ORIGINAL ARTICLE

Positioner—a method for preventing sleep apnea

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Abstract

Conclusions. A ‘Positioner’ preventing sleeping on the back can effectively reduce obstructive sleep apnea (OSA), but not always snoring for patients with long-term OSA. By preference, the device should be used for younger snorers without OSA as a training tool to avoid sleeping on the back. Instructions and support by a nurse are necessary for compliance. Objectives. Snoring is a progressive condition with a prevalence of 25–30% among the adult male population. Long-term snoring seems to be the basis for apneas caused by vibration damage to the pharyngeal tissue. Patients with OSA often have more apneas in the supine position than in the lateral position. Preventing sleeping on the back is a way to treat OSA. The aim of this study was to evaluate the efficacy and comfort of a recently developed Positioner. Subjects and methods. A total of 23 patients diagnosed with positional sleep apnea (AHI ≥ 15 in supine position and AHI < 5 in lateral position), were included. The Positioner—a soft vest, attached to a board placed under the pillow, makes it impossible for the patient to sleep on his back. It was fitted and tried out individually. Patients answered sleep questionnaires and kept sleep diaries before beginning use. After 3 months, a new sleep study was done while using the Positioner and new questionnaires were filled out. Results. Eighteen patients (5 women and 13 men) completed the study. The rest could not tolerate being strapped into the Positioner. Of those participating, 61% demonstrated a decrease of AHI to ≤10 using the Positioner. The Epworth Sleepiness Scale (ESS) decreased from a mean of 12.3 to 10.2. Half of the patients snored more frequently with the Positioner. The evaluation of comfort showed that minor adjustments are desirable.

Keywords: OSA, snoring, Positioner, prevention

Introduction

Snoring is a progressive condition with a high risk that it will ultimately result in sleep apnea syndrome (OSAS). Many patients with OSAS relate that ‘first I was snoring only on my back, but now I snore in all positions and my partner tells me that I stop breathing’. Vibration damage to the pharyngeal tissue seems to be the basis of the apneas [1,2]. By adopting a supine position, changes to the anatomy occur in the upper airways (the tongue falls back, the nasal mucosa swells), which cause an increase of the breathing resistance in the upper airway system and result in snoring. To prevent such a deleterious development, it seems logical to prevent the snorer from sleeping on their back. Many home remedies and commercial devices have been developed that claim to maintain a lateral position during sleep, but their effectiveness is not documented. One problem is that the snoring sound, although disturbing, is difficult to define, both with respect to how often it occurs and its loudness.

It would be beneficial to find a simple and safe noninvasive treatment alternative with high efficacy for patients with positional snoring/sleep apnea. In the present study, a recently developed ‘Positioner’ was tested for efficacy and comfort. The purpose was to investigate whether patients with position-dependent OSA could significantly reduce their apnea-hypopnea index (AHI) and whether this reduction of AHI also was mirrored in reduced general symptoms, e.g. less daytime sleepiness. A second purpose was to evaluate the patients’ and their bed partners’ opinion about the comfort and quality of the equipment.
Subjects and methods

Subjects

Patients were invited to participate who were over 27 years of age, were having snoring problems mainly when sleeping on their backs, and in whom an overnight sleep study diagnosed a positional sleep apnea (PSA) of >15 apneas of \( \geq 10 \) s per hour’s sleep in the supine position and <5 apneas per hour’s sleep in the lateral position. Invited patients had to be otherwise healthy with no serious medical conditions such as heart failure or uncontrolled high blood pressure, no drug problems, and no other conditions preventing sleep in a lateral position (back/shoulder problems).

In all, 23 patients fulfilling the stipulated criteria were included – 7 women (mean age 60.4 years) and 16 men (mean age 49.8 years). Of these 23 patients, 16 had a first sleep study recorded with an Embletta Recording System (Sonomologica software, ResMed Sweden AB, Trollhättan, Sweden) and 7 with Breas SC20 (Breas analysis software, Breas Medical AB, Mölndal, Sweden). All the sleep studies were performed in the patients’ homes. The Ethical Committee at Linköping University approved the study and informed consent was obtained from the patients.

Methods

After a clinical examination/consultation by an otorhinolaryngologist, the patients were instructed by the study coordinator (a registered nurse) in using the Positioner and filling in diaries and questionnaires. A sleep questionnaire was used that was already customary at the clinic. It consisted of 16 questions about the patients’ situation regarding sleep and snoring. The Epworth Sleeping Scale (ESS) was included in the questionnaire. The body mass index (BMI) was calculated.

The equipment to be tested was tried out individually so that the patient could learn how to lie down and gain experience using the equipment, preventing a supine position (Positioner, see Figure 1).

For 1 week before beginning use of the Positioner, the participants filled in a sleep diary at home. During the same week, the patient’s bed partner also filled in a diary. The diary included questions about sleep, awakenings, dryness of mouth, and stuffiness of nose as signs of snoring for the participant and for the partner, and the reasons for being awakened. After collecting these baseline data, the participant used the Positioner for 3 months. During the last week, the participant and the partner filled out a second diary, now with the Positioner in use. The satisfaction with the present snoring situation when using the Positioner was evaluated on a visual analog scale (VAS). An evaluation of the comfort and usability of the equipment, suggestions for improvements of the equipment and of the design of the manual were obtained at the same time and were sent together with the questionnaires and diaries to the project coordinator, who scheduled the patient for a second sleep study – this time using the Positioner.

This second, 1-night sleep study took place in the participant’s home. Breas SC20 (except for one patient who was recorded with Embletta) was used after detailed instructions were given. Data collected were: breathing effort by chest movements (electrical impedance), body position, oxygen saturation and heart rate by pulse oximetry (finger probe), airflow and snoring by a pressure-sensitive nasal cannula. Data were continuously recorded to a memory card mounted in the device. The equipment was returned to the clinic and the data were analyzed. The patients estimated the time they had slept and noted awakenings they remembered during the night. The periods where the patient appeared to be awake were excluded before analyses of AHI/ODI. Oxygen desaturation index (ODI) was defined as the number of desaturations ≥3% from baseline of 10 s or longer.

Equipment preventing the supine position

The equipment preventing the supine position used in this study, called the Positioner, is not yet available on the market. It was supplied for the study to allow testing for utility. The Positioner consists of three parts: a soft vest made of cotton tricot with a zip in front having woven straps that attach to a board using Velcro® fasteners, and a pillow to be placed on top of the board. The straps are attached to the board in such a way that makes it possible for the user to lie down comfortably in a lateral position, maximally 90°. When correctly adjusted, the straps make it impossible to roll over to the supine position, but allow the user to turn over to either side (see Figure 1). The vest is available in several sizes and can be used with or without a pyjama jacket/T-shirt underneath. In order to obtain a perfect fit, each vest was tried out individually. The pillow is only available in one model, i.e. there was no possibility to choose height or firmness, but the patients were told that they could place their favorite pillow on top of the other if necessary. A brochure, ‘Instructions for Use’, was enclosed with the equipment.

Statistical methods

Observations on AHI before and after the treatment were available for each patient in the study. The
The difference between observations before and after the treatment was determined for each patient. The hypothesis of a successful treatment was tested using the one sample Wilcoxon signed rank test.

ESS was evaluated in the same manner. A $p$ value of $<0.05$ was considered to be statistically significant. Differences in AHI and ESS between women and men were tested with the two-sample Wilcoxon rank sum test. All computations were performed with SAS program, version 9.1.

**Results**

In all, 18/23 patients (5 women, 13 men) completed the study. The mean age for women was 60.4 years and 49.8 years for men. The reason given for
dropping out (two women, three men) was in all cases lack of acceptance of the Positioner due to the feeling of being caught, and always occurred within the first 3 weeks. These patients were offered other treatment, i.e. continuous positive airway pressure (CPAP) or a mandibular advancing device (MAD).

After 3 months of treatment, a second sleep study was performed with the Positioner in use. This sleep study was carried out at a mean of 6.9 ± 3.2 months after the first one. The results demonstrated a decrease of AHI for 13/18 patients. Eleven of these responders (61%) had an AHI <10 and could therefore be classified as ‘cured’ (see Figure 2).

The AHI data for total sleep time and in supine position before treatment and with the Positioner in use are shown in Table I as well as the ESS data. The mean AHI before treatment was 21.8 and during treatment it was 14.3. The decrease of AHI was significant (p=0.02). The difference in AHI between women and men was not significant. The daytime sleepiness measured with ESS decreased significantly during treatment from a mean of 11.8 to 10.2 (p=0.02). The difference in ESS between women and men was not significant. Of the 13 patients who had a reduction of their AHI, 7 also reported less daytime sleepiness. Four patients did not experience any difference in sleepiness and two reported a slight worsening. Of the four patients who had an increase of AHI when using the Positioner, three experienced less sleepiness and one experienced more. One patient did not answer the ESS during treatment. The duration of snoring could be estimated visually from the respiration recordings (Figure 3). Six of the patients snored less frequently with the Positioner, for two there was no difference and nine patients (50%) seemed to snore more while using the Positioner. One patient failed to put on the pressure-sensitive nasal cannula correctly. Results of snoring data are shown in Table II and Figure 3.

Comments were obtained from bed partners about snoring and breathing sounds, e.g. ‘I have noticed less apneas, but the snoring is louder due to easier breathing’.

Patients’ satisfaction with their present situation concerning snoring while using the Positioner is shown in Figure 4. A 10-point VAS was used, where 0 = ‘not at all satisfied’ and 10 = ‘absolutely satisfied’. Eleven patients responded with a score <5 and seven responded ≥5.

The patients were questioned about how they experienced the effect of the Positioner on their symptoms. A VAS was used, where 0 = ‘I have become worse’ and 10 = ‘I am cured’. One patient had a score <5, 13 patients = 5 and 4 did not answer the question.

With regard to the comfort of the equipment, the patients evaluated the pillow, the vest, and the brochure. Ten patients considered the height of the pillow to be appropriate and three thought it was too low. Seven patients used an extra pillow on top of the basic pillow. Five patients considered the pillow to be too high. The majority of the patients thought that the size of the vest was correct; four patients reported it to be tight, and one patient found it too large. Half of the patients were pleased with the comfort of the vest, and almost everyone thought it was easy to dress/undress. Overall, the written directions for using the Positioner were considered sufficient, but two-thirds of the patients said that they also needed the instructions given by the nurse and practical experience in trying on the equipment. Nine of the 18 patients could recommend treatment with the Positioner to other snoring acquaintances while 2 patients were uncertain. Most of the complaints against the equipment concerned the straps from the vest to the board. These felt hard and scraped one patient’s hands. One patient said: ‘The straps can come loose and lead to the possibility of lying in supine position’. Others thought that it was difficult to turn from one side to another because they had to turn to their face before turning to the opposite side. One patient felt that his arms were stuck.

Results from the diaries (18 participants, 14 partners) show that the participants themselves mostly are unaware of their snoring; 62% did not know if they had snored whether with or without the Positioner. Four participants had no bed partner and none of them was aware of snoring. Before using the Positioner, the participants woke up on average 6 nights per week, a mean number of 17 times/week. With the Positioner they woke 6 nights per week, a mean number of 16 times/week. In both diaries, the reason for waking up was primarily to visit the toilet and secondarily, when using the Positioner, due to discomfort and trouble with the equipment.
The bed partners woke up because of snoring by partners, on average every second night, with no change when the Positioner was used.

**Discussion**

The results from the present study demonstrate that patients with OSA who have more apnea events when they are sleeping in the supine position than in the lateral position improve their condition if they are prevented from sleeping on their back. This is in accordance with earlier investigations [3–8]. Cartwright defined positional patients as those who have supine respiratory events, resulting in an AHI that is twice as high during sleep in a supine position as compared with that in a lateral position [3]. The prevalence of positional patients varies in different reports, probably due to the small groups being investigated and to different types of OSA patients being studied. In a retrospective analysis of OSA patients, Oksenberg et al. found 55.9% to be positional [8].

![Figure 3. Snoring before treatment and with the Positioner in use (18 patients).](image-url)
To reduce the obstruction of the pharyngeal airway during sleep, the patient should sleep in a lateral position; this is supported by several studies [9]. In the present investigation the majority of the patients gained a reduction of the AHI when prevented from sleeping on their back. To substantiate this effect, we had to conduct our trial with a group of patients where it was possible to obtain hard data (i.e. AHI). This group had already been selected from a larger group of persons with positional sleep apnea. The selection was made after the patient had tried on the vest and had had the Positioner described in detail. Many persons could not even think of wearing a restraining device and others had physical complaints preventing them from sleeping in any other position than on their back. CPAP or MAD was prescribed in those situations.

The result shows that almost two-thirds (61%) of this selection of patients actually were ‘cured’ by using the Positioner, not only with respect to AHI, but also with respect to less daytime sleepiness. However, five patients (28%) had a higher AHI when using the Positioner. This could in part be due to the fact that different recording equipment was used for the baseline sleep study and for the control sleep study. It is always difficult to determine whether a single baseline night is representative – the patient might normally have had more apneas in the lateral position and therefore should not even have been included. The OSAS might also have increased due to the time that had passed prior to treatment.

In a retrospective study, Oksenberg et al. found that overweight patients with severe OSA are less likely to be positional. Their condition is so severe that they have breathing abnormalities in all body postures. It appears that patients with mild to moderate OSA who are mainly positional convert into nonpositional when they gain weight. This is perhaps a characteristic of the natural development of the OSA and also of snoring [8].

The majority of the patients in the present study experienced improvement in their general situation while using the Positioner related to their decreased AHI. We did not get the same positive results with regard to snoring in that half of the patients seemed to snore more frequently while using the Positioner than without, as measured with the recording device,
Breas SC20. However, this device is not optimal for this kind of recording. Snoring was estimated visually from the recording graphs. The question in the diary about snoring showed that most patients were unaware of their own snoring. Our findings are in accordance with those of Maurer et al., who tested treatment of OSA with another vest preventing supine position. An increase of snoring was observed in 30% of those patients [12].

The results with respect to snoring are interesting with regard to plans for the future field of application for the Positioner. The Positioner is probably not optimal for patients with a positional sleep apnea syndrome when the habit of sleeping on the back is too well established and even might have been the cause of the OSAS already developed. Nakano et al. found that the positional dependency is different between snorers without apneas and patients with OSA. Most of the snorers without apneas snore less in the lateral position than in the supine position, in contrast to patients with OSA, who often fail to decrease snoring (but do decrease apneas!) even in the lateral position [13,14].

In the present study, the comfort of wearing the Positioner was not rated very high by some patients, who woke up every time they tried to turn onto their back. However, the results from the diaries show that the number of awakenings among the participants decreased somewhat with the Positioner in use compared with the week before use. Making the equipment more comfortable in accordance with participant comments from the present study would probably only partially improve the situation with respect to snoring, but might help to increase compliance.

On the other hand, if instead of treating older OSAS patients, we focus on a younger/earlier patient material with people who not yet have developed inveterate snoring habits and who snore mainly when sleeping on their back, a Positioner could be a less disturbing snore prevention method than the kick or push they currently often get from their bed partners. The use of a Positioner might even prevent these people from further development towards a sleep apnea syndrome.

If the Positioner were marketed as a ‘sleep apnea preventing device’ nurses and doctors involved in the primary care of snorers could recommend it as a first choice of treatment, where the risk seems to be low that the patient has already developed OSAS. Since the prevalence of habitual snoring is high (about 25–30% of the adult male population [15] and about half that for females [16]), this attempt to reduce a social annoyance might be beneficial both to prevent a future development of OSAS and for marital health.

It is important to note that the patients need support when beginning treatment with the Positioner: quite a number of the participants in the present study regarded the instructions given by the nurse as necessary. It is of great importance for the patient, and perhaps also for the bed partner, to obtain information not only about snoring, apneas and the consequences, but also about the connection to body position. This can very well be a task for specially trained nurses in primary care who are well suited for giving patients the information and support they need, as a nurse’s professional duty is to prevent sickness and work for maintenance of health.

Cartwright et al. were of the opinion that it is possible for some patients to learn how to avoid the supine sleep posture. Using a Positioner for some period could therefore be a method of such training. Some patients may need it periodically for reinforcement of the training. A third of positional trained patients learned to avoid the supine position after 8 weeks of training [9].

Other fields of application for the Positioner might be those who are not able to use CPAP or MAD and those waiting for a surgical procedure could also be recommended the treatment. To some extent, avoiding the supine posture during sleep may always be beneficial [14]. Jokic et al., who compared the efficacy of CPAP treatment versus positional treatment, support the idea of treating patients who are intolerant to CPAP with positional treatment [11].

Conclusion
A Positioner that prevents a person from sleeping on their back can effectively reduce OSA – but not always snoring – for long-term OSAS patients. Preferably, the device should be used for younger individuals without OSAS as a training tool to avoid sleeping on their back/snoring and development of OSA. Instructions and support by a nurse are likely to be of substantial value in increasing compliance.

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References


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