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Clinical assessment of olfactory functions in children who underwent adenotonsillectomy during pre- and post-operative period

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ABSTRACT

Objective: The aim of this study was to investigate the changes of both ortho- and retronasal olfactory function in children who underwent adenotonsillectomy (AT) operation due to infectious and/or obstructive adenotonsillar disease.
Material and methods: A total of 25 children with adenotonsillar disease are included in the study; the children were followed for 6 months in the conducted clinics and underwent AT operation. An age- and sex-matched control group was constituted with 25 healthy children free of adenotonsillar disease. Adenoid and tonsillar hypertrophy was graded according to the subjective size scales. Each subject's orthonasal and retronasal olfactory functions were assessed using odor identification test and retronasal olfactory testing. These tests were performed once, at the beginning of the study, for the control group and performed twice, at the beginning of the study and the third month follow-up, for the disease group. Parents of children in the adenotonsillar disease group filled out a visual analog scale to evaluate the children's appetite at the same time with olfactory testing.
Results: The current investigation produced four major findings: (1) both ortho- and retronasal olfactory abilities of participants were improving following AT operation, (2) adenoid hypertrophy had a significant negative effect on both ortho- and retronasal olfaction, whereas tonsil hypertrophy had significant negative effect only on the retronasal olfactory score, (3) retronasal olfaction was found to be more affected by the adenoid size than the orthonasal, as shown with correlation analysis, and (4) the increase in appetite of children after AT operation had been specified by parents.
Conclusions: Children with adenotonsillar disease have increased olfaction abilities, namely ortho- and retronasal olfactory function following AT operation. In addition, retronasal olfactory function, an important component of flavor, seems to be more affected than orthonasal function. These results also explain the increased appetite of operated children.

Introduction

The most common problems affecting the tonsils and adenoids are recurrent infections of the nose and throat. Significant enlargement of the tonsils and/or adenoids causes nasal obstruction and/or difficulty breathing, swallowing, and sleep problems. Chronic tonsillitis and infections of tonsillar crypts within the palatine tonsils, which produce malodorous white deposits, can also affect the tonsils and adenoids, making them sore and swollen [1]. Because of these problems, adenotonsillectomy (tonsillectomy together with adenoidectomy) (AT) operation is one of the most common operations performed in a pediatric-aged patient [2]. The current literature shows that AT operation is associated with marked improvement in quality of life, physical health, and general well-being in both obstructive and infectious adenotonsillar disease [3–5]. In addition, the parents of children who underwent AT operation relate an improvement in the appetite or eating of their children. Although smell and taste greatly affect food preference, selection, and consumption, there is no sufficient data about the effects of AT operation on smell and taste in the literature.

The olfactory epithelium is located on the roof of the nasal cavity; this narrow location is called the olfactory cleft and is where open both ortho- and retronasal air flow [6,7]. This means that "sniffing" brings odorants through the nostrils into the nasal

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cavity (orthonasal olfaction), and chewing and swallowing force odorants emitted by foods upward, behind the palate, into the nasal cavity from the rear of the mouth (retronasal olfaction). Clear differences are shown between orthonasal and retronasal olfaction in neuronal processing and perception; these two pathways convey two distinct sensory signals [8–11]. Additionally, in everyday life, flavor perception consists mainly of the interaction between olfactory, gustatory, and trigeminal sensations including thermal, painful, tactile, and/or kinesthetic effects during the oral processing of food [12,13].

There is only one study investigating the effect of adenoid hypertrophy on both ortho- and retronasal olfactory functions in terms of pre- and post-operative clinical assessment in the pediatric population [14]; however, to the best of our knowledge, no other literature is found regarding the effects of adenotonsillar disease on both ortho- and retronasal olfactory functions. Thus, the aim of this study was to investigate the changes of olfactory function in children who underwent AT operation due to infectious and/or obstructive adenotonsillar disease.

Material and methods

Study design

This study was approved by the Clinical Research Ethics Committee of Istanbul Cerrahpasa Medical Faculty (10.05.13-83045809/11282). The study was conducted at the otolaryngology clinics of Gulhane Military Medical Academy Haydarpaşa Training Hospital and Istanbul Surgery Hospital, and informed consent was obtained from the parents of all participating subjects.

Prior to the onset of olfactory testing, data were registered for each subject individually, including height and weight, to calculate body mass index (BMI) and obtain medical history and a list of current medications. A complete otorhinolaryngology examination with flexible pediatric nasopharyngeal endoscopy was performed. Exclusion criteria included subjects with a history of upper respiratory infections within the past three weeks, sinonasal disorders (severe nasal septal deviation, nasal polyps, allergic rhinitis), asthma, malignancy, head trauma, neurologic and psychiatric disorders, and metabolic and endocrine disorders (diabetes mellitus, hypogonadism). Additionally, using the BMI as an indicator of growth, children were classified as eutrophic or underweighted due to their position above or below of the 5 percentile position in the growth curve of children. Underweighted children were not included in the study.

A total of 25 children with adenotonsillar disease are included in the study; the children were followed for 6 months in the conducted clinics and underwent AT operation. The study also includes an age- and sex-matched control group was constituted with 25 healthy children free of adenotonsillar disease and diseases causing nasal obstruction such as nasal septum deviation or nasal polyposis.

Grading of adenoid and tonsillar hypertrophy

Adenoid hypertrophy was graded from 1 to 4, according to a subjective scale, by performing flexible pediatric nasopharyngeal endoscopy [15]. Adenoid hypertrophy was graded as: Grade 1; the fiber-endoscopic image appeared more or less normal, evidencing scarce adenoid tissue involvement in nasopharynx. As a result, the choanal opening was free (<25%). Grade 2; the adenoid tissue appeared confined to the upper half of nasopharyngeal cavity, with sufficiently pervious choanae and perfect visualization of tube ostium (<50%). Grade 3; adenoid vegetation took up about 75% of the nasopharynx with considerable obstruction of choanal opening, free only in the inferior area, and partial involvement of tube ostium (<75%). Grade 4; the adenoid tissue reached the lower choanal border and impeded the visualization of the tube ostium.

During the physical examination of the children, tonsillar hypertrophy was graded according to the subjective tonsil size scale [16]. Tonsil size was evaluated by a five-point scale, graded from 0 to 4+, (0: no enlargement; 1: slight enlargement with the transverse air slit more than half of the diameter of the palatal airway; 2: moderate enlargement with the air slit about half of the palatal airway diameter; 3: profound enlargement with the air slit less than half of the airway diameter; 4: total obstruction with tonsil touching each other at the midline).

Orthonasal olfactory testing

Psychophysical testing of olfactory function was performed using the identification test kit of the validated Sniffin' Sticks test, where odorants were presented in commercially available felt-tip pens ("Sniffin' Sticks", Burghart GmbH, Wedel, Germany) [17,18]. For odor presentation, the pen's cap was removed by the experimenter for approximately 3 s, and the tip of the pen was placed approximately 1.0–2.0 cm in front of the nostrils. Odor identification was assessed by means of 12 common odors (Table 1). Using a multiple forced-choice paradigm, identification of individual odors was performed from a list of four verbal descriptors each. Each odorant was presented by the experimenter and there was an interval of at least 30 s to prevent olfactory desensitization. Subjects were free to sample the odors as often as necessary to make a decision. The test result was a sum score of the correctly identified odors.

Retronasal olfactory testing

The test is based on the identification of odorized powders or granules presented to the oral cavity (e.g., spices, instant drinks, and instant soups; Table 2) [19]. The substances were applied to the midline of the tongue on fenestrated plastic sticks. Subjects were free to sample as much stimulant as needed for identification. This approach also minimized the problem of standardizing the area of stimulation, as well as differences in tongue or oral cavity size. In a typical trial, the experimenter placed approximately 0.05 g on the middle of the tongue inside the oral cavity. After administration of each powder, participants rinsed their mouths with tap water. The procedure was self-timed. Each substance was identified by means of a closed set with four verbal items using a forced-choice procedure. The test result was a sum score of the correctly identified stimuli.

The parents of the children in the adenotonsillar disease group were asked about their children's appetite; they filled out a visual analog scale (VAS) at the beginning of the study and three months

Table 1
List of descriptors originate from the original "Sniffin' Sticks" test.

Target item	Distracter items
Orange	Strawberry, blackberry, pineapple
Leather	Smoke, glue, grass
Cinnamon	Honey, cholate, vanilla
Peppermint	Chives, onion, wood
Banana	Coconut, walnut, cherry
Apple	Melon, orange, peach
Liquorice	Mint, cherry, cracker
Coffee	Cigarette, wine, smoke
Cloves	Cinnamon, pepper, mustard
Pineapple	Pear, peach, plum
Rose	Chamomile, raspberry, cherry
Fish	Bread, cheese, ham