STUDY OF CARIES ACTIVITY OF MIXED DENTITION IN BACĂU
PHD THESIS ABSTRACT

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STUDY OF CARIES ACTIVITY OF MIXED DENTITION IN BACĂU

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KEYWORDS: mixed dentition, children, caries, dental neglect scale, dental indifference scale, remineralization, demineralization.
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This PhD thesis contains pages and is illustrated by 87 figures and 39 tables. Documentation was performed using 225 references. The abstract of the thesis contains a limited number of figures, maintaining the numbering and contents from the thesis.
5.1. Introduction

Dental caries is an infectious disease in which bacterial fermentation from the plaque due to a rich diet of carbohydrates produces organic acids that erode the hard tissues of teeth, being the chronic disease with the highest prevalence in paediatric communities, affecting more than 40% - 50% of USA and UK children and 60% - 90% of children worldwide between the ages of 2 and 11 years.

Caries prediction methods can be helpful in identifying the patients with carious risk; also they can help in selecting a high risk fraction from a group of subjects. Caries prediction methods have been developed by combining bacterial tests and salivary tests with oral hygiene scores and dietary factors. Other prediction methods have combined these risk factors with risk indicators like the socioeconomic status.

Caries experience in three or more temporary molars at the age of 5 was the best predictor of caries experience in the permanent first molars at the age of 7. Numerous previous studies confirmed the major impact of the status of the temporary dentition depending on the occlusal plaque accumulation, reported brushing frequency and gender, on the incidence of visible caries experience in permanent first molars.

5.2. Aim of the study

The aim of the study: the optimisation of the child’s dental management, especially regarding the health and
odonto-periodontal integrity of mixed dentition with an especially long term pedodonto-orthodontic impact.

5.2. Materials and methods
In building, supporting and achieving the objectives and the intended purpose, we performed a clinical and paraclinical population based study from the point of view of carious activity in mixed dentition on a lot of 212 subjects (108 boys and 104 girls) with the ages between 6 and 12 years, originating from urban and rural areas of Bacau and Iasi.

Direct clinical examination and the registration of the patients was performed in the medical offices of the schools where the examined children were registered.

For the clinical examination we used: front light (artificial light), natural light, air pump, disposable gloves, sterile kits consisting of consultation dental mirror and dental probe.

The dmft/DMFT system was used for grading carious lesions.

The questionnaire used in this study contained varied questions about dental hygiene, snacks served during the day and sweets consumption.

5.3. Results
In our study group the male percentage is approximately equal to that of the females; subjects aged between 6 and 8 years are predominant (approximately 45%), followed by those aged between 8 and 10 years (approximately 36%) and the lowest percentage is represented by the 12 year old subjects (3.77%).

In 92.5% of cases the dmft value was greater than zero, in 50.98% exists an association with the value of the DMFT index higher than zero, and 33.33% have an association with the value of the DMFT index equal to zero.
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There were also cases (5.88%) where although the dmft value was zero, the DMFT value was greater than zero, fact which confirms the hypothesis that primary teeth affected by caries are not the only predictor of dental caries appearance in permanent dentition.

One of the prediction factors mentioned in specialty literature is the frequency of the tooth brushing. Low frequency of tooth brushing associated with dmft values higher than zero, lead to an increased risk of caries in permanent dentition (fig.5.4).

![Brushing frequency in the group of studied children](image)

Other mentioned risk factors are the consumption of carbohydrates and the number of snacks between main meals. In the studied lot most children admit eating sweets (86.79%), of which 65.21% have over two snacks a day between main meals.

By using the Pearson test (the most widely used type of significance test) it is observed that the health condition of young permanent teeth depends moderately inversely proportional to the number of brushings done in a day thus: as the number of daily brushings increases the number of caries in permanent dentition are less numerous; depends moderately directly proportional to the number of snacks between meals and carbohydrates.
intake thus: as the number of snacks taken between meals and carbohydrates intake increases the more numerous the carious lesions in the permanent dentition.

Regarding the health status of temporary teeth, with the help of Pearson test, it’s observed that it depends moderately directly proportional to the number of snacks taken between meals and the intake of carbohydrates thus: the higher the number of snacks between meals and the carbohydrates intake the higher the number of carious lesions in temporary dentition.

5.4. Discussions

In our study, as in other previous ones, is observed that the great majority of dmft values which are greater then zero are closely correlated with higher that zero values of DMFT.

Although previous carious experience is a good carious predictor, its main disadvantage is the fact that it is not possible to intervene in its change.

Multiple studies (Al-Malik et al., 2001; Ferreira et al., 2007; Gibson și Williams, 1999; Milgrom et al., 2000; Sohn et al., 2006; Tsai et al., 2006; Watson et al., 1999) found a significant association between the age at which the dental examination was conducted and the presence of cavitated caries.

Our study showed a predominance of subjects with the age between 6 and 8 years old (approximately 45%).

Although the decline of dental cavities in many countries is closely connected to the exposure to flouride and the improvement of dental hygiene, the eating habits still influence the risc of dental caries formation.

For many years the simplified message in order to prevent the occurence of dental caries was „do not eat too many sugar or sweet products”. During the last
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Decades the intake of sugar in many countries remained constant while the level of carious lesions decreased. This fact suggests that in the case of respecting oral hygiene (for example, regular brushing using fluoride toothpaste) the role of sugars in the occurrence of dental caries is less important.

5.5. Conclusions

It is considered that clinical variables (dmft, DMFT) can be relevant predictors for the occurrence of dental caries in mixed dentition and permanent dentition.

Caries lesions of primary teeth along with the consumption of carbohydrates (sweets) were associated with the occurrence of new lesions of permanent teeth in mixed dentition and in permanent dentition.

Increased frequency of tooth brushing associated with reducing snacks and the number of meals, are considered unfavourable elements for caries development in the permanent dentition.

CH. 6 STUDY OF CARIES ACTIVITY OF MIXED DENTITION IN TERMS OF DENTAL NEGLECT SYNDROME IN BACĂU

6.1. Introduction

Unhealthy behaviors adopted early in life, which can be modeled by dental experience, are likely to be maintained throughout the individuals life and, along with the cumulative effects of exposure to risk factors in sensitive periods of development, may lead to a precarious odonto-periodontal status over time (Luca 2003). In other words, the improvement of the body of knowledge and that of healthy attitudes (food hygiene, dental care, lifestyle) will ensure a state of optimal health existence, first in the adult and later to the elder, with
STUDY OF CARIES ACTIVITY OF MIXED DENTITION IN BACĂU

positive effects on the quality of life, in terms of oral health (Mesaros and Muntean, 2012).

Dental Neglect is a predictor of oral health deficit in both children and adults, manifested in behavior and/or attitudes of oral health understatement.

Signs of oral health neglect:
- untreated caries, infections, bleeding;
- trauma affecting the orofacial region;
- missing history of identified dental pathology treatment;
- presentation to the dentist for the first time with severe childhood carious lesions (baby bottle caries)

Thus, dental caries and periodontal disease, if left untreated, can lead to pain, infections and loss of function, which can affect in a negative way the process of learning, communication, nutrition and other activities needed for a normal growth and development of the child.

6.2. Aim of the study

The aim of the study was to optimize the child's behavioral and educational quality through his orodental health.

6.3. Materials and methods

The study was conducted, basically, by direct examination and registration of 636 patients, both male and female, aged between 6 and 12 years old, from both urban and rural areas of the Bacau county, Romania.

The average age of the subjects is 7.67 years, with a balanced gender distribution: 336 subjects (53%) male, and 300 (47%) female.
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The Dmft and DMFT system were used for marking caries, and Dental Neglect Score (DNS) for quantifying the dental neglect.

A questionnaire containing various questions, including the 6 questions from DNS, was used in this study. Each question had an answer based on a scale of 1 to 5, ranging from "Absolutely not" and "Definitely yes". Possible scores can fall between the values of 6 and 30, higher values indicating a higher degree of dental neglect.

6.4. Results

In the studied group we found that 39.62% of patients are 6 years old, 20.75% are 7 years old, 11, 32% are 8 years old, and the rest were aged between 9 and 12 years. The provenance of urban patients does not exceed by much the provenance of patients from rural areas (58.5% and 41.5%).

The appurtenance to the same gender of the subjects in the study group is about equally divided: 47.2% female and 52.8% male.

Regarding dental neglect we observe that DNS has values between 15 and 22, over 50% of the subjects having a high score (21 and 22), indicating a high degree of oral negligence.

In this study we ascertained that there is a correlation between the origin and the age of a patient, and dental neglect score (DNS) along with carious lesions. Thus it was observed that in rural areas complicated caries appear both in 3.6 and 4.6 (in 4.54% of the cases), and in urban areas only on 4.6 (in 3.22% of the cases). Simple caries occur more often in urban areas and pigmentation occurs more often in rural areas on first permanent molars, except 4.6.
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Also, it’s distinguishable that higher DNS values occur between the ages from 6 to 10 years old.

In our study is established that DNS values having a score between 20 and 22 are correlated with simple carious lesions on the first permanent maxillary and mandibulary molars in 32,075% of cases (fig. 6.3); DNS values with scores between 17 and 19 are present concomitant with complicated carious lesions on the first permanent molars in 5,66% of cases. Thus we observe a rapid evolution of the simple caries on the first permanent molars to a complicated form through oral health neglect.

Subjects in the study group were between the ages of 6 and 12 years old, presenting mixed dentition. It was found that the temporary first molar was affected by complicated caries in proportion of 10.37%, by simple caries in proportion of 31.59, while the temporary two molar was affected by simple caries in 10.84% of the cases and by complicated caries in 33.48% of the cases, plus damaged first premolar in 1.41% of cases by simple caries and complicated caries in 0.47% of the cases. These cavities influence by early affecting the first permanent molars in the maxillary with pigmentation, in a percentage of 14.15% of the cases and simple caries in a percentage of 9.43%, while the mandible is affected by pigmentation in a percentage of 17.92%, by simple caries in a percentage of 13.2% and by complicated caries in a percentage of 3.77%.

Thus we can assert that the health condition of temporari molars moderately influence the health condition of the first permanent molars.

In the studied lot it was observed that dental brushing is performed by most subjects (58,5%) once a day, while only 35,8% performs dental brushing twice a day, as is recomended, and the rest of 5,7% brush their
teeth only when they remember to. There are no significant gender percentage differences in the studied lot.

Regarding the number of snacks served in a day by the subjects in the studied lot it was noted that: 13.2% have less than two snacks in between meals per day, 39.6% receive two snacks a day, and 47.2% exceed two snacks a day, which determines a drop in pH levels multiple times during the day, thus a series of acidic attacks occur on the teeth.

![Carie simpla](image.png)

**Fig.6.3. Caries vs. SND**

24.5% of the subjects from the studied lot declared that they do not eat carbohydrates, the rest of 75.5% admit to the consumption of carbohydrates as being present in their diet.

In the present study a low significance statistical correlation can be observed between the development of carious lesions on young first permanent molars and the following socio-economic factors: the civil and occupational status of the parents, in this case there is an inversely proportional connection, meaning that the lesser the importance of the parents position the higher the
number of caries lesions on the child's first permanent molars.

6.5. Discussions

In previous conducted studies, the association between dmft index, dental brushing frequency and carbohydrates intake was analyzed, concluding that the association between a dmft value higher than zero (Helm, Helm, 1990), sweets consumption and irregulate dental brushing has a predictor role in the occurrence of approximated carious lesions, during adolescence, on the first permanent molars (Gray et al., 1991, Stenlund et al., 2001, Mejäre et al., 2001).

Previous studies revealed the fact that a higher dental brushing frequency associated with an elevated socio-economic (Devey et al., 1990, Diehnelt, Kiyak, 2001) and educational level of the parents corresponds with a significant lower number of carious lesions (Chankanka et al., 2011). Also in the present study a significant moderate correlation can be observed between the frequency of dental brushing, the parent’s educational level, position and profession, and an inversely proportionate impairment of the young first permanent molars.

The results of this study, by point of view of carbohydrates consumption, are approximately similar to the ones from a previous study conducted in the Clinic of Infantile Dentistry Iasi (cap. 5): 75,5% / 86,79% eat sweets, and 24,5% / 13,2% declare to not serving sweets.

In our study it was observed that there is a correlation between origin enviroment, the age of the patient with carious lesions and oral neglect (DNS). Various studies have reported the association between oral neglect and socio-demographic factors: age, gender,
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enviroment, socio-economic status, etc. (McGrath et al., 2007, Coolidge et al., 2009).

6.6. Conclusions
1. Both in urban and rural areas the predominant carious lesions in mixed dentition on temporary molars are the cavitary ones (simple and complicated caries), prevailing on mandibulary molars.
2. Dental neglect score, in the studied lot, has values contained between 15 and 22, higher values indicating an elevated level of oral neglect (over 50% have a DNS of over 20). Also it’s noticeable the fact that the values of dental neglect score are higher for the ages between 6 and 10 years. A fast evolution of the simple caries on the first permanent molars to a complicated form through the prism of oral neglect is noticeable.
3. Dental neglect score could be applied in the first consultation session and so oral neglect could be detected and prevented in advance.
4. Carious lesions of temporari teeth, along with carbohydrates intake (sweets), have been associated with the occurence of cavitary carious lesions on permanent teeth, and mainly with the impairement of the first permanent molars.
5. Given the fact that dental neglect score can have a long lasting effect on the general and oral health condition, it should be detected and reported to specialised centers.

CH. 7 STUDY OF ORAL CAVITY’S ENVIRONMENT AND DENTAL INDIFFERENCE SCALES IN BACĂU

11
7.1. Introduction
The human oral cavity is an open ecosystem exposed to various external factors during food intake and respiration. Intraoral microflora plays a vital role in maintaining homeostasis of the oral cavity. Saliva (salivary flow rate, buffering capacity and pH of saliva) and pathogenic bacteria associated with susceptibility intraoral dental structures (biochemistry and dental morphology) contributes to the development of dental caries in temporary dentition, mixed dentition and permanent dentition, this being the most common disease of the oral cavity in children. There are several ways to quantify pathogenic microflora in the oral cavity and salivary properties associated with caries in mixed dentition, some of which are: salivary biomarkers (salivary pH, salivary flow, buffer capacity), the presence of Streptococcus mutans and Streptococcus sobrinus, the presence of Lactobacillus spp, the concentration of metals in saliva (copper, magnesium, lead, etc.) and the most recent and innovative qualitative and quantitative PCR methods standard (standard polymerase chain reaction) and real time quantified PCR (qPCR).

7.2. Aim of the study
The purpose of the study is to determine whether conventional tests of saliva and cariogenic microorganisms can predict the carious activity in terms of Dental Indifference Scale.

7.3. Materials and methods
The study was conducted basically by direct examination and logging of 117 patients, both male and female, aged between 6 and 12 years, from the urban and rural areas of Bacau county.
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Direct clinical examination and patients logging was carried out in the medical offices of the schools to which the students belong.

The dmft and DMFT system were used for marking caries.

The salivary kit Saliva-Check Buffer was used in order to test the saliva samples and obtain the salivary pH level, the salivary flow rate and buffering capacity.

The salivary level of this bacteria is useful for the caries risk assessment from patient to patient, when used in combination with other clinical information. The SALIVA CHECK mutans test kit offers a semi-quantitative assessment for the levels of Streptococcus mutans in saliva, in 15 minutes, by using monoclonal antibodies.

To assess dental indifference a questionnaire was used which includes 8 questions, each question can have one or more answers. Maximum points available for the component score is one. The sum of all scores is to reach a total score of dental indifference. This can range from 0 to 8, with higher scores associated with high levels of dental indifference.

7.4. Results

On this study group, we found that 55.55% of subjects are 6 years old and 9 to 12 years, in equal proportions, and 44.44% are between 7 and 8 years, also in equal proportions. Parents accompanying children were aged between 30 and 59 years as follows: 65.8% were aged between 30 and 39 years, 22.2% between 40 and 49 years and 12% between 50 and 59 years. The number of patients originating from urban areas is twice higher than in rural areas (66.7% and 33.3%). Belonging to a specific gender, the children in the study group are
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roughly equally divided: 57.3% female and 42.7% male. Regarding the gender of the parent accompanying the child, it’s observed that females are about 4 times more dominant than males (77.8% and 22.2%).

Regarding Dental Indifference scale is noted that the score for children is between one and five, 68.4% with score of 1 and 2 in equal proportions, and the remaining 31.6% in roughly equal proportions between 3 and 5; the score for accompanying parents is between 1 and 5, with a score of 1 and 2 for 52.1% of subjects, and 3 to 5 for 47.9% of the subjects, which indicates a higher degree of dental indifference for the parents.

![Present of Str. mutans](image)

**Fig.7.8 Present of Str. mutans**

Dmft index value, a major predictors of dental caries in the permanent dentition is greater than 0 at the rate of 76.9% and coincides with the presence of Str. mutans in saliva, determined using a kit SALIVA-CHECK mutans and its cultivation on selective growth media (fig.7.9).

Between the child’s score of Dental Indifference scale and area of origin (r = 0.22, p <0.05) (table 3), and the presence of Streptococcus mutans there's a correlation of relatively low significance (r = 0.294, p <0, 01) (Table 3), while between this score and the parent’s score of Dental Indifference scale are moderately significant correlations (r = 0.683, p <0.01) (table3). The
value of the Dental Indifference scale for parents is inversely related to age, therefore as the parent's age is greater then the value of Dental Indifference scale is lower ($r = -0.248$, $p < 0.01$).

Between Dmft and the age of the child is observed that there is a significant moderate inverse correlation ($r = -0.377$, $p < 0.01$): as the child's age is greater then the value of the Dmft score decreases.

The presence of Str. mutans is inversely proportional to salivary biomarkers ($r = -0.420$, -0.457, -0.237, -0.481 respectively and $p < 0.01$ except for the buffering capacity when $p < 0.05$), in most cases there is a significant moderate correlation; thus, as the value of Str. mutans is higher the values listed in salivary tests are lower. The same inversely proportional ratio applies to the DMFT score value in relation to the salivary tests.

7.5. Discussions

From previously conducted studies which have in common the presence of Streptococcus mutans (Thibodeau, O'Sullivan, 1999), it has been observed that the carious index dmf/DMF was used in proportion of 90% as against ICDAS, which indicates the fact that dmf/DMF index is much easier to be used in a study as against ICDAS which demands certain conditions that are difficult to ensure outside the dental clinic. Also, it was noticed that both indexes have the same tendency, except ICDAS offers more information regarding evolution status, severity and carious lesions evolution on patients. In our study, due to the ease of usage, the chosen index for carious lesions was DMFT.

In some speciality literature studies, the diet (Mitrakul et al., 2013) has been associated with salivary biomarkers as follows: the drop salivary pH level due to sweets and carbonated drinks intake multiple times
during the day leads to multiple acidic attacks on the teeth in the same day, fact which can lead to the occurrence of carious lesions. It is also established the association between salivary biomarkers and oral hygiene habits, which, when their values are low, favor the development of carious lesions (Bhayat et al., 2013, Abbate et al., 2014).

In the present study, an inversely proportional relation was established between the presence of Streptococcus mutans and salivary biomarkers: the higher the number of bacteria the lower the values of salivary biomarkers.

In specialty literature it’s been noted that the scale of dental indifference is laborious to complete and apply in a dental clinic as compared to the score of dental neglect, which is much more easier to apply to the patient and for the doctor to calculate.

In the present study between the scale of dental indifference and dmft/DMFT values, implicitly the presence of Streptococcus mutans, there has been a significantly weak correlation, although in specialty literature the increased prevalence of caries are associated with oral hygiene neglect.

7.6. Conclusions
1. A good indicator for caries are cariogenic microorganisms. There is a strong correlation between the presence of clinical caries (DMFT) and Streptococcus mutans in saliva and plaque.
2. Presence of Streptococcus mutans is inversely proportional and statistically moderately significant, influenced mostly by: consistency of saliva, salivary pH, buffer capacity of saliva and salivary flow rate; in the same situation is the DMFT value.
3. Salivary tests for identification of Streptococcus mutans could be used in the dental clinic, as they are efficient, specific and deliver results in a short period if time (15 minutes). Also salivary test for identifying salivary biomarkers could be useful in a dental clinic in order to identify patients with an elevated carious rise.

4. Dental Indifference Scale is an easy method to use for oral health assessment; in our study there was a correlation between it and DMFT relatively low values, but there is a moderately significant correlation between the dental indifference score of the child and that of the parent’s.

CH. 8 COMPARATIVE IN VITRO STUDY REGARDING THE EFFECT OF DIFFERENT EMINERALIZING PRODUCTS ON PRIMARY AND PERMANENT TEETH ENAMEL AND DENTINE CARIES LESIONS

8.1. Introduction

Dental decay is a bacterial disease (Duckworth, 1994) that involves a dynamic process of cyclical demineralization and remineralization (Stoleriu et al., 2014, Elliott, 1994). It is considered a health condition when net mineral losses (etching) and net mineral gain (remineralization) remain in balance (Hassanein, El-Brolossy, 2006).

Initial demineralisation occurs under the enamel surface, the exterior enamel layer, generally, remains intact in early stages of caries development. Actually, a substantial amount of demineralisation can occur underneath without compromising the structural integrity of outer enamel.
STUDY OF CARIES ACTIVITY OF MIXED DENTITION IN BACĂU

Remineralization of the incipient caries lesions could be supported by fluoride therapy (Ten Cate, 2001, Ten Cate, 2008). Fluoride plays a key role in the remineralization of the tooth by accelerating the absorption of calcium and phosphate ions, and by incorporating the molecular structure of apatite (Van Rijkom et al., 2002). Fluoride takes the place of a hydroxide in the apatite structure resulting fluorapatite, which is stronger and more acid-resistant than the natural hydroxyapatite (Diedendefer, Stahl, 2008).

8.2. Aim of the study

The purposes of this research were to investigate the surface topography and to compare the potential of four commercial remineralizing products containing fluoride and hydroxyapatite to remineralize the enamel and the dentine of deciduous and permanent teeth.

8.3. Materials and methods

Fifteen primary molars and eight premolars were extracted in the Clinic of Pediatric Dentistry, Faculty of Dental Medicine, University of Medicine and Pharmacy, Iaşi, Romania. The primary teeth were extracted from 13 children of about 10 years old (7 female and 6 male) and the permanent premolars were extracted by orthodontic reason from 8 children of about 12 years old (5 female and 3 male).

The teeth were stored in 0.1 M lactic acid solution adjusted to a pH of 4, for 14 days. The solution was renewed every five days. After artificial caries lesion formation, the permanent teeth enamel samples were obtained by cutting the buccal and lingual surfaces of premolars using low speed diamond discs (Komet Dental, Brasseler GmbH&Co, Germany), under watercooling. For temporary teeth the enamel sample
was represented by the whole temporary crown. All the enamel samples of permanent and primary teeth were divided into five experimental groups.

In group 1, the samples have been stored in distilled water (control group). In groups 2 and 3 the enamel samples was brushed two times a day for fourteen days with a commercial fluoride gel (Colgate® 6+, CarrefourKids® +6). The interval between brushing sessions was of 8 hours. Every brushing session has been performed for 30 seconds using an electric toothbrush with a constant pressure and using a bean sized toothpaste aliquot wetted with tap water, closely resembling the in vivo usual tooth brushing procedure. After every treatment session, every enamel sample was washed with tap water using a cleaned toothbrush in order to remove residual toothpaste. In group 4, a water-based cream with fluoride and hydroxyapatite (Remin Pro®, Voco) was applied for 5 minutes two times a day for fourteen days. In group 5 the enamel samples were rinsed with 20ml antibacterial mouthwash with alcohol free natrium fluoride (Colgate® Plax) for 30 seconds two times a day for fourteen days.

Between the remineralizing cycles, the samples have been stored in artificial saliva (AFNOR NF S90-701). All the samples were then washed and kept in distilled water.

The surface topography has been analyzed using a scanning electron microscope VEGA II LSH (TESCAN, Czech Republic) and the quantitative and qualitative chemical composition has been evaluated using an EDX detector (QUANTAX QX2, BRUKER/ROENTEC, Germany).

8.4. Results

In group 1 aspects of distinct dissolution of
enamel and dentine surface were observed. Exposure of enamel prisms and the lost of interprismatic and prismatic material were showed by SEM evaluation.

Also dentine surface was evaluated with SEM.

For the samples in groups 2 and 3, rare areas of dissolution were surrounded by large areas of remineralization. The remineralizing pattern in these groups was very similar.

In group 4, young permanent teeth as well as temporary teeth, large areas of remineralization were clearly observed, supporting the fact that a commercial product that in addition to flourine as sodium flouride also contains hydroxyapatite, has a increased potential in the proces of enamel remineralisation.

Enamel samples from both young permanent teeth and temporary teeth from the study group 5 exhibit clean surfaces, without smear-layer zones of enamel demineralisation.

Chemical analysis of the enamel and dentine showed that the highest concentration of enamel ions was represented by calcium and phosphorus ions. For that reason, only calcium and phosphorus ions were reported as a result of enamel samples quantitative chemical analysis.

For primary teeth samples, lower values of calcium and phosphorus ion concentrations were recorded in groups 2-5 when compared to group 1. For groups 2 and 3 the values of calcium and phosphorus ion concentrations were nearly the same. In group 4 the concentration of both ions recorded the highest level from all study groups (groups 2-5). The lowest values of calcium and phosphorus ion concentrations were observed in group 5.

For permanent teeth samples, the values of calcium and phosphorus ion concentrations were very
close to those from control in groups 2 and 3. In group 4 the value of both ions concentration was higher than in groups 2, 3 and 5, but lower than that recorded in control group. In group 5 was recorded the lowest values of calcium and phosphorus ion concentrations from all the study groups.

The values of both ions were lower in enamel and dentine samples of primary teeth when compared to permanent enamel samples.

In all groups the calcium and phosphorus ion concentrations had the same tendency of variation.

8.5. Discussions

Commonly, acidic solutions were used to create carious lesions similar to those in vitro (acetic acid or lactic acid) (Hassanein, El-Brolossy, 2006, Yanagisawa, Miake, 2003), which do not compulsory produce deep lesion, but the surface of the enamel is etched. There has been a dissolving constant from the enamel surface to its thickness (Balan et al., 2015). In this study, the lactic acid 0.1 M solution was used to create artificial carious lesions.

In the present study, the best results regarding enamel remineralisation, were achieved with the water based fluorine and hydroxyapatite creme (Remin Pro®, Voco). The reconstruction of demineralized tissue with a material that has the same anorganic composition seems to be a very effective method to increase remineralisation (Hannig C, Hannig M, 2010). Using flouride and hydroxyapatite enamel remineralisation can increase due to the formation of surface apatite that covers the enamel (Roveri et al., 2009). Previous studies showed that covering biomimetic sinthesized hydroxyapatite is more crystalline than natural enamel apatite, but it does not represent a suitable restoration process for depositing
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apatite in the enamel demineralized zone (Roveri et al., 2009).

8.6. Conclusions
1. All the products tested in this study had the capacity to remineralize dental enamel and dentine of primary and permanent teeth, but the remineralization was not complete.
2. In all groups the calcium and phosphorus ion concentrations had the same tendency of variation atât la nivelul smârțului, cât și la nivelul dentinei.
3. The values of both ions were lower in enamel and dentine samples of primary teeth when compared to permanent enamel samples.
4. The products containing fluoride and hydroxyapatite showed a higher remineralization potential when compared to fluoride products.

CAP. 9 GENERAL CONCLUSIONS

- The most precise predictor for carious activity in young permanent dentition is represented by clinical variables, especially, carious experience with temporary dentition, followed by carious experience in mixed dentition.
- Carious experience from temporary dentition associated with the intake of foods rich in carbohydrates and elevated number of snacks between meals, were associated with the occurrence of new lesions in mixed dentition and permanent dentition. Carious lesions of temporary teeth
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alongside with carbohydrates intake were associated with the occurrence of carious lesions on the permanent teeth, especially on the first permanent molars.

- Correct oral hygiene associated with a reduction of carbohydrate rich foods intake and of the number of snacks between meals do not support the formation of new carious lesions on permanent dentition.

- Also, a high frequency of dental brushing in a day using a flouride toothpaste, associated with an elevated socio-economic level, a better education for the parents and the reduction of carbohydrates intake, are considered as being unfavorable elements for the development of carious lesions in permanent dentition.

- Dental neglect score, in the studied lot, indicated in over 50% of cases a high degree of oral negligence (values over 20). Also, it is noticed that values for dental neglect score are highest between the ages of 6 and 10 years, favoring a rapid evolution of the simple caries to a complicated form, on the first permanent molars.

- Dental indifference scale is another easy to use instrument for assessing oral health, but it is a little more difficult than dental neglect scale; in the present study there is a correlation between dental indifference scale and a dmft value which is relatively low, but there is a moderately significant correlation between the child’s dental indifference scale and that of the parents

- It has been observed that dental neglect score is easier to use than the dental indifference scale; dental neglect score could be performed during the consultation, being a good predictor for carious activity in permanent dentition.
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• Thus, prevention programs must be carried out in order to promote health education and awareness.
• A reason for success in designing prevention programs may rely on the combination of three factors: „school – parents – communication”, which seems to come closet o a child’s normal behaviour.
• Change in behaviour and attitude can only occur if the patient is motivated and educated accordingly. The final aim of these attempts is to increase the quality of life.
• Another good indicator of carious activity, besides previous carious activity, is the presence of cariogenic microorganisms in the oral cavity, as there is a strong corelation between the presence of clinical carious lesions (dmft) and that of Streptoccous mutans in saliva and plaque.
• In the present study, the existance of Streptoccous mutans is influenced, mostly, significantly moderate and inversely proportional by salivary biomarkers (saliva consistency, salivary pH, buffering capacity and flow rate), as well as the dmft value.
• Salivary tests for identifying Streptoccous mutans have been relevant and conclusive, offering the same results as those retrieved from cultivating Streptoccous mutans in special mediums, only that the time needed for these salivary tests is much shorter (15 minutes) compared to the other tests (48 hours). Thus, the fact that these salivary tests would be useful and indicated to be used in the consultation meeting to identify in a short period of time the presence of Streptoccous mutans, can be concluded.
• For the in vitro study realized the surface topography was analyzed with the help of an scanning electronic microscope, and it was noticed that all the products
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had the capability to remineralise the enamel and dentine of temporary teeth and young permanent teeth, but the remineralisation was not complete. It was also noticed that the products that contain fluoride and hydroxypatite have a greater potential to remineralise in comparison to the products that contain only flouride.

CAP. 10 STUDY’S ORIGINALITY AND THESIS PERSPECTIVES

Within the framework of the doctorate study, the main focus was centered on the evaluation of carious activity in mixed dentition on the regional level of Bacau city.

The research materialized in an exhaustive study through multiple interdisciplinary methods: clinical examination (dmft, DMFT), usage of the questionnaire (daily brushing frequency, number of daily snacks, carbohydrates intake), using the dental neglect score and oral indifference scale, alongside the usage of salivary tests in order to identify the presence of Streptococcus mutans while cultivating it in special growth enviroments. Salivary test were also used to determine the characteristics of salivary biomarkers. The research culminated with an in vitro study.

The predictor for carious activity in young permanent dentition was evaluated in the first study – carious experience from mixed dentition associated to dental brushing frequency, the intake of carbohydrates and the number of snacks served between the main meals of the day, in the regional level of Bacau city.
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The dental neglect score correlated to carious activity in mixed dentition was used in the second study, in the regional level of Bacau city.

The scale of oral indifference associated with the oral cavity medium was used for the third study. In order to find the characteristics of oral cavity medium salivary tests were used to determine the presence of *Streptococcus mutans* (Saliva Check Mutans) and salivary tests to determine the values of salivary biomarkers (Saliva Check Buffer). *Streptococcus mutans* was also cultivated on special growth mediums in order to determine if salivary test are exact and helpful, and the results reliable, so that they could be used in dental clinics during a consultation.

The results obtained from the two studies conclude that the dental neglect score and oral indifference scale can be correlated with the presence of carious lesions in mixed dentition and young permanent dentition, and, the presence of *Streptococcus mutans*. Thus dental neglect score and oral indifference scale could be applied, given the fact that dental neglect score is easier to use than oral indifference scale (the latter resorting to complex calculus), in a study designed to prevent among children, starting from the age of 6, the development of new carious lesions by identifying neglect in oral care. Salivary tests for identifying *Streptococcus mutans* could also be easier to use in dental clinics rather than incubating special growth cultures in a study which aims at preventing the development of carious lesions among children and young teenagers.

In the fourth and final study of this research, an in vitro study, a comparison was conducted regarding the effect of remineralisation products on carious lesions in enamel and dentine on temporary and young permanent teeth, representing an original aspect of this study. In this
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final study a topographical evaluation was conducted on enamel and dentine using a electronic microscope, SEM VEGA II LSH (TESCAN, Czech Republic) and a quantitative and qualitative evaluation of the calcium and phosphorus ions from enamel and dentine using as detector EDX (QUANTAX QX2, BRUKER/ROENTEC, Germany).

Obtained results from this in vitro study concluded that remineralisation products containing flouride and hydroxyapatite are much more effective than the ones containing only flouride. These products could be used in a in vivo study, associating them with brushing frequency, number of snacks during a day and the diet of children and young teenagers.

Thus, conducted research conclude the formulation of hypoteses that can materialize in future studies objectives.

A different research perspective is represented by the realisation of a longitudinal study on a greater lot of patients and an extended period of time, in order to evaluate carious activity in mixed dentition, by using the questionnaire method, dental neglect score, oral indifference scale and salivary tests along side with clinical examination.

Reference

Andrian S. Tratamentul minim invaziv al cariei dentare. Edited by Princeps Edit, Iași- Romania, 2002
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