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MISCELLANEOUS

The effects of oropharyngeal–lingual exercises in patients with primary snoring

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Abstract Primary snoring (PS) is one of the sleep breathing disorders with suboptimal results of treatment. It is recommended that Oropharyngeal exercises can be a therapeutic choice for the patients with mild to moderate degrees of PS. We assessed the effects of oropharyngeal–lingual (OPL) exercises on patients with primary snoring (PS) referred to Amiralmomenin University Hospital, Rasht, Iran in 2012. Fifty-three patients with PS underwent the sets of OPL exercises for 3 months, 5 days a week, and 30 min a day under the supervision of a speech therapist. Severity of the snoring was assessed by use of Visual Analogue Scale (VAS) and Snoring Scale Score (SSS) criteria before and after the exercises, and data were analyzed using SPSS version 17. Mean SSS before the study was 7.01 ± 1.72, while it was 3.09 ± 2.7 after the study; and the mean VAS scores were 8.54 ± 1.89 and 4.69 ± 2.94 before and after the study, respectively ($P = 0.0001$). There was a significant relationship between having conflicts with roommates ($P = 0.0001$), duration of snoring occurrence ($P = 0.0001$), severity of snoring ($P = 0.0001$) before and after the intervention. In conclusion, doing the OPL exercises significantly decreases the severity of PS.

Keywords Snoring · Oropharyngeal lingual exercises · Severity

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Introduction

Snoring is defined as a low frequency sound from partial obstruction of upper respiratory airways due to vibration of airway wall structures [1]. Snoring is common, with reported prevalence of 3.2–12.1 % in children and about 50 % in adults [2, 3]. Primary (simple) snoring is known as a sleep breathing disorder (SBD) [4]. The patients with Apnea Hypopnea Index (AHI) scores less than five episodes per hour of sleep time and who do not experience excessive daytime sleepiness (somnolence) are categorized as patients with primary snoring [5]. Polysomnography is the gold standard modality to differentiate primary snoring from obstructive sleep apnea syndrome (OSAS), although it is not usually a routine and available diagnostic procedure, and using a combination of clinical history taking, physical examination, Epworth Sleepiness Score (ESS) and Body Mass Index (BMI) it may be possible to screen the non-obstructive snores with 93 % sensitivity and 60 % specificity [1, 6]. Positive signs of apnea/hypopnea obstructive sleep syndrome, day-time somnolence, having apnea attack during sleep, morning headaches and feeling head discomfort without drinking alcohol, along with ESS $\geq$15 and BMI $\geq$28 are highly suggestive for sleep obstructive apnea [1].

A treatment with little discomfort and low risk for the patients and cost effective for society is in great demand

[7]. Continuous positive airway pressure (CPAP) is a device and a standard treatment method in patients with SBD [5, 8]; however, its acceptance among patients is barely more than 50 %. Bi-level positive airway pressure (BPAP) and auto adjusting positive airway pressure (APAP) have developed a moderate acceptance rate among patients compared with CPAP. Similarly, oral devices/appliances used for mandible or tongue advancement have a 50 % success rate but their acceptance is also low (25 %) [5]. Various surgical methods like nasal, palatal and hypopharyngeal surgeries are considered as other more aggressive modalities of treatment, each of them have different complications and lead to about 50 % of positive treatment results [5, 7–9].

Elasticity and tonicity of oropharyngeal muscles decrease with age and also during sleeping in individuals [5]. Some investigators introduced physical exercise as an adjunct therapy in sleep apnea and saw meaningful reductions in SDB severity following some supervised exercise training regimens in their groups of patients with moderate SDB. These effects were independent of changes in BMI, and the authors speculated that engagement of the pharyngeal and glossal muscles during the exercises might have had a training effect on those muscles and thus, helped to maintain patency during periods of nocturnal susceptibility to upper airway obstruction [10, 11]. Also, some authors found that SDB and primary snoring were less common in singers and musicians who play wind instruments [12, 13] and recently, some other investigators suggested the Oro-Pharyngeal-Lingual (OPL) exercises as a new line of treatment for SDB [14, 15]. In a preliminary study by Ojay and Ernest in 2002, it was revealed that vocal exercises might decrease snoring by promoting the tonicity of pharyngeal muscles [12]. In 2007 during another study, the incidence and severity of snoring and daytime somnolence among semi-professional singers and non-singer subjects was compared. According to this study, singers had a significant lower score of Snoring Scale Score (SSS) compared with the other group, thus authors believed that singing exercises might be effective in the treatment of snoring [13]. In Guimaraes et al. study thirty-one patients (25–65 years old) with moderate OSAS visiting one of the Sau Paulo University clinics were trained to do a 30 min of oropharyngeal exercises for 3 months (probably considering above concepts and other speech therapy techniques). The results showed a 39 % decrease in OSAS severity [14].

Of course, there are some paradoxical evidences in the literature about these investigations [16]. Theoretically, it seems that the purpose of OPL exercises is to reinforce oropharyngeal muscles that have low tonicity during sleep and vibrate while snoring. Also these exercises as a medical intervention seems to be non-invasive, simple, safe and inexpensive.

Considering the fact that night-time snoring is a common problem among general population and influences on different aspects of individuals' lives, and also knowing that noninvasive, inexpensive and available solutions to treat these people are more acceptable and might actually help a lot of people, in the present study we aimed to evaluate the effects of OPL exercises in patients with primary snoring.

Materials and methods

This study was a semi-experimental, before and after study on 53 patients with chief complaint of snoring who were referred to Amiralmomenin university hospital, Rasht, Iran. The proposal of the research was evaluated and approved in ENT Research Center of Guilan University of Medical Sciences. The inclusion criteria were: age over 20 and lower than 65 years old, night-time snoring for more than 1 year, not taking regular amounts of sedative medications, and negative history of following diseases: severe OSAS, excess obesity (BMI $\geq$ 40), advanced pulmonary diseases (i.e. COPD), craniofacial malformations, hypothyroidism, history of cerebrovascular accidents (CVAs), rhinosinusitis, neuromuscular diseases, heart failure, coronary artery disease, severe obstructive nasal diseases, and tonsillitis. The exclusion criteria were: inability to learn the exercises because of mental problems or low educational state (according to the speech therapist), and failure to perform regular exercises during the 3 months of experiment (according to the patients, their family, and diagnosis of speech therapist)—the acceptable level of exercises was doing at least 80 % of activities.

The patients who fulfilled the inclusion criteria were referred to the speech therapy clinic and learned the OPL exercises by a skilled speech therapist in several sessions. These exercises were categorized into three different groups involving soft palate (2 exercises), tongue (4 exercises) and oro-facial muscles (4 exercises). These exercises had to be repeated daily and forcefully. Some modifications, also were made in OPL exercises relative to the Guimaraes study [14].

Soft palate exercises

1. Pronouncing the oral vowel "ooo" intermittently while the tongue is contracted in the floor of the mouth (isotonic exercise), and
2. Doing the same, but this time pronouncing continuously (isometric exercise).

The palatopharyngeus, palatoglossus, uvula, tensor veli palatine, and levator veli palatine muscles are recruited in these exercises. The isotonic exercise also recruits pharyngeus lateral wall. These exercises had to be repeated for 3 min daily.

Tongue exercises

1. Brushing the mid-superior and lateral surfaces of the tongue while the tongue is positioned in the floor of the mouth (to brush the left lateral side of the tongue, it would be a little deviated to the right and wise versa). We modified this exercise in some cases who could not brush the tongue by asking to massage the tongue by fingertip.
2. Placing the tip of the tongue against the posterior hard palate and front of the soft palate and sliding the tongue backward or the sweeping exercise (a total of 3 min throughout the day).
3. Forced tongue sucking upward against the palate, pressing the entire tongue against the palate while the mouth is open (a total of 3 min throughout the day).
4. Forcing the back of the tongue against the floor of the mouth while keeping the tip of the tongue in contact with the inferior incisive teeth (a total of 3 min throughout the day).

Facial exercises

The exercises of the facial musculature use facial mimicking to recruit the orbicularis oris, buccinator, major zygomaticus, minor zygomaticus, levator labii superioris, levator angularis, lateral and medial pterygoid muscles. These exercises include:

1. Orbicularis oris muscle pressure (sucking the lips inwards while the mouth closed with pressure for 30 s-isometric exercise).
2. Regular suction movements contracting only the buccinator. These exercises were performed with repetitions (isotonic) and holding the position (isometric).
3. Recruitment of the buccinator muscles against the finger that is introduced in the oral cavity and pressing the buccinators muscle upward and outward. The exercise was performed in both sides.
4. Alternated elevation and lateral movement of the mandible—first left and up, then right and up. This particular exercise was done with both open and closed mouth. We modified this exercise in some cases such as exaggerated chewing movements with their jaw.

After training the participants, a CD containing the teaching videos of the exercises were given to each of them, and to supervise the process of learning and doing the exercises, they were called several times and also visited repeatedly every 3 or 4 weeks for 3 months. The exercises were done for at least 5 days a week, 30 min a day. The quality of performing the exercises and the severity of snoring were closely checked and documented. The severity of PS was evaluated with VAS (Visual Analogue Scale in that the score 0 was defined as no audible snoring and score 10 as the most severe snoring sound that was imaginable for the roommates of the cases) and SSS criteria both before and 1 week after ending the intervention. Both of these scores were questioned from roommate of the cases. Finally, the data were analyzed by the SPSS software version 17.

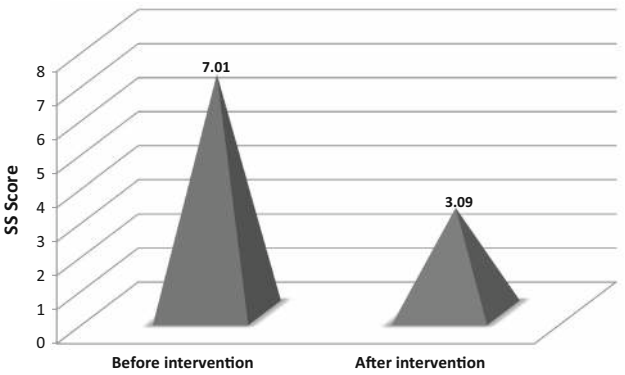

Fig. 1 The mean SSS of patients before and after the oro-pharyngeal-lingual exercises were 7.01 ± 1.72 and 3.09 ± 2.7, respectively ($P = 0.0001$)

Results

Among 63 patients who commenced the study, 53 patients finally completed the treatment course (84.12 % treatment acceptance rate). Thirty-two patients were male (60.4 %) and the mean age of the participants was 45.35 ± 10.08 (22–65 years old). Also the mean of weight, height and BMI of the participants were 79.99 ± 10.56 (63–111) kg, 168.3 ± 10.65 (147–188) cm, and 26.46 ± 5.21 (19–31.7) kg/m^2, respectively. The mean duration of lifetime PS among the patients was 29.46 ± 5.21 (1–37) years. Moreover, the mean Epworth Score of sleepiness was 5.11 ± 3.63 (0–14). None of the subjects had ESS more than 14, BMI more than 40, and full criteria of OSAS, although 12 cases had BMI between 30–32 kg/m^2. Before and after the intervention, the mean SSS of patients were 7.01 ± 1.72 and 3.09 ± 2.7 (Fig. 1); and the mean rate of VAS score were 8.54 ± 1.89 and 4.69 ± 2.94, respectively (Fig. 2). There was a significant relationship between the mean of SSS ($P = 0.0001$) and VAS scores ($P = 0.0001$) and also, conflicts with roommates

($P = 0.0001$), duration of snoring time ($P = 0.0001$) and severity of snoring ($P = 0.0001$) before and after the study (Tables 1, 2). According to our results, and assuming the scores 3 or less as the cut-off point of improvement level for both VAS and SSS criteria, we proposed that these exercises improved the problem of our cases for 41.5 and 62.3 %, respectively.

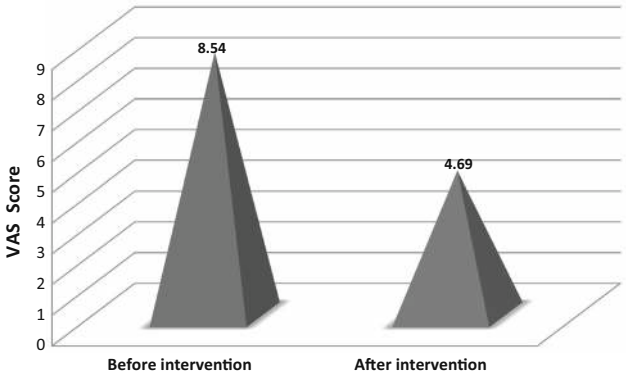

Fig. 2 The mean of Visual Analogue Scale (VAS) score before and after the oro-pharyngeal-lingual exercises were 8.54 ± 1.89 and 4.69 ± 2.94 respectively ($P = 0.0001$)

Discussion

The present study revealed the effectiveness of oropharyngeal–lingual exercises in primary snoring cases. In our study, the mean BMI of patients was 29.64 ± 5.21, that was similar to Guimaraes et al. [14] study with mean BMI of 29.6 ± 3.8 and 31 ± 2.8 in case and control groups, respectively, but a little different from that of Barnes et al. [15] (36.1 ± 4.3). The mean Epworth sleepiness score in our study was 5.11 ± 3.63 (0-14) while it was 14 ± 5 in Gumaraes et al. [14] study; excluding the patients with moderate to severe OSAS from our study could be the possible reason for this difference.

Table 1 Frequency distribution of time and duration of occurrence of snoring before and after the oro-pharyngeal-lingual exercises in 53 Iranian subjects

Before the intervention		After the intervention							
		Every night/all night long		Most nights/most hours of the night		Some nights/some hours of the night		Seldom or never	
Time of occurrence	Frequency	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Time/duration of snoring occurrence									
Every night	36	11	30.6	5	13.9	8	22.2	12	33.2
Most nights	12	0	0	3	25	4	33.3	5	41.7
Some nights	5	0	0	0	0	0	0	5	100
Total	53	11	20.8	8	15.1	12	22.6	22	41.5
All night long	15	3	20	1	6.7	9	60	2	13.3
Most hours of the night	27	0	0	7	25.9	7	25.9	13	48.1
Some hours of the night	11	0	0	0	0	2	18.2	9	81.8
Total	53	3	5.7	8	15.1	18	34	24	45.3

Table 2 Frequency distribution of snoring intensity during the night in 53 Iranian patients with primary snoring before and after the oro-pharyngeal-lingual exercises

Before the intervention		After the intervention							
		Strident sound		Heard in adjacent room with closed doors		Only be heard in the bedroom		Snoring sound is not heard	
	Frequency	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Strident sound	34	6	17.6	8	22.5	14	41.2	6	17.6
Heard in adjacent room with closed doors	12	0	0	3	25	7	58.3	2	16.7
Only be heard in the bedroom	7	0	0	0	0	3	42.9	4	57.1
Total	53	6	11.3	11	20.8	24	45.3	12	22.6

In the present study, the most common predisposing factors were obesity (30 patients, 36.1 %), taking especial medications like antihypertension drugs (16 patients, 19.3 %) and having gastro-esophageal reflux disease (13 patients, 15.7 %), respectively. In the study of Barnes et al. [15], obesity was also stated as the most important adjustable factor. Moreover, 18 of our patients (21.6 %) were either active or passive smokers, comparing to the 30 patients in Sengul et al. [17] study. Furthermore, in the study of Guimaraes et al. [14], 20 % of control group population and 6.3 % of subject group were reported to have smoking exposure.

The mean severity rate of night-time snoring based on SS scoring were 7.01 ± 1.72 and 3.09 ± 2.7, before and after the intervention, that was statistically significant ($P = 0.0001$); while in another article evaluating the effect of singing on night-time snoring and day-time somnolence by Pai et al. [13], the SSS mean scores were 2.51 (0–7) for singers group and 3.6 (0–9) in non-singer group. Also the mean VAS score for evaluating the severity of snoring was 8.54 ± 1.89 before the intervention while it turned to 4.69 ± 2.94 at the end of our study. As a result, our study revealed that taking these exercises can improve both SSS and VAS scores, as it does for conflicts with roommates and duration of snoring. These exercises may increase the strength of oropharyngeal musculature and perpetuate muscular tonicity of the upper airway muscles; hence prevent collapsing these muscles during the sleep.

On study of Guimaraes et al. [14] it was also revealed that oropharyngeal exercises cause significant decrease in the severity of OSAS symptoms, thus they were introduced as a new modality of treatment for patients with moderate OSAS. The differences between the present research and the Guimaraes' might come from the fact that our study was designed as a before-after study, thus it does not face biases stated in case group and control group synchronization process; also, our study was performed on patients with PS who did not have moderate to severe OSAS signs; and finally, some modifications were made in OPL exercises in our study.

A caveat for these exercises may be the patients' non-compliance with doing these exercises perfectly and regularly; and we found nearly 15 % of our subjects did not perform or maintain the exercises perfectly. So with more studies in this field and designing simpler and fewer-but more effective exercises we can increase the compliance of the patients for doing these exercises to much better degrees. Another defect of this study is its loss of following up the subjects and investigating the durability of the exercises.

The results of our study revealed that the OPL exercises significantly decrease the average severity scores of night-time snoring among our patients with PS. Also the time and duration of night-time snoring showed a significant decline. Future modifications could be necessary on these exercises to help patients do them; also more studies could be designed to assure the surveillance of such exercises to resolve the clinical signs.

Conflict of interest None of the researchers had conflict of interest during this study.

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