The effects of masticatory exercise using a gum on the cognitive function and stress

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Abstract. Masticatory function affects energy expenditure, heart rate, working memory, choice reaction time and psychological arousal. In other words, masticatory function is closely related to cognitive process ability. And it also influences concentration enhancement and stress alleviation. The purpose of this study was to determine whether an masticatory exercise training using a gum can improve cognitive function and stress. The participants were recruited from Sahmyook University and were divided into a masticatory exercise group (n=15) and a control group (n=15) by having each of the subjects take out one card from a box containing two types of cards representing both the study groups. This study used chewing gum as sugar free with xylitol for masticatory exercise. Cognitive function and stress were assessed before and after the masticatory exercise. Number memorizing, Pictures finding by Name and Three consecutive card play in COMCOG® test was measured to determine cognitive function which is closely linked to memory, attention and concentration. SA-3000P® system was performed to against stress. Cognitive functional of Numbers Memorizing (NM), Picture Finding by Name(PFN), and Three Consecutive Card Play(TCCP), and against stress of stress resistance(SR) and stress index(SI) score were assessed before and after the training. A significant intergroup difference was observed in the NM, FPN, MC, SR, and SI score (p < 0.05). Base on the result, These findings suggest that exercise of the masticatory using a gum had a positive effect on the cognitive function and stress.

Keywords: masticatory exercise; cognitive function; stress

1 Introduction

Cognition is an ability to understand events taking place in the surrounding environment, assess the situation, making decisions and adapt to the surrounding conditions. In general, the cognitive area includes memory and attentiveness at the basic level and planning, systemization, problem solving and abstraction in the upper level. The ability to integrate sensory information, linguistic information and visual perception information is its basis. The loss of cognitive ability brings together problems in memory, calculation ability, judgment, orientation, understanding ability, etc. to cause huge restriction in one’s daily lives[1]. Minor dementia or cognitive
problem causes pains to the patient and his or her family such as stress and restriction on social activity[2]. Cognitive function shows a very significant effect on the recovery and rehabilitation of patients with motor functional disturbance. If the cognitive function is undermined, patients have difficult in pursuing daily routines independently. Therefore, as damaged cognitive function also undermines motor functional recovery, cognitive functional treatment is a key factor for patients’ recovery, rehabilitation and independent daily activities[3, 4].

Masticatory function affects energy expenditure, heart rate, working memory, choice reaction time and psychological arousal. In other words, masticatory function is closely related to cognitive process ability[5]. And it also influences concentration enhancement and stress alleviation. According to the research by (fMRI) or (PET), during the masticatory activity, brain activity increased in primary somatosensory cortex (SI), primary motor cortex (MI), supplementary motor area (SMA), premotor area (PM), prefrontal cortex (PFC), insula, posterior parietal cortex (PPC), thalamus, striatum, and cerebellum[6]. Masticatory activity and handgrip exercise elevate MCAV(middle cerebral arterial blood flow) velocity and heart rate. Handgrip exercise showed increased cerebral circulation velocity on the opposite side of hand activity. But masticatory activity showed increase in MCAV cerebral circulation of both sides[7].

It is deemed that masticatory activity affects brain activity and helps improve cognitive function. With this assumption, this study selected healthy participants to run a pilot study to understand the effect of masticatory movement on cognitive function and stress index and further to provide a ground of treatment for patients with cognitive damage.

2 Methods

2.1 Participants

Forty young adult with healthy in sahmyook university were informed of the goals and overall protocol of this study. Of these healthy young adult, 30 met the selection criteria and were assigned randomly to either the exercise (n = 15) or control group (n = 15) by having each of the subjects take out one card from a box containing two types of cards representing both the study groups. We included subjects who had no previous history of facial fracture and paralysis that would influence the restriction on the movement of the jaw, had no history of dental disease. All protocols and procedures were approved by the Institutional Review Board of Sahmyook University (Seoul, South Korea) and all the subjects signed a statement of informed consent before the study began.
2.2 Outcome measures

Cognitive function measured

In this research, a computer-assisted cognitive rehabilitation program (COMCOG) (Maxmedica Co., Ltd., 2004 version 1.0, ROK) was utilized and the program is largely divided into an attentiveness program and memory program. It has the total of 10 items each in elementary, intermediary and advanced levels. The process of computer-assisted cognitive rehabilitation program training is consisted of training selection, time limit, achievement and start level change. The program is applicable appropriately for each phase depending upon memory status by using a 17-inch color monitor, COMCOG program panel and headset. In this study, it was used as a tool to assess the participants.

Stress measured

In this study, the stress-measuring equipment, SA-3000P (Medicore Co., Ltd.) was utilized. The diagonal device is capable of checking autonomic nervous system function, cardiovascular problem, stress, artery hardening or peripheral blood circulation problem just by one round of assessment. Herein, the device was utilized to assess HRV (Heart rate, Variability)-based stress index and stress resistance – evaluation means to trace the homeostasis regulating mechanism in the autonomic nervous system against stress.

2.3 Statistical analysis

The data obtained in this study were analyzed using SPSS version 18.0 for Windows (SPSS Inc., Madison, WI, USA). In order to make comparisons between the pre- and post-test data for the two groups, a repeated measures analysis of variance (2 × 2) with a between-subjects factor was used. For comparing the differences in the pre- and post-intervention between the two groups, a paired t-test was conducted. Independent t-tests were performed to compare the pre- and post-test scores and the difference by time for the two groups. A p-value less than 0.05 was considered to indicate a statistically significant difference.

3 Results

3.1 Comparison of outcome variables in cognitive function

Memorize Numbers

There was a significant difference in the Memorize Numbers of the exercise group before and after exercise, in both group (p < 0.05), There was no significant difference between the two groups (p > 0.05)
Find a Picture by Name
The Find a Picture by Name was measured before and after the exercise. A significant increase was observed in the exercise group (p < 0.05), but not in the control group. The mean difference in the Find a Picture by Name before and after the exercise showed a significant difference between the two groups (p < 0.05)

Three consecutive card play
The three consecutive card play was measured before and after the exercise. A significant increase was observed in the exercise group (p < 0.05), but not in the control group. The mean difference in the Match Card before and after the exercise showed a significant difference between the two groups (p < 0.05)

3.2 Comparison of outcome variables in stress.

Stress Resistance
There was a significant increase in the exercise group (p < 0.05), but not in the control group, when comparing the Stress Resistance before and after the exercise. The mean difference in the Stress Resistance before and after the exercise showed a significant difference between the two groups (p < 0.05).

Stress Index
There was a significant decrease in the exercise group (p < 0.05), but not in the control group, when comparing the Stress Index before and after the exercise. In addition, the mean difference in Stress Index before and after the exercise was significantly different between the two groups (p < 0.05).

4 Discussion
In this recognition, this study set up a hypothesis that masticatory movement would help improve cognitive function and ease stress. The study participants were divided into an exercise group and control group to find out the effect on their memory, attentiveness and stress.

Zoltan(2015) in his study on cognitive treatment of brain-damaged patients based on a computer-assisted cognitive rehabilitation program, reported noticeable improvement in memory, problem solving ability and attentiveness[8]. Another preceding study conducted the training repeatedly by elevating the difficulty level of cognitive test gradually based on the neural plasticity theory and reported to find cognitive functional enhancement[9]. Chen, et al. (1997), in their research, applied the computer-assisted cognitive rehabilitation program to traumatic brain-damage patient and observed significant improvements in diverse cognitive aspects. But they reported
no difference with the control group receiving a conventional treatment method[10]. Physical activity or, that is, exercise bring a positive effect on cognitive enhancement[11]. A recent study said that patients who had followed non-aerobic but movement-based exercise therapy for 6 weeks showed elevated concentration, visual memory and working memory than the control group. There is also another study that found muscle strengthening exercise helped improve cognitive function[9]. As such, diverse cognitive therapeutic interventions have been applied in the clinical field. According to preceding studies, as there are diverse different symptoms such as reduced cognitive function and abnormal behavior intention, it is difficult to use only single intervention method to respond to them all. So multi-disciplinary complicated interventions have been said effective[3].

In this study, the number memorization, picture finding by name and three consecutive card play found significant results in the exercise group while the control group showed significant result in the number memorizing activity only. In picture finding by name and three consecutive card play, significant changes were observed between the exercise group and control group before and after the experiment. Such a result is deemed because of a positive effect of masticatory movement on memory and attentiveness. The stress resistance and stress index test found significant result in the exercise group only and in the change of the exercise group and control group before and after the experiment. Such a finding seems because masticatory exercise has a positive effect on cognitive function improvement and stress alleviation. This study is limited in investigating adults without a cognitive problem and the number of experiment participants was small. Its intervention period was short and intervention frequency was lower. Subsequent study will deal with patients with a cognitive problem and apply the intervention by increasing its period and frequency.

References

