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Clinical Report

Effect of Swallowing Exercises in Independent Elderly

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Abstract

The aim of this study was to investigate the effects of swallowing exercises on oral function in independent elderly patients visiting the Department of Prosthodontics at Tokyo Dental College Chiba Hospital. Twenty-nine patients aged over 65 years (15 men and 14 women; mean age, 75.0 years) in whom treatment was completed at this college were enrolled in the study. The patients were instructed on how to perform swallowing exercises monthly (including at baseline) for the first 2 months from the start of the study and asked to perform those exercises at least once daily. At the beginning and end of the study (a 3-month study period), the Repetitive Saliva Swallowing Test was conducted and occlusal force, oral diadochokinesis, unstimulated whole saliva flow rate, stimulated whole saliva flow rate, salivary pH at rest, and salivary buffering capacity measured to determine the effects of the exercises on oral function. Analyses demonstrated significant increases in diadochokinesis rate (/ta/ and /ka/) and unstimulated whole saliva flow rate ($p<0.05$), suggesting that the swallowing exercises promote the maintenance and improvement of oral function in the independent elderly.

Key words: Independent elderly — Oral function — Swallowing exercises — Prevention of long-term care — Saliva production

Introduction

The Long-Term Care Insurance Act, which was aimed at promoting independence and care in the elderly in Japan's rapidly aging society, was enacted in April 2004. This act was modified in April 2006 to focus on preventive nursing care, with the aim of reducing the number of elderly persons requiring higher nursing care levels by incorporating nursing care insurance services. Elderly individuals over 70 years of age are at higher risk of aspiration due to a decrease in eating and swallowing function, which often increases

susceptibility to severe pneumonia or respiratory disease. Since improvement of oral function was introduced as part of this preventive program, it has become common practice to give instruction on swallowing exercises to elderly persons requiring nursing care. These swallowing exercises include activities which promote rehabilitation of oral functional, and include breathing, neck and shoulder exercises, mouth opening and closing exercises, tongue and cheek exercises, vocal exercises, and massage of the salivary gland. They can easily be performed anywhere, including at home and care centers for the elderly. Recently, it has been reported that oral care and oral functional rehabilitation in the elderly receiving nursing care facilitated improvement of eating and swallowing function[1,3,5,7,9,10]. However, little is known about the effects of swallowing exercises on oral function in independent elderly individuals with potential dysphagia. The purpose of this study was to investigate the effects of swallowing exercises on oral function in independent elderly patients attending a dental college and hospital.

Participants and Methods

1. Participants

The participants comprised 29 patients aged over 65 years (15 men and 14 women; mean age, 75.0 years) attending the Department of Prosthodontics at Tokyo Dental College Chiba Hospital. Treatment had been completed in all patients, and no change in oral condition was observed throughout the study period. No clear impairment of swallowing function was observed in any patient. Written informed consent was obtained from all patients for participation in the study. The study period was from March 2008 to July 2008. The study was approved by the Ethics Committee of Tokyo Dental College (No.199).

2. Study procedures

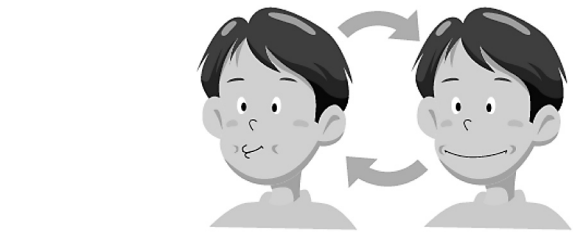
The patients were given instruction on how to perform the swallowing exercises monthly (including at the baseline) for the first 2 months from the start of the study. The swallowing exercises comprised the following procedures: 1) deep breathing, 2) neck exercises, 3) shoulder exercises, 4) opening and closing exercises of the mouth, 5) tongue exercises, 6) cheek exercises, 7) vocal exercises, 8) massage of the salivary gland, and 9) deep breathing (Table 1, Fig. 1). The patients were instructed to perform the swallowing exercises once or more daily before meals according to detailed directions provided in advance. In addition, the patients were instructed to keep a tally of their swallowing exercises to allow degree of compliance to be ascertained.

At the beginning of the study and at 3 months (the end of the study), the repetitive saliva swallowing test (RSST) was conducted and occlusal force, oral diadochokinesis, unstimulated whole saliva flow rate (UWS) and stimulated whole saliva flow rate (SWS), salivary pH at rest, and salivary buffering capacity measured in order to compare oral function between at before and after implementation of the swallowing exercises.

Evaluation of oral function was carried out as follows: 1) RSST: The patient was required to swallow saliva as often as possible in a sitting position for 30 sec, during which time the number of clear palpations of the laryngeal prominence and elevations of the hyoid bone were counted. The criterion for judgment was a score of less than 3 times in the RSST; 2) Occlusal force: Maximum occlusal force at the maxillomandibular first molar was measured using a dental occlusal force meter GM-10 (NAGANO KEIKI Co., LTD., Tokyo, Japan) with dentures inserted for denture wearers; 3) Oral diadochokinesis[2]: Instruction was given to say each of the following syllables —/pa/, /ta/, or /ka/— for 5 sec as quickly as possible, during which time the number of repetitions per second was calculated as the repetition speed of the syllables; 4) UWS: The total amount of saliva yielded during 5 min by the spitting method provided the UWS; 5) SWS: The total amount of saliva secreted during chewing special gum for 5 min provided the SWS.

Table 1 Procedure of oral function training

1. Deep breathing (3 times): Breathe in through nose, out through mouth.
2. Neck exercises (5 times): Nod head back and forth; tilt head from side to side.
3. Shoulder exercises (5 times): Raise shoulder and then lower by releasing tension.
4. Opening and closing exercises for the mouth (5 times each). 1) Open the mouth wide and slowly close. 2) Repeat the following two syllables, one after the other, while exaggerating the shape of the mouth: /i/-/u/.
5. Tongue exercises (5 times each): Poke the tongue out and move the tip up and down; poke the tongue out and move it from side to side.
6. Cheek exercises (5 times): Inflate and pucker the cheeks alternately.
7. Vocal exercises: Run through the set of Chiba Hakkiri-kotoba Exercises once.
8. Massage of the salivary gland (5 times each): Massage the parotid, submandibular and sublingual glands, one after the other, with the hands.
9. Deep breathing (3 times).



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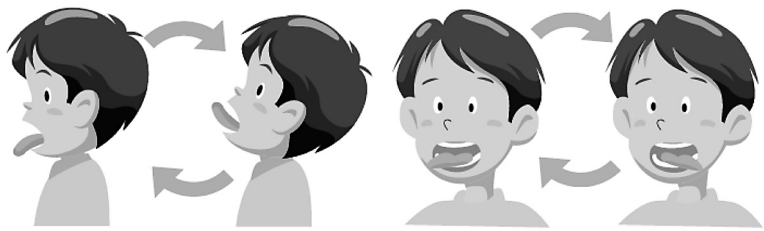

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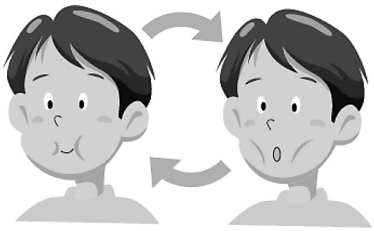

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Fig. 1 Illustrations of oral function training

Three exercises from procedure for oral function training (Table 1) are illustrated.
(A) Repeat following two syllables, one after the other, while exaggerating shape of mouth: /i/-/u/.
(B) Tongue exercises: Poke tongue out and move tip up and down; poke tongue out and move it from side to side.
(C) Cheek exercises: Inflate and pucker cheeks.

Table 2 Results of measurements at before and after implementation of swallowing exercises (n=24)

	Before implementation of swallowing exercises	After implementation of swallowing exercises	p-value (Two-tailed probability)
Occlusal force (N)	137.08±70.96	118.13±65.71	0.078
Repetitive saliva swallowing test (times)	4.43±1.79	4.04±1.78	0.296
Oral diadochokinesis (times/sec) /pa/	3.67±0.96	4.14±0.93	0.058
Oral diadochokinesis (times/sec) /ta/	3.66±0.96	4.26±0.90	*0.002
Oral diadochokinesis (times/sec) /ka/	3.58±0.91	4.07±1.04	*0.031
Unstimulated whole saliva flow rate (ml/min)	0.25±0.22	0.37±0.26	*0.011
Stimulated whole saliva flow rate (ml/min)	1.22±0.69	1.19±0.56	0.738
Salivary pH at rest	6.38±0.41	6.31±0.45	0.352
Salivary buffering capacity	10.87±1.78	10.91±1.83	0.857

*$p<0.05$

3. Statistical analysis

The results of the occlusal force, RSST, oral diadochokinesis, and saliva tests were analyzed using a *t*-test ($\alpha=0.05$) to compare oral function between at before and after implementation of the swallowing exercises.

Results

Five patients dropped out of the study due to complications such as poor health. Consequently, the results of measurements performed at before and after the swallowing exercises were compared in a total of 24 patients (13 men and 11 women; mean age, 75.6 years). Although all the patients were instructed to perform the swallowing exercises once or more daily, the compliance rate during the 3-month study period ranged from 35.7 to 100% (mean, 83.6±17.3%).

The results of measurements obtained at before and after implementation of the swallowing exercises are shown in Table 2. Significant differences were found in the rate of oral diadochokinesis (/ta/, /ka/) and UWS flow, with both values being higher at after the study than at before. No significant differences were found in occlusal force, RSST, SWS flow rate, salivary pH at rest, or salivary buffering capacity. Figure 2 shows the individual rates of oral diadochokinesis and UWS and SWS flow rates as measured at before and after implementation of the swallowing exercises. Many patients showed a marked increase in these measurements, with overall significant differences between at the start and end of the study, particularly in UWS flow rate. Some of the patients reported a decrease in thirst. After implementation of the swallowing exercises, many patients showed an insignificant increase in oral diadochokinesis for /pa/.

Discussion

Oral function plays a major role in social life, including in maintenance or improvement of quality of life, communication, eating/swallowing, articulation, and those functions required for life-support such as breathing[7]. Various therapies, including oral care, oral functional training, and swallowing exercises, have been implemented to promote these functions. In this study, independent elderly persons were instructed to perform swallowing exercises for 3 months, which resulted in a significant increase in the rate of oral diadochokinesis (/ta/, /ka/) and UWS flow rate.

A number of studies have investigated the effects of swallowing exercises. Anai *et al.*[1]

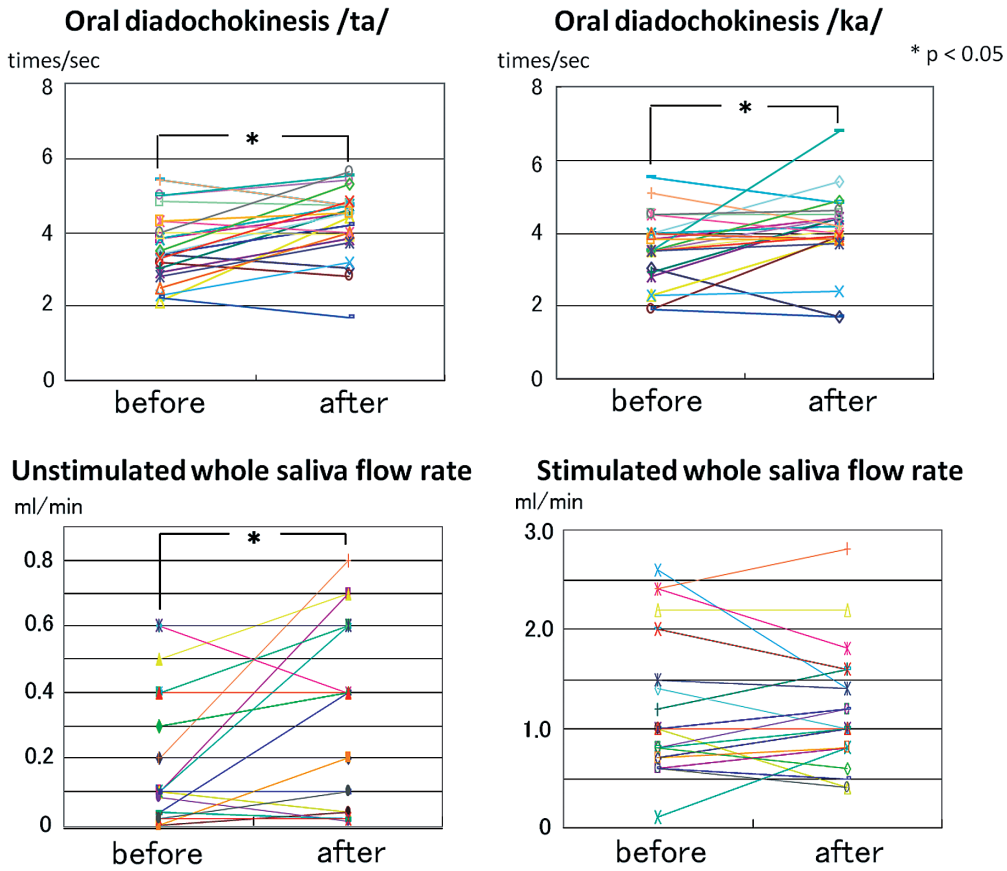

Fig. 2 Results of measurements at before and after implementation of swallowing exercises (n=24)

reported significant increases in salivary flow, mouth opening, and RSST score after swallowing exercises and massage of the salivary gland for 10 min, 3 times daily were performed by 15 elderly individuals without dysphagia who were admitted to a geriatric hospital. In addition, they reported an immediate effect of massage of the salivary gland. The study also showed a significant increase in UWS flow rate and a decrease in the subjective sensation of thirst after implementation of the swallowing exercises, suggesting that these exercises, and particularly massage of the salivary gland, are effective.

Minami *et al.*[5] reported that oral functional rehabilitation implemented daily in a group of 116 elderly individuals admitted to a long-term care insurance facility yielded an increase in the RSST value, indicating an improvement in swallowing function in approximately 50% of these patients. Ibayashi *et al.*[3] reported a significant improvement in RSST score following the performance of oral exercises for 3 months. Ooka *et al.*[7] also reported that a training program conducted for 3 months yielded a clear improvement in oral function, particularly among elderly individuals with an RSST score of less than 3 times/30 sec at first measurement. In the present study, however, no significant difference was observed in the RSST score after implementation of the swallowing exercises, probably because the initial RSST values were already high, with an average score of 4.43 times/30 sec.

In addition, Ooka *et al.*[7] noted a marked

improvement in the rate of oral diadochokinesis after performance of oral exercises. Their study also demonstrated a significant difference in the rate of oral diadochokinesis (/ta/, /ka/) between at before and after implementation of swallowing exercises. The syllable /ta/ is pronounced by bringing the tip of the tongue into contact with a tooth or gum, while the syllable /ka/ is pronounced by bringing the posterior area of the tongue into contact with the soft palate[6]. This increase in the rate of oral diadochokinesis (/ta/, /ka/) suggests that the swallowing exercises induced an improvement in tongue motor function. The average alternating motion rate in healthy adults is 6.3 times for the syllable /pa/, 6.2 times for /ta/, and 5.8 times for /ka/[4], values that are lower than those in this study. The reason for this seems to be that the motion function of the tongue decreases, even among the independent elderly and, generally, skilled motor behavior of the tongue declines with aging, resulting in a decrease in the alternating motion rate. This suggests that performing tongue and pronunciation exercises promotes recovery of decreased motion function and improvement of eating and swallowing function. An earlier study of elderly individuals with extremely poor oral function who required nursing care[8] also found that implementation of an oral function training program for 3 months resulted in a marked improvement in the RSST score and rate of oral diadochokinesis. This indicates that swallowing exercises promote recovery of motion function in the tongue.

Two studies comparing oral function between groups that had or had not undergone an oral function training program demonstrated that oral function was maintained in those who had participated in the training program[9,10]. However, a significant decrease was found in oral function when the training program was terminated[10], indicating that swallowing exercises should be performed continuously. The swallowing exercises in their study included items such as massage of the salivary gland and vocal exercises, which directly act on specific functions. The results of the present study suggest that continuous implementation of swallowing exercises maintains oral function among independent elderly individuals with increasingly diminished oral function, indicating the potential of such programs in care prevention. Further study is needed, however, to compare the effects of continuous and interrupted implementation of such swallowing exercises over an extended period of time.

Conclusion

In this study, swallowing exercises were implemented over a 3-month period in independent elderly individuals with impaired oral function. Significant increases were observed in the rate of oral diadochokinesis (/ta/, /ka/) and UWS flow rate, indicating that the swallowing exercises promoted maintenance and improvement of oral function.

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