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ORIGINAL ARTICLE

LATERAL TELE RADIOGRAPHY FOR DIAGNOSIS OF OBSTRUCTIVE SLEEP DISORDER IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

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ABSTRACT:

Background: Obstructive sleep apnea syndrome (OSAS)affects children worldwide and might be associated with underdeveloped maxillary growth, behavioral abnormalities, neuro-cognitive impairment and other complications associated with attention deficit hyperactivity disorder (ADHD).**Objective:** The aim of this study was to evaluate lateral tele radiography (tele-X-ray) used for the diagnosis of OSAS in children with ADHD. **Methodology:** Two tele-X-ray images were taken of each child (n=23), both genders, aged 7 to 13 years. Images were obtained considering two different positions: habitual occlusion (HO) and mandibular rest (MR). The narrowest airway in the naso-oro-hypopharyngeal region was measured and data were analyzed by descriptive statistics and Pearson's correlation. **Results:** Tele-X-ray images revealed enlarged adenoids in 19 children (83%) and hypertrophic tonsils in all children. Twenty-one children (91%) presented a low lingual apex, 13 (56.5%) maxillary retrognathia, and 9 (39%) mandibular retrognathia. Pearson's correlation showed a value of -0.78 concerning the upper pharyngeal airway and adenoid. A reduction in the nasopharyngeal airway resulted in an increase in the oropharyngeal space (P = -0.58). **Conclusion:** Tele-X-ray can be used for an interdisciplinary diagnosis of OSAS in children with ADHD.

Keywords: diagnosis, obstructive sleep apnea, teleradiography, attention deficit hyperactivity.

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INTRODUCTION

Obstructive sleep disorder (OSD) is known to affect children worldwide. Among the main etiological factors are underdeveloped oral-facial growth, incompetent lips, a narrow upper dental arch, a retrognathic mandible, nasal airway obstruction, enlarged adenoids and tonsils, rhinitis, obesity, and allergies.[1] Adenotonsillectomy has been the treatment of choice for OSD in patients with attention deficit hyperactivity disorder (ADHD).[2]

Reparative sleep is known to result from harmonious nasal breathing, which depends on the position of the tongue, oral-facial growth and dental occlusion, which, if not in concert, may result in OSD, characterized by nightmare, bruxism, enuresis, regurgitation, sweating and snoring.[3;4]A maxillary expansion device, combined with adenotonsillectomy if necessary, has been recommended to treat OSDin preschool children.[4-7]

Attention deficit hyperactivity disorder (ADHD) is a common condition that affects children and adolescents and might continue into adulthood. ADHD diagnosis should meet criteria described by the Diagnostic and Statistical Manual of Mental Disorders DSM-V published by the American Psychiatric Association (APA).[8] Such disorder, affecting 3 to 6 percent of schoolchildren, predominantly in males,[3] is a neurobehavioral disorder characterized by persistent inattentiveness, with or without hyperactivity. This disorder might begin in the early months of life; however, it is usually diagnosed when children start to go to school, where attention and learning behaviors are expected and more closely observed.[9] The treatment for OSD, as described above, has been reported to reduce hyperactivity in children.[2-4,6,10]

Chronic respiratory allergies related to air pollution and low air humidity seem to affect the airway passages, causing respiratory discomfort. This might result in sleep fragmentation and, consequently, predominant oral breathing, which, in turn, might impair the harmonious development of the orofacial structures.[11]The orofacial underdevelopment involves retrognathic mandible and/or maxilla, a condition known to impair the airway passages, which is aggravated when associated with hypertrophy of the tonsils and adenoids, and need early treatments[1,4,6,12]

Nasopharyngeal airway imaging systems, such as the nasopharyngoscopy, computed tomography and magnetic resonance have been used to diagnoseOSAS. In dentistry, alateral tele radiograph (tele-Xray) tracing analysis is an alternative to measure the velo-oro-hypopharyngeal airway, aiding in the diagnosis of OSAS[13], and this analysis enables to measure the smallest empty spaces of the nasopharyngeal airway. [13] Besides, especially in attention deficit hyperactivity disorder (ADHD) patients, [8,17,18,22] itmight serve as a primary analysis of the adenoids, the lingual apex and dorsum position[14], and the soft palate, all of whichplayssubstantialroles in the dynamics of breathing during sleep.[22,23] This study aimed to diagnose OSD in awakechildren with their mandible atrest (MR) and in habitual occlusion(HO) using lateral cephalometric radiographs.

SUBJECTS AND METHODOLOGY

This study was approved by the Ethics Committee of the School of Medical Sciences, University of Campinas (Unicamp) —protocol: 342/2004. Parents or guardians of children signed a free and informed consent form as they complied with their participation in the study. The study model included twenty-three children (4 females and 19 males; age 7–13 years), diagnosed with ADHD at the Clinic for Neurological Learning Disabilities at Medical Sciences, Clinical Hospital of Unicamp.

To be included, ADHD patients should have four permanent first molars. Exclusion criteria were syndromes, oral-facial deformities, previous use of any orthodontic or intra-buccal device, and non-collaborative behaviors during X-ray image taking.

For the image taking, the children were trained and informed of the adequate positions. The images were captured by only one operator from the Dental Radio Diagnostic Institute of Campinas (Campinas, SP, Brazil), using a tele-X-ray machine (Instrumentarium, orthopantomographOP 100, Orthoceph OC 100, Wisconsin, USA). Two images were taken of each child, considering two different positions — habitual occlusion (HO) and mandibular rest (MR) — with irradiation values for soft tissues of about 77 KVp at 12 mA and an exposure time of 40 s. The oral points are: lingual dorsum (LD), lingual apex (LA), incisive papilla (IP). The elements measured were as follows: nasopharyngeal space (NPhS), soft palate (SP), oropharyngeal space (OPhS), adenoid (AD) and tonsils (T).

Prior to image taking, Barium Sulfate contrast medium was used and a line was drawn in amid-lingual-to-apical perspective. The individuals were trained towards the proper position (natural position of head) of their head prior to the X-ray imaging.[20] The first X-ray image was taken in habitual occlusion (HO) and the second at mandibular rest (MR), with the lips lightly closed and no occlusion. To measure the upper airway, a cephalometric tracing was done in the naso-oro-hypopharyngeal smallest spaces (Figures 1 and 2). The data were statistically analyzed by Descriptive Statistics and Pearson's Correlation (SAS Institute Inc., Cary, NC, USA, 2003), at a significance level of 5%.

RESULTS

The children's mean age was 9.6 years. The X-ray images revealed enlarged adenoids in 19 (83%) and hypertrophic tonsils in all of the children. Of the twenty-three individuals assessed, twenty-one (91.3%) had a low lingual apex.

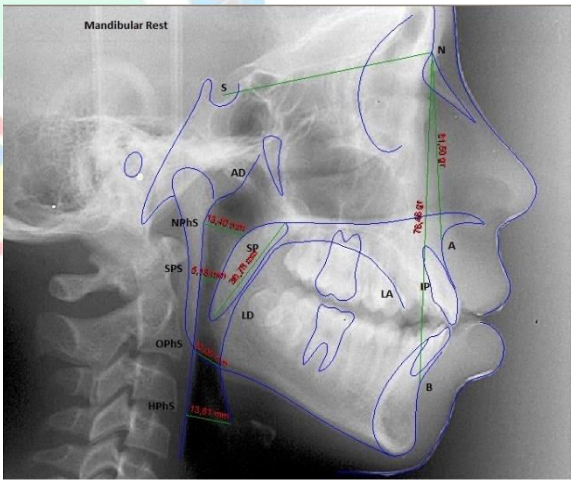


Figure 1: Mandibular Rest

Standard lateral teleradiography and cephalometric tracing analysis of a patient (male, 13 years old) in habitual Rest (MR): adenoid (AD)); sella (S); nasion (N); A - subspinale maxilla point; B - supramentale mandible point; soft palate (SP); lingual dorsum (LD); lingual apex (LA); incisive papilla (IP);
SNA = 82°
SNB in mandibular Rest >71° = SNB in mandibular occlusion
Elements measured:
FT = 32.72%;
[1] NPhS FT MR = FT in Nasopharyngeal space = 13,64mm
[3] NPhSPS MR = Nasopharyngeal space in soft palate space = 5,18 mm
[7] OPhS LD in MR= Oropharyngeal space = 11,32 mm
HPhS LD in MR= Hipopharyngeal space = 10,07mm
Length of soft palate in mandibular rest = 29,26mm

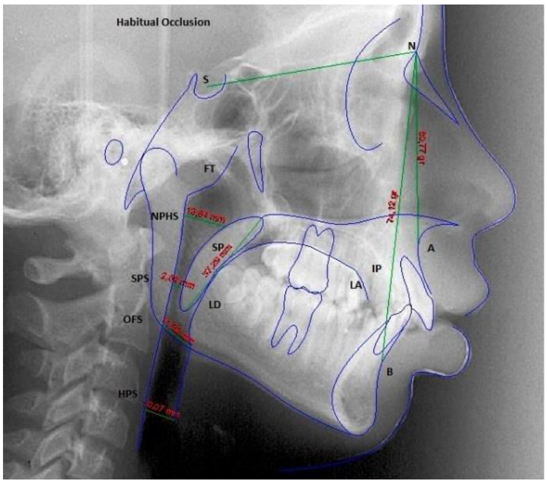
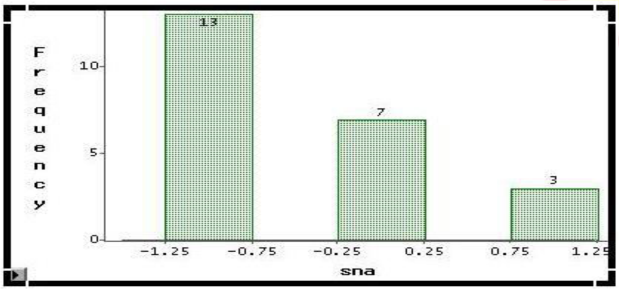


Figure 2: Habitual Occlusion

Standard lateral teleradiography and cephalometric tracing analysis of a patient (male, 13 years old) in habitual occlusion (HO):
SNA = 82°
SNB = 71°
Elements measured: AD = 32.72%

[2] AD space HO = Tonsil Pharyngeal space 32,71%
[4] NPhSPS HO = Nasopharyngeal soft palate space = 2,89mm
[8]OPhS LD HO= Oropharyngeal space = 8,5mm
Length of soft palate HO= 37,29mm

In habitual rest (Figure 1), individuals revealed spontaneous mandibular displacement. In habitual occlusion (Fig. 2), thirteen (57%) of the individuals showed normal occlusion (Angle class I), seven (40%) mandibularretrognathia (Angle class II), and three (3%) protrusion (Angle class III). Individuals presented with different maxillary positions: retrognathia (n=13); normal (n=7), and overjet (n=3). These positions were established based on the S-N-A angle (Graph 1).



Graph 1: Graph showing establishment of positions based on the S-N-A angle

Pearson's correlation concerning the nasopharynx and the adenoid (NPhS) showed a value of -0.78. It varied from -0.45 (HO) to -0.58 (MR) regarding the soft palate (NPhS) and oropharynx (OPhS), respectively.

DISCUSSION

ADHD might involve comorbidities such as OSD and anatomical factors such as hypertrophic adenoids and tonsils, low tongue apex combined with retro-positioned dorsum of the tongue, and mandibular and/or maxillary retrognathia. In the present work, an analysis of cephalometric tracing data was used to evaluate these factors.

Although most studies focus on mandibular retrognathia, a retro positioning of the maxilla might also occur. In the present study, the cephalometric tracing analysis showed maxillary retrognathia in thirteen children with a smaller nasopharyngeal respiratory space, aggravated by the enlargement of the adenoids. The respiratory airways (NPhS and OPhS) were hampered by adenoid (83%) and hypertrophic tonsils (100%). As the nasopharynx airway space (NPhS MR – mandibular rest position) decreases, the oropharynx airway (OPhS - habitual occlusion) increases, resulting in mixed or predominantly oral breathing, with a low LA, obstructing the pas51 airway in mandibular rest position during supine sleep.

Most children (21 = 91.3%) presented with the tongue apex in a low position and the dorsum in a high and retro-position. The lingual apex resting on the incisive papilla (2 = 8,7%) contributes to nasal respiration and lingual equilibrium, conditions which stimulate nasomaxillary growth. When this does not occur, the lingual dorsum touches the soft palate, causing the air to flow through the nose. During sleep, in supine position, the tongue at rest tends to be in a retro-position, moving down- and backward, diminishing and obstructing the OPhS airway. [1]

The Pearson Correlation values concerning the NPhS and OPhSairways varied in the two mandibular positions assessed (HO and MR). The value obtained for the airway NPhS in one (Angle Class II; deep bite) of the individuals was 2.89 mm (Fig. 2) while the desired is approximately 10 mm in mixed and permanent dentition.[24] This significant reduction, which hampers nasal breathing, can be explained by an underdevelopment and retro-positioning of the maxilla and mandible. The SP elongates when the mandible is at rest and contracts in habitual occlusion, conditions that might lead to a retro-positioning of the tongue.

Most of the children (n=21) in our study presented with a low tongue apex and a high lingual dorsum, which might result in mixed breathing and unbalance of the tongue during sleep. This could justify the alterations in the airways, fragmenting sleep and increasing the hyperkinetic of OSD, a common feature in ADHD.

The equilibrium of the tongue in the incisive papilla contributes to nasal breathing during sleep.[5]This is possible when harmony occurs among the spaces of airways (PT, NPhS, OPhS and the adenoid and tonsils with normal volume. Pediatric, dental, and otorhinolaryngological interventions [5,7,12,15,17-20] may help reduce the hyperkinetic of OSD in hyperactive individuals.[15,19,21] Previous studies evaluating oral devices used to treat OSD[8,12,13,20,25] and otorhinolaryngological interventions reported improvements in nasal breathing, sleep, attention, and learning.[8,22]

In the present study, the radiographic images were useful in the first diagnosis of the individuals assessed. However, interdisciplinary interventions aimed at the diagnosis and treatment of OSD in patients with ADHD are needed to provide such individuals with better quality of breathing and thus sleep.

CONCLUSION

Within the limitations of the present study, the lateral teleradiography aids in the diagnosis of OSD in children with ADHD. Dental surgeons could benefit from such images as they enable not only a detection of the occlusion patterns but also a more precise view of the airways and thus a more adequate diagnosis. Moreover, further studies are needed to improve the treatment of children with ADHD having underdeveloped jaws and malocclusions associated with OSD.

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