

Biofeedback from sEMG has been widely described to be effective, improving both oral and pharyngeal aspects of the swallow. The graph illustrates the beneficial impact of sEMG on an oral intake for post-stroke survivors and oncology patients, using the FOIS scale.

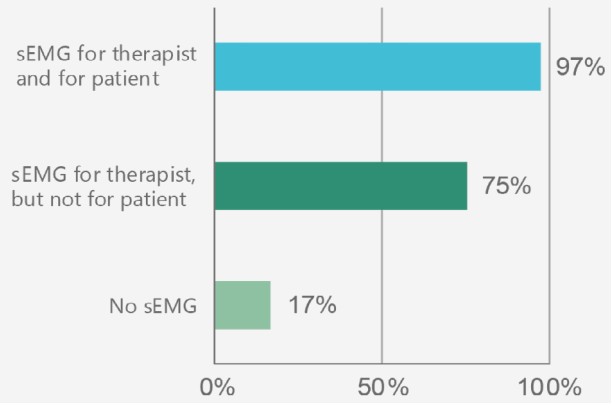
1 - No oral intake
2 - Tube dependant with minimal / inconsistent oral intake
3 - Tube supplements with consistent oral intake
4 - Total oral intake of a single consistency
5 - Total oral intake of multiple consistencies requiring special preparation
6 - Total oral intake with no special preparation, but must avoid specific food or liquids
7 - Total oral intake with no restrictions



Source: Crary et al. (2004)

sEMG feedback facilitates the learning of the Mendelsohn Maneuver

% of participants learning Mendelsohn Maneuver



Galek et al. (2018) show that the use of sEMG on the American version of the Rephagia improves the understanding of the exercises for both the Mendelsohn Maneuver and the effortful swallow. Participants with sEMG feedback appear to be able to perform the correct movement much more often.

n=119 healthy people, divided into three groups.The group with maximum feedback learned the Mendelsohn Maneuver much faster

Source: Galek et al. (2018)

SilverFit Rephagia

Literature

American Speech-Language-Hearing Association (asha)(2008). Communication Facts: Special Population: Dysphagia.

Archer, S.K., Wellwood, I., Smith C.H., & Newham, D.J. (2013). Dysphagia therapy in stroke: a survey of speech and language therapists. International Journal of Language and Communication Disorders, 48(3), 283-296.

Athukorala, R.P., Jones, R.D., Sella, O., & Huckabee, M. (2014). Skill Training for Swallowing Rehabilitation in Patients With Parkinson's Disease. Archives of Physical Medicine and Rehabilitation, 95(7), 1374-1382.

Benfield, J.K., Everton, L.F., Bath, P.M., & England, T.J. (2018). Does Therapy With Biofeedback Improve Swallowing in Adults With Dysphagia? A Systematic review and MetaAnalysis. Archives of Physical Medicine and Rehabilitation.

Boogaardt, H.C., Grolman, W., & Fokkens, W.J. (2009). The use of biofeedback in the treatment of chronic dysphagia in stroke patients. Folia Phoniatrica et Logopaedica, 61, 200-205

Bryant, M. (1991). Biofeedback in the treatment of a selected dysphagic patient. Dysphagia, 6, 140-144.

Carnaby, G., Graeme, J.H., & Pizzi, J. (2006). Behavioural intervention for dysphagia in acute stroke: a randomized controlled trial. Lancet Neural, 5(1), 31-37.

Carnaby-Mann G.D., & Crary M.A. (2009). A case-control evaluation of the McNeill dysphagia therapy program (mdtp). Dysphagia, 24, 451.

Carnaby-Mann G.D., & Crary M.A. (2010). McNeill Dysphagia Therapy Program: a case control study. Archives of Physical Medicine and Rehabilitation, 91(5), 743-749.

Crary, M.A., Carnaby-Mann, G.D., Groher, M.E., & Helseth, E. (2004). MA: Functional Benefits of Dysphagia Therapy Using Adjunctive sEMG Biofeedback. Dysphagia, 19(3), 160-164.

Daniels, S.K., & Huckabee, M. (2008). Dysphagia following stroke. San Diego, CA: Plural Publishing.

Ekberg, O., Hamdy, S., Woisard, V., Wuttge-Hannig, A. & Ortega, P. (2002). Social and psychological burden of dysphagia: its impact on diagnosis and treatment. Dysphagia, 17(2), 139-146.

Galek, K.E., Bice, E., Smith-Gagen, J., & Allen, K. (2018). Training and visual feedback increase the intensity of effortful swallows in healthy normals.

Groher, M.E., & Crary, M.A. (2016). Dysphagia: Clinical Management in Adults and Children (2nd ed.). St. Louis: MO: Elsevier Health Sciences.

Haynes, S.N. (1976). Applications of EMG in clinical and sports medicine. Electromyographic biofeedback treatment of a woman with chronic dysphagia. In C. Steele (Ed.), Applications of EMG in clinical and sports medicine (pp. 121-126). InTech Publishing.

Huckabee, M.L., & Cannito, M.P. (1999). Outcomes of a swallowing Rehabilitation in chronic brainstem dysphagia; a retrospective evaluation. Dysphagia, 14, 93-109.

Huimin, Z., Yongchao, Y., Jiang, R., Liu, L., Wang, Y., Shao, W., & Zhang, J. (2015). Effect of surface electromyographic biofeedback on the pharyngeal phase activities in patients with dysphagia after stroke. Chinese Journal of Cerebrovascular Diseases, 12, 572-576.

Langmore, S.E., & Pisegna, J.M. (2015). Efficacy of exercises to rehabilitate dysphagia: A critique of the literature. International Journal of Speech-Language Pathology, 17(3),

222-229.

Li, C.M., Lee, H.Y., Hsieh, S.H., Wang, T.G., Wang, H.P., & Chen, J. (2016). Development of innovative feedback device for swallowing therapy. Journal of Medical and Biological

Engineering, 36, 357-368.

Lim, K.B., Lee, H.J., Lim, S.S., & Choi, Y.I. (2009). Neuromuscular electrical and thermal-tactile stimulation for dysphagia caused by stroke: a randomized control trial. Journal of Rehabilitation Medicine, 41(3), 174-178.

Malloy, J.R., Valentin, J.C., Hands, G.L., Stevens, C.A., Langmore, S.E., Noordzij, J.P., & Stepp, C.E. (2014). Visuomotor control of neck surface electromyography in Parkinson's disease. NeuroRehabilitation, 35(4), 795-803.

Mann, G., Hankey, G.J., & Cameron, D.(2000). Swallowing disorders following acute stroke: prevalence and diagnostic accuracy. Cerebrovascular Diseases, 10(5), 380-386.

McCullough, G.H., Kamarunas, E., Mann, G.C., Schmidley, J.W., Robbins, J.A., & Crary, M.A. (2012). Effects of Mendelsohn Maneuver on Measures of Swallowing Duration Post Stroke. Top Stroke Rehabilitation, 19(3), 234-243.

McCullough, G.H., & Kim, Y. (2013). Effects of Mendelsohn Maneuver on Extent of Hyoid Movement and UES Opening Post-Stroke. Dysphagia, 28(4), 511-519.

Nguyen, N.P., Frank, C., Moltz, C.C., Vos, P., Smith, H.J., Bhamidipati, P.V., Sallah, S. (2006).

Nguyen, N.P., Moltz, C.C., Frank, C., Vos, P., Smith, H.J., Karlsson, U., ... Sallah, S. (2008).

Spronk, L.E.J., Lut, J., Dekker, E., Jansen, M., van Munster, B., Lemmens, J., Kröner, A., &

Steele, C.M., Bennett, J.W., Chapman-Jay, S., Polacco, R.C., Molfenter, S.M., & Oshalla, M. (2012). Electromyography as a Biofeedback Tool for Rehabilitating Swallowing Muscle Function. In C. Steele (Ed.), Applications of emg in clinical and sports medicine (pp. 311-328). [Chapter 19] InTech Publishing