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Tonsillar Tissue Effect on Occlusal Development: literature review

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Pos-graduated Project presented to the University Fernando Pessoa as part of the requirements for obtaining a Master's Degree in Dental Medicine

Prof Tiago Bessa Martins

Abstract

The aim of the study is to make a systematic review of the literature on the effect of tonsil tissue on the development of bite. The tonsils are mostly made up of lymphoid tissue and the epithelium is rich in lymphocytes. They react to the antigens and produce antibodies against them in the tonsils. They are greatest in infants and just before puberty shrink. Excessive growth of a child's tonsils can make it difficult to breathe through your nose. As a result, the child may be forced to keep his mouth open and breathe through it. In oral breathing, the head is tilted backwards, the mandibular and tongue are lowered. This causes a change in the balance of the muscle and changes the pressure in the jaw as well as the teeth, which can eventually change the shape of the face and the development of the bite. Connection to the occurrence of tonsil tissues and specific skeletal patterns are a topic that is still debated.

Keywords: "Tonsils"; "Adenoids"; "Occlusion"; "Malocclusion";

Resumo

O objetivo do estudo é fazer uma revisão sistemática da literatura sobre o efeito do tecido da amígdala no desenvolvimento da oclusão. As amígdalas são compostas principalmente de tecido linfoide e o epitélio é rico em linfócitos. Amígdalas reagem aos antígenos e produzem anticorpos. Eles são maiores em crianças e pouco antes da puberdade encolher. O crescimento excessivo das amígdalas de uma criança pode dificultar a respiração pelo nariz. Como resultado, a criança pode ser forçada a manter a boca aberta e respirar através dela. Na respiração oral, a cabeça é inclinada para trás, a mandíbula e a língua são abaixadas. Isso causa uma alteração no equilíbrio do músculo e altera a pressão na mandíbula e nos dentes, o que pode mudar a forma da face e o desenvolvimento da mordida. A conexão com a ocorrência de tecidos das amígdalas e padrões esqueléticos específicos é um tópico ainda em debate.

Palavras-Chave: "Amígdalas"; "Adenóides"; "Oclusão"; "Maloclusão";

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LIST OF ABBREVATIONS

A – subspinale

B – supramentale

BMI – body mass index

MB – mouth-breathing

Me – menton

ml – millilitre

N – nasion

NB – nasal-breathing

NR – nasal resistance

OSA – obstructive sleep apnoea

Pa – transnasal pressure

s – seconds

S – sella turcica

I. INTRODUCTION

Since the 19th century, it has been thought that obstruction of the upper airways leading to oral breathing has affected the morphology of the teeth and mouth. Behlfelt (1990) reported that young children with enlarged tonsils breathes through mouth 59 per cent of the time during the day and 82 per cent during the night. The growth peak is usually at the age of 5-6, although it is determined by the surrounding skeletal structures. (Ikävalko et al. 2017).

The space occupied by the tonsils between the anterior pillars of the oropharynx corresponds the severity of obstruction. Patients with this type of obstructive tonsillar hypertrophy can have low tongue posture, which further them to substitute nose breathing to mouth breathing (Diouf et al. 2014). The impact of mouth breathing during the development of malocclusion seems to be significantly correlated and it can have efficient interference on the facial morphology during growth (Macari and Haddad, 2016).

During mouth breathing tongue is no longer involved in morphological palate formation and as a result the palate becomes deeper and narrower (Diouf et al. 2014). Becking et al. (2017) suggested also that children with obstructive hypertrophy of tonsils have a tendency for a more horizontal growth, more labial inclination of the upper and lower incisors, and enhanced transverse dental dimensions. Early examination no later than 5 years of age plays important role to detect treatable causal factors (Macari and Haddad, 2016).

This study aims to review the present literature and study the correlation between the tonsils and the development of malocclusion. The topic is current by the connection with the presence of adenoid tissues and specific skeletal patterns are still a subject of controversy. A topic that continues discussions about the reporting of diverse assessment methods used to evaluate adenoid tissue.

1. Materials and Methods

The purpose of this work is to conduct a literature review. Research of scientific articles and other publications was carried out through the research sources in scientific databases, namely PubMed, Scopus and Duodecim health port, in addition to books found in library.

The selected articles I compile a literature that meet the criteria of my study and are within the limits the subject of this work. I screened articles by title and abstract. The search of the scientific articles was based on the written languages of English and Finnish. I use tonsil OR adenoids AND (occlusion OR malocclusion) as my keywords. The publication dates of the articles cover to December 2019.

II. DEVELOPMENT

1. Anatomy

Breathing is the first function that develops after birth, as it is vital for survival. It can be defined as the function from which gases necessary for cellular metabolism are absorbed from the external environment and harmful gases are eliminated. The usual breathing pattern is the nasal breathing pattern, but when it is necessary to increase the ventilator capacity, such as during exercising or in pathological situations, an oral breathing pattern is adopted. (Salem, Briss and Annino, 2004).

The upper airway comprises the nasal cavity, nasopharynx, oral cavity, oropharynx, and laryngopharynx. These parts take part of several physiological functions such as respiration, deglutition and speech. (Mankarious & Goudy 2010). The passage of air through the nose depends on the anterior opening of the nostrils, on a middle portion where the turbinate's are and which is normally altered in allergic rhinitis, on the "posterior openings or nostrils" and the choanae whose opening may be caused by hypertrophy of the adenoids. (Vig, 1998; Salem, Briss and Annino, 2004).

The main causes of oral respiration are: hypertrophy of the tonsils and adenoids, allergic rhinitis, hypertrophy of the lower turbinates and deviations of the nasal septum and in small percentages polyps and tumors. More recently, obstructive sleep apnoea syndrome has emerged, with well-defined characteristics. (Vig, 1998).

1.1 Pharyngeal lymphoid tissue

Tonsils are pharyngeal lymphoid tissue and they form part of the Waldeyer ring, which include the adenoids, the palatine tonsils and the lingual tonsils. (Drake et al. 2014). Tonsils which are mass of lymphoid tissue are covered on their free surface by the stratified epithelium of the mucous membrane and there are apertures leading into recesses in the substance of the gland. There is ducts of numerous small mucous glands open. (Proudfoot, 1892). The tonsils apparently are the first barrier to protect the body from microorganisms that come through the mouth and nose. Recesses or wells are traps that take samples of the microorganisms that enter the body. Then they form against them antibodies. (Nienstedt et al. 2001). Tonsils vary in size from one person to another and the size of an individual's tonsils can vary depending on the infection situation. (Mäkinen & Nokso-Koivisto 2019).

1.2 Nasopharyngeal tonsil

The pharyngeal tonsil, which has many names including pharyngeal tonsil, third tonsil, adenoid vegetations and adenoid. It is located on the posterior and upper nasopharynx (Jokić et al. 2014). The size of the nasopharyngeal tonsil can become up to the size of a plum or it can be discreet. The nasopharyngeal tonsil tends to increase during childhood and usually reaches the maximal size by the age of 6 or 7 which after it gradually decays and in adulthood the nasopharyngeal tonsil is almost non-existent. (Geiger & Guptra 2019). Nasopharyngeal tonsils are usually removed because the enlarged adenoid makes it difficult to breathe through the nose. This causes snoring and difficult the sleep quality. An enlarged adenoid may also have a negative effect on the bite. (Blomgren 2015).

1.3 Palatine tonsils

There are two palatine tonsils. They are lymph node-like tissue and are located on both sides of the pharynx. Palatine tonsils has an effect on the development of resistance in early childhood and are involved in the body's immune defence. Their removal has not been found to be associated with and increased susceptibility to upper respiratory tract infections. (Mäkinen & Nokso-Koivisto 2019). Volume of the palatine tonsils decreases normally with age. Tonsils start to atrophy after 10 years of age and ends at adulthood. (Diouf et al. 2014). Palatine tonsils usually become infected with upper respiratory tract infections. Usually when the tonsils become inflamed they are called tonsillitis. Tonsillitis usually has the same cause as pharyngitis mainly by streptococci. (Mattila P. 2015).

Bordsky and Koch in 1991 made a clinical grading regarding to the tonsil sizes. They came to conclusion to five grades of tonsil sizes which are:

0 – Tonsils limited to the tonsillar fossa

1 – Tonsils occupy up to 25% of the space in oropharynx

2 – Tonsils occupy 25%-50% of the space between the anterior pillars

3 – Tonsils occupy 50%-75% of the space between the anterior pillars

4 – Tonsils occupy 75%-100% of the space between the anterior pillars

1.4 Lingual tonsil

The lingual tonsil is situated on the tongue in a dorsal side and posterior to the circumvallate papillae. It is also formed by lymphoid tissue as the other tonsils and is part of the Waldeyers Ring. (Galli et al. 2019).

2. Occlusal development in the presence of enlarged lymphoid tissue

2.1 Epidemiology and symptoms

Normal naso-respiratory function can change by upper airway obstruction and it can restrict normal airflow from nose to lungs and by that requires oral breathing. (Petraccone et al., 2014). During intense growth and development, according to the Moss theory of the functional matrix, bone growth take place in response to function. Growth of the face occurs as a response to functional needs and is mediated by soft tissue in which the jaws are embedded. (Moss-Salentijn, 1997). Chronic mouth breathing will change the form and the size of the maxillary and mandibular arches in the response to the alterations in head, mandibular and tongue positions. (Petraccone et al., 2014; O'Ryan et al., 1982).

McNamara in 1981 reports that Meyer (1872), Johnson (1943), Moore (1972) and Linder-Aronson (1979) established the possible correlation between the abnormal form of craniofacial development and respiratory obstructions, which are observed in the adenoid facies and they are characterized by narrow nose, open mouth, poorly developed cheeks, short upper lip, projected upper incisors, and vague facial expression. Regarding the position of the teeth, it would be associated with the pro-inclination of the upper incisors and with class II of Angle. (McNamara, 1981).

Adenotonsillar tissues play important role during child-hood as it is the first barrier for the host against pathogens. (Kim et al. 2015). Adenoid hyperthrophy is an increased size of the adenoids and is an obstructive condition. This condition can occur with or without an acute or chronic infection of adenoids. (Geiger & Gupta 2019). Hypertrophy of tonsillar and adenoid tissues are considered to be most common cause for upper airway obstruction in children. (Zhu et al. 2016). The obstruction forces a person breath through it mouth which makes the tongue posited anteriorly. (Petraccone et al. 2014).

Souki et al. carried out a study in 2009 and they verified that in 401 children with age of 2-12 years and the mean age of 6.6 years. Children were evaluated by otorhinolaryngologists to confirm the breathing trough mouth. 71.8% had hypertrophy of adenoids and/or tonsils, regardless of whether or not they had allergic rhinitis. 18.7% had allergic rhinitis alone and 9.5% had non-obstructive mouth breathing diagnosis. Cross-bite was presented in 30% of deciduous and mixed dentition, and 48% in definitive dentition. When children presented mixed and permanent dentitions there was a high prevalence of open and class II bite. In relation to occlusion, 11.2% have normal occlusion, 46.9% have class I malocclusion, 29.9% class II and 12% class III. The percentage of class II, class III, and cross-bite increases with age. Children with mouth breathing, hypertrophied adenoids/tonsils or the presence of rhinitis were not risk factors in the development of class II occlusion, posterior cross-bite or anterior open bite.

2.2 Cephalometric and occlusal studies

Kawashima et al., in 2002 compared 38 Japanese children with tonsil hypertrophy and sleep apnoea to 31 children without these characteristics and this group consisted of control group. The mean age was 4,7 years. He divided the sleep pathology group into two, with 15 children having hypertrophy of the tonsils visible 75% or more and 23 children less than 75% visible tonsils. Compared with the control group, children with >75% of hypertrophy of the lymphoid tissue were verified to have a more retrognathic mandible, a greater posterior height of the facial, a greater interincisal angle with retroclined lower incisors, pharyngeal airway space narrower, position of the tongue more towards anterior and long soft palate. When inspecting children with <75% of hypertrophy of the lymphoid tissue the anterior lower facial height was larger and they had short nasal floor. Also this group and controls did not present retrognathic mandible. As the results show that children with hypertrophied tonsils they have typical facial expression at an early age. Because this condition has an effect on growth it must be prevented by regulating morphology and function in young age. (Kawashima et al., 2002)

Wysocki et al., in 2009, divided 148 children between the ages of 9 and 11 into three groups: Group 1 with tonsil hypertrophy subject to tonsillectomy, group 2 with hypertrophy and malocclusion without surgery and group 3 with malocclusion without obstructive disease. They made a cephalometric assessment from the x-rays. Children in group 1 and 2 have alterations in SNA, SNB, ANB angles, and in SN-Me and N-Me distances and airway size. Group 1 who had adenoidectomy had beneficial influence when measured after 3-4 years of surgery. They concluded that the surgery should be made as soon as possible in children's life.

Dong-Kyu Kim et al., in 2015 examined Korean children with hypertrophic tonsils and the connection to the occlusal development. A total of 1083 children were concluded in the study and they had habitual oral breathing, sleep apnoea and snoring due adenotonsillar hypertrophy. Endoscopy and cephalometric X-rays were used to asses' adenoids. In the study 38% children had adenotonsillar hyperthrophy and malocclusion. 22% of children without adenotonsillar hyperthrophy and with malocclusion. ($P<0.001$). Age, sex, BMI, allergic rhinitis had also considered in the study. The result gave that a children have estimated a 4.5 times risk for a malocclusion if she/he have hypertrophic adenoids. Upper airway obstruction is associated with the development of high and narrow maxilla. Also association of short horizontal orientation of the mandibular and maxilla. Allergic rhinitis is also associated with the risk of developing open bite in anterior and cross-bite in the posterior. They concluded that adenotonsillar hypertrophy may be a risk factor for dentofacial abnormalities and early surgical intervention is considered toward dentofacial normality. (Kim et al. 2015).

The specific craniofacial patterns might not be associated with adenoid hypertrophy such as Class II occlusion. The study was made to compare the cephalometric pattern of children with and without adenoid obstruction. Total of 100 children was concluded to the study with age range of 4 to 14 years old mean age being 9, males and females. They were examined for sagittal and vertical skeletal analysis done by cephalometric examination. The group was analysed also by nasofibroendoscopy to see the degree of adenoid obstruction. In the results we can see that the children had tendency towards vertical craniofacial growth, mandibular retrusion and convex profile. Still there were low or not significant differences between the individuals with adenoid obstruction and without. (Feres et al. 2015).

Diouf et al. 2015 in Senegal studied 80 children. Age range being 6-12 years and mean age being 8.96 years. Children were divided to 5 different subgroups regarding on their tonsil sizes. The grading scale of these subgroups is made by Brodsky and Koch and it is based on the space occupied by the tonsils between anterior pillars on the oropharynx. The tonsillar grade was observed with same observer. There were measured inter and intra arch parameters transversally, vertically and sagitally. All these measurements were taken from the plaster casts. Their study showed that the total depth of the palatal vault had correlation with the size of the palatine tonsils. Maxillary intercanine, interfirst premolar and interfirst molar widths were not correlated with the grade of the palatine tonsils. The ratio of the mandibular to maxillary interfirst molar widths had correlated to the grade of tonsils. The ratio of the mandibular to maxillary interfirst premolar widths was positively correlated to grade. The ratio of the total depth of the palatal vault to maxillary interfirst molar width was positively correlated to the grade. Grade 4 of tonsillar size was significantly associated with molar Class II occlusion and posterior cross-bite with functional lateral deviation of the mandible.

In Nigeria Osiatuma 2017 studied occlusal characteristics of children with hypertrophied adenoids. They evaluated the effect of adenoid hypertrophy and the occlusion in children. They had total of 180 children which were in age 3-12 years old. In the study was included 90 children with hypertrophied adenoids and 90 children to the control group. They made orthodontic examination and took impression models from the children. They assessed occlusion in the anterior-posterior, transverse and vertical planes. Study group found out that in group of hypertrophied adenoids upper and lower arch were found shorter dimensions, palatal height was increased and volume was reduced when compared to control group. If there was found Class II division I occlusion it was significantly higher in the group which had hypertrophic adenoids than the control group. Posterior cross-bite were higher in the group of enlarged adenoids and in the age range of 9-12 years. The vertical plane was greater and had higher prevalence in male than female who had enlarged adenoids. (Osiatuma et al., 2017).

2.3 Airway studies

Handelman and Osborne, in 1976, made an evaluation in 12 children. They measured the growth patterns of children from 9 months to 18 years and their dimensions of the nasopharynx, adenoids and skeletal disorders using polar planimeter. There were decreased of nasopharyngeal airway during the early preschool and school years due to increased lymphoid tissue and the airway path increased during pre- and yearly adolescence. No alteration of the mandibular plane angle was verified from the cause of nasopharyngeal airway obstruction.

In 2002 Lopatiene carried out a study on airway resistance in 49 children aged 7 to 15 years with high obstruction confirmed. Children were examined by otorhinolaryngologist and rhinomanometry test were obtained to confirm the nasal obstruction. Also there were made dental casts and panoramic radiographs. It was verified that the mean nasal resistance on inhalation and on expiration was found to be statistically significant differences between children with adenoid hypertrophy of 1 and 2 degrees and chronic rhinitis compared to healthy children. There were also verified orthodontic anomalies with nasal resistance. There is a positive statistical association between the degree of obstruction and posterior cross-bite, maxillary and mandibular teeth crowding, increased overjet and overbite.

Poddebniak and Zielnik-Jurkiewicz (2019) studied nasal obstruction and its relation to adenoid hypertrophy and malocclusion. They examined 236 patients in the age range of 7-12 years. They had a group of children total of 93 with adenoid hypertrophy and presenting nasal breathing disturbances. This group underwent to surgical treatment for removing the obstruct. Control group consisted 143 children without adenoid hypertrophy or breathing disturbances. Children went to the nasofibrescopy examination, the adenoids were measured and respiratory volume was observed. In the results they got that it's more common to have open bite or partial anterior open bite when you have adenoid hypertrophy and presenting nasal breathing disturbances compared to who do not have these features. Also this was more common in boys when compared to girls. (Poddębniak and Zielnik-Jurkiewicz, 2019)

2.4 Treatment of tonsillar hypertrophy and obstruction removal studies

Treatment for the tonsillary hypertrophy include tonsillectomy, adenoctomy and adenotonsillectomy. In the tonsillectomy palatine tonsils are completely removed, in adenoctomy the hypertrophied adenoid is removed and in adenotonsillectomy palatine tonsils and adenoid are removed. (Blomgren 2015).

Linder-Aronson et al., in 1993, studied the effect of adenoidectomy in children and its repercussions after 5 years of surgery. They concluded that oral respirators that initially had lower tongue position, retro-inclined upper and lower incisors regressed after surgery. There was a positive correlation between nasal resistance and a higher mandibular plane angle.

Wijk et al., in 2006, compared 17 children mean age being 5.6 years with OSA undergoing adenotonsillectomy with an equivalent sample of children without respiratory pathology. They were evaluated with cephalometric x-ray before surgery and 1, 3 and 5 years after surgery. Initially, the group with OSA had posterior rotation of the mandibular plane, more anteriorly inclined maxilla, lower anterior face height was greater, shorter anterior cranial base, posterior lower face height was smaller, retroinclination of the upper and lower incisors and decreased airspace. Also they had less pronounced nose. After 5 years there were no statistically significant differences between the groups except on the nose was still shorter and the length of the anterior cranial base.

Pereira et al., in 2011, studied 38 patients from age range of 7-11 years old. They were divided into two groups. Group 1 which included mouth breathers (MB) and it includes

18 children with nasal fibroscopic diagnosed hypertrophic pharyngeal tonsils and/or palatine tonsils. They went under adenotonsillectomy after the diagnosis. The group 2 was a control group and it included 20 nasal breathing (NB) children. Cephalometric radiographies were taken from all the children. From these radiographs the angular and linear dental measurements were compared within the groups in a 14 months' interval. In the results they got that the sagittal position of the superior and inferior incisors increased significantly and also the axial angle in the inferior incisors.

Caixeta et al. (2014) in Brazil studied pre-pubertal children and their dental arch dimension changes after adenotonsillectomy. They had total of 95 pre-pubertal children in the study and they studied the changes from the plaster cast's. 49 of the children were mouth breathers (MB) and 46 nasal-breathing (NB). From the 49 obstructed MB children 24 had adenotonsillectomy and composed one subgroup and 25 of these 49 MB children the MB pattern was not changed during 1-year study period and they composed the control subgroup. In the results the MB children showed before the surgery deeper palatal vault, a larger mandibular arch length and larger mandibular width when compared to the NB group. After the surgery of airway clearance, the adenotonsillectomy group had significant maxillary transverse width gain when it was compared to the control subgroup. The control subgroup had significant deepening in the palatal vault when compared to the group who had adenotonsillectomy after 1 year. When they were compared to the NB group the MB group still showed deeper palatal vault, a larger mandibular width and larger mandibular arch length.

III. DISCUSSION

Airway obstruction due to enlarged tonsils which results mouth breathing often lead to an extended head posture, lowered mandible, hyoid bone and tongue position. (Diouf et al. 2014). Oral respiration is usually associated with an increase in sleep disturbances and can have a significant effect on bone growth and bite development. In particular, abnormalities in mandibular growth and growth direction have been observed, contributing to an increase in occlusal defects. (Caixeta et al., 2014).

In 1981 the McNamara reports the observation of adenoid facies with characteristics of narrow nose, open mouth, poorly developed cheeks, shorter upper lip, projected upper incisors and vague facial expression can be concluded to be cause of hypertrophied tonsils. From the epidemiological studies when compared to controls, oral respirator had higher prevalence for anterior open bite, lateral crossbite and class II occlusion. (Souki et al., 2009)

Cephalometrically, a large anterior face height, malocclusion, high and narrow maxilla, short horizontal orientation of mandible can be observed. (Dong-Kyu et al. 2015). It could be assumed that nocturnal growth hormone secretion changes, resulting in less growth of the ramus compared to nasal respiratory children. (Peltomaki, 2007). In the same time other studies had very low or not significant results in these features. (Feres et al. 2015). In the airway studies there is decreased airway when hypertrophied tonsils are presented. When nasal resistance is presented posterior cross-bite, maxillary and mandibular teeth crowding, overjet and overbite increased. (Lopatiene et al. 2002).

Before the surgery children had deeper palatal vault, larger mandibular arch length and larger mandibular width. After surgery maxillary transverse width gained but not to the same levels as to the nose-breathers. (Caixeta et al. 2014). Continuous mouth breathing also can prevent the tongue from resting normally. The tongue and cheeks are then subjected to different forces compared to healthy one. This results in a low position of the mandible. After the treatment of tonsillar hypertrophy and obstruction the children presented positive correlation between nasal resistance, higher mandibular angle and lower tongue position. Also the retro-inclined incisive regressed after surgery. (Linder-Aronson et al. 1993).

Especially in children, this early diagnosis is essential. Because the occurrence of occlusal defects and the growth of the jaws are more controlled by the environment than by genes, it is very important to take all possible actions that can affect the favourable development of a child with hypertrophied tonsils. The role of oral health professionals is important in assessing the causes of biting errors. When inquiring about the anamnesis, it would be important to remember to ask about snoring and upper respiratory problems. An assessment of the tonsils and pharyngeal air space should always be included in the bite examination, as an oral health care professional may be the first to suspect these problems. Early consideration can help enable successful orthodontic treatment as the child grows.

IV. CONCLUSION

Patients with currently observed or identified adenoidal hypertrophy have significant differences in many features of cranial geometry than patients without adenoidal hypertrophy.

Abnormal airway reflection occurs first at the height of the front and lower face and at the angle of the mandibular plane.

If similar inclusions occur with adenoidal hypertrophy, adenoidectomy should be performed as soon as possible.

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