

METHODS TO INCREASE MUSCLE TONUS OF UPPER AIRWAY TO TREAT SNORING

Systematic review

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Abstract – Background: Snoring is the noise caused by vibration during the in-breath; and which structure actually vibrates depends on many factors. **Objective:** The treatment of snoring with methods to increase muscle tonus of upper airway has been controversial, and poorly reported, thus a review of evidence is necessary to evaluate the effectiveness of these methods. **Method:** A review of randomized or *quasi*-randomized, double blind trials on snoring treatment that have employed any method to increase muscle tonus of upper airway like phonotherapy or physical therapy among others. **Outcomes:** decrease or completely stop of snoring, sleep quality, quality of life, and adverse events. **Results:** Three eligible trials were potentially analyzed, but none of them could provide good scientific evidence favoring the intervention. The objective analyses of one study showed improvement of snoring, although the objective sub-analyses and subjective analyses showed controversial results. The adverse events were not reported. **Conclusion:** There is no enough evidence to support the recommendation of methods to increase muscle tonus of upper airways in treatment of snoring. Well designed randomized clinical trials are needed to asses the efficacy of such methods, and a standard and worldwide accepted method for snoring assessment would be useful for future researches.

KEY WORDS: snoring, sleep disorders, treatment, review.

Métodos para aumentar o tônus muscular da via aérea superior no tratamento do ronco: revisão sistemática

Resumo – Contexto: O ronco é o ruído causado pela vibração durante a inspiração, cujas estruturas vibratórias, dependem atualmente de vários fatores. **Objetivo:** O tratamento do ronco com métodos para aumentar o tônus muscular da via aérea superior tem sido controverso e pouco relatado, portanto uma revisão de evidências é necessária para avaliar a efetividade destes métodos. **Método:** Revisão sistemática de ensaios clínicos randomizados ou *quasi*-randomizados, duplo-cegos para o tratamento do ronco, com métodos visando o aumento do tônus da via aérea superior, tais como fonoterapia e fisioterapia. **Desfechos:** diminuição ou cura do ronco, qualidade do sono, qualidade de vida e efeitos adversos. **Resultados:** Três estudos elegíveis foram potencialmente analisados, porém nenhum deles demonstrou evidência científica de qualidade favorecendo a intervenção. As análises subjetivas em um estudo mostrou melhora do ronco, entretanto as sub-análises objetivas demonstraram resultados controversos. Os efeitos adversos não foram relatados. **Conclusão:** Não existe evidência científica suficiente para sustentar a recomendação de métodos para aumentar o tônus muscular da via aérea superior no tratamento do ronco. Ensaios clínicos randomizados bem elaborados são necessários para avaliarmos a eficácia de tais métodos e uma padronização de métodos para intervir no ronco mundialmente aceitos se tornariam úteis em pesquisas futuras.

PALAVRAS-CHAVE: ronco, distúrbios do sono, tratamento, revisão.

Snoring is caused by vibration during the in-breath, which structure actually vibrates depends on many factors, few of which are well understood. Estimates of prevalence of habitual snoring range from 24% to 50% for men and from 14% to 30% for women¹⁻⁶.

Most commonly, the soft palate is assumed to be the primary noise generator, although other structures, such as tongue base, epiglottis or pharyngeal mucosa, may also vibrate to a greater or lesser extent, in any one individual⁶. Immediately before each in-breath, the muscles of

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Received 23 May 2008. Accepted 11 August 2008.

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the upper airway, including the palatal muscles, should tighten to maintain patency of upper airway⁷. This muscle tone is necessary to withstand the negative pressure from the lungs as they draw in air, and, by keeping the airway wide and clear, keeps the air pressure moderate. In sleep, tension is lost from these muscles, and whilst non-snorers retain sufficient tone in their upper airway to resist the air-flow and maintain patency, snorers do not⁸. Without this muscle tension any relaxed tissue collapses into the throat where it may cause turbulence and vibration (snoring) or completely block off the airway (sleep apnea)⁹⁻¹¹. Snoring is known to worsen with age, gender, obesity (collar size, Body Mass Index), alcohol ingestion, cigarette consumption, and nasal obstruction^{5,12-17}, and it results in significant social disability, contributing to relationship disharmony, and social ostracism¹⁸. In addition, snoring has been implicated in the etiology of more morbidity, such as: hypertension, ischemic heart disease, cerebrovascular accident, increased morbidity and mortality from road traffic and work related accidents¹⁹⁻²¹.

Treatment for snoring can be divided into two approaches. One approach aims to affect the force of the breath²². The other approach aims to affect the tone and/or size of the soft palate and/or upper throat. The treatment could also be divide in: nonsurgical (weight reduction, reduction of alcohol intake, pharmacological treatment of coincident nasal obstruction¹³⁻¹⁶, Continuous Positive Airway Pressure (CPAP) appliance²³, Mandibular Advancement Oral Appliances^{24,25}, and surgical (surgery for coincident nasal obstruction²⁶, uvulopalatopharyngoplasty^{27,28}, palatal stiffening techniques²⁹⁻³⁴, palatal shortening techniques)³⁵⁻³⁷. Based on these approaches, methods to increase muscle tonus of upper airway, such as singing exercises, miofunctional therapy, instrumental therapy (music), and electrical stimulation have been used as an alternative treatment for snoring. We know much more now about the pathogenesis of snoring and obstructive sleep apnea (OSA), and some studies brought us evidences that the muscles in the pharynx are affected, showing fiber desproportion³⁸⁻⁴¹. Based on such information, would be interesting to search for studies that have treated patients aiming to interfere with a diseased upper airway through out any sort of physical intervention to increase muscle tonus⁴²⁻⁵³.

The aim of this systematic review is to evaluate if methods to increase muscle tonus of the upper airway is effective and safe for treatment of snoring based on accepted scientific evidence.

METHOD

Inclusion criteria

Study design: Parallel and cross-over randomized and *quasi*-randomized controlled trials; **Participants:** Patients who meet any clinical criteria for snoring; **Exclusion criteria:**

Studies predominantly recruiting subjects with obstructive sleep apnea, physical obstruction in nose or throat, abnormally large tonsils, uncorrected deviated septum, drug/alcohol abuse, smoking, depression disease, previous treatment for snoring (surgical or nonsurgical), neurologic or psychiatric disorders, pregnancy or lactation, use of drugs acting on neuromuscular system, diabetes mellitus, serious cardiac arrhythmias, wearing of a cardiac pacemaker or cardioverter or desfibrillator, trauma and cutaneous lesions were excluded; **Types of interventions:** All methods to increase muscle tonus of upper airway in the treatment of snoring were included; **Comparison groups include:** placebo, no intervention, and other alternative treatments; **Outcomes:** Primary outcomes: decrease or completely stop of snoring marked on a validated scale. Secondary outcomes: subjective sleep quality, sleep quality measured by night polysomnography, quality of life measured by subjective measures, adverse events associated with the treatments were described in terms of the numbers of patients relating any side effect associated with interventions.

The electronic search

The search strategies were ran on september 2007 using the following terms and their synonymous: snoring, snore, noisy breathing, respiratory sound, breathing sounds, rhonchi, rhonchus, stridor, crackle, wheezing. The search for trials was carried out through The Cochrane Library, Medline, Pubmed, Lilacs, Embase and Scielo. Besides the most traditional electronic databases, other sources were also considered: thesis indexed at BIREME/PAHO-WHO (Biblioteca Regional Medicina/Panamerican Health Organization of the World Health Organization); reference list of all recovered trials; additional information asked for the authors of primary studies by electronic mail. There was no restriction of neither origin nor language of publications.

Methodological quality of included studies

As to the randomization, the studies were judged according to the allocation concealment based on the following criteria:

A. Adequate: Randomization method described that would not allow investigator/participant to know or influence intervention group before eligible participant entered in the study.

B. Unclear: Randomization stated but no information on method used is available.

C. Inadequate (*quasi*-randomized controlled trials): Method of randomization used such as alternate medical record numbers or unsealed envelopes; any information in the study that indicated that investigators or participants could influence intervention group.

D. Non-randomized controlled trials.

The included studies were also judged according to the other sources of risk of systematic error (bias) as related below:

Performance bias: Were the participants and researchers blinded as to the allocation?

- Yes: low risk of systematic error
- No: high risk of systematic error
- not stated: moderate risk of systematic error.

Detection bias: Were the outcome assessors blinded as to the allocation?

- Yes: low risk of systematic error
- No: high risk of systematic error
- not stated: moderate risk of systematic error.

Attrition bias: No systematic difference between comparison groups including withdrawals.

- Yes: low risk of systematic error
- No: high risk of systematic error
- not stated: moderate risk of systematic error.

All doubts about methodological issues were discussed by electronic mail with authors of the study.

RESULTS

Only one trial was related to increase muscle tonus of upper airway in treatment of snoring (Ojay⁵⁴), and it was not included in this review for it was not randomized one (D). But the search strategy also found two ongoing randomized clinical trials (MWE Elliot⁵⁵, submitted; M Puhhan⁵⁶, submitted).

The Ojay⁵⁴ trial used a specific method to increase muscle tonus consisting of “singing exercises” to decrease snoring, under an open label design, in 20 patients. The authors had found some improvement on the mean value of recorded snoring per hour slept (pre-treatment, 6.1±1.8 minutes versus post-treatment, 5.1±2.6 minutes; mean reduction 17.6%) post-exercise (95%IC, p=0.04).

Despite the side effects were not reported, the authors mentioned three withdrawals in which the causes were not specified.

DISCUSSION

The Ojay⁵⁴ trial was the only study selected by our search strategy for this systematic review (clinical condition and intervention). However, such study was a case-series design, and showing promising results. Unfortunately, the insufficient methodological qualities of this available evidence ask for further researches.

Before any decision-making can be done in this regard, it is advisable to wait for results from two ongoing randomized controlled trials: 1) Elliot⁵⁵ is a study testing for over-tone singing as a treatment for snoring randomized fashion one, with objective measures of snoring, and 2) Puhhan⁵⁶ is

a study testing for didgeridoo playing on snoring, measured by Epworth scale, Pittsburgh Sleep Quality Index, SF-36, proxy evaluation and apnea-hypopnea-index. Because they included adequate methods to exercise muscles tonus of upper airway, under a good methodological quality, we hope they will support evidences on these methods.

The muscle is made up of both Type I and Type II fibers (Type I having endurance and Type II having speed capabilities). Snoring and OSA patients have a prevalence of Type II fiber, probably because of inflammatory trauma promoted by vibration, affecting and decreasing the myofunction of upper airway³⁸⁻⁴¹.

Improvement of muscle tonus by physical training has been shown on several studies, and they were based on exercises for endurance and strength properties. This improvement was associated with increases in the proportion of Type I fiber and in the size of Type II fiber, demonstrated by muscle biopsy samples⁴²⁻⁵³. Methods to increase muscle tonus of the stomatognathic system are based on gain of endurance and strength properties either, so we considered this option as a possibility to increase the proportion of fiber Type I, resulting in decrease of snoring and clinical symptoms.

Trials on methods to increase muscle tonus of the stomatognathic system in the treatment of snoring definitely need randomized controlled designs, and should follow internationally published guidelines for reporting trials.

In conclusion, based on our systematic review, there is no sufficient evidence about increasing muscle tonus of the stomatognathic system for treatment of patients with snoring. There are some few and poor quality trials assessing these interventions, and our recommendation for practice to clinicians can be done based on their own experience to improve oropharyngeal muscle tonus, that is not supported by scientific evidence yet.

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