

## New Orofacial Physiotherapy of Dysphagia after Stroke

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### Abstract

**Background and Aim:** Dysphagia commonly occurs after bulbar or pseudobulbar stroke. In our study, we used an X-ray videofluorography examination of swallowing to diagnose and measure the dysphagia post stroke. The therapy recommended for treating swallowing disorders is referred to as orofacial physiotherapy. During the new orofacial physiotherapy, an emphasis is placed on the optimization of movements of the tongue and hyoid muscles.

**Methods:** The effect was evaluated in a prospective pre-post-test study of chronic post stroke patients with a swallowing disorder. After eight weeks of physiotherapy, changes in swallowing were evaluated using a physiotherapy examination (functional oral intake scale – FOIS) and videofluorography (VFSS). The experimental group of 29 cases treated with our new orofacial physiotherapy was compared with 30 control cases with standard dysphagia therapy.

**Results:** The experimental group was composed of twenty-nine patients, while the control group was made up of thirty patients. Comparing swallowing function (FOIS) and the time differences of each swallowing phase before and after therapy between the experimental group and the control group, there were statistically significant differences ( $p < 0.05$ ) in parameters of performance for FOIS (median value change from 4 to 6 in the experimental group, median value change from 4 to 5 in the control group), and two of the swallowing phases: OTT (transport time of the oral phase of swallowing) and PTT (transport time of the pharyngeal phase). The mean of differences before and after therapy of OTT in the experimental group was  $0.49 \pm 0.15$ , in the control group  $0.12 \pm 0.09$ . The mean difference before and after therapy of PTT in the experimental group was  $0.19 \pm 0.09$ , in the control group  $0.06 \pm 0.05$ .

**Conclusion:** After new orofacial physiotherapy, there was significant improvement in swallowing and of food intake in patients post stroke with dysphagia.

**Keywords:** Stroke; Dysphagia; Orofacial physiotherapy; Tongue; Hyoid muscles

### Introduction

Dysphagia is a swallowing disorder of solid or liquid foods that commonly occurs after bulbar or pseudobulbar stroke. The incidence of post stroke dysphagia is 20%-65% [1-3]. It manifests clinically as subjective feelings of swallowing stagnation, swallowing pain (odynophagia) to a complete inability to swallow. The interdisciplinary approach of the dysphagiologist team is necessary for the diagnostics of dysphagia [4]. For the objective evaluation of a swallowing disorder there are instrumented techniques such as fibre-optic endoscopic evaluation of swallowing (FEES) [5] and the videofluoroscopic swallow study (VFSS) [6]. VFSS is an X-ray method that acquires and evaluates a video recording of the swallowing act. This technique allows the assessment of the oral and pharyngeal phases of the swallowing, and reveals aspiration, penetration or regurgitation. VFSS permits a quantitative analysis of the swallowing, i.e. we obtain times of the

different swallowing phases: oral transit time (OTT) and pharyngeal transit time (PTT) [7].

Orofacial physiotherapy is important in the treatment of swallowing disorders because it has an impact not only on eating restoration but also on other orofacial functions (facial expression, speech) and on the general health condition and quality of the patient's life [8,9].

**Our hypothesis:** Is new orofacial physiotherapy (OFP) with an emphasis on the optimization of tongue and hyoid muscle function associated with improvement in food intake in dysphagia patients after stroke?

### Methods

This prospective pilot study was conducted in the period of 1/2012-3/2017. The aim of the study was the evaluation of the OFP effect in stroke patients with a swallowing disorder. Inclusion criteria for study were an early phase of swallowing disorder after stroke half a year to five years after stroke onset, a negative water-test excluding aspiration [10], the ability of active cooperation and independent

sitting (necessary for VFSS examination). All patients signed an informed consent and the study was performed in accordance with the Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects.

The examination of the swallowing functions was performed by clinical examination (speech and language therapist), by a water

swallowing test excluding aspiration and by assessment according to international clinical questionnaire for dysphagia-FOIS (functional oral intake scale) [11]. The FOIS questionnaire is based on the clinical evaluation of the patient's ability to accept food according to varying food consistency and time needed for consumption. This questionnaire uses a scale with 7 degrees of disability (Table 1).

Characteristics	Degree (FIOS)	E		C	
		Before (number)	After (number)	Before (number)	After (number)
Food intake impossible/unfit for testing	1	0	0	0	0
PEG, NG tube	2	0	0	0	0
Intake of liquid food only	3	5	0	4	1
Intake of mushy food only	4	18	1	20	8
Intake of ground food	5	4	6	5	15
Independent swallowing that requires longer time	6	2	14	1	5
Normal swallowing	7	0	8	0	1

**Table 1:** FOIS (Functional oral intake scale)–clinical questionnaire evaluation of food intake by the number of patients in the experimental (E) group and in the control (C) group before and after 8 weeks of therapy with (E) or without (C) OFP.

We then performed a VFSS examination and measured the duration of the particular swallowing phases: OTT and PTT. Measurements were taken at the start of physiotherapy (before OFP) and after 8 weeks (after OFP) during a hospital stay in the rehabilitation departments at NMB Brno and at CLR Prostějov.

### Patients were divided randomly into two groups

Thirty-one patients were screened in the experimental group. Twenty-nine patients met the inclusion criteria (outpatient rehabilitation, ability of active cooperation, from a half year to five years after stroke onset). The experimental set included 29 stroke patients with swallowing difficulties, 15 men and 14 women with an average age of 68 years (SO 5.0), 21 ischemic and 8 hemorrhagic strokes, 19 cortical and 10 brainstem lesions. All patients had their first stroke event.

Thirty-one patients were screened in the control group. Thirty patients met the inclusion criteria, 15 men and 15 women with an average age of 68.5 years (SO 6.0), 23 ischemic and 7 hemorrhagic strokes, 20 cortical and 10 brainstem lesions. All patients had their first stroke event.

Conventional therapy was performed on all patients in both groups. The experimental group was subjected to an extra specific OFP 1 x daily, 25 minutes, 5 days a week. Our OFP included 3 steps:

**Step 1 (Preparatory phase):** postural therapy of cervical spinal cord, temporomandibular joint and head and respiratory rehabilitation with practise to close the laryngeal strait.

**Step 2 (Practise of “dry” swallowing):** practising the oral phase (exercise of tongue, thermal touch therapy, exercising face and lip muscles) and pharyngeal phase (strenuous swallowing training with the pressure of tongue on palate and strengthening vocal cord closure).

**Step 3 (Targeted physiotherapy of swallowing):** Practise of swallowing with the use of foods and drinks of different consistency, activation of the propulsion force (pressure of the tongue with the bite on the palate), training of the supraglottic swallowing and eventually practise of the compensation swallowing strategy with the help of controlled head position (turning, bending forward). In our OFP we put special extra emphasis, unlike other physiotherapy techniques [12-14], on the relaxation exercise of the tongue and restoration of the hyoid muscle functions (activation and relaxation exercise according to the principle of proprioceptive neuromuscular facilitation). This rehabilitation technique is newly described in our study.

Measured values and changes after OFP were statistically processed and evaluated using the Wilcoxon test for FOIS, OTT, PTT and ANOVA for testing changes between the groups, at a level of statistical significance of  $p < 0.05$ .

### Results

After eight weeks of therapy we found improvement of swallowing in dysphagia patients after stroke. Comparing swallowing function (FOIS) and the time differences of each of the swallowing phases before and after therapy between the experimental group and the control group, there were statistically significant differences ( $p < 0.05$ ).

In parameters of performance for FOIS, the improvement was better in the experimental group (median value change from 4 to 6) than the improvement in the control group (median value change from 4 to 5) (Table 1).

The mean value of differences before and after therapy of OTT in the experimental group was  $0.49 \pm 0.15$  seconds (sec.), in the control group  $0.12 \pm 0.09$  sec. The difference between both groups was significant ( $p = 0.005$ ). The mean value of differences before and after therapy of PTT in the experimental group was  $0.19 \pm 0.09$  sec. and in

the control group was  $0.06 \pm 0.05$  sec. There were statistically significant differences ( $p=0.01$ ) (Table 2).

	E			C		
	Mean_before (Standard Deviation)	Mean_after (Standard Deviation)	Difference (Standard Deviation)	Mean_before (Standard Deviation)	Mean_after (Standard Deviation)	Difference (Standard Deviation)
OTT	0.99 ( $\pm 0.2$ )	0.50 ( $\pm 0.2$ )	0.49 ( $\pm 0.15$ )	1.00 ( $\pm 0.22$ )	0.88 ( $\pm 0.1$ )	0.12 ( $\pm 0.09$ )
PTT	0.6 ( $\pm 0.21$ )	0.41 ( $\pm 0.1$ )	0.19 ( $\pm 0.09$ )	0.61 ( $\pm 0.2$ )	0.55 ( $\pm 0.15$ )	0.06 ( $\pm 0.05$ )

**Table 2:** VFSS – swallowing phase times OTT (oral transit time) and PTT (pharyngeal transit time) in the experimental group (E) and in the control group (C) before and after 8 weeks of therapy with (E) or without (C) OFP (sec.).

## Discussion

Significant differences in times measured by VFSS before and after therapy between the experimental group and the control group show us greater improvement of food intake after the new orofacial physiotherapy (OFP) of post-stroke patients with dysphagia. Especially important are transport time of the pharyngeal phase of swallowing (PTT), which plays a crucial role in optimal bite swallowing with transport in the correct direction to the oesophagus and the prevention of food aspiration into airways (Table 2). A serious complication of dysphagia is aspiration pneumonia, which is usually described in serious dysphagia stroke patients (1<sup>st</sup> to 3<sup>rd</sup> degree according to FOIS) which occurs according to Smithard et al. in 22% of cases during the first days and in 15% of cases during the first month after stroke onset [15]. In a study of 128 stroke patients conducted by Mann et al., dysphagia was diagnosed in 64% of cases and aspiration in 20% of cases on the 10<sup>th</sup> day after stroke onset [16]. None of our patients had the complications that occur in dysphagia stroke patients as aspiration or aspiration pneumonia, malnutrition or dehydration. We should note that our study included only patients with relatively mild to moderate dysphagia (degree). At the beginning of study in both groups, a liquid food disorder (3<sup>rd</sup> degree) was present in 9 patients (experimental (E): 5), a mushy food intake disorder (4<sup>th</sup> degree) was present in 38 patients (E:18), disorders for ground food intake (5<sup>th</sup> degree) were present in 9 patients (E:4) and independent swallowing that requires a longer time (6<sup>th</sup> degree) was present in 3 patients (E:2). After eight weeks of therapy with OFP, the experimental group has no patients with a liquid food disorder (3<sup>rd</sup> degree), a disorder of mushy food intake (4<sup>th</sup> degree) was present in 1 patient, disorders for ground food intake (5<sup>th</sup> degree) were present in 6 patients, independent swallowing that requires a longer time (6<sup>th</sup> degree) was present in 14 patients and normal swallowing (7<sup>th</sup> degree) was present in 1 patient.

In the control group without OFP, a disorder of liquid food (3<sup>rd</sup> degree) was present in one patient, a disorder of mushy food intake (4<sup>th</sup> degree) was present in 8 patients, disorders for ground food intake (5<sup>th</sup> degree) were present in 15 patients, independent swallowing that requires a longer time (6<sup>th</sup> degree) was present in 5 patients and normal swallowing (7<sup>th</sup> degree) was present in one patient (Table 1).

Therapy of dysphagia after stroke is important for the recovery of physiological food and fluid intake, improvement in the quality of life and reduction of morbidity and mortality [17]. Therapy of dysphagia could be performed using physiotherapy based on a re-education exercise of the swallowing process [9].

The importance of orofacial rehabilitation in stroke patients with dysphagia was confirmed in the work of Hägga and Larsson, who in

their prospective clinical study after six months of orofacial regulation therapy (ORT) according to clinical examination demonstrated a significant effect [18]. Shaker et al. described the importance of targeted exercise in dysphagia patients to affect the upper esophageal sphincter, which is important in the first phase of swallowing [19]. We can see good results in dysphagia therapy after the use of tactile and termic stimulation of the oral area [20]. There are differing views on the use of pharyngeal neuromuscular electrical stimulation (NMES) in the treatment of dysphagia [21]. The study of Permisirivanich et al. compared the effect of four weeks ORT rehabilitative therapy (11 patients with dysphagia after stroke) against NMES (12 patients with dysphagia after stroke). Food intake improved in both groups (evaluated by FOIS). Better results were reported in the NMES group [22].

In contrast, the study by Power et al. did not prove the benefit of NMES. After one hour of NMES therapy per day during one-month rehabilitation there was no significant functional or neurophysiological change in dysphagia patients after stroke [23]. We did not use NMES in our study but instead emphasised individual physiotherapy-targeted OFP exercise, which was more pleasant, not painful, and more physiological for the patients.

## Conclusion

After eight weeks of our new orofacial physiotherapy with an emphasis on the optimization of tongue and hyoid muscle function, there was significant improvement of food intake in dysphagia patients after stroke. Transport times of particular swallowing process phases measured by VFSS were also improved. VFSS is reliable method that brings objective proof that OFP is effective according to the principles of evidence-based medicine (EBM).

## Conflict of Interest

The authors have no conflict of interest with the contents of this study.

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