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Original articles

Malocclusions and auditory tube dysfunction in children: an integrative review

Maloclusões e disfunção da tuba auditiva em crianças: uma revisão integrativa

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ABSTRACT

This integrative literature review aimed to conducted in order to analyze the available scientific evidence about the relationship between malocclusion and the Eustachian Tube Dysfunction. A search was carried out in the Virtual Health Library / Bireme, using the following keywords: *"malocclusion", "eustachian tube", "otitis media*". Articles published in English, Portuguese and Spanish, without publication date limit were included in the research. Repeated articles in databases, case reports and those who had not scientific paper format, such as reviews, theses, editorials, essays and letters were excluded. After analysis, it was selected 09 articles that accoplished criteria inclusion; the majority was conducted in Europe Continent and only one was conducted in Brazil. The lack of articles about the relationship between malocclusion and the Eustachian Tube Dysfunction was found. Among the available studies, there was no consensus about the relationship between the middle ear disorders and malocclusions. Intervention studies have shown that rapid maxillary expansion has a positive effect on the functioning of the Eustachian Tube. It can be concluded that, because of shortage of articles, there is need for more studies on this topic, for Dentistry, along with the other areas of health, can contribute to the choice of treatments that aim a better quality of life for this population.

Keywords: Malocclusion; Eustachian Tube; Otitis Media

RESUMO

Esta revisão integrativa da literatura objetivou analisar as evidências científicas disponíveis sobre a relação entre as maloclusões e a disfunção da tuba auditiva. Através dos descritores *"malocclusion","eustachian tube", "otitis media*", fez-se uma busca na Biblioteca Virtual em Saúde / Bireme, incluindo artigos publicados em inglês, português e espanhol, sem limite de data de publicação. Os artigos repetidos nas bases de dados, relatos de caso e os que não se apresentaram em formato de artigo científico, tais como resenhas, teses, editoriais, dissertações e cartas foram excluídos. Após análise foram selecionados 09 artigos que preenchiam os critérios de inclusão estabelecidos, sendo que a maioria foi conduzido no continente Europeu e apenas um estudo foi realizado no Brasil. Foi possível verificar uma escassez de artigos sobre a relação entre as maloclusões e a disfunção da tuba auditiva. Não houve um consenso entre os estudos disponíveis sobre a relação entre as desordens da orelha média e as maloclusões, no entanto os estudos de intervenção mostraram que a expansão rápida da maxila tem efeito positivo no funcionamento da tuba auditiva. Em meio a escassez de artigos, verifica-se a necessidade de mais estudos sobre essa temática para que a Odontologia e a Fonoaudiologia, juntamente com as demais áreas da saúde, possam contribuir na escolha de tratamentos que possibilitem uma melhora na qualidade de vida desta população.

Descritores: Maloclusão; Disfunção da Tuba Auditiva; Otite Média

INTRODUCTION

The middle ear comprises the tympanic cavity, consisting of the tympanic membrane (middle and inner layers), ossicular chain with its muscles and ligaments, the auditory tube, the aditus, antrum and mastoid cells[1,2].

The auditory tube, formerly called the Eustachian tube, is the structure that allows the nasopharynx to communicate with the tympanic cavity of the middle ear, and consists of three parts: cartilage, bone and medial portion. The proximal - also called cartilaginous - part, empties into the nasopharynx. The distal or bone portion is connected with the anterior portion of the middle ear, being located in the petrous part of the temporal bone. The medial portion refers to that part of the auditory tube which connects to the cartilaginous part[3,4].

Its length varies between 31 and 38 mm in an adult located in a plane at 45°, and about 18 mm in a child, forming an angle of 10° with the horizontal plane[5].

The three main functions of the auditory tube are: middle ear ventilation, protection and drainage. Under normal physiological conditions, it remains closed at rest. The only muscle responsible for opening the tube is the tensor muscle of the soft palate, which when contracted promotes ventilation of the middle ear[6]. This mechanism protects the ear from rapid pressure changes, keeps the mucosa preserved and allows the eardrum - ossicular unit to vibrate uneventfully[7].

Muscular changes in the palate may entail a reduction of tubal functioning[8]. Functional tubal obstruction may occur due to muscular disability, or have mechanical origins due to intrinsic factors such as infections, inflammations, allergies and congenital stenosis, or extrinsic factors such as adenoids and tumours[9].

The function of the auditory tube plays an important role in the etiology of otitis[10]. Otitis media is a very common infectious disease in childhood, characterized by an inflammation of the middle ear that may be accompanied by an outpouring of fluid accumulated in the middle ear[11]. Otitis media with effusion is one of the most common diseases in children, affecting 28-38% of the pre-school population[12]. Auditory tube dysfunction can cause pathological changes in the middle ear, which in turn can lead to conductive hearing loss or other complications of otitis media[12,13]. Hearing loss is classified as conductive (referring to lesions on the external and middle ear), sensorineural (lesions of the cochlea or involving the eighth nerve) or mixed[14].

The relationship between malocclusions and middle ear diseases has aroused interest among medical and dental researchers. Some authors have suggested that malocclusions may be related to auditory tube dysfunction[6,15]. In the field of dentistry, studies assessing the effect of rapid and semi-rapid maxillary expansion on conductive hearing loss, showed statistically significant results in terms of improved auditory conduction, as well as benefits in the middle ear[16-19].

Given the above, this study aimed to analyze the available scientific evidence on the relationship between malocclusions and auditory tube dysfunction through an integrative literature review.

METHODS

A systematic search was performed of the Virtual Health Library / Bireme (http://www.bireme.br), in the LILACS, SCIELO, IBECS and MEDLINE databases. An advanced search form was used, adopting the following descriptors: *"malocclusion", "Eustachian tube", "otitis media"*.

Inclusion criteria were that the relevant articles, of any date, be published in English, Portuguese or Spanish. Works were considered for this review that addressed the issue of malocclusion and auditory tube dysfunction or related topics, as seen from reading the title and abstract. Articles repeated in the databases were excluded, as were case reports and those that did not show in scientific paper format, such as reviews, theses, editorials, essays and letters.

LITERATURE REVISION

Forty articles were found: 37 indexed in Medline, two in LILACS and one in IBECS. After analysis, 31 articles were excluded for not meeting the established inclusion criteria or because they were repeated in the databases consulted. Thus, 9 articles were considered in this study.

The year of publication ranged from 1994 to 2011. All studies included children as participants, averaging 8.4 years of age. With regard to their geographical location, most of the studies were conducted on the European continent, only one being in Brazil[15].

Only one article assessed the relationship between malocclusion and dysfunction of the auditory tube itself. McDonnell *et al*.[6] conducted a case-control study in the US, with the participation of 105 2-6 year-olds: 60 cases and 45 controls. As inclusion criteria, children with a ventilation tube or in need of tube placement were

considered, diagnosed with auditory tube dysfunction by a pediatric otolaryngologist. The authors investigated the association between deep bite and auditory tube dysfunction. It was observed that children with overbite showed a 2.8 times greater risk of developing auditory tube dysfunction in relation to children without deep bite. It was found that a family history of otitis media in under-three year-olds was a risk factor for the development of auditory tube dysfunction.

Auditory tube dysfunction is a common factor in the pathogenesis of otitis media in children[20]. In this review, four articles evaluated the relationship between otitis media and malocclusion[11,15,20,21]. In all four studies, children with some genetic syndrome or cleft lip and/or palate were excluded from the sample. Considering the diagnostic criteria, the two more recent studies[15,21] were performed with similar approaches, otitis media was diagnosed by an otolaryngologist; in the other two programmes[11,20], the diagnosis of otitis was obtained by assessing pediatric and parental reports.

Gois Nery *et al*. [15] in a study conducted in Brazil, evaluated 52 4-10 year-olds with otitis media with effusion and 48 children without otitis enrolled in the ENT department of São Paulo University, in order to determine the relationship between otitis media with effusion and malocclusions. Otitis media with effusion was diagnosed by otoscopy and confirmed through audiometry and tympanometry tests. The evaluated malocclusions assessed were posterior cross bite, anterior cross-bite, anterior open bite, overbite and overjet; angle classification also being evaluated. In this study the authors found no relationship between malocclusion and otitis media with effusion, and no association was found with other confounding variables such as oral habits and natural and artificial feeding.

Giuca *et al*.[21] conducted a study in Italy, aimed at determining the correlation between otitis media and malocclusions in children. The authors evaluated 50 children averaging 7.8 years of age, 25 with otitis media, otitis and 25 without. The diagnostic criteria for otitis were the same used by Gois Nery *et al*.[15]. There was a significant association between posterior cross bite and adenoid hypertrophy with otitis media. These results displayed discrepancy from the study by Gois Nery *et al*.[15]. One possible explanation for this may be the fact that in the first, the case group was only of children with otitis media with effusion. Otitis media with effusion may occur for auditory tube dysfunction or as an inflammatory response after an episode of acute otitis media, which may heal spontaneously[22].

Watase and Mourino[11] evaluated 112 American under-sixes; all diagnosed with otitis media by their pediatricians. The most frequent malocclusions were anterior open bite (17%) and deep bite (17%). The authors found that the most common factors found in children with otitis media were bottle-feeding, frequent respiratory infection, otitis media history in the family, dummy/pacifier use, snoring and oral breathing. However, after logistic regression analysis, no association was revealed between factors related to otitis media and studied malocclusions.

Niemelä, Uhari and Hannuksela[20] conducted a cohort study in Finland with 938 5-year-olds requiring dental care, in order to evaluate the relationship between otitis media, dummy, or pacifier-sucking and respiratory diseases. The diagnosis of acute otitis media was obtained through parental reports, which suggests an information bias. The children were divided into groups according to the number of otitis media attacks: Group 1: those who had three or fewer attacks and Group 2: those who had four or more attacks. There was a significant association between oral breathing and anterior open bite with acute otitis media.

Taking into account the results obtained in the studies mentioned, it appears that the relationship between otitis media and malocclusions has not yet been well established in the literature. In the search for scientific evidence through intervention studies, in the literature reviewed, studies were found that evaluated the effect of rapid maxillary expansion on conductive hearing loss, which is considered a consequence of auditory tube dysfunction.

In a longitudinal study, Kilic*et al.*[17] evaluated the effect of semi-rapid maxillary expansion in adolescents diagnosed with conductive hearing loss. All 19 patients had severe maxillary transverse deficiency, deep palate and bilateral posterior cross bite. Ages ranged from 12 to 14 years, with a mean of 13.5. Hearing was assessed by an otolaryngologist using audiogram at four different times. The first record was before orthodontic treatment; the second was after the semi-rapid expansion (approximately 3.4 months); the third was at the end of the holding arches (about 6 months later), and the fourth recording was performed at the end of treatment with the braces (about 2 years later). The results (ANOVA test) of the semi-rapid maxillary expansion treatment were positive and the effect on hearing and normal functioning of the auditory tube was statistically significant.

Kilic *et al*. [17] evaluated the effect of rapid maxillary expansion in 15 adolescents with an average age of 13, attended in the orthodontics department of a faculty of dentistry in Turkey. In this study, the hearing of patients was also evaluated through audiometry and tympanometry tests before treatment. Mild to moderate levels of conductive hearing loss were observed in all patients. About two years after the end of orthodontic treatment, new audiometric screening and tympanometry tests were performed. A statistically significant improvement was observed in all patients, seen in the positive and stable effect on hearing and functions of the adolescents' auditory tube.

De Stefano *et al*.[23], in a study conducted in Italy, submitted 27 children with an average age of seven years, to RME using Hyrax. All children were diagnosed with recurrent otitis media associated with adenoid hypertrophy and transverse maxillary deficiency. Before starting treatment, patients were examined and evaluated by endoscopic examination of the nasopharynx, audiometry, tympanometry and orthodontic examination. RME, in addition to intervening directly on the sutures, was observed to improve nasal breathing. Moreover, the rapid maxillary expansion worked on the elevator muscles and tensor soft palate, helping to restore the normal function of the auditory tube, even in the presence of adenoid hypertrophy.

Chiari *et al.*[19], sought to describe the morphological and functional changes in the upper airway and middle ear after rapid maxillary expansion in 10 children with a average age of 8 years, attended by the Orthodontic Department of Medical University of Vienna, Austria. There were 7 cases and 3 controls. Inclusion criteria were selected children with unilateral or bilateral posterior crossbite and evidence of maxillary deficiency, evaluated by an orthodontist. In addition to examination by an orthodontist, an otolaryngologist examined the patients, who were evaluated by tympanometry tests and rhinomanometry (a dynamic test that calculates flow, pressure and nasal resistance). The authors observed that patients with maxillary constriction and hypertrophic adenoids showed negative pressure in the middle ear. RME relieved middle ear pressure in all patients, suggesting an improvement in hearing. According to the authors, maxillary constriction combined with the auditory tube dysfunction can cause negative pressure in the middle ear, and confirmed by tympanometry.

CONCLUSIONS

The shortage of studies on the relationship between the auditory tube dysfunction and malocclusion was evident. There was a consensus among observational studies available about the relationship between otitis media and malocclusions; intervention studies, however, have shown that RME has a positive effect on the functioning of the auditory tube. There is an apparent need for studies on this topic for health fields such as dentistry and speech therapy, to be able to contribute to the establishment of treatment protocols aimed at improving the quality of life of this population.

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