Poor Oral Hygiene and Middle Ear Infections: Any Relationship?

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Abstract The purpose of this study is to evaluate the relationship between poor oral hygiene and middle ear infections. 59 children between 3–12 age intervals were included in this study. The ears were examined by microscope. The findings were marked according to Kempthorne clinical scale and tympanograms were performed. For data analysis of dental caries, dft and DMFT indexes were used in accordance with WHO (World Health Organization) criteria for oral health surveys. The oral hygiene status was determined by using Simplified Oral Hygiene Index of Greene and Vermillion. The scores of 0–1 were classified as low, and of 2–3 as high oral hygiene index (OHI-S). The low OHI-S was taken as the control group (30 patients). The high OHI-S was taken as the study group (29 patients). The effusion scores, the compliance values and the middle ear pressure values in the two groups were compared. The difference between the effusion score values of the control and study groups was found to be statistically meaningful ($p = 0.338$, and the $\chi^2 = 2.167$). The compliance values of the control and study groups did not differ meaningfully

statistically ($p = 0.671$). However, there was a statistically meaningful low middle ear pressure ($p = 0.044$, $\chi^2 = 4.069$) in the control group. Since this finding is expected in the study group, instead of the control group, we did not make an issue of this result. We conclude from these clinical results that there is no statistically meaningful relation between the oral hygiene index and the middle ear.

Keywords Dental caries · Otitis · Ear effusion

Introduction

Oral hygiene is identified by the ratio of the dental caries. *Streptococcus mutans* and *Streptococcus sobrinus* together known as Mutans Streptococci (MS) and *Lactobacillus* are responsible for initiating caries. The plaques made up of mucus, dead epithelial cells and bacteria provide the ideal medium for these oral bacteria, through which decalcification and destruction in enamel protein takes place as dental caries. The risk factors like poor dental hygiene, reduced saliva production, acidic foods and drinks often promote bacterial growth [1].

Middle ear infections are one of the most popular pathologies of childhood. *Streptococcus pneumoniae*, *Haemophilus influenza*, *Moraxella catarrhalis*, Group A beta hemolytic streptococcus are the most popular bacteria in otitis. Ventilation, protection and drainage functions of the eustachian tube are the three important functions which protect the middle ear in childhood. The microorganisms in the nasopharynx and in middle ear effusion show similarity at times of infection [2].

The relationship between dental caries, nasopharynx and middle ear is not clear. The colonization of *S. mutans* may influence the colonization of *S. pneumonia* in the

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nasopharynx. The vice versa relation such as middle ear and nasopharyngeal colonization may influence teeth development during childhood [3]. In fact, ear infections occurring in the first year of life may cause enamel hypoplasia during primary teeth formation causing dental caries later [4]. In this study the condition of the middle ear is analyzed in children with poor oral hygiene against a control group with good oral hygiene, and then the results are discussed.

Materials and Methods

At Baskent University Istanbul Hospital, 59 children, who consulted with Pedodontics are included in this study. The low oral hygiene index score group of 30 patients was designated as the control group. The high oral hygiene index score group of 29 patients was designated as the study group. The patients had no craniofacial anomalies, no allergic histories with positive prick skin tests, no hypertrophic adenoid tissue obstructing more than 25 % of the space between the choanal floor and the posterior nasopharyngeal wall, no other systemic diseases. The parents were questioned simply about previous chronic ear problems. The ones operated on or treated for chronic serous otitis media or chronic otitis media were not included in the study. Finally ASA (American Society of Anesthesiologists) I and II patients were included.

The oral health status was determined by assessing caries status and oral hygiene status by a single examiner. For data analysis of dental caries, teeth were examined under proper light and with dental mirror according to WHO (World Health Organization) criteria using dft index for primary teeth (d = decayed, f = filled, t = teeth) and DMFT index for permanent teeth (D = decayed, M = missing due to caries, F = filled, T = teeth). The DMFT score for any individual may range from 0 to 32 and the dft score may range from 0 to 20 in whole numbers [5]. The oral hygiene status was determined by using the Simplified Oral Hygiene Index of Greene and Vermillion [6]. The six surfaces were stained with basic fuchsin and subsequently examined from four posterior and two anterior teeth. In the posterior region, the first fully erupted tooth, usually the first molar, no. 16 was examined. The buccal surfaces of the selected upper molars and the lingual surfaces of the selected lower molars were inspected. In the anterior region of the mouth, the labial surfaces of the upper right, no 11, and the lower left, no 31, central incisors were scored. The oral hygiene index scores (OHI-S) range from 0 to 3 as follows:

OHI-S 0 = No debris or stain present.

OHI-S 1 = Soft debris covering not more than one-third of the tooth surface or presence of extrinsic stains without other debris regardless of surface area covered.

OHI-S 2 = Soft debris covering more than one-third but not more than two-thirds of the exposed tooth surface.

OHI-S 3 = Soft debris covering more than two-thirds of the exposed tooth surface.

After the scores for debris were recorded, the index values were calculated. For each individual, the debris scores were totaled and divided by the number of surfaces scored. The patients were divided into two groups according to the caries activity and oral hygiene. Patients with OHI-S 0–1 were grouped as the control group with good oral hygiene. Patients with OHI-S 2–3 were designed as the study group with poor oral hygiene [5, 6].

Before dental treatment, the ears are examined microscopically. The findings are marked according to Kempthorne clinical scale [7, 8].

The score system contained the following details:

Opacity of the tympanic membrane (0: good, partial opacity; 1, complete opacity; 2).

Color of the tympanic membrane (0: gray, white, 1: partially yellow, 2: completely yellow).

Position of the tympanic membrane (0: neutral, 1: retracted, 2: flat, 4: pars flaccida full, 8: totally full)

The air–fluid level (0: absent, 8: exists).

Mobility of the tympanic membrane (0: normal, 2: diminished, 4: absent).

Tympanometry results (0: the height of the apex > 0.2 mmho, width of the apex <150 Da Pa.

2: the height of the apex <0.2 mmho, width of the apex <150 Da Pa.

4: the height of the apex <0.2 mmho, width of the apex >150 Da Pa.

Light reflex of the tympanic membrane (0: normal, 1: diffuse or absent).

Under evaluation of these details final effusion is scored as:

no effusion: total score 0–2/probable effusion: total score 3–9/positive effusion: total score >9.

To evaluate the middle ear aeration, a tympanogram is performed. Compliance values less than 0.2 ml and pressure values less than –150 Da Pa are accepted as abnormal values.

NCSS (Number Cruncher Statistical System) 2007 and PASS 2008 Statistical Software (Utah, USA) package has been used for the statistical analyses as the results were being evaluated. The qualitative data were evaluated using χ^2 test and Fisher's Exact Test. Significance was accepted at $p < 0.05$ level.

This study was approved by the Baskent University Institutional Review board (project no: KA 10/58) and supported by the Baskent University Research Fund

Results

At Baskent University Istanbul Hospital, 59 children who consulted to Pedodontia Clinic are included in this study. The age interval was 3–12. The low oral hygiene index score group of 30 patients was designated as the control group. The high oral hygiene index score group of 29 patients was designated as the study group. 23 patients who had positive skin Prick tests, 20 patients with hypertrophic adenoid tissue obstructing more than 25 % of the space between choanal floor and the posterior nasopharyngeal wall and 5 patients operated for chronic serous otitis media were not included in the study.

In the control group, 46.7 % (14/30) were primary teeth, 36.7 % (11/30) were mixed teeth, 16.7 % (4/30) were permanent teeth. In the study group 17.2 % (5/29) were primary teeth, 44.8 % (13/29) were mixed teeth, 37.9 % (11/29) were permanent teeth.

In the control group 76.7 % (23/30) of the patients had effusion scores between 0–2, 20 % (6/30) of them had effusion scores between 3 and 9, 3.3 % (1/30) of them had effusion scores greater than 9. In the poor oral hygiene group (high OHI-S), 89.7 % (26/29) of the patients had the effusion scores between 0–2, 6.9 % (2/29) of them had effusion scores between 3 and 9, 3.4 % (1/29) of them had effusion scores greater than 9. The difference between the effusion score values of the control group and the poor oral hygiene group were not found to be statistically meaningful, with the *p* value being 0.338, and the χ^2 value being 2.167 (Table 1).

In the control group 93.3 % (28/30) of the patients had normal compliance values, 6.7 % (2/30) of them had compliance values less than 0.2 ml. In the poor oral hygiene group, 89.7 % (26/29) of the patients had normal compliance values, 10.3 % (3/29) of them had compliance values less than 0.2 ml. The variance between the compliance values of the control group and the poor oral hygiene group was not found to be statistically meaningful, with the *p* value being 0.671 (Table 2).

In the control group, 63.3 % (19/30) of the patients had normal middle ear pressures, 36.7 % (11/30) of them had

Table 1 OHI score and effusion score

Effusion score	OHI-S		<i>p</i>
	0–1 <i>n</i> (%)	2–3 <i>n</i> (%)	
0–2	23 (76,7 %)	26 (89,7 %)	χ^2 : 2,167 <i>p</i> :0,338
3–9	6 (20,0 %)	2 (6,9 %)	
>9	1 (3,3 %)	1 (3,4 %)	

χ^2 test

Table 2 OHI score and compliance

Compliance	OHI-S		<i>p</i>
	0–1 <i>n</i> (%)	2–3 <i>n</i> (%)	
Normal	28 (93,3 %)	26 (89,7 %)	Fisher's Exact <i>p</i>:0,671 <0.2
	2 (6,7 %)	3 (10,3 %)	

Fisher's exact test

Table 3 OHI score and middle ear pressure

Pressure	OHI-S		<i>p</i>
	0–1 <i>n</i> (%)	2–3 <i>n</i> (%)	
Normal	19 (63,3 %)	25 (86,2 %)	χ^2 : 4,069 <i>p</i> :0,044*
<–150	11 (36,7 %)	4 (13,8 %)	

χ^2 test * *p* < 0.05

middle ear pressures less than –150 Da Pa. In the control group, 86.2 % (25/29) of the patients had normal middle ear pressure, 13.8 % (4/29) of them had middle ear pressure less than –150 Da Pa. However, there was a statistically meaningful low middle ear pressure (*p* = 0.044), (χ^2 = 4.069) in the control group. Since this finding is expected in the study (poor oral hygiene) group, instead of the control group, we did not make an issue of this result. (Table 3).

Discussion

Middle ear infection is the inflammation of the middle ear cavity, either chronic or acute. Pathogenesis is multifactor, such as upper respiratory infections, adenoid hypertrophy, allergies, craniofacial anomalies, low socio-economical conditions, seasonal differences. It is a childhood disease treated with antibiotics. Dental caries and poor oral hygiene can be also one of the other etiologies. A number of clinical researches have been made to support this hypothesis.

In pathogenesis of otitis media, the attachment of bacteria *S. pneumoniae*, *H. influenza* and *Moraxella catarrhalis* to the nasopharyngeal wall play a very important role. The colonization of *S. mutans* in dental caries may influence the colonization of other bacteria in the nasopharynx. Xylitol is a polyol sugar alcohol used as a sugar substitute in gums. In some studies it has been shown that it prevents the colonization of *S. pneumoniae* and *S. mutans* [9–11]. 5 % xylitol also inhibits attachment of both pneumococci and *H. influenza* to nasopharyngeal cells [12]. Since the former is responsible for otitis media, and the latter for

dental caries, some clinical researches have been performed to argue the relation between the two. Uhari et al. have clinically found in a study that the children's at least one episode of otitis media ratio in follow up of 3 months decreased 42 % with xylitol chewing gum. *S. mutans* is the most important effective bacteria for dental caries. They recommend xylitol to be used in chewing gums and in foods as a sweetener to prevent caries and otitis media [13]. Uhari et al. have also questioned the effect of xylitol on otitis media in another double blind randomized study. In 3 months of follow up, 41 % of the control placebo group and 29 % of the xylitol syrup group had at least one episode of otitis media. The difference was statistically significant ($p = 0.028$) meaning 30 % decrease on receiving xylitol [14].

However, Nelson has divided 126 children between 2 and 5 years into two categories as dental caries group and no dental caries group. Furthermore, he hasn't found any difference in lifetime ear infection history between the two groups statistically. But, the number of ear infections in the past year was found to be greater ($p = 0.07$) in the dental caries group [15]. In our study, also, we did not find any difference between the high and low OHI-S group concerning current middle ear infections.

In our study we analyzed the current state of the middle ear. The children with obstructive hypertrophic adenoid tissues, allergies, upper respiratory infections, acute and chronic otitis media were not included. The parents were questioned about the ventilation tube and adenoidectomy operations, the ones operated on were not included either. The current state of tympanic membrane and tympanometric findings give good clues about both the history and the prognosis of the middle ear. All of the patients were the starting dental cures for the first time. The compliance values, the middle ear pressures and the effusion scores were not found to be related to the OHI scores. There was a controversial finding in the middle ear pressure values. The control group had statistically meaningful low middle ear pressure values compared to the poor oral hygiene group. This also shows the irrelevant relation.

We conclude from these clinical results that there is no statistically meaningful relationship between the oral hygiene and the middle ear. Further studies including more

parameters concerning oral hygiene and the middle ear are advised.

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