

# Effects of the nasal strip and dilator on nasal breathing – a study with healthy subjects\*

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## SUMMARY

**Objective:** To investigate effects of the nose dilating devices on nasal anatomy and breathing in healthy subjects.

**Materials and methods:** 27 healthy subjects were tested when using the Breathe Right® nasal strip or the Nozovent® dilator. Posterior rhinomanometry, acoustic rhinometry, and a subjective evaluation were used as methods.

**Results:** Both devices significantly increased the minimum cross-sectional area of the nasal valve and decreased nasal resistance. The Nozovent® dilator proved to be significantly more effective in reducing nasal resistance than the Breathe Right® nasal strip.

**Conclusions:** Nose dilating devices, the Breathe Right® nasal strip and the Nozovent® dilator, can be used to reduce nasal resistance. More studies are needed to evaluate the usefulness of the devices for patients with chronic obstruction for any reason in the valve area.

**Key words:** nasal breathing, nasal valve, nasal dilation, rhinomanometry, acoustic rhinometry.

## INTRODUCTION

The narrowest area in the upper airways is located in the front part of the nasal cavity approximately within 1.2–2.8 cm distance from the nostril (Jones et al., 1988; Grymer et al., 1991; Roithmann et al., 1995 and 1997). This area, called the nasal valve, is an oblique structure, bounded laterally by the caudal end of the upper lateral cartilage, medially by the septum, and ventrally by the inferior rim of the piriform aperture (Tarabichi and Fanous, 1993). Most of the nasal resistance is formed in the valve area (Bridger and Proctor, 1970; Haight and Cole, 1983). During quiet breathing, a normal vestibule withstands the range of negative intranasal pressure, but in deeper inspiration, with increased negative pressure, the upper lateral cartilages move towards the septum and the aperture of the nasal valve is reduced to a small orifice conforming to Bernoulli's effect. This can be observed in most people in deep inspiration through one nostril only (Bridger, 1970; Bridger and Proctor, 1970).

Nasal valve insufficiency is a troublesome clinical entity, which can be caused by rhinitis (the most common reason for obstructive nose) or pathological anatomy of the nose, resulting from congenital and iatrogenic causes, trauma, and aging. There is also a form of inspiratory nasal obstruction called alar collapse, in which the cartilaginous vault of the vestibule has a diminished tendency to stay rigid, and collapse occurs at even

small negative intranasal pressures (Bridger, 1970; Santiago-Diez de Bonilla et al., 1986). Treatment choices for nasal valve insufficiency are medication, surgery, and different kinds of devices for dilating the nasal vestibule.

The Breathe Right nasal strip has been designed to mechanically pull the lateral walls of the nasal vestibule laterally in order to dilate the valve area of the nasal cavity and to make the vestibular wall stable and resistant to collapse. The strip is placed superiorly to the alar cartilages on either side in order to allow the built-in elastic splints to pull the wall of the vestibule laterally and to dilate the valve area (Figure 1). Using the strip is easy, which increases compliance for the treatment. In many studies, the strip has been shown to increase the minimum cross sectional area of the valve area and to decrease the nasal airflow resistance (Gosepath et al., 1997; Griffin et al., 1997; Portugal et al., 1997; Roithmann et al., 1997; Peltonen et al., 2003). The strip is commonly used by athletes and, furthermore, people who snore because of nasal stuffiness. The physiological effects of the nasal strip during physical exercise, especially the effect on capacity, have been discussed with some controversy, and athletes have used it in order to achieve better capacity, but the real benefit for them is questionable (Griffin et al., 1997; Portugal et al., 1997; Gehring et al., 2000; O'Kroy, 2000; O'Kroy et al., 2001). However, in most studies the severity and frequency of snoring have been reduced when



Figure 1. The Breathe Right® nasal strip is placed on the front part of the nose. It pulls the lateral walls of the vestibule laterally and dilates the valve area.



Figure 2. The plastic dilator Nozovent® in position. The dilator tends to straighten up and simultaneously moves the lateral walls of the vestibule laterally, dilating the valve area.

the nasal strip has been used (Scharf et al., 1994 and 1996a; Ulfberg and Fenton, 1997; Todorova et al., 1998; Gosepath et al., 1999; Pevernagie et al., 2000). In newborns, the nasal strip has reduced the frequency of obstructive respiratory events (Scharf et al., 1996b). It has also been useful in managing pregnancy- or rhinitis-related nocturnal nasal congestion (Turnbull et al., 1996; Pevernagie et al., 2000).

The Nozovent dilator is made of plastic and it consists of two

end tabs with a connecting bar. When positioned in the nose, it moves the lateral walls of the nasal vestibule laterally (Figure 2). It has been designed to improve nasal breathing in patients with or without collapsing ala nasi during the sleep. When the nasal dilator has been used, the nasal airflow has increased as assessed by rhinomanometry in many studies (Petruson, 1988; Höijer et al., 1992). The use of the dilator reduces snoring and patients themselves have noted significantly less dryness of the mouth (Petruson, 1989 and 1990; Petruson and Theman, 1996). The apnoea index with the nasal dilator in the nose decreased 47% in a group of patients with habitual snoring and/or obstructive sleep apnoea, and the overnight minimum arterial oxygen saturation increased from 78% to 84% with the patients in the same study (Höijer et al., 1992). It has been shown that sleeping with the nasal dilator reduces nocturnal asthma, most evidently resulting from lesser mouth-breathing (Petruson and Theman, 1996). The Nozovent® is easy to use and no serious side effects have been noted, but some patients do not get used to the pressure of the dilator against the nasal skin or find the use of the dilator otherwise uncomfortable (Petruson, 1989).

In this study, we have investigated the effects of the Breathe Right® nasal strip and the Nozovent® dilator on nasal breathing and anatomy in healthy subjects by rhinomanometry, acoustic rhinometry and subjective evaluation.

#### MATERIALS AND METHODS

The series comprised of 27 volunteers (15 men, 12 women) without history of any nasal operations. The mean age was 27 years (range 18-50 years). The subjects were healthy except for one, who had allergic rhinitis. In the anterior rhinoscopy, a minor septal deviation was seen in three subjects and a moderate septal deviation in one subject. No one had nasal disorders at the time of the experiment. In order to standardize the conditions, the nasal mucosa of each subject was decongested by 0.5% xylometazoline hydrochloride nasal spray in each nasal cavity 15 minutes before all measurements.

NR6-2 computerized rhinomanometer (G.M. Instruments Ltd., Glasgow, UK) was used to measure the nasal resistance of the subjects. The nasal resistance measurements were recorded by active posterior rhinomanometry. The method of Broms 200 units circle was used (Broms et al., 1982a and 1982b). Before statistical analysis, the values of nasal resistance were logarithmically transformed, in order to achieve a fairly normal distribution (Pallanch et al., 1985). The volumes and the minimum cross-sectional areas were measured from each nasal cavity within the distance of 3 cm from the nostrils with an A1/2 acoustic rhinometer (G.M. Instruments Ltd., Glasgow, UK) (Grymer et al., 1991; Roithmann et al., 1995 and 1997). The sums of unilateral volumes and the minimum cross-sectional areas were used as variables.

After decongestion of the nasal mucosa, the measurements were recorded first without any device in the nose, then with the Breathe Right® nasal strip or the Nozovent® dilator, and

finally with the device that was not used in the second measurements. Every time after a measurement with a device (Breathe Right® or Nozovent®), the subjects evaluated the effect of the device on nasal breathing on a visual analogue scale (VAS) (0: no effect, 5: nasal breathing became very much easier). In order to avoid bias in the results, the subjects were randomized to two groups, so that half of the subjects got first the Nozovent® and then the Breathe Right® in the nose, and vice versa. The subjects were not told any details about the devices before the experiment, and they had not used the devices before.

## RESULTS

The subjects evaluated that the Nozovent® improved nasal breathing a bit more than the Breathe Right®. In the visual analogue scale the average improvement value was 2.25 (SD 0.95) for the Breathe Right® and 2.86 (SD 1.03) for the Nozovent®. The difference between the average values was 0.61 (95% confidence interval (CI) 0.09–1.14,  $p = 0.025$ ,  $t = 2.39$ ). Two subjects felt that the Breathe Right® had no effect on nasal breathing. All subjects reported at least a little improving effect when using Nozovent®.

Posterior rhinomanometry did not succeed in two persons, so 25 of the 27 subjects were included in this experiment. The geometrical average value (GAV) of the nasal resistance without any device in the nose was 0.0941 Pa/(cm<sup>3</sup>/s) (95% CI 0.081–0.109). Both devices diminished nasal resistance. The GAV of the nasal resistance using the Breathe Right® was 0.0735 Pa/(cm<sup>3</sup>/s) (95% CI 0.0604–0.0894) and 0.0655 Pa/(cm<sup>3</sup>/s) using the Nozovent® (95% CI 0.0557–0.770) (Figure 3). The ratio of geometrical average values was 1.12 (95% CI 1.01–1.25,  $p = 0.037$ ,  $t = 2.21$ ).

The average minimum cross-sectional area summarized from both nasal cavities was 1.40 cm<sup>2</sup> (SD 0.24), and the corresponding value for the average volume was 5.52 cm<sup>3</sup> (SD 0.66) without any device in the nose. Both devices dilated the anterior

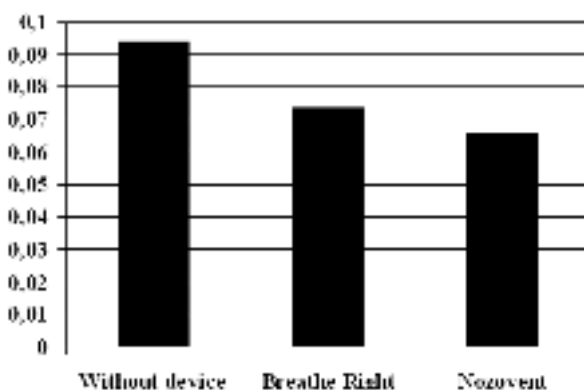


Figure 3. The bars represent the geometrical average values of the nasal resistance Pa/(cm<sup>3</sup>/s) without a device, with the Breathe Right®, and with the Nozovent® in the decongested nose.

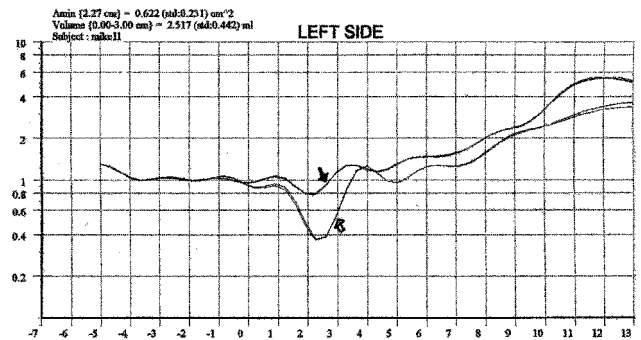


Figure 4. Two curves of the same subject recorded by acoustic rhinometer. The X-axis represents the distance from the nostril and the Y-axis the cross-sectional area of the nasal cavity. The white arrow indicates the curve recorded without device and the black arrow indicates the curve recorded with the Breathe Right® in the nose. The difference between the curves is greatest at approximately 2.6 cm from the nostril (in the valve area).

or part of nasal cavity. The dilative effect of the Breathe Right® is demonstrated in Figure 4. The average values for the Breathe Right® were 1.73 cm<sup>2</sup> (SD 0.19) and 6.57 cm<sup>3</sup> (SD 0.66). For the Nozovent® the values were correspondingly 1.51 cm<sup>2</sup> (SD 0.23) and 6.69 cm<sup>3</sup> (SD 0.72). The differences between the average values in dilated nose were 0.22 cm<sup>2</sup> for minimum cross-sectional area (95% CI 0.14–0.30,  $p < 0.0001$ ,  $t = 5.45$ ) and 0.12 cm<sup>3</sup> for volume (95% CI 0.15–0.40,  $p = 0.36$ ,  $t = 0.93$ ).

## DISCUSSION

The aim of this study was to investigate the dilative effect of the Breathe Right® and the Nozovent® on nasal vestibule and their effect on nasal resistance, and to compare the efficacies of the devices. In order to minimize the reactions of nasal mucosa (i.e. nasal cycle), all the measurements were done after induced decongestion of the mucosa.

Both devices significantly increased the minimum cross-sectional area of the nasal valve and decreased nasal resistance. The subjects almost without exceptions reported that both devices improved nasal breathing at least to some degree. Both objective measurements and subjective evaluations show that the Nozovent® improves nasal breathing more than the Breathe Right®.

In our study, the subjects did not suffer from nasal breathing problems. In spite of this, the devices improved nasal airflow significantly in decongested nose, in which the nasal resistance is already diminished due to decongestion. It is possible that the devices could improve nasal breathing more in persons with obstructed nasal valve region than in healthy subjects. In fact, there are some reports according to which the benefit of the devices could be greater for those who suffer from obstruction in the valve area than for people with a healthy nose because of this additive effect on dilation after decongestion

(Lorino et al., 1999; Kirkness et al., 2000). The devices may be useful for patients with nasal valve insufficiency caused by rhinitis, earlier rhinoplasty, remarkable septal deformity, or hypertrophy of the inferior conchae.

To our knowledge, side-effects in long-term use have not been studied or reported. The glue of the Breathe Right® can irritate skin, and the Nozovent® can cause pressure and irritate skin of the vestibule in some patients. There is some experience on negative compliance with the use of the Nozovent® because of the skin-pressing side-effect and because the Nozovent® falls out in some patients during sleep (Peterson, 1989). In our study, some patients complained of pressure with the use of the Nozovent®, although the dilative effect was felt, on the average, better than with the Breathe Right®. It is possible that these persons would have got used to the pressure by the time.

The Breathe Right® nasal strip can be used at all hours, because it is cosmetically better accepted, but still the strip is used mostly during the night, as is the dilator.

In conclusion, the Breathe Right® nasal strip and the Nozovent® dilator decrease nasal resistance and improve nasal breathing in healthy subjects. However, we cannot directly estimate how much they would improve nasal breathing in patients with a pathologically obstructed nose. More studies are needed to find out the benefits of the dilators in long-term use in patients with obstruction in the valve area.

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