

# Central facial paresis and its impact on mimicry, psyche and quality of life in patients after stroke

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**Aim.** Using functional scales and face video analysis, changes in central facial paresis are monitored in patients with stroke after orofacial therapy and correlations between changes in mimicry, mental function and overall quality of life of patients after stroke are made.

**Materials and Methods.** A prospective randomized study of patients after stroke with facial paresis. The functional status of the experimental group of 50 cases with orofacial regulation therapy and 49 control cases without mimicry therapy is observed after four weeks of rehabilitation.

**Results.** Changes in mimicry functions evaluated by the House-Brackmann Grading System (HBGS) clinical range and using 2D video analysis of the distance between the paretic corner of the mouth and earlobe at rest and during smiling were statistically better in the experimental group than in controls. Changes in mental function – depression using Beck Depression Inventory and changes in the quality of life using Bartle index and modified Rankin score (scale) were significantly greater in the experimental group. There was a very close relationship between the changes in mimicry, mental state and overall quality of life according to the Spearman correlative coefficient.

**Conclusion.** Orofacial rehabilitation therapy for patients with paresis after stroke has a significant influence on the adjustment of mimicry, mental functions and overall quality of life after 4 weeks of treatment.

**Key words:** stroke, facial paresis, depression, quality of life, orofacial rehabilitation

Received: November 2, 2011; Accepted with revision: February 14, 2013; Available online: March 21, 2013  
<http://dx.doi.org/10.5507/bp.2013.014>

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## INTRODUCTION

One of the most common disorders in patients after stroke is facial paresis (n. VII), which is reflected in a change in mimicry. Stroke is defined as rapidly developing focal or global symptoms of brain function disorder which last more than 24 h or result in death of the patient, all without other apparent cause than vascular origin<sup>1</sup>.

Mimicry is one of the functions of human communication system. It serves not only to maintain the facial expression but has an important role in speech, in singing, in social communication interaction, in food intake and in eye protection.

Mimicry muscles, which can alter the facial surface in many different ways, execute this function. In addition to opening and closing the eyes and mouth they also have a reporting function. Highly differentiated and complex facial musculature can express a large number of sensations, and can reflect the state of mind and the mood of an individual.

Paresis of the facial nerve after stroke causes a functional and aesthetic defect in a patient which is manifested by facial asymmetry with mimicry muscle disability of the lower half of the face, falling of the corner of the mouth, saliva leakage from the corner of the mouth, asymmetrical

smile and speech explicitness disorder with atonia of the lips, tongue and throat<sup>1,2</sup>.

This mimic disability can be qualitatively and quantitatively evaluated. Neurological facial examination, focusing on the examination of the function of the facial nerve, is the principle. On the basis of clinical examination we can diagnose central or peripheral paresis of the facial nerve. We use standard international clinical scales in the quantitative n. VII paresis (paresis of nervus facialis) evaluation. The most used test battery is testing by means of the House-Brackmann Grading System<sup>3-5</sup>.

Mimicry reflects to us, among other things, the psychological state of the patient, and contrarily, mimicry failure may have psychological consequences. Many patients suffer from anxiety and depression after stroke. Within 3 months after stroke 50-60% of patients suffer from depression<sup>6-9</sup>. Patients with depression after stroke have a worse prognosis. Deterioration in the quality of life is demonstrated with increasing motor movement disability in normal daily activities. Patients have worse rehabilitative care effect, a longer period of hospitalization and are less often able to return to the home environment<sup>6,8,10</sup>. Beck Depression Inventory (BDI-II) test, which quantitatively evaluates the burden of depression, can be used to evaluate it<sup>10-12</sup>.

## METHODOLOGY

The aim of this study was to evaluate the impact of central n. VII paresis in patients after stroke on mimic functions, mental functions and overall quality of life using international clinical scales and objective measurement of mimicry changes using two-dimensional video analysis<sup>13-15</sup>.

The prospective study included 99 patients in the subacute stage of a stroke. Patients were initiated into rehabilitation on the second day after the stroke. Initially they were in the "stroke unit" /ICU/ - Neurology Clinic, Hospital Olomouc - and after transfer rehabilitation continued at the Department of Sports and Exercise Medicine, University Hospital Olomouc (RHB).

At the beginning of rehabilitation, patients were randomly divided into experimental and control groups. The experimental group consisted of 50 persons of whom 26 were men with an average age of 57 years and 24 women, where the average age was 62 years. The control set consisted of 49 persons - 27 men, where the average age was 60 years and 22 women with an average age of 61.5 years. In both groups there was speech therapy once a day focused on the treatment of communication disorders and there were rehabilitation exercises twice a day aimed at reconstruction of damaged physical functions of the trunk, arms and legs. In addition, targeted physiotherapy orofacial treatment took place in the experimental group once a day, including rehabilitation of myofascial structures of the face, breathing rehabilitation and targeted facilitation of mimic functions using the elements of orofacial regulation therapy, which seeks creation of physiological function in the orofacial areas by applying pressure, touch, vibration and traction in specific points on the face of activating the orofacial muscles<sup>16,17</sup>. Central n. VII paresis does not affect the upper half of the face and that makes

the difference in approach to treatment. In "central type" of n. VII paresis the aim of orofacial therapy is to relax spastic muscles, restore selective functions of orofacial muscles and re-educate fundamental mimicry and communication (verbal and non-verbal) features, and functions during food intake.

Clinical evaluation took place at the beginning of therapy and after 4 weeks of therapy. Mimicry was assessed via a House - Brackmann Grading System standardized clinical questionnaire<sup>3</sup> and via device measurement - two-dimensional video analysis - measuring changes in distance of control points on the paretic corner of the mouth and earlobe<sup>13,15</sup>, mental functioning was evaluated according to the Beck Inventory of Depression<sup>11</sup> and overall self-sufficiency was assessed via questionnaire by Bartel with determination of Bartel Index (BI) (ref.<sup>18</sup>) and via the modified Rankin score<sup>19</sup>.

Basic statistics (arithmetic mean, standard deviation) were calculated for individual parameters. The data were statistically verified using single-factor analysis of variance for repeated measures with statistical significance set at  $P < 0.05$  and as a subsequent post-hoc test the Fischer LSD test was used to compare individual groups in repeated measurements. Further, correlation of mimicry changes (with mental function and the overall state) was tested using the Spearman correlation coefficient at  $P < 0.001$ . For graphical representation we used the average values of monitored parameters and their standard deviation.

## RESULTS

The results show that there is a statistical improvement in mimic functions in both groups. Statistically significant improvement of mimic functions can be observed in the

**Table 1.** Number of patients from experimental and control groups before and after rehabilitation divided into groups according to HBGS.

	E_Before	E_After	C_Before	C_After
I. group	0	1	0	0
II. group	1	34	2	3
III. gorup	18	10	18	24
IV. group	27	5	24	20
V. group	4	0	5	2
VI. group	0	0	0	0

**Table 2.** Number of patients from experimental and control groups before and after rehabilitation divided into groups according to modified Rankin score.

	E_Before	E_After	C_Before	C_After
I. group	0	1	0	0
II. group	4	30	3	19
III. group	6	10	4	24
IV. group	33	9	32	6
V. group	7	0	10	0
VI. group	0	0	0	0

E\_before RHB - number of probands in experimental group before rehabilitation

E\_after RHB - number of probands in experimental group after rehabilitation

C\_before RHB - number of probands in control group before rehabilitation

C\_after RHB - number of probands in control group after rehabilitation

I. group - fully self-sufficient according to modified Rankin scale

II. group - mild helplessness

III. group - slight helplessness

IV. group - medium helplessness

V. group - heavy helplessness

VI. group - death

experimental group, as the evaluation of results by HBGS (Table 1, Fig. 1) and results using 2D video analysis show - changes in distances between corner of the mouth and earlobe after 4 week treatment (Fig. 2).

Statistically significant improvement of the condition in the experimental group can be seen again in the evaluation of mental functions according to BDI-II (Fig. 3) and the overall quality of life according to BI (Fig. 4) and modified Rankin score (Table 2).

A very close relationship with a positive Spearman correlation coefficient value of 0.69 ( $P < 0.001$ ) was found in the correlation of changes in mimicry and psychological functions. Comparing mimicry (HBGS) and self-sufficiency according to BI showed a loose relationship with a positive Spearman correlation coefficient value of 0.53 ( $P < 0.001$ ).

A very close relationship with a positive Spearman correlation coefficient value of 0.72 ( $P < 0.001$ ) was found between correlation of changes in mimicry (HBGS) and the overall quality of life according to the modified Rankin score.

## DISCUSSION

Our study demonstrates positive results in patients who have undergone targeted orofacial rehabilitation. Significant mimicry improvement of two and more degrees according to HBGS can be seen after 4 weeks in 31 cases (62%), mimicry improvement by one degree according to HBGS occurred in 18 cases (36%). The condition remained the same in 1 case (2%), and there was no upset in the experimental group. Unlike the control group, there was spontaneous improvement by two degrees or more in 2 cases (4%), a slight improvement in one grade occurred in 20 cases (40.8%), an unaltered state remained in 28 cases (55.2%).

Similar results were reached by Svensson et al.<sup>20</sup> in their study comparing the effect of mimic EMG biofeedback in 23 patients after stroke to a control group of 12 patients without EMG mimic therapy. In their study, they observed the recovery of facial functions after 1 month in both groups, and there were normal facial functions or only mild dysfunctions after 6 months in two-thirds of patients. Patients with right-sided facial disability had significantly better results than patients with left-sided facial disability.

Furthermore, in their study, Svensson et al.<sup>20</sup> provide the same functional state of mimicry (according to HBGS), sensitivity and awareness of facial asymmetry in both experimental and control groups 6 months after the inception of stroke. Based on this finding the authors in conclusion did not recommend mimic EMG biofeedback therapy in patients after stroke with n. VII paresis. They predicted spontaneous remission of central n. VII paresis. It should be noted that this study was conducted on a relatively small sample of patients and the results did not reach statistical significance. In comparison with Svensson et al.<sup>20</sup>, our study involved a sufficiently large

set of patients with results that are statistically significant and which confirm the positive effects of orofacial physiotherapy with central paresis after stroke.

In assessing depression after stroke using the BDI-II we again find significant improvement in mental functions in the experimental group, with 45 cases (90%) showing significantly improved mental state, 5 cases (10%) unchanged and in no cases was the condition impaired. In the control group we observed improvement in 29 cases or 60%, in 20 cases (40%) the condition remained the same and in case was the condition impaired.

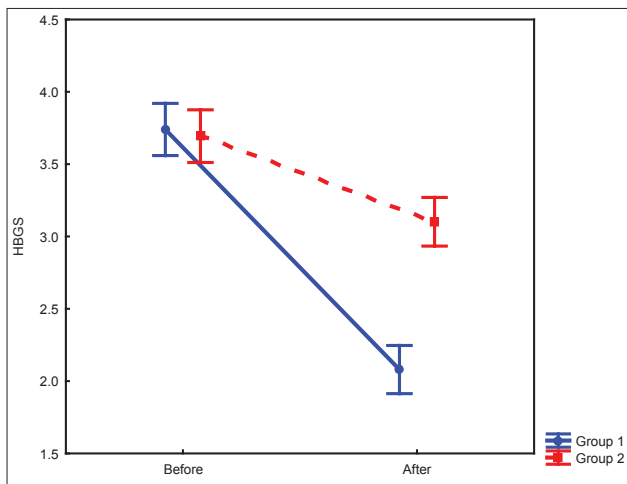
In both groups all patients used antidepressants from the group of SSRI (citalopram 20 mg/day) in the effective dose.

Depression after stroke (post-stroke depression - PSD) occurs in 40-60% of patients<sup>6,9</sup>. Patients with depression after stroke have a significantly poorer self-sufficiency prognosis, worse rehabilitation effect, worse quality of life, longer hospitalization period, and impaired ability to return to the home environment<sup>6,7,10</sup>. Women have greater difficulty accepting the facial change and orofacial rehabilitation plays a more important role here<sup>9,10</sup>. Mikulik<sup>9</sup> and Svensson et al.<sup>20</sup> suggest that in a small number of patients there is spontaneous alteration in mimicry and PSD remission, without treatment. In contrast, studies by Roth et al.<sup>6</sup> and Rima et al.<sup>7</sup> are associated with better modification of cognitive function and neurological deficit including central paresis of the facial nerve in patients with PSD treated with antidepressants and psychotherapy.

Assessment of overall self-sufficiency and quality of life using the BI and modified Rankin score shows improvement in both groups. A more significant effect of therapy can be seen in the experimental group. The difference in results is at the border of statistical significance ( $P = 0.049$ ). It seems that mimicry impairment plays a minor role in self-sufficiency and overall quality of life. The same conclusions were reached by other authors, where the most significant negative prognostic factors influencing the self-sufficiency and quality of life of patients after stroke were repeated stroke attacks, advanced age of patients, immobility, urine and stool incontinence, cognitive dysfunction, and impaired ability to communicate<sup>21-26</sup>.

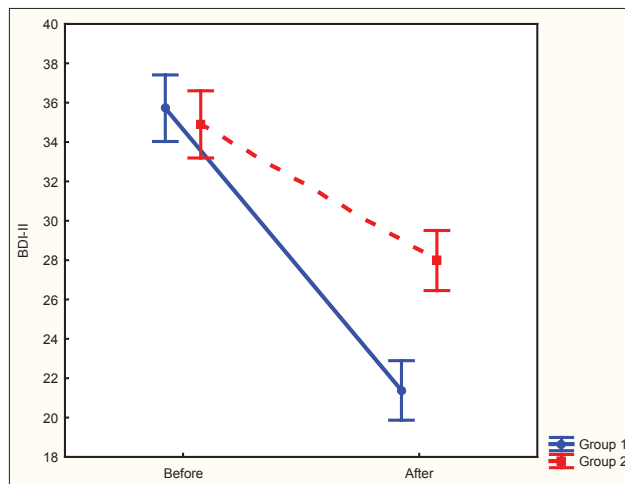
Svensson et al.<sup>20</sup> reached similar conclusions, where half a year after stroke, they found no significant difference between the experimental and control groups.

Relatively little attention is paid to the issue of mimicry disorders after stroke in the scientific literature. Nevertheless, the consequences of mimicry disorders have repercussions not only at a somatic (orofacial), but also psycho-social level<sup>7,10</sup>. More attention is devoted to peripheral n. VII paresis and to the effects of rehabilitation, where significant positive results are observed in the treatment of mimicry after targeted rehabilitation<sup>27,28</sup>. It should be noted that the etiopathogenesis of central n. VII paresis is different from peripheral n. VII paresis and thus the orofacial therapy should be modified accordingly.



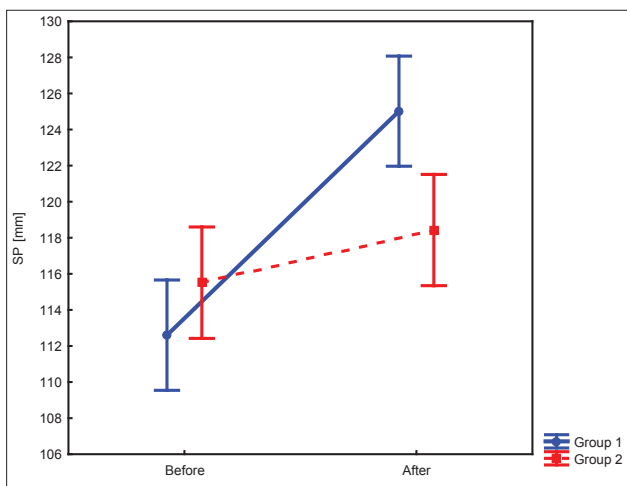
**Fig. 1.** Change in mimic functions after rehabilitation according to HBGS.

Before - average value of HBGS score before rehabilitation  
 After - average value of HBGS score after rehabilitation  
 HBGS - score values according to HBGS  
 Group 1 - experimental group of patients  
 Group 2 - control group of patients



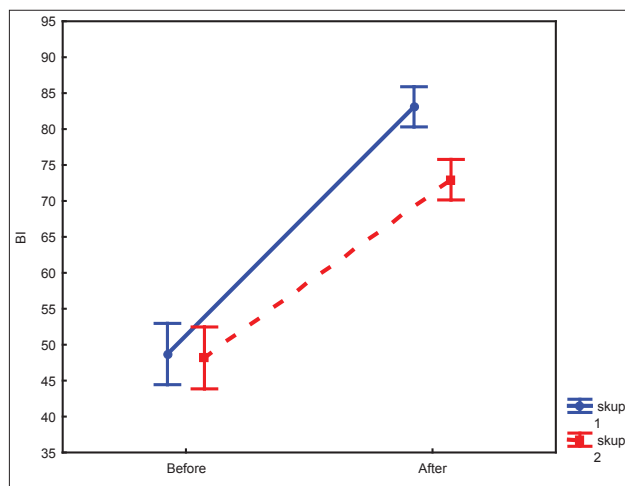
**Fig. 3.** Evaluation of depression according to BDI-II before and after rehabilitation.

Before - average value of depression score before rehabilitation  
 After - average value of depression score after rehabilitation  
 BDI-II - score values of depression according to BDI-II  
 Group 1 - experimental group of patients  
 Group 2 - control group of patients



**Fig. 2.** Average values of change in distances between corner of the mouth and earlobe in mm assessed at 2D video analysis at maximal voluntary mouth pouting before and after RHB.

Before - average value of distance between corner of the mouth and earlobe in mm before rehabilitation  
 After - average value of distance between corner of the mouth and earlobe in mm after rehabilitation  
 SP - distance between corner of the mouth and earlobe in mm  
 Group 1 - experimental group of patients  
 Group 2 - control group of patients



**Fig. 4.** Evaluation of self-sufficiency according to BI.

Before - average value of BI score before rehabilitation  
 After - average value of BI score after rehabilitation  
 HBGS - score values according to BI  
 Group 1 - experimental group of patients  
 Group 2 - control group of patients

**CONCLUSION**

Orofacial rehabilitation as a part of complex rehabilitation care contributes considerably to improving the quality of life after stroke with orofacial function disorder. After complete stabilization of basic life functions and after improving the overall functional state, orofacial rehabilitation is one of the most important aspects of rehabilitation for the patient.

Our study confirms the positive effect in orofacial function improvement after 4 weeks - improvement of mimicry, alleviation of depression and improvement of the overall quality of life in patients after stroke with the central n. VII paresis, who had - in addition to physiotherapy and speech therapy - targeted orofacial therapy.

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