Evaluation of Food Retention in Occlusal Surfaces of First Primary Molars

Evaluación de la Retención de Alimentos en las Superficies Oclusales de los Primeros Molares Temporales

Meneghel, L. L.[*]; Fernandes, K. B. P.[*]; Lara, S. M. H.; Ferelle, A.[**]; Sturion, L.[***] & Walter, L. R. F. [*]

ABSTRACT: Some food characteristics, like stickiness and consistency, can modify the time for food removal from the mouth as well as favors the activity of cariogenic bacteria, increasing dental caries risk. This study aimed to observe food retention in contact with a cariogenic substrate in 24-30 months old children. Therefore, 27 children (54 teeth) were evaluated. They intake a chocolate cookie and the food retention area was documented by digital photography in two experimental times (to: 0 and t1: 30 minutes) and it was calculated using Image Tool 3.0 software. The food retention surface index (mm2) was statistically reduced (Wilcoxon's test, p=0.001) after 30 minutes for both maxillary (to: 0.37 ± 0.04 and t1:0.042 ± 0.015) and mandibular (to: 0.30 ± 0.03 and t1: 0.078 ± 0.019) molars. No differences were observed between the groups in food retention surface index at the initial time. At the final time, the mandibular molars show a higher retention area than the maxillary ones (Mann-Whitney's test, p=0.04). The prevalence of food retention at the mandibular molars is higher than the maxillary molars (Chi Square's test, p=0.03). In conclusion, first primary mandibular molars retain more food than the maxillary molars, being in agreement with clinical results of dental caries' prevalence.

KEY WORDS: dental caries, food retention, primary first molar, risk, infants.

INTRODUCTION

A national survey performed by Health Department about Brazilian Oral Health show that nearly 27% of 1.5 to 3 years old children exhibit at least one primary tooth with caries experience, being the decayed component responsible for 90% of this index (Ministério da Saúde, 2004).

Occlusal surfaces of primary molars show a high risk for dental caries lesions, once there are several anatomical accidents on theses surfaces, such as pits and grooves (Feigal & Donly, 2006). There are some reports that the dietary habits can be considered as caries predictor (Zero, 2004). Despite the frequency of exposition to carbohydrates is related to caries activity (Tinanoff & Palmer, 2000), some food characteristics, like stickiness and consistency can also modify the time for food removal from the mouth, increasing caries risk.

Moreover, it can also favor the activity of cariogenic bacteria (Loesche, 1986; Mathewson et al., 1982), once the dental plaque can sustain cariogenic levels for a period of 30 minutes after carbohydrates intake (Loesche, 1986).

The food retention is also related to morphological characteristics. At this context, Oka et al. (2003) reported the occurrence of food retention in occlusal surface of primary molars caused by the presence of deep grooves. Steinberg (2005) reports the carious lesions in deep pits and grooves is caused by the presence of cariogenic bacteria in these anatomical accidents. Moreover, Walter et al. (2008) has reported that occlusal surfaces may evoke food retention, increasing dental caries' risk in primary dentition.

[*]   School of Dentistry, North Parana University, Brasil.
[**] School of Dentistry, Londrina State University, Brasil.
[***] Department of Applied Mathematics, North Parana University, Brasil.

Although Axelsson (2006) has pointed out the importance of new preventive methods in order to decrease dental caries risk, food retention in occlusal surface of primary molars is not usually evaluated; even some authors have reported that food retention can be a predictor of caries risk (Fraiz & Walter, 2001).

Considering that the food retention increases the risk of caries development, at this study, we aimed to evaluate the food retention in occlusal surfaces of first primary molars in 24-30 months old children.

MATERIAL AND METHOD

Ethical Procedures. Ethical Commitee of Londrina State University validated this study (no. 280/06). The selected children were submitted to methodological sequence after their parents or legal guardians signed an informed consent.

Experimental design and subjects. At this cross-sectional study, 34 children among 2 to 2.5 years old enrolled in dental program at Baby Clinic at Londrina State University were examined. This program offers educational and preventive dental care from the first to fifth year. The inclusion criteria for this study were lack of systemic diseases; totally eruption of first primary molars; caries free and absence of structural defects. Children that presented a non-cooperative behavior (crying or refusal of cookie intake) were also excluded from the study.

Data Collection

1. Dental Records Analysis. All the 634 patients' dental records that enter the program between april/2004 and march/2005 were analyzed. Considering that the children's first visit occur between 06 to 12 months old, all the children were 2 to 3 years old at the moment of research. The recorders were investigated in order to verify the inclusion criteria and 254 children were able to join the research.

2. Pilot study and Sample Determination. A pilot study was performed in order to establish the results variance and determinate the minimum sample size necessary for this study.

At this preliminary data, it was observed a variance of 3.13 (S2), assuming 5% as the significance level (p<0.05). Considering that the population was composed by 254 children (n) at the selected age, it was determinate that the minimum sample size was 12 children (24 teeth). In order to achieve reliable results, 34 patients were selected by lottery and were scheduled afterwards.

3. Clinical examination. The parents were informed about the risks and benefits of the research. The informed consent was signed. The clinical examination was carried out by visual inspection after the inclusion criteria was confirmed. After that, 7 children were excluded. However, the children excluded received the routine preventive procedure.

4. Retention areas recording. The child was instructed to intake a chocolate cookie (Negresco, São Luiz – Nestlé). This cookie kind was selected based on its color, flavor and adherence (Fraiz & Walter). The child had 2 minutes for cookie intake. After that, it was offered a glass of water (20mL) to remove the food excess of mouth.

A digital picture was taken after the cookie intake (initial time) and it was verified the permanence of cookie residues in the occlusal surface. The picture was taken with the digital camera Nikkon D-70S and macro lens Nikkon SB-29s. The focal distance was established in 0.32m, opening 32mm, speed 1/250'', dimension (2240 X 1488 pixels) and normal resolution were used for all pictures.

The child waited 30 minutes after the first picture without intake any kind of food or beverage until the new picture was taken (final time). After the pictures were taken, a prophylaxis was performed.

5. Impression to obtain study models. An adjustable impression tray usually used for topical fluoride application was cut and it was used to obtain the selected teeth impression. The material used was a condensation silicone (Optosil/ Xantopren, Heraeus Kulzer) in two steps with putty and fluid material. The impression should include the canine and second primary molar (if present in the mouth) or the first molar distal surface.

The teeth were dried with air jet to remove the saliva and the mold was washed in current water, dried and identified. The disinfection was performed with glutaraldehyde (2%) solution during 10 minutes in closed plastic container. After that, the mold was washed in current water and a liquid to reduce the tension surface (Tergensol) was applied.

6. Study casts. The type IV gypsum (GC Fujirock EP – GC Leuven – Belgium) was mixed according to the manufacturer proportion (100g powder/ 20ml deionized water). The stone die was obtained from casts and their height was established in 2cm. The study casts were used to obtain the mesio-distal distance of the first primary molars for further calibration in Image Tool 3.0 Software (USA) in order to calculate the food retention area.

7. Food retention surface analysis. The pictures were evaluated by Image Tool 3.0 software to quantify the food retention area in the occlusal surface. This area was calculated (mm^2) from previous calibration with study casts known measure, obtained with a digital pachymeter(Mitutoyo®, Andover, Hampshire, UK). For the mesio-distal distance measure, the outer limit of marginal crests of study casts was used. After that, the value obtained was transferred to digital image in order to reproduce at the picture the occlusal surface measure of the respective teeth.

A food retention surface index was established considering the relation between food retention area and total occlusal area at the initial and final time, according to modifications in the method described by Splieth & Nourallah (2006). This index allows the comparison of food retention surface area between maxillary and mandibular molars, even considering differences on teeth size.

Statistical Analysis. Differences between retention areas at the experimental times, t0 (0') e t1 (30') were assessed by Wilcoxon's test. Additionally, the retention areas in maxillary and mandibular at different experimental times were compared by Mann-Whitney's test. Moreover, the prevalence of food retention in maxillary and mandibular molars was compared by Chi Square's test. It was established a significance level of 5% (p<0.05) for all the statistical tests performed.

RESULTS

Patients' profile. Among the 27 patients included at the study, 14 were female and 13 were male with mean age of 29.5 months, being 29.4 the mean age observed for female and 29.5 for male.

Food retention surface index. Digital pictures were used to determinate food retention areas and the teeth were shared in two groups (Maxillary and Mandibular).

Pictures of retention pattern at the initial and final time for the maxillary and mandibular molars are presented in figure 1 and 2 respectively.
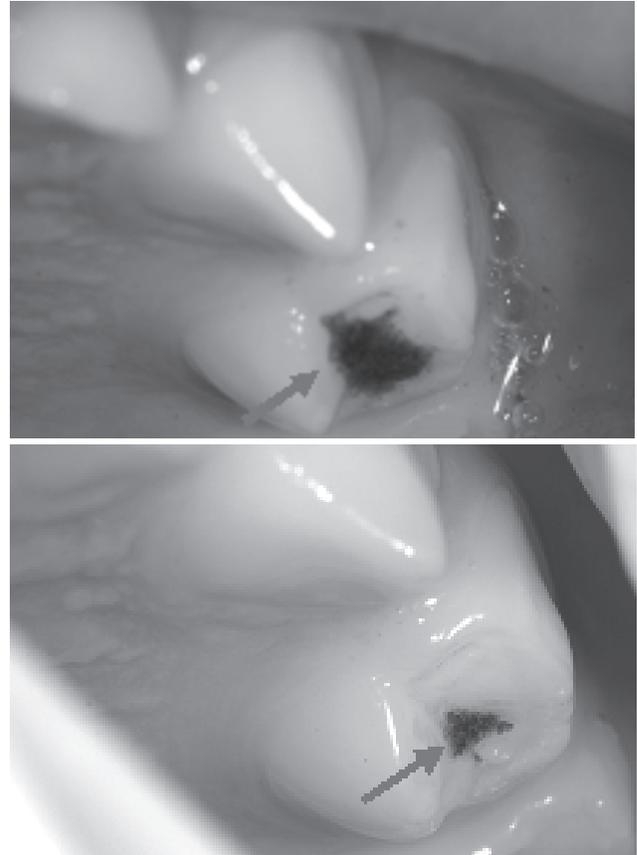

Fig. 1. Representative pictures of food retention pattern in the first primary maxillary molars at the initial (t0) and final (t1) experimental times.

At the maxillary group, 14 (51.9%) teeth presented food retention in occlusal surface after 30 minutes. Moreover, it was alsoobserved a marked reduction in food retention surface index (mm^2) at the final time (mean: 0.042 ± 0.015 mm^2) when compared to initial time (mean: 0.37 ± 0.04 mm^2), according to Wilcoxon's test (p=0.001). The data related to retention areas in maxillary teeth are presented in Figure 3.

At the mandibular group, 19 (70.4%) teeth showed food retention after 30 minutes. Moreover, it was observed that the food retention surface index at final time was statistically smaller (mean: 0.078 ± 0.019 mm^2) than the initial time (mean: 0.30 ± 0.03 mm^2), according to Wilcoxon's test (p< 0.01) as shown in Figure 3.
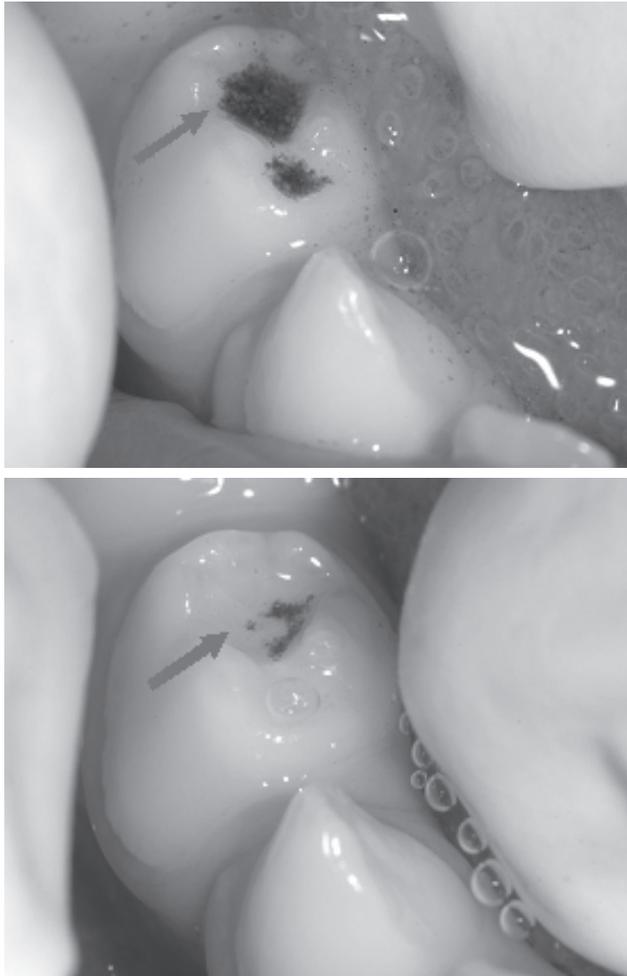
When the maxillary and mandibular groups were

Fig. 2. Representative pictures of food retention pattern in the first primary mandibular molars at the initial (t0) and final (t1) times.

compared, no difference was observed in food retention surface index between the maxillary and mandibular molars at the initial time, according to Mann-Whitney's test (p> 0.05). On the other hand, the mandibular molars show a food retention surface index higher than maxillary ones at the final time (mean Whitney's test, p= 0.04). These data are summarized in Figure 3. In addition, it was observed that the first primary mandibular molars retain more food at the final time (70.4%) when compared to the maxillary ones (51.9%), according to Chi Square's test (p=0.03).

DISCUSSION

Despite an increase in oral health status at industrialized countries is observed, the dental caries still represents an important infectious disease and it is a great concern in public health. Moreover, high DMFT index can be observed at world population, showing that curative techniques are being ineffective in dental caries control.

On the other hand, preventive measures have been considered the best approach to control dental caries progress as the disease affects the children since early childhood.

The infantile diet is related to dental caries growth by some aspects such as, ingestion frequency and food characteristics. Moreover, the food consistency and stickiness are associated with the time for food removal
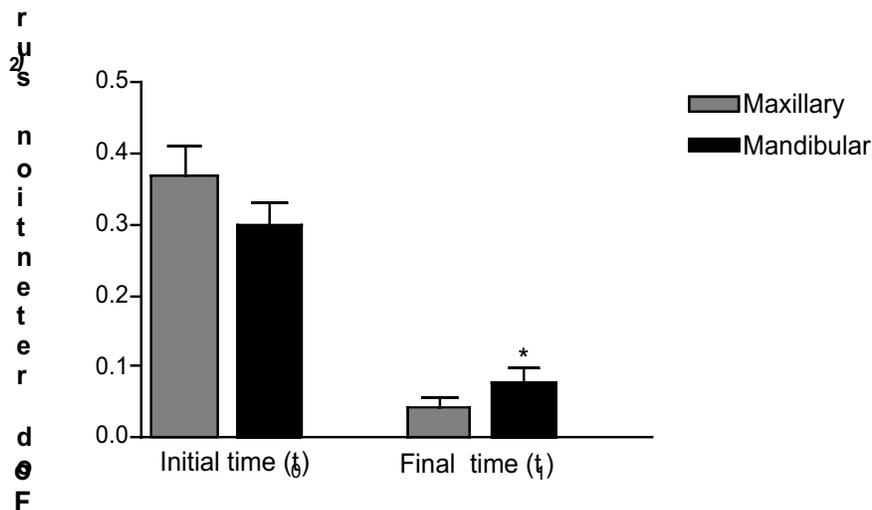

Fig. 3. Changes in food retention index (mean ± EPM) at the initial (t0) and final (t1) experimental times for the first primary maxillary (hatched columns) and mandibular (closed columns) molars * statistically significant, Mann-Whitney's test, p<0.05.

from the mouth, increasing dental caries risk (Morita *et al.,* 1993; Bratthall, 2007).

The period which the food remains in contact with the teeth is important for the activity of cariogenic bacteria. Additionally, plaque cariogenic levels are observed for 30 minutes after carbohydrates ingestion (Loesche). This aspect was considered at our study to determinate the interval period between the digital photographs.

There are many reports about the association between dental caries prevalence and food habits (Santos & Soviero, 2002). Wyne *et al*. (1995) reported that the sugar is mainly introduced in infantile diet at 17.4 months ($\pm$ 9.2) and the ingestion frequency is about 1.6 ($\pm$ 0.8) times/day. The changes at the diet pattern observed concomitantly to primary molars eruption tends to increase the dental caries risk at this period.

At this study, no differences were observed at the food retention area of maxillary molars when compared to mandibular ones at the initial time. However, at the final time, the mandibular molars presented a greater food retention area when compared to maxillary molars.

Moreover, it was also observed that the mandibular molars retain more food than maxillary molars at the final time. Considering that many authors report that food retention is related to an increase in caries risk, the retention pattern observed at our study may suggest a greater susceptibility of primary mandibular molars to dental caries. These data agree

with Mattos-Graner *et al.* (1998), where the authors observed that 48.4% of caries lesions in children of 1 to 2.5 years old was observed in mandibular molars. The primary molars show structural irregularities, such as grooves, pits and fissures located at occlusal surfaces that favors food retention and, consequently, an increase in dental caries risk. According to Oka et al., the presence of fissures in primary mandibular molars could be the responsible for the high caries prevalence at these teeth. These data are in agreement with our results since we observed greater food retention in mandibular molars, possibly caused by the complexity of occlusal surface.

The morphology is being described as a factor that can also evoke dental caries. The occlusal surface anatomy has pointed out as a strong clinical predictor of caries incidence (Powell, 1998; Maltz *et al.*, 1993). Moreover, this surface is related with 95% caries in the teeth (Harris & Garcia-Godoy, 1999).

Therefore, the knowledge about morphology and its relation to food retention in occlusal surfaces could represent an efficient method to establish preventive approaches for primary teeth.

According to the results observed, we can suggest that: There was no difference between the food retention index of first primary maxillary and mandibular molars at the initial time; At the final time, the food retention index is greater in mandibular when compared to maxillary molars; The prevalence of food retention in first primary mandibular molars (70.4%) is greater when compared to the maxillary ones (51.9%).

MENEGHEL, L. L.; FERNANDES, K. B. P.; LARA, S. M. H.; FERELLE, A.; STURION, L. & WALTER, L. R. F. Evaluación de la retención de alimentos en las superficies oclusales de los primeros molares temporales. *Int. J. Odontostomat., 4(2)*:117-122, 2010.

RESUMEN: Algunas características de los alimentos, como la viscosidad y consistencia, puede modificar el tiempo para el retiro de alimentos de la boca, así como favorecer la actividad de las bacterias cariogénicas, y el aumento de riesgo de caries dental. Este estudio tuvo como objetivos verificar la retención de alimentos en contacto con un sustrato cariogénico en niños de 24-30 meses de edad. 27 niños (54 dientes) fueron evaluados. Se realizo la ingesta de una galleta de chocolate, y la zona de retención del alimento fue documentada por la fotografía digital en dos tiempos de experimentación (to: 0 y t1: 30 minutos) y se calculó utilizando el software Image Tool 3.0. El índice de superficie (mm2) de retención de alimentos fue estadísticamente reducido (test de Wilcoxon, p = 0,001) después de 30 minutos para molares maxilares (to: 0,37 $\pm$ 0,04 y t1: 0,042 $\pm$ 0,015) y mandibulares (to:0,30 $\pm$ 0,03 y t1: 0,078 $\pm$ 0,019). No se observaron diferencias en El índice de superficie de retención de alimentos entre los grupos en el tiempo inicial. En el momento final, los molares inferiores muestran una zona de retención superiores a los maxilares (prueba de Mann-Whitney, p = 0,04). La prevalencia de la retención de alimentos en los molares inferiores fue más alta que los molares superiores (Chi cuadrado, p = 0,03). En conclusión, los primeros molares mandibulares primarios retienen más alimentos que los molares superiores, siendo concordante con los resultados clínicos de la prevalencia de caries.

PALABRAS CLAVE: caries dental, retención de alimentos; primer molar primario; riesgo; infantes.

REFERENCES

Axelsson, P. The effect of a needs-related caries preventive program in children and young adults: results after 20 years. *BMC Oral Health, 6*:S7, 2006.

Bratthall, D. *Basic cariology. Malmö University, Faculty of Odontology.* Available at <http://www.db.od.mah.se/car/data/basic.html> Accessed October, 2007.

Fraiz, F. & Walter, L. R. F. Study of the factors associated with dental caries in children who receive early dental care. *Pesqui. Odontol. Bras., 15*:201-7, 2001.

Feigal, R. J. & Donly, K. J. The use of pit and fissure sealants. *Pediatr. Dent., 28(2)*:143-50, 2006.

Harris, N. & Garcia-Godoy, F. *Primary preventive dentistry.* 5. ed. Stanford, Connecticut, Appleton and Lange, 1999.

Loesche, W. J. Role of Streptococcus mutans in human dental decay. *Microbiological Rev., 50*:353-80, 1986.

Maltz, M.: Barbachan e Silva, B.; Carvalho, D. Q. & Volkweis, A. Results after two years of non-operative treatment of occlusal surface in children with high caries prevalence. *Braz. Dent. J., 14*:48-54, 2003.

Mathewson, R. J.; Primosh, R. E.; Sanger R. G. & Robertson, D. *Fundamentals of Dentistry for Children.* Chicago, Quintessence, 1982.

Mattos-Graner, R. O.; Zelante, F.; Line, R. C. & Mayer, M. P. Association between caries prevalence and clinical, microbiological and dietary variables in 1.0 to 2.5-year-old Brazilian children. *Caries Res., 32*:319-23, 1998.

Ministério da Saúde. *Projeto SB Brasil – Condições de saúde bucal da população brasileira – Resultados Principais.* Brasília, Ministério da Saúde, 2004.

Morita, M. C.; Walter, L. R. F. & Guillain, M. Prévalence de la carie dentaire chez des enfants brésiliens de 0 à 36 mois. *J. d´Odontstomatol. Pédiatr., 3(1)*:19-28, 1993.

Oka, A. E.; N´Cho, K. J. C.; Catie, A. L.; Koffi, N. A. D. & Bakayoko-Ly, R. influence de la qualite et de la quantite de d'alimentation sur les dents chez l'enfant. *Odonto-Stomatol Trop., 102*:5-12, 2003.

Powell, L. V. Caries prediction: a review of the literature. *Community Dent. Oral Epidemiol., 26*:361-71, 1998.

Santos, A. P. P. & Soviero, V. M. Caries prevalence and risk factors among children aged 0 to 36 months. *Pesqui. Odontol. Bras., 16*:203-8, 2002.

Splieth, C. H. & Nourallah, A. W. An occlusal plaque index. Measurements of repeatability, reproducibility and sensitivity. *Am. J. Dent., 19*:135-7, 2006.

Steinberg, S. C. *Dental caries treatment as an infectious disease*. Skokie, Ill.: University of Illinois, 2005. Available at: <http://www.uic.edu/classes/peri/peri343/> .

Tinanoff, N. & Palmer, C. A. Dietary determinants of dental caries and dietary recommendations for preschool children. *J. Public. Health Dent., 60*:197-206, 2000.

Walter, L. R. F.; Lara, S. M. H.; Meneghel, L. L. & Fernandes, K. B. P. Retención de alimentos en la superficie oclusal de los segundos molares deciduos. *Int. J. Odontostomat., 2(2)*:189-95, 2008.

Wyne, A. H.; Adenubi, J. O.; Shalan, T. & Khan, N. Feeding socioeconomic characteristics of nursing caries children in a Saudi population. *Pediatr. Dentr., 17*:451-4, 1995.

Zero, D. T. Sugars: the arch criminal? *Caries Res., 38*:277-85, 2004.

Correspondence to:
Prof. Dr. Luiz Reynaldo de Figueiredo Walter
Rua Marselha 183, Jardim Piza
86041-100 Londrina PR
Tel: 43-33717820

Email: luiz.walter@unopar.br