Int. J. Odontostomat.,
1(2):133-139, 2007.

Functional Treatment of Snoring Using Oral Shields in Conjunction with the Tongue Repositioning Manoevre

Tratamiento Funcional para los Roncadores con Protectores Orales en Conjunción con la Maniobra de Reposicionamiento de la Lengua

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ENGELKE, W.; REPETTO, G.; MENDOZA-GAERTNER, M. & KNOESEL, M. Functional treatment of snoring using oral shields in conjunction with the tongue repositioning manoevre. ***Int. J. Odontostomat., 1(2)***:133-139, 2007.

ABSTRACT: The tongue repositioning manoeuvre has been demonstrated to lead to a closed rest position of orofacial structures with increased contact of the velum with the tongue and a contact position of the tongue at the hard palate. Within the multifactorial etiology of snoring, the tongue repositioning manoeuvre was used as training method in conjunction with pressure indicating oral shields to reduce symptoms of snoring by stabilisation of the orofacial system. Bed partner ranking of 128 snorers treated consecutively showed a score before treatment of 8.9 on a 10 cm visual analogue scale. After treatment the score decrease to 4.2 ($p<0.01$). No significant BMI , age or gender specific influence of the outcome could be observed. The data give evidence, that dynamic stabilisation of the orofacial system with oral shields in conjunction with the tongue repositioning manoevre is a valuable instrument to reduce the snoring problem.

KEY WORDS: Snoring, orofacial function, intraoral pressure, oral shield, tongue repositioning manoevre.

INTRODUCTION

Snores are common breath sounds produced during sleep. They are less commonly encountered in children with unimpeded upper airway and the clinical significance is not completely clear. Snoring may be a risk factor in the development of cardiovascular diseases and is a cardinal symptom of the obstructive sleep apnea syndrome (OSAS) (Issa & Sullivan, 1984).

The pathophysiologic mechanism of snores although not fully understood may be explained by either the obstacle theory or the Bernoulli theory (Fajdiga, 2005): According to the obstacle theory an increased negative pressure during inspiration retracts the structures of the pharynx and makes them vibrate in the air flow to produce the snore and possible obstruction in OSAS (Rappai *et al*., 2003).

The Bernoulli theory assumes that according to the principle of Bernoulli (1738), the velocity of streaming air is higher and the pressure lower at a constriction of a tube compared with the larger part. This may cause an inward suction of pharyngeal structures in a constricted area and snores by the vibration of the wall structures.

It is common knowledge that most snorers breathe through their mouths while snoring (Fajdiga). This observation seems to be most important for primary snorers and the mechanism of vibration of the soft palate within an unimpeded airflow. Generally, two different types of constrictions may be formed, during nasopharyngeal breathing and during mouth breathing. In case of mouth breathing, the constriction in the isthmus faucium represents an anatomical constriction relative to the oral cavity allowing the soft palate to be pulled against the tongue.

Snoring in the context of adenoid hyperplasia is a common phenomenon (Pirsig, 1988). It is well documented for school children, that nasal obstruction is a risk factor for heavy snoring (Urschitz *et al*., 2004). Maw *et al.* (1983) reported that snoring in 75% of 34 children with adenoid hyperplasia was observed

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preoperatively. After a 2 years control, 48% of the children did not snore any more, a further 15 % reported a reduction of snoring.

Sleep disorders also occur in adults after nasal obstruction. Although during nasal obstruction mouth breathing is observed, intrathoracic negative pressure during respiration increases with the nose obstructed and oropharyngeal conditions are provided, which provoke episodes of snoring and apnea. (Pirsig). Schäfer (1996) also confirmed that with anterior nasal occlusion the snoring loudness increases as well the frequency of noise events during sleep.

Snoring theoretically can be reduced by anterior displacement of the tongue, to compensate missing neuromuscular activity of the genioglossus muscle as the main pharyngeal opening muscle. Direct anterior displacement of the tongue leads to an amplification of the mesopharyngeal airway space, but is difficult to be performed clinically. However, the use of tongue retaining devices has been reported to reduce the time of loud snoring during sleep (Cartwright *et al.,* 2000). The main approach to the treatment of snoring in dentistry is a static mechanical one with the intention to enlarge the mesopharynx during sleep by mandibular advancement. Many authors emphazise the role of protrusive devices to compensate oropharyngeal obstruction and snoring (Schmidt-Nowara *et al.,* 1995, Pantin *et al.,* 1999).The principle of therapy with protrusive devices is that the soft tissue of the tongue follows the anterior displacement of the mandible. Dental protrusive devices are directed towards an enlargement of the pharyngeal cross-section and therefore primarily are indicated in case of snoring, which arises from pharyngeal constriction. They are also recommended in mild OSAS (Ferguson *et al.,* 1996).

Within the concept of a multifactorial aetiology of snoring, mouth closure and nasal breathing mode have been advocated to be important factors for prevention and reduction of snoring.

The use of mouth closing devices has been published in 1985 by Campion, who reported successful treatment of snoring by simply preventing snorers from mouth breathing. Campion used custom fitted vestibular mouth shields. The study was focussed on primary snorers only, subjects with obstructive sleep apnea syndrome as well as persons with obesity were not included.

Comparing various dental appliances, Marklund & Franklin (1996) found amongst 5 patients treated with mouth shields for snoring according to Campion, only 1 successful treatment result, 4 patients did not benefit from the use of the shield, in contrast 4 of 5 patients were treated successfully with activators. Veres (1993) referred to the study of Campion and conducted a study of 80 snorers using a modified vestibular shield. Veres emphasized the compliance factor of the treatment and also intended to avoid shortcomings of the approach of Campion by modification of the device. To allow transoral expiration in order to avoid nocturnal involuntary displacement, Veres used vestibular shields with 2 perforations and a palatal tag to assist the stabilisation of the device in the mouth. Additionally, Veres used thermoplastic stock shields, which could be adapted chairside to the patient´s mouth. The author reported a success rate of 66%.

In all studies no previous functional training was performed concerning nasal breathing. The use of the devices was recommended if at least one side of the nasal cavity was clear and the patient`s ability to breathe through his nose was not restricted.

After developing the tongue repositioning manoeuvre (TRM) (Engelke, 2003), vestibular shields have been modified and used as a measuring device and therapeutic biofeedback instrument. Fig. 1.

The TRM implies the generation of negative intraoral pressure during swallowing of saliva. By using a membrane funnel shield (Fig. 2), the patient is enabled to observe the formation of negative intraoral pressure during and after deglutition and thus to continuously train a tongue position at the hard palate with close tongue-velum contact, which is needed for the posterior mouth closure.

With the intraoral negative pressure as target criteria for exercises, tongue repositioning, mouth closure and breathing mode can be trained by the patient on an objective basis. Based on this clinical manoeuvre, the existing treatment of snoring with mouth closing devices was revisited and transformed in an advanced concept comprising the following components:

1) Training of nasal breathing.
2) Training of closed oral rest position and.
3) Nocturnal assistance of mouth closure.

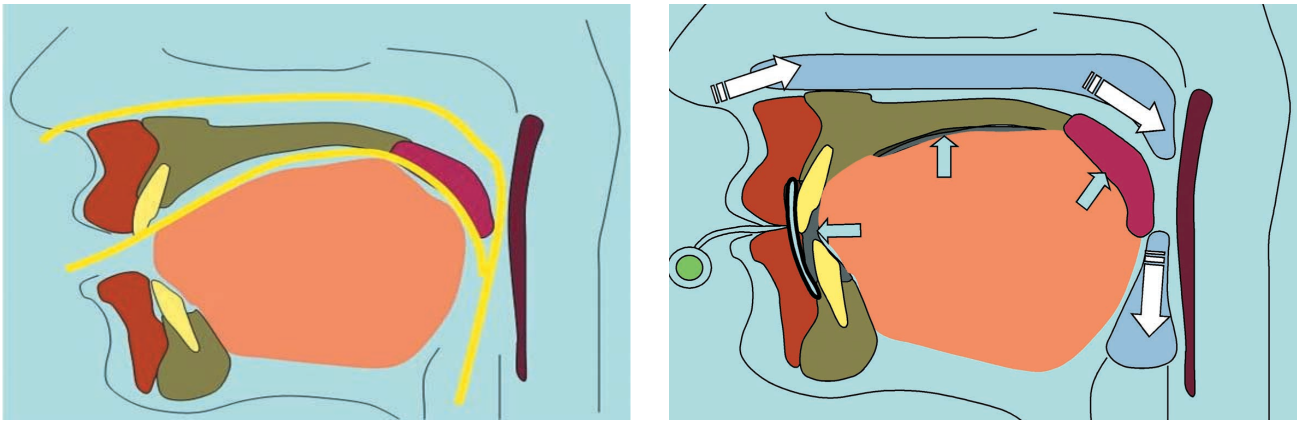

Fig. 1: Effect of the tongue repositioning manoeuvre on the oronasopharyngeal rest position. Left: Open rest position with mixed oronasal breathing mode. Right: Control of closed rest position by negative intraoral pressure during tongue repositioning manoeuvre TRM.

PATIENTS AND METHOD

A total of 128 consecutive patients of the Göttingen Rhonchopathy Clinic were assessed retrospectively. Distribution of age and BMI is shown in Table I.

All patients suffered from snoring. To be included in the treatment concept, primary snoring only was accepted. No restriction was made concerning BMI. The aim of the treatment was exclusively restricted to the reduction of snoring. Treatment of OSAS was not in the focus of the treatment concept.

System functional exercises. All patients received a training device (Membrane funnel shield MFS; Duderstädter Dental Labor, Duderstadt, Germany). The device was adapted individually by thermoplastic molding. The patients then underwent a training phase of at least 4 weeks, with 30 min duration every day. They were instructed to practise the TRM awake in the evening before rest. The tongue repositioning manoeuvre (TRM)was carried out as follows: Patients were asked to collect saliva with the MFS placed in the anterior vestibulum. Swallowing the saliva, negative pressure formation can be observed with the MFS by inversion of the membrane into the funnel (Fig. 2). After deglutition, the patient was instructed to breathe quietly and to maintain the intraoral negative pressure indicated by the inward position of the membrane for as long as possible (Fig. 3). Patients were informed that the aim of the treatment was to achieve nasal breathing pattern and a "tongue parking position" at the palate in order to stabilise the orofacial system. They were instructed not to provoke excessive negative pressure during the exercise to avoid side effects by pressure on the gingiva. In case of nasal obstruction, the patient was instructed to interrupt the training immediately and to see his/her otorhinolaryngologist for further examination. If no signs of nasal obstruction were present, the patient was allowed to use an oral shield overnight to support the mouth closure continuously after 4 weeks of initial training.

Table I. Distribution of age and BMI.

		Number	Mean	Std. Deviation	Min	Max
	Female	24	56.7	10.3	39.0	74.0
AGE	Male	104	54.0	11.9	11.0	80.0
	Total	128	54.5	11.0	11.0	80.0
	Female	24	26.9	3.7	18.9	33.3
BMI	Male	104	27.2	3.6	19.8	38.5
	Total	128	27.1	3.7	18.9	38.5

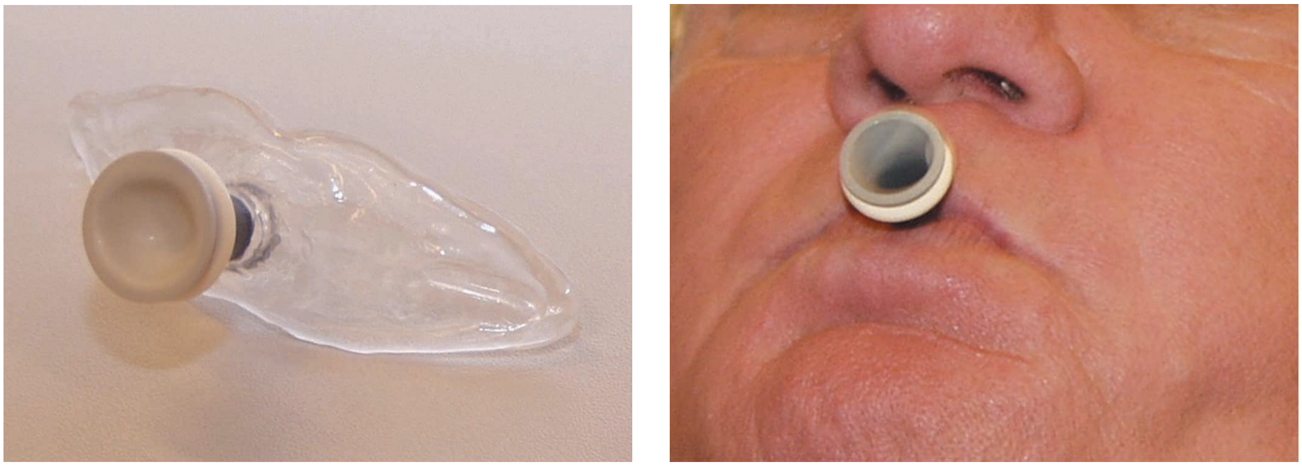

Fig. 2. Use of the membrane funnel shield: Left: Training device Right: Patient during generation of negative intraoral pressure (membrane is inverted).

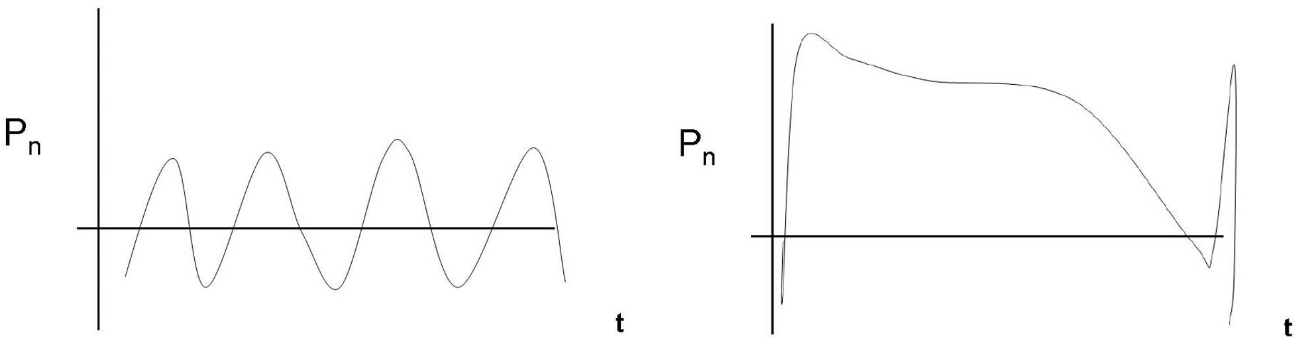

Fig. 3. Intraoral pressure diagrams: Left: Spontaneous variable pressure. Right: Constant negative pressure indicating closed rest position of the oronasopharyngeal system.

Evaluation. Snoring was assessed by using bed partner ranking on a 10 cm visual analogue scale. The patients bed partners were asked to describe snoring loudness on a 10 point scale. Evaluation was carried out before treatment and during the last follow-up. Descriptive statistic and comparison of BMI and gender dependent differences were carried out using Wilcoxon matched-pairs rank-sum test.

RESULTS

Bed partner ranking showed a score before treatment of 8.9 on the 10 cm visual analogue scale (VAS) (Fig. 4) . After treatment (at least 3 months) the score decrease to 4.2 ($p<0.01$). No significant BMI, age or gender specific influence of the outcome could be observed

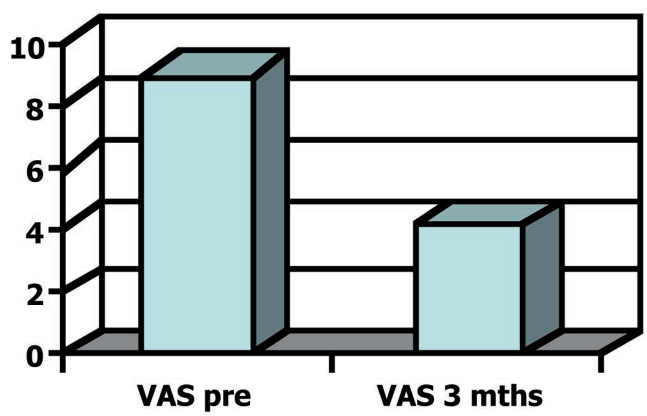

Fig. 4. Outcome of functional dynamic treatment of snoring (Bed partner ranking on a 10 cm VAS, n =128).

DISCUSSION

Treatment Concept. Sleep disordered breathing can both result from and be worsened by nasal obstruction. Nasal congestion typically results in a switch to oronasal breathing that compromises the airway (Rappai *et al.*). Therefore, re-education of nasal breathing theoretically provides an important requisite to normalise and to maintain physiologic respiratory functions. Re-educaion of nasal breathing is the first therapeutic intention of the concept presented here. In the past therapeutic recommendations in conjunction with mouth closure and nasal breathing have been unclear and could not clinically be controlled. In contrast, the generation of negative intraoral pressure is an objective criteria to judge continuous nasal breathing for re-education of habitual oronasal breathing pattern. Furthermore, it can be observed endoscopically, that vacuum controlled posterior mouth closure during nasal breathing reduces the ability of subjects to produce voluntary snoring. Missing nasal breathing mode also may be responsible for unintended loss of oral shields in the treatment of snoring which reported by Campion and Veres. The study of Marklund and Franklin does not indicate, if previous re-education of nasal breathing has been included in the treatment of snorers before using oral shields with poor success.

The training concept in this study comprises the intraoral formation of negative pressure leading to a cranial position of the tongue, as well as the intensification of the velum-tongue contact (Engelke *et al.* 2006). It should be stressed, that the phenomenon of negative intraoral pressure during placement of oral shields is not new. Strong negative pressure experimentally has been observed by Fränkel (1969), moderate negative pressures also were measured in 1969 by Witt & Kühr when using oral shields in volunteers. Negative pressure is present in newborns (Lindner & Hellsing, 1991) during dummy sucking. However, therapeutic consequences for the treatment of snoring using the oral vaccum mechanism according to our knowledge have not been recommended in the literature so far. As a result of the evacuation of the oral cavity during swallowing, the orofacial system shows stable conditions comparable with a closed hydraulic chamber. It has not been evaluated clearly, up to what degree the temporarily achieved stable status of the orofacial system is maintained overnight, although there is evidence, that daytime training generally influences orofacial functions and symptoms over night. Although details of the system mechanics have not yet been clarified, our clinical results show, that a significant improvement can be acheived.

Our therapeutic recommendations to reduce snoring can be summarised as follows:
1) Teach the patient the mechanism of autostabilisation of the system (using for example the membran funnel shield or any other pressure indicating device).
2) Teach the maintenance of the stabilised status of the orofacial system.
3) Provide appliances to support the lip closure during sleep.

Failures of oral shield treatment may be due to different types of snoring (Fajdiga) and orofacial dysfunctions interfering with the ability of adequate mouth closure and continuous nasal breathing. Conventional shields provide no control on the breathing mode during awake training or during sleep. Anatomical aspects also may play an important role for non responders of the treatment concept presented here. Anatomical obstruction of the collapsible segment of the oropharynx has to be excluded radiograpically and / or endoscopically if re-education of nasal breathing is not successful. The early training therefore has two objectives:
1) Functional training of post-deglutition oral behaviour and 2) Pure nasal breathing.

System functional training may be compared with daytime training of orofacial muscles with the intention to influence the disturbance which occurs overnight (Randerath *et al*., 2002, Wiltfang *et al*., 1999) although no neuromuscular training but rather a change of behaviour is in the focus of the treatment. Nasal breathing as a very important preventive therapeutic goal (Rappai *et al.*) is not trained directly, but results as a product of the stable condition of the oronasopharyngeal system. It is important to prove proper nasal breathing before recommend the patient an overnight wearing of any mouth closure supporting device.

During rest, patients are recommended to maintain comfortable levels of negative intraoral pressure during the exercises. They are instructed that physical factors rather than pure neuromuscular activity are responsible for maintenance of the negative pressure and that voluntary continuous muscle tension is not necessary for maintenance of the system closure as pointed out by Eckert - Möbius, more than 50 years ago. With regard to the concept presented here, previous studies (Witt & Kühr; Lindner & Hellsing) support our hypothesis, that a spontaneous formation of negative intraoral pressure seems to be common during sleep. A similar stabilisation of tongue and velum position might be responsible to prevent obstruction of the narrow airway of infants, as the continuous negative pressure during dummy sucking gives evidence (Lindner, 1991). Nevertheless nocturnal intraoral pressure monitoring in conjunction with polysomnography is necessary before any statement for the potential use of the concept for patients with obstructive sleep apnea can be made.

Results of treatment. Generally, the functional treatment presented here has been proven to reduce symptoms of snoring in a wide majority of persons who underwent the training. It was not the aim of the study, to influence the frequency of obstructive events by the treatment. Therefore, the Epworth Sleepiness Scale has not been used. The working hypothesis of our concept influences mainly primary snorers without obstruction.

Our study lies within the same range of general success as reported with oral shields in the studies of Campion and Veres. Comparative studies are necessary in the future to clarify details of the therapeutic mechanisms. From our point of view, mouth shields alone do not provide direct control on the posterior mouth closure and therefore may be disadvantageous as outlined by Marklund & Franklin.

CONCLUSION

The present data give evidence, that the principle of functional dynamic stabilisation of the orofacial system with oral shield in conjunction with the tongue repositioning manoevre is a valuable instrument to reduce the snoring problem.

ENGELKE, W.; REPETTO, G.; MENDOZA-GAERTNER, M. & KNOESEL, M. Tratamiento funcional para los roncadores con protecores orales en conjunción con la maniobra de reposicionamiento de la lengua. ***Int. J. Odontostomat., 1(2)***:133-139, 2007.

RESUMEN: La maniobra de reposicionamiento lingual ha demostrado tener ventaja para mantener cerrada el resto de estructuras orofaciales, con un aumento del contacto del paladar blando con la lengua y también en posición de contacto el paladar duro con la lengua. Dentro de la etiología multifactorial del ronquido, la maniobra de reposicionamiento lingual ha sido usada como método de entrenamiento, en conjunto con protectores orales que indican la presión para reducir los síntomas del ronquido y estabilizar el sistema orofacial. Un total de 128 pacientes roncadores tratados consecutivamente mostraron una puntución antes del tratamiento de 8,9 a 10 cm en una escala visual análoga. Después del tratamiento, el puntaje disminuyó a 4,2 cm (p< 0,01). El índice de masa corporal no fue significativo, y no pudo ser observado si la edad o el género tenían influencia. Los datos evidenciaron que la estabilización dinámica del sistema orofacial, en conjunto con la maniobra de reposicionamiento lingual resulta ser una valiosa herramienta para reducir el problema del ronquido.

PALABRASCLAVE: Ronquido, función orofacial, presión intraoral, protector oral, maniobra de reposición lingual.

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Received: 22-09-2007
Accepted: 16-11-2007