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Maxillary dentoskeletal changes 1-year after adenotonsillectomy

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ABSTRACT

Objective: To measure the maxillary dentoskeletal and soft tissue changes of severely obstructed mouth breathing (MB) young children who had their mode of breathing normalized after adenotonsillectomy (T&A), in comparison with a matched group of severely obstructed untreated MB children (CG).
Methods: Seventy patients who had an Ear, Nose, and Throat examination (ENT), including flexible nasal endoscopy, to confirm the severe obstruction of the upper airways and the indication of T&A composed the sample. Cephalograms and dental casts were available from the patient's orthodontic records. Treatment group (TG) and CG included 35 children each. Groups were matched by gender (24 males and 11 females in each group), age (TG, 6.7 ± 1.8 years; CG, 6.9 ± 2.3 years), tooth development (TG, 13 primary dentition, 22 mixed dentition; CG, 14 primary dentition, 21 mixed dentition), and skeletal maturation status. Records were taken at baseline (T0) and 1-year after T&A (T1) for TG; while CG records were taken with a 1-year interval. Dentoskeletal measurements were performed in the lateral cephalograms, and dental casts were used to assess the palatal volume and occlusal changes.
Results: TG showed a significant increase (503.3 mm^3, $P < 0.001$) in the palatal volume (10% of change), while CG palatal volume was stable. No dimensional occlusal changes were detected between T0 and T1 in both groups. Significant downward (point A, 2.1 mm; ANS, 2.1 mm) and forward displacements (point A, 0.7 mm; ANS, 1 mm) of the anterior region of the maxilla were observed in the TG, but CG presented only significant downward displacement (point A, 1.8 mm; ANS, 1.4 mm). The maxillary posterior region (PNS, PTM, and Molar) displaced downward in both groups ($P < 0.05$), however no sagittal change was found. The palatal plane inclination was stable in both groups.
Conclusions: TG presented significant increase in the palatal volume and in the forward displacement of the maxilla. No other significant maxillary dentoskeletal changes were found.

1. Introduction

Despite the controversies that exist about the influence of mouth breathing (MB) on dentofacial growth [1], maxillary morphological abnormalities are expected in patients with airway problems [2–8]. MB allows the tongue to set in a low position in the oral cavity, resulting in unbalanced forces between external pressure (cheeks) and internal pressure (tongue) [9]. Also, the failure of the natural process of continuous airflow through the nasal passage during breathing removes the physiological stimulus for the lateral growth of the maxilla and for lowering of the palatal vault [4,10].

The most common etiology of MB in young children is the obstruction of the upper airways caused by hypertrophic adenoids and tonsils [11]. In the early years of the 20th century surgical removal of tonsils was overused [12,13], which made the Otolaryngologists (ENTs) to re-think the indications for adenotonsillectomy (T&A), and for many decades to adopt a more conservative management of the upper airway obstructive hypertrophic tissues [12,14]. Today, because there is evidence that quality of life in children with a surgical indication for symptomatic adenotonsillar hypertrophy is significantly improved with T&A [14,15], such surgical procedure is very common in children [16]. In the decision process of referring an MB children to T&A, many times orthodontists are required to provide to the ENTs their opinion about the benefit of surgical approach on facial growth, dental occlusion, and quality of life [15,17].

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Much emphasis has been given to mandibular rotation and development in MB [11,18,19], and to the impact of T&A [20]. However, reports of the changes in the nasomaxillary complex and of adjacent soft tissues that are functionally involved are less frequent [4,21]. Moreover, investigations on the dentoskeletal changes of the maxilla after the surgical correction of the mode of breathing have been neglected, and objective data are rare [20–24]. Previous longitudinal studies have shown that surgical treatment of nasal obstruction in growing individuals may result in a facial development closer to a normal pattern [25,26].

At this point, some questions still have no objective answers:

(1) Is the maxilla affected in the sagittal and vertical positions 1-year after the T&A?
(2) Does the palatal volume change significantly when the mouth breathing habit is interrupted?

Therefore, the aim of this retrospective study was to quantify 1-year post T&A the changes of the maxilla in a group of children who had a normalization of the mode of breathing when compared with an untreated control group of severely obstructed MB children.

2. Materials and methods

Approval for this study was obtained from the Institutional Review Board of the Federal University of Minas Gerais, Belo Horizonte, Brazil. The participant's rights were protected, and informed consent was obtained according to the Ethics Committee of the Federal University of Minas Gerais.

2.1. Population

The sample consisted of 70 children, ranging from 3.5 to 12.9 years of age referred by pediatricians and primary care physicians to the Federal University of Minas Gerais, with a diagnosis of MB. An interview with children's parents, or guardians, asking about the quality of the children's sleep, snoring, and oral breathing confirmed the "chief complaint" of MB. Ear, Nose, and Throat (ENT) clinical and endoscopic assessment confirmed that all children presented significant airway impairment with T&A indication. Tonsils had obstructive Brodsky and Koch [27] grades 3 and/or 4; while adenoids obstructed more than 80% of nasopharyngeal airway. None of the children had undergone T&A previously.

At the beginning of this study, 27 children (22 males and 5 females) were in deciduous dentition and 43 (26 males and 17 females) presented in mixed dentition. The treatment group (TG) was comprised of those 35 children with a mean age of 6.7 ± 1.8 years whose surgical procedure was immediately authorized by municipality public healthy service. The control group (CG) consisted of 35 patients (24 males and 11 females, with a mean age of 6.9 ± 2.3 years) who lived in an adjacent town in the same district of TG, but who had to wait more than 1 year for the surgical authorization by the public healthy system, following another public bureaucratic protocol. CG matched the TG as to the mean age at baseline, gender distribution, cervical vertebral maturation (CVM) [28], tooth development and mean duration of observational periods (Table 1).

Table 1
Comparison of demographic characteristics in treated group (TG) and control group (CG).

Group	Mean age at T0	SD T0	Mean age at T1	SD T1	Diff T1-T0	SD Diff T1-T0
Treated	6.9	2.3	7.71	2.04	1.12	0.23
Control	6.7	1.8	8.18	2.01	1.13	0.33

The surgical effects on mouth breathing habits of TG children were determined with the same ENT criteria used pre-surgically. Normalization of the MB pattern was confirmed by parents' report during bimonthly visits along with the 1-year post-surgical consultations. Clinical examination, including flexible nasoendoscopy, was performed one-month post-surgery, and then approximately 1-year post-surgery. All CG patients kept their MB habit during the 1-year period, as reported by their parents quarterly.

2.2. Cephalometric analysis

Standard lateral cephalometric radiographs were obtained to evaluate the skeletal characteristics of the two groups. Cephalometric records in the TG were taken before surgery (T0), and then at approximately 1-year post-operatively (T1). For the CG corresponding cephalometric radiographs were available at baseline and approximately 1-year after (T0 and T1, respectively). For each child, both radiographs were taken with the same equipment. Cephalograms were hand-traced using a 0.3-mm lead pencil on 0.003-mm matte acetate tracing paper. All tracings were performed by one investigator, and subsequently re-traced by a senior investigator, in random order. If any disagreement appeared between the two investigators, a common decision was taken for the final landmark identification. The hand-traced cephalograms were scanned using a professional table scanner (HP Scanjet G4050, Palo Alto, CA, USA), with resolution set to 300 dots per inch (dpi) gray scale. Computer aided measurements were performed using ImageJ [29,30].

The assessment of treatment results was based on a previously described reference system traced through craniofacial stable structures [31]. First, the stable basicranial line (SBL) was traced through the most superior point of the anterior wall of sella turcica at the junction with tuberculum sellae (point T), and of the FMN point (fronto-maxillary-nasal suture). The next step was the identification of the following 5 skeletal landmarks, as shown in Fig. 1: (1) Point A (A), (2) Anterior Nasal Spine (ANS), (3) Posterior Nasal Spine (PNS), (4) Pterygomaxillary fissure (PTM), and (5) Molar (5).

Then, the following angular and linear measurements were performed (Fig. 1):

(A) ANS-SBL: perpendicular distance of the Anterior Nasal Spine to the SBL, corresponding to the anterior height position of the maxilla.
(B) PNS-SBL: perpendicular distance of the Posterior Nasal Spine to the SBL, corresponding to the posterior height position of the maxilla.
(C) A-SBL: perpendicular distance of the A point to the SBL, corresponding to the anterior maxilla height position.
(D) 5-SBL: perpendicular distance of the most occlusal and distal cusp of the second deciduous molar or the most mesial and occlusal cusp of the first permanent molar to the SBL.
(E) PTM-SBL: perpendicular distance of the highest and most posterior point of the pterygomaxillary fissure to the SBL.
(F) ANS-SBLv: perpendicular distance of the Anterior Nasal Spine to the SBLv, line constructed orthogonally to SBL, corresponding to the anterior–posterior position of the maxilla.
(G) PNS-SBLv: perpendicular distance of the Posterior Nasal Spine to the SBLv, line constructed orthogonally to SBL, corresponding to the anterior–posterior position of the maxilla.
(H) A-SBLv: perpendicular distance of the A point to the SBLv, line constructed orthogonally to SBL, corresponding to the anterior–posterior position of the maxilla.
(I) 5-SBLv: perpendicular distance of the most occlusal and distal cusp of the second deciduous molar or the most mesial and occlusal cusp of the first permanent molar to the SBLv, line constructed orthogonally to SBL.