

Effect of Mouth Gymnastics Program on Saliva Secretion and Oral Health Status in the Elderly

Research Article

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Abstract

Purpose: This study was conducted to determine the effect of mouth gymnastics program as systematic elderly oral health care program to improve the oral health and healthy life of elderly.

Materials and Methods: The changes in oral health status according to the mouth gymnastics program conducted for 3 months for the elderly aged 65 years or older who are admitted to the S nursing hospital located in Busan, Korea were analyzed with the SPSS (Statistical Package for the Social Science) 25.0 program.

Results: The results of saliva secretion test ($p < .001$), saliva pH test ($p < .01$), *Streptococcus mutans* and *Lactobacillus* colony confirmation ($p < .01$) at 6 and 12 weeks after the mouth gymnastics program showed statistically significant positive changes in oral function and oral health status of the elderly compared with before the program.

Conclusion: The mouth gymnastics program is considered to be helpful in improving the elderly oral health as well as the general health status. Therefore, a systematic Senior oral health care program, mouth gymnastics program should be prepared for the improvement of oral function of elderly patients admitted to nursing hospitals.

Keywords: Mouth Gymnastics; Elderly; Saliva; *Streptococcus mutans*; *Lactobacillus*.

Introduction

According to the UN's "World Population Prospects 2019" report, life expectancy increased from 64.2 years in 1990 to 77.1 years in 2050, resulting in an increase in life expectancy and a decline in fertility rates, leading to a rapid aging of the world population [1]. In particular, it is reported that the population over 65 will increase the fastest, and by 2050, 1 in 6 people in the world will be over 65 (16%) [2]. With the increasing interest in the healthy life of individuals due to the aging population, the health problem of the elderly in an aging society is emerging as a new social problem [3]. The health of the elderly is affected by a variety of factors, and in particular, oral health for basic living such as food intake and swallowing acts as an important factor in reducing the difference between extending the healthy life span and the expected life span [4]. More than 90% of elderly patients admitted to nursing hospitals suffer from chronic dis-

eases that require long-term hospitalization and drug treatment due to dementia, stroke, and arthritis [5, 6]. Various oral diseases and serious systemic health problems are caused by long-term medications [7] and oral health management provided by nursing hospitals is insufficient compared to systemic management [1, 8, 9]. Oral health status is the best determining factor for measuring the overall health status of hospitalized elderly patients [10], comprehensive oral health management including systemic health of elderly patients hospitalized in nursing hospitals is necessary. Since the reduction of oral salivation increases the salivary consistency and makes an oral environment suitable for the growth of bacteria, the increase in the amount of salivation through the oral function improvement exercise program regulates the growth of microorganisms in the oral cavity, thereby will act as a defense line in preventing various internal and external infectious oral diseases of the elderly [10-12]. Therefore, a systematic Senior oral health care program should be prepared as a way to improve the

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general health condition as well as the oral health of the elderly. In particular, the elderly is of the age group who can benefit greatly from exercise [13], and various exercises performed in old age have a great effect on improving the health of the elderly [14]. As an elderly exercise program, the implementation of an oral function improvement exercise program for the recovery and improvement of oral function will have a positive effect on the promotion of oral health in the elderly [13]. Therefore, there is a need for an exercise program to improve the oral function of the elderly in connection with an increase in the amount of salivation that suppresses the occurrence of various oral diseases in the elderly by providing moisture in the oral mucosa [13, 15]. In particular, mouth gymnastics is effective in improving dry mouth symptoms and increasing non-irritating saliva secretion without being influenced by demographic and oral health behavior characteristics, and is an exercise to improve oral function that not only helps to maintain oral health, but is also effective in improving the oral health and general health status of the elderly [16, 17]. Therefore, this study was conducted to determine the effect of mouth gymnastics program as systematic elderly oral health care program to improve the oral health and healthy life of elderly.

Material and Methods

Subjects

This study was conducted on the elderly aged 65 or older among the patients admitted to S nursing hospital in Busan, Korea from October 11, 2019 to January 13, 2020. After explaining the necessity and purpose of the study to subjects, 30 people who understood and agreed were first selected. In the secondary selection of the study subjects, subjects with experience in treatment of temporomandibular joint disease and surgery, subjects with limited mastication and neck movement and, subjects who are likely to be affected by oral health status through dental treatment during the research process and unfaithfully performed the mouth gymnastics program were excluded, and the final 24 subjects were used for the analysis.

Inclusion and exclusion criteria

Mouth gymnastics program lasted for a total of 12 weeks, two dental hygienist educators and two investigators conducted the Mouth gymnastics program training. Table 1 shows the contents of the activities of the mouth gymnastics program. Training was conducted twice a week for 3 months at the same time and place for 15 minutes through direct demonstrations and videos. The effects of the mouth gymnastics program were evaluated based on the results of saliva secretion, saliva pH, Streptococcus mutans and Lactobacillus casei colony count tests before the start of the program, 6 weeks after the program, and 12 weeks at the end of the program. Amount of saliva secretion and saliva pH are measured according to the manufacturer's method using Saliva-Check BUFFER product (GC Korea, Seoul, Korea) and pH test strip (Doosan, Seoul, Korea), and irritating saliva before (1 week), during (6 weeks), and after (12 weeks) the mouth gymnastics program was used in the experiment. The changes in colony formation of S. mutans and Lactobacillus in saliva according to the mouth gymnastics program were measured using CRT bacteria (invoclar Vivadent, Inc., NY, USA). The number of colonies formed above 105 (CFU/ml) was evaluated as 3 points for high

and 2 points for moderate and judged as high caries risk, while those below 105 (CFU/ml) were evaluated as 1 and 0 point for no occurrence and judged as low caries risk.

Statistical analysis

The collected data in this study were analyzed using the SPSS (Statistical Package for the Social Science) 25.0 program and determined based on the significance level of 0.05. The general characteristics of the study subjects were descriptive statistical analysis by frequency and percentage. Measurements of saliva secretion, saliva pH, and S. mutans and Lactobacillus colony in saliva for the evaluation of caries incidence factors according to the mouth gymnastics program was a dependent variable and analyzed by Repeated Measures ANOVA.

Results

In general characteristics, the gender was 41.7% for men and 58.3% for women, the age was 33.3% for 65-74 years old and 66.7% for over 75 years old, and smoking was 25.0% and non-smoking was 75.0% (Table 2). To confirm the effect of the mouth gymnastics program on saliva secretion, the results of measuring the saliva secretion are as follows. Saliva secretion amount before the administration of mouth gymnastics program was 4.37ml, 5.21ml after 6 weeks, 6.02ml after 12 weeks. The amount of salivation after 6 weeks ($p < 0.01$) and 12 weeks ($p < 0.01$) after the mouth gymnastics program was significantly increased in comparison with the pre-administration (Table 3). The result of confirming the effect of the mouth gymnastics program on saliva pH are as follows (Table 4). The pH of saliva before the mouth gymnastics program was pH 8.21, pH 8.42 after 6 weeks, and pH 7.63 after 12 weeks. The pH of saliva after 12 weeks of application of the mouth gymnastics program showed a statistically significant difference in comparison with before and after 6 weeks of application ($p < 0.01$). The effect of the mouth gymnastics program on the formation of S. mutans and Lactobacillus colony in saliva showed as a caries risk scores, and results are shown in Table 5 and Figure 1. The caries risk scores of S. mutans and Lactobacillus before the administration of mouth gymnastics program were 2.83 and 2.83 (Figure 1-A1,B1), respectively, 1.83 and 2.08 after 6 weeks (Figure 1-A2,B2), 1.42 and 1.83 after 12 weeks (Figure 1-A3,B3). Each caries risk score at all time points showed statistical significance ($p < 0.01$).

Discussion

With the aging of the global population, interest in the general health of the elderly is increasing and elderly health problems are emerging as a new social problem [2, 3]. The importance of oral health, which is a key factor in prolonging a healthy lifespan, is being emphasized [6]. Therefore, this study was conducted to determine the effect of mouth gymnastics program as systematic elderly oral health care program to improve the oral health and healthy life of elderly. The factors that indicate oral health are oral condition, dry mouth and bad breath, and saliva pH, and each of the factors influences each other [18]. In the results of this study, the amount of salivation in elderly patients admitted to nursing hospitals who applied the mouth gymnastics program was significantly increased in comparison with that before application of the program (Table 3). As the mouth gymnastics program pro-

Table 1. Mouth gymnastics program content.

1st week	Pre-inspection	saliva secretion, saliva pH, Streptococcus mutans and Lactobacillus caseicolony count tests
3rd-5th weeks	Mouth gymnastics program (Demonstration and video)	Stage 1: Deep respiration, Ready mouth gymnastics, Deep respiration, neck and shoulder gymnastics Stage 2: Mouth gymnastics for saliva secretion, Mouth gymnastics for chewing force, Mouth gymnastics for vocalization and swallowing Stage 3: Finishing gymnastics (Deep respiration)
	Mouth gymnastics program (Video)	Stage 1: Warm-up exercise, Deep respiration, neck and shoulder gymnastics Stage 2: Mouth gymnastics for saliva secretion, Mouth gymnastics for chewing force, Mouth gymnastics for vocalization and swallowing Stage 3: Finishing gymnastics (Deep respiration)
6th week	Mouth gymnastics program (Demonstration and video)	Stage 1: Warm-up exercise, Deep respiration, neck and shoulder gymnastics Stage 2: Mouth gymnastics for saliva secretion, Mouth gymnastics for chewing force, Mouth gymnastics for vocalization and swallowing Stage 3: Finishing gymnastics (Deep respiration)
	Intermediate inspection	saliva secretion, saliva pH, S. mutans and Lactobacillus caseicolony count tests
7th -11th weeks	Mouth gymnastics program (Demonstration and video)	Stage 1: Deep respiration, Ready mouth gymnastics, Deep respiration, neck and shoulder gymnastics
		Stage 2: Mouth gymnastics for saliva secretion, Mouth gymnastics for chewing force, Mouth gymnastics for vocalization and swallowing
		Stage 3: Finishing gymnastics (Deep respiration)
	Mouth gymnastics program (Video)	Stage 1: Warm-up exercise, Deep respiration, neck and shoulder gymnastics Stage 2: Mouth gymnastics for saliva secretion, Mouth gymnastics for chewing force, Mouth gymnastics for vocalization and swallowing Stage 3: Finishing gymnastics (Deep respiration)
12th week	Mouth gymnastics program (Demonstration and video)	Stage 1: Warm-up exercise, Deep respiration, neck and shoulder gymnastics
		Stage 2: Mouth gymnastics for saliva secretion, Mouth gymnastics for chewing force, Mouth gymnastics for vocalization and swallowing
		Stage 3: Finishing gymnastics (Deep respiration)
	Intermediate inspection	saliva secretion, saliva pH, S. mutans and Lactobacillus caseicolony count tests

Table 2. General Characteristics.

Classification	Categories	N	%
Gender	Male	10	41.7
	Female	14	58.3
Age	65~74	8	33.3
	≥75	16	66.7
Smoking	Yes	6	25
	No	18	75
Total		24	100

Table 3. Changes in saliva secretion amount according to administration of mouth gymnastics program.

	Before	During	After	F	p
		(6week)	(12 week)		
Saliva	4.37±0.62	5.21±0.61	6.02±0.72	26.483	p <0.001
amount (ml)	md=0.83, p=0.001		md=0.82, p=0.052		
	md=1.65, p< 0.001				
mean±S.D md=mean difference					

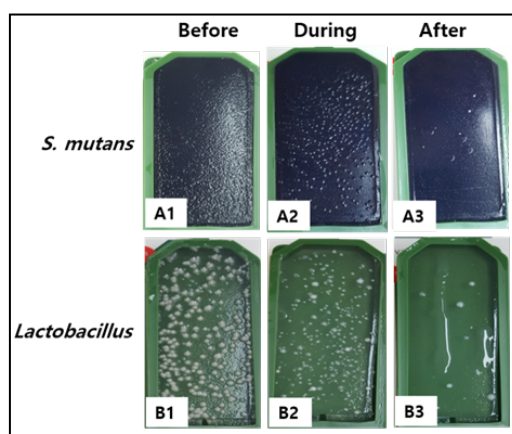
Table 4. Changes in saliva pH according to administration of mouth gymnastics program.

	Before	During	After	F	p
		(6week)	(12 week)		
	8.21±0.26	8.42±0.25	7.63±0.26	8.402	p <0.01
Saliva pH	md=10.21, p=0.295		md=0.79, p=0.006		
	md=0.58, p=0.006				
mean±S.D md=mean difference					

Table 5. Changes in caries risk of *Streptococcus mutans* and *Lactobacillus* in saliva according to administration of mouth gymnastics program.

	Before	During	After	F	p
		(6week)	(12 week)		
<i>S. mutans</i>	2.83±0.17	1.83±0.21	1.42±0.15	38.301	p <0.001
	md=1.00, p=0.001		md=0.42, p=0.05		
	md=1.42, p<0.001				
<i>Lactobacillus</i>	2.83±0.17	2.08±0.15	1.83±0.27	11.595	p <0.001
	md=0.75, p=0.002		md=0.25, p=0.218		
	Md=1.00, p=0.002				
mean±S.D md=mean difference					

Figure 1. Changes in colony formation of *Streptococcus mutans* and *Lactobacillus* according to administration of mouth gymnastics program.



gressed, the saliva pH changed to about 7.63 (Table 4). The health range of human saliva pH ranges from pH 5.75 to pH 7.05 and can increase to pH 8 as the amount of saliva increases [17]. In addition, an increase in the amount of salivation in the elderly with impaired oral function may help maintain a healthy saliva pH [19]. Therefore, the mouth gymnastics program has the effect of increasing the amount of salivation and changing the pH of the saliva into a healthy range. Although there was a difference in the method of evaluating saliva secretion, results of this study are consistent with the results of Lee [6] on the Mouth gymnastics program and changes in oral health status for the elderly, the results of Kim [3] on the oral health status of elderly patients after applying the Mouth gymnastics program and Watanabe brushing, and the results of Jeon [15] on the effect of the Mouth gymnastics program on improving dry mouth. In addition, the number of colonies of *S. mutans* and *Lactobacillus* and caries risk scores significantly decreased as the mouth gymnastics program pro-

gressed in this study (Table 5, Fig. 1). This result was due to the increase in saliva secretion and the change in saliva pH according to the mouth gymnastics program. Kim [3], who reported the effect of the Mouth gymnastics program on improving oral health-related functions in the elderly, also reported the same results. From the above results, the mouth gymnastics program is effective in improving oral health and preventing oral infectious diseases in elderly patients admitted to nursing hospitals who have a high risk of oral bacterial infection due to decreased saliva secretion and insufficient oral health management. Although this study only suggested changes in amount of saliva, saliva pH and some oral microbial changes according to the mouth gymnastics program for a limited period of time, the mouth gymnastics program is an effective oral health care method for the elderly that has no side effects, is easy to apply to elderly patients, does not have a relationship with the characteristics of individual oral health behaviors, has no time, place, and time limit, and has no economic

burden.

Conclusion

The mouth gymnastics program is considered to be helpful in improving the elderly oral health as well as the general health status. Therefore, a systematic senior oral health care program, mouth gymnastics program should be prepared for the improvement of oral function of elderly patients admitted to nursing hospitals.

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