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The Pharyngeal Muscle Trainer for the Therapy of Primary Snoring - An innovative therapy approach

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Summary

Snoring is a concomitant of sleeping. This phenomenon is not only considered annoying, but also often taboo because it affects the privacy of those affected. In addition, however, snoring can be the cause of sometimes life-threatening diseases, such as hypertension, stroke and myocardial infarction.

A new method of velo-pharyngeal muscle building with the novel pharyngeal muscle trainer was tested in 102 patients (74 male and 28 female) during an outpatient clinical observation over 4 weeks. Patients wore the pharyngeal muscle trainer twice a day for 15 minutes.

It was observed a highly significant reduction in snoring intensity, from very heavy to tolerable snoring in 75% of the users within four weeks (p>99%). A further reduction of the snoring intensity by 26 % per week can be assumed (p>98 %).

Keywords: Snoring; Oral Musle Stimulation; Well beeing

Introduction

Snoring is a concomitant of sleeping. This phenomenon is not only considered annoying, but also often taboo because it affects the privacy of those affected. In addition, however, snoring can be the cause of sometimes life-threatening diseases, such as hypertension, stroke and myocardial infarction [1].

There are numerous surgical and non-surgical treatment options for snoring and snoring apnea syndrome. All surgical and conservative treatments do not address the cause of snoring, but merely help to prevent the snorer from obstructing the airway during sleep, thereby preventing snoring [2].

In the present paper, a novel therapeutic concept is presented that treats the cause of primary snoring. The cause of primary snoring results from a vibration of the soft tissue structures of the upper airway (source). In about 80% of cases, the cause is decreased muscle tension in the soft palate area (source). The pharyngeal muscle trainer is used to specifically strengthen the muscles in the area of the soft palate and the palatal arches. During each swallowing act, the soft palate presses against the posterior edge of the pharyngeal muscle trainer and an isometric contraction of the soft palate muscles occurs, thus strengthening these muscles. As a result, the vibration of the soft palate during breathing is reduced and the snoring sound is reduced [3].

Material and Methods

The method of velo-pharyngeal muscle building with the pharyngeal muscle trainer was tested in 102 patients (74 male and 28 female) during an outpatient clinical observation. This pharyngeal muscle trainer is attached to the teeth of the maxilla, can be removed, and is made of a thermoplastic dental resin (Figures 1 and 2). The mean age was 53.7 years [4].

Figure 1: The pharyngeal muscle trainer, top view

Figure 2: The pharyngeal muscle trainer, lateral view

All patients suffered from primary snoring. Prior to enrollment in the clinical observational study, each patient was interviewed for medical history and clinical findings were obtained to rule out a rhinogenic etiology for the primary snoring. Patients wore the pharyngeal muscle trainer twice a day for 15 minutes. Wearing at night was strictly forbidden to the patients [5].

Over a period of four weeks, the patients were called in once a week for clinical examination and questioning. The severity of the snoring noise was recorded subjectively using a 10-point scale [6].

Statistical analysis was performed using a weighted chi-square test.

Results

Figure 3 shows the median, upper and lower quantiles of all 102 patients over the study period of 4 weeks. There is a highly significant reduction in snoring intensity over the study period (p>99%). It can be assumed with a probability of p>99% that the snoring intensity (snoring strength) is reduced from very heavy to tolerable snoring in 75% of the users within four weeks.

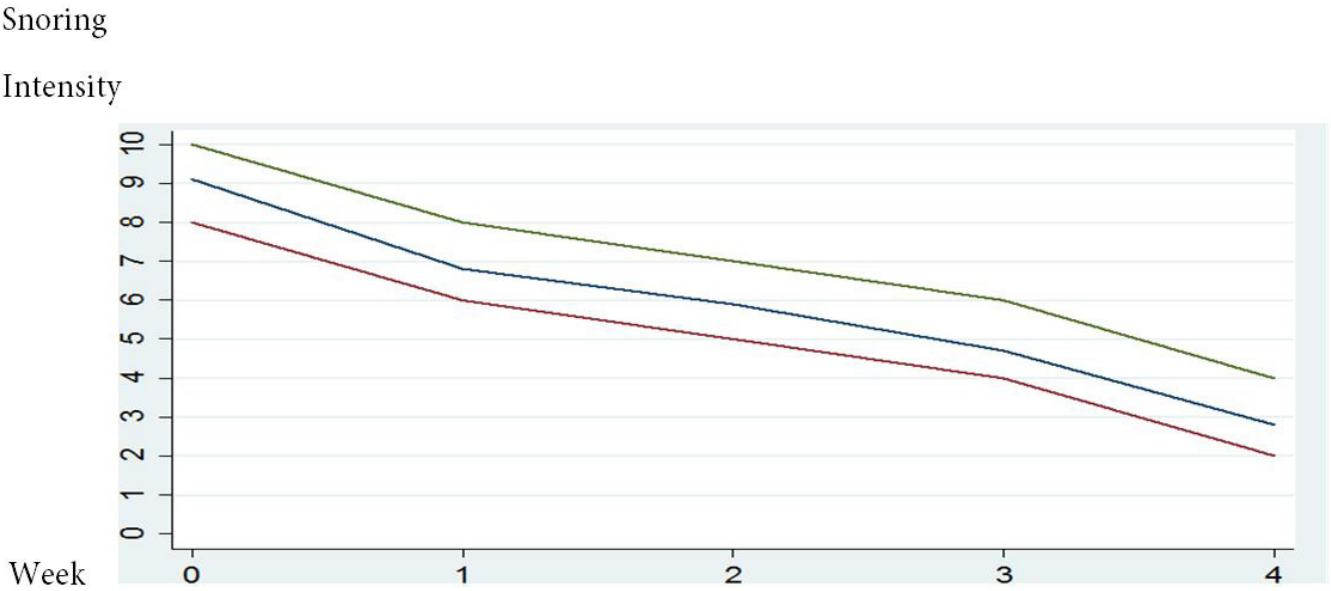

Figure 3: Average snoring intensity of all 102 patients (median, upper and lower quantiles)

The average snoring intensity was 9.1 (baseline findings). This represented extreme snoring. This baseline value has been documented with 100%. After one week, this value was 6.8. Thus, an average reduction of snoring intensity by 25% has been achieved in the first week. In the following week, a further reduction of 10 % was achieved. The absolute value was 5.9 (mean snoring) and relatively 65%. The third week resulted in a decrease of 13 %, so that tolerable snoring was achieved after four weeks. The average snoring intensity has been evaluated as 2.8. Thus, snoring intensity was reduced by 69% to light snoring within four weeks (Table 1).

	Average snoring intensity	
Point in time	**absolute**	**relative**
(Start) 0. week	9,1	100 %
1. week	6,8	75 %
2. week	5,9	65 %
3. week	4,7	52 %
(Final) 4. week	2,8	31 %

Table 1: Development of the average absolute and relative snoring intensitya

Figures 4 and 5 show the changes in the soft palate. At the beginning of therapy (Figure 4), a flaccid soft palate was present. The uvula tilted dorsocranially, at the A phonetic articulation. There is a so-called "2D shape" of the uvula as a sign of the deficient muscle tension. After four weeks (Figure 5), the velum is significantly strengthened. The uvula is stable in the pharynx in a caudally directed position during A-sound formation and as an expression of the achieved muscle tension it now has a "3D shape".

Figure 4: Initial findings - A dorsocranially tilting uvula during A-sound formation

Figure 5: Findings after four weeks - uvula in physiological position

With the help of the weighted chi-square test, it is possible to estimate the further development (Table 2). A weekly reduction by a factor of 0.2682 could be calculated with a probability of p>98 %. Thus, a further reduction of the snoring intensity by 26 % per week can be assumed.

	Coefficient	Standard-deviation	z	P < z
week	0,26582	0,02703	-9,92	0,000
cons	2,20313	0,03341	65,92	0,000

Table 2: Prediction of snoring intensity from week 5

Discussion

Physiologic quiet breathing (eupnea) during sleep is nearly silent. The American Sleep Disorders Association defines snoring as a loud, predominantly inspiratory upper airway breathing sound coupled to sleep, without apnea or hypoventilation, resulting from oscillations of the dorsal portions of the soft palate and lateral pharyngeal walls [61].

Novel muscle building therapy using isometric contraction in the soft palate and palatal arches was able to approximate this condition. After four weeks, the subjectively measured snoring noise could be reduced by 69% [7].

In the case of mild to moderate obstructive sleep apnea, i.e., an apnea-hypopnea index (AHI) of less than 30, positive pressure ventilation or the mandibular advancement splint (UPS) is the primary treatment [80]. Two-rail systems are usually used as mandibular advancement splints for the therapy of sleep-related breathing disorders. These systems support on the maxilla and push the mandible anteriorly [8].

The innovative pharyngeal muscle trainer studied in this paper is attached to the upper jaw and therefore does not affect the mouth opening. Compared to the three types of splint mentioned above, the pharyngeal muscle trainer has a distinct advantage because it is much more comfortable for the patient to wear [9].

Conventional splint systems always target the mandibular advancement and aim to open the hypopharynx. The success rate of these systems is about 60%. Specht and Schmidt-Bylandt (2014) report a reduction in snoring from a mean of 31.8 to 13.2% for their SNX protrusion splint. The mean mandibular advancement was 5.83 mm [81]. Globally, Major (2006) reported a mean reduction in snoring noise of 77% [10].

The innovative pharyngeal muscle trainer tested in this paper reduced snoring noise by 69% after four weeks. According to the study design, the subjects were terminated after four weeks. The regression analysis allows the estimation of the further development. A weekly reduction of the snoring noise of 26.8 % can be assumed (p > 98 %). Thus, this investigated innovative approach is superior to conventional mandibular advancement splints in the therapy of primary snoring after 5 weeks at the latest. The explanation for this finding lies in the strengthening of velar muscles and palatal arches [82]. The effectiveness of muscle building by isometric contraction has been widely documented [83] and is used, for example, in high-performance sports [84].

Tongue position is also influenced by the anterior palatal arch, among other muscle groups. Bilateral strengthening of the palatopharyngeus muscle, due to its craniocaudal orientation [79], results in elevation of the base of the tongue in a cranioventral direction during tension. This opens the hypopharynx. Airflow is improved and the strength of airflow turbulence at anterior to the posterior pharyngeal wall, and thus the loudness of snoring, is reduced [11].

The improvement of the spatial conditions for the airflow leads to a reduction in the work of breathing and thus to reduced stress and lower release of adrenaline in the body. This reduces the risk of cardiovascular disease (hypertension, myocardial infarction,

stroke), increased intraocular pressure, weight gain, increased susceptibility to infection, sexual dysfunction, relationship problems, and psychological stress and depression [60].

Koskenvuo et al. (1985) showed in 3,847 men and 3,664 women in Finland between the ages of 40 and 69 years that 9% of the men and 3.6% were chronic snorers. Hypertension correlated highly significantly with habitual snoring. Especially in men in the age group between 40 and 49 years and independent of weight (obesity) and blood pressure (hypertension), there was a significant correlation between angina pectoris and chronic snoring [29].

Norton and Dunn studied 2,629 subjects from Toronto between the ages of 30 and 90 years. They observed snoring in 42% of the subjects. By the age of 70, the proportion of snorers increased steadily, reaching 84% in men and 73% in women in this age group. The snorers over 40 years of age suffered from hypertension twice as often as the non-snorers. In addition, the snorers suffered more frequently from heart disease and obesity. Among them were frequent diabetics, smokers and alcoholics. Snoring men who smoked and were also overweight were particularly at risk, as they were four times more likely to suffer from hypertension than non-snorers [30].

Conclusion

These typical complications of obstructive snoring can be alleviated by the tested muscle building with the help of isometric muscle contraction. A reduction in body weight is always recommended as a concomitant measure [80].

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