

## Internal nasal dimensions of adults with nasal obstruction

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### Abstract

Nasal septum deviation (SD) and turbinate hypertrophy (TH) increase the resistance to respiratory airflow and may impair nasal patency.

**Objective:** To characterize the nasal geometry of individuals with nasal obstruction secondary to SD and/or TH by means of acoustic rhinometry.

**Method:** This prospective study included 30 adults with complaints of nasal obstruction (NO) and SD + TH (n = 24), SD (n = 5) or TH (n = 1) seen by clinical examination. The cross-sectional areas of the three main dips of the rhinogram (CSA<sub>1</sub>, CSA<sub>2</sub>, CSA<sub>3</sub>), the distance between them and the nostrils (dCSA<sub>1</sub>, dCSA<sub>2</sub>, dCSA<sub>3</sub>), and the volumes of segments 1.0-3.2 cm (V<sub>1</sub>), 3.3-6.4 cm (V<sub>2</sub>), and 7.0-12.0 cm (V<sub>3</sub>) were measured before and after nasal decongestion (DN). For analysis, right and left cross-sectional areas and volumes were added and mean dCSA was calculated.

**Results:** Mean values ( $\pm$  standard deviation) before ND were:  $0.83 \pm 0.23$  (CSA<sub>1</sub>),  $1.66 \pm 0.52$  (CSA<sub>2</sub>), and  $2.36 \pm 0.77$  (CSA<sub>3</sub>) cm<sup>2</sup>;  $2.19 \pm 0.20$  (dCSA<sub>1</sub>),  $4.01 \pm 0.33$  (dCSA<sub>2</sub>), and  $5.85 \pm 0.37$  (dCSA<sub>3</sub>) cm;  $2.77 \pm 0.51$  (V<sub>1</sub>),  $6.52 \pm 1.99$  (V<sub>2</sub>), and  $26.00 \pm 9.62$  (V<sub>3</sub>) cm<sup>3</sup>; all values were lower than laboratory reference values ( $p < 0.05$ ). ND led to proportionally greater increases of sectional areas and volumes in the NO group, suggesting an associated functional component. Individual analysis revealed 12 cases with normal results despite nasal obstruction.

**Conclusion:** Most patients with structural nasal obstruction had results suggestive of nasal patency impairment in acoustic rhinometry.

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## INTRODUCTION

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The nose plays a series of vital functions. It filtrates, heats, and moistens inhaled air; it is the first line of defense against inhaled allergens; it acts as a sensory olfactory organ and affects resonance in speech production. Conditions such as deviated septum and turbinate hypertrophy affect nasal geometry and may impair nasal patency and the physiology of the nose, due to reductions in the inner dimensions of the nasal cavity and increases in the resistance to the flow of breathed air<sup>1-3</sup>.

Acoustic rhinometry can be used to verify nasal geometry in an objective non-invasive manner<sup>4,5</sup>. This test uses the acoustic reflections of a sound pulse to measure the nose and the nasal cavity<sup>6</sup>.

This study aimed to measure the nasal cavities of adult patients with nasal obstruction caused by deviated septum and/or nasal concha hypertrophy and compare them to measurements made in subjects without signs of involvement. Cross-sectional areas, distances to the nostrils, and volumes of specific areas of the nasal cavity were analyzed and compared to reference values of individuals without signs of nasal obstruction described by Gomes<sup>7</sup>.

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## METHOD

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### The series

This study was approved by the Research Ethics Committee of the Craniofacial Rehabilitation Hospital of the University of São Paulo (HRAC/USP) and given permit 381/2006-SVAPEPE-CEP, and by the Research Committee of the Bauru State Hospital (HEB) as per permit HEB-CC-097/06.

This prospective study included an accidental sample of 30 adult individuals with nasal obstruction due to deviated septum and/or turbinate hypertrophy (Caucasian/brown adults of both genders, aged between 18 and 40 years). Participants were selected from a group of individuals who came to the ENT Clinic of the Bauru State Hospital (HEB) for nasal obstruction of any grade confirmed through physical examination at a later stage. Patients meeting the enrollment criteria were invited to join the study. Patients with enlarged pharyngeal tonsils, nasal obstruction of different etiologies such as previous nose surgery, or other conditions that prevented them from completing the study were excluded. Patients on nasal medication of any type were requested to stop treatment for five to seven days to undergo acoustic rhinometry.

### Clinical examination

The diagnosis of nasal obstruction was based on the information collected during patient interviews and physical examinations performed in accordance with a

protocol designed with this purpose (Figure 1A-B). The assessment protocol consisted primarily of a directed interview, in which the following data was collected:

1. time and duration of obstruction symptoms;
2. side of nasal obstruction;
3. frequency of nasal obstruction episodes;
4. rhinitis symptoms;
5. pharyngeal symptoms;
6. sinus symptoms;
7. ear symptoms;
8. nasal disease history;
9. associated diseases and habits.

Physical examination included anterior rhinoscopy, performed with the aid of a frontal light source and a nasal speculum, before and after administration of nasal vasoconstrictors, posterior rhinoscopy aided by a Garcia speculum to assess the rhinopharynx, otoscopy, and neck examination to capture possible associated lesions. When the more superior portions of the nasal fossae and rhinopharynx could not be assessed satisfactorily in clinical examination, subjects underwent examination with a Storz 3.4 mm endoscope. These measures were taken to rule out the presence of obstructive lesions in the respiratory portion of the nasal fossa such as tumors and inflammatory or neoplastic polyps. The characteristics of the nasal mucosa and nasal secretions, the degree and type of septum deviation, and the presence of inferior turbinate hypertrophy were analyzed during nasal cavity examination. The observed variables had a merely exploratory character and were considered only for the purposes of this study.

### Acoustic rhinometry

Acoustic rhinometry was carried out at the Physiology Laboratory at HRAC/USP. An Eccovision Acoustic Rhinometer (HOOD Laboratories) was used and the tests were conducted as proposed by Trindade et al.<sup>8</sup> and Gomes et al.<sup>9</sup> Figure 2 shows a rhinogram from a patient with nasal obstruction.

The area-distance graph was used to calculate nasal cross-sectional areas (CSA) in square centimeters and the distance relative to the nostrils (dCSA) in centimeters in the rhinogram's second dip, corresponding to the area of the nasal valve (CSA<sub>1</sub> and dCSA<sub>1</sub>), in the third dip (CSA<sub>2</sub> and dCSA<sub>2</sub>), corresponding to the anterior end of the inferior and/or medial nasal concha, and in the fourth dip (CSA<sub>3</sub> and dCSA<sub>3</sub>), corresponding to the medial-posterior end of the medial nasal concha<sup>10</sup>. The first dip in the rhinogram, which corresponds to the area of the nostril, was not considered. For this reason, the three dips mentioned above were considered as the first, second, and third dips respectively. The integration of the area-distance curve was used to find the volumes in cubic centimeters<sup>11</sup> of

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