SUMMARY
PH.D THESIS

CLINICAL AND LABORATORY STUDIES REGARDING CLINICAL-BIOLOGICAL INDICES RELATED TO DENTAL EROSIONS

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GENERAL CONCLUSIONS

REFERENCES
Key words: dental erosions, prevalence, acid agents, demineralisation, remineralisation, therapeutic management

PhD Thesis contains:
- stage of knowledge organised in 5 chapters (44 pages);
- personal studies organised in 5 chapters (176 pages);
- 163 tables and 131 figures;
- 326 references.

Note: the abstract presents selective references, tables and figures, respecting the content and counting in PhD Thesis.
CHAPTER VI. REASONS FOR RESEARCH THEME CHOICE. 
THE RESEARCH METHODOLOGY

VI.1. Reasons for the choice of research theme

The quality of dental assistance and technological novelties depend on the understanding of teeth properties, basic principles and mechanisms implied in the interaction with surrounding environment.

Last decade the dental erosion and the associated erosion wear are considered high risk factor for the integrity of hard dental tissues.

The initiation and evolution of dental erosion is influenced by structural characteristics of teeth, saliva properties, acids sources, parafunctional habits.

A major role in the initiation and evolution of dental erosions is played by the interaction between chemical factors (composition), biological factors (presence of saliva/acquired pellicle, salivary rate) as well as behavioural factors (habits regarding the way of beverages drinking, patterns of teeth abrasion after acid exposure).

Apart from visible clinical defects produced by dental erosion, the prolonged exposure to acid produces the changes of hard dental tissues physical properties. The demineralisation produced by dental erosion reduces the tooth resistance and makes tooth surfaces susceptible to erosion wear. The dental erosion is also linked by other forms of wear and increases the physical wear.

The erosion manifests as dental wear, with increasing rate at global level.

Actually there is no accurate data regarding each category of dental wear due to various indices systems that are not reflecting the ethiology as well as the epidemiological research models performed on populations with diverse characteristics and age groups. The interpretation and comparisons of epidemiological data studies is difficult due to the differences in terminology as well as high number of indices systems used in diagnostic, classification and monitorisation of erosive lesions categories.

Considering the increasing prevalence and incidence of dental erosion to childrens and young adults, the early diagnosis of dental erosions for these age categories will allow the approach for properly preventiv-therapeutical measures.

This approach is important considering the the negative impact of dental erosion on definitive denture followed by damage of interocclusal and intermaxillary relations requesting complex prosthetic therapeutical solutions with high financial and psychical costs for patients with dental erosions.

The dental pratitioners must posess theoretical and practical knowledges regarding the interaction between chemical, biological and behaviourial factors, major feature of patients with high risk.

Following the concern in current practice and during PhD preparation:
- the collecting of materials that integrate literature data regarding diverse forms of dental erosions.
- the study of clinical, paraclinical and systemic aspects of patients with dental erosions taken in research.
the statistical studies, clinical studies, experimental studies, were performed using a personal database recorded on patients diagnosed and treated in Clinical Base of Dental Medicine Faculty, U.M.F. “Grigore T.Popa”.

VI.2. Objectives

For the performing of proposed aims, were specified the objectives as follows:

- the structuring of a complex assessment program including diagnostic correlated with evolution stage and patients characteristics
- the statistical processing of clinical cases from a three years database
- the determination of ethiopathogenic factors
- the description of clinical elements and paraclinical examens used in the epidemiological study (prevalence, distribution of dental erosion in relation to the investigated parameters)
- the description of paraclinical examens used in in vitro studies regarding the demineralization and remineralisation processes to the enamel and dentine surfaces of teeth affected by dental erosions
- the description of questionnaire used to determine the opinions and therapeutical attitudes of dental practitioners.

VI.3. Research directions

The study was oriented to the research directions as follows:

- Clinical study regarding the identification of clinical cases with dental erosions and analysis of dental erosion distribution related to the researched factors (sex, age groups, dental groups, dental surfaces, sextants)
- The impact of extrinsic and intrinsic factors on prevalence, distribution and severity of dental erosions
- Chemical analysis of dental surfaces affected by dental erosion under action of chemical erosive agents like beverages and sports drinks
- Chemical and profilometric analysis of dental enamel and dentine surfaces affected by dental erosions and submitted to remineralisation processes by using CPP-ACP based products
- Paraclinical assessment of physical-chemical properties of some beverages and sport drinks with erosive potential
- The questionnaire-based study regarding the opinions and attitudes of dentists on diagnostic possibilities, treatment techniques and materials, patients vindicate and systemic factors analysis.
CHAPTER VII. PREVALENCE AND DISTRIBUTION OF DENTAL EROSIONS: EPIDEMIOLOGICAL STUDY

VII.1. AIM OF STUDY

The aim of study was to assess the prevalence, distribution and severity of dental erosion related to different clinic-biological indices on young adult patients.

VII.2. MATERIALS AND METHOD

The study group included 1296 patients investigated in Clinical Base of Dental Medicine Faculty U.M.F.”Grigore T.Popa” Iasi. Written consent was obtained for each patient. The study group included 594 males and 702 females (fig.7.1). 1074 patient were age 18-25, 192 patients in age 26-35, 75 patients over 35 years(fig.7.2.). The mean age was 24,45 years. A total number of 72 patients and 396 teeth were diagnosed with dental erosions. The severity of dental erosions was recorded using BEWE indices system (tabel 6).

Clinical aspects of dental erosions from study group are presented in figures 7.3.a-c.

![Fig.7.3.a. M.A., age 25. Dental erosions-anterior maxillary teeth. Frequent consumption of sport drinks.](image1)

![Fig.7.3.b.B.G., age 32. Dental erosions mandibular bicusps. Frequent consumption of beverages.](image2)
Fig. 7.3.c.M.N., age 35. Dental erosions mandibular bicuspids. Frequent consumption of soft drinks.

For each patient the examiner (PhD student) performed a clinical examen including localisation, BEWE indices, nutritional habits, lifestyle, parafunctional habits. All teeth were examined in same conditions of light and magnification. It were recorded data about consume (frequency, quantity) of beverages, soft drinks, cola drinks, fruit juices, sport drinks, acid aliments and medication with erosive potential.

Data were recorded as follows:
- presence/absence of dental erosions:
  - related to study group;
  - related to sex;
  - related to age group;
  - related to ethiological factor.
- distribution of dental erosion on dental groups/dental surfaces/sextants:
  - related to sex
  - related to age group;
  - related to ethiological factor.
- severity of dental erosion (BEWE system):
  - related to sex;
  - related to age group;
  - related to ethiological factor.
- distribution related to combination sextant/dental surface/ BEWE/sex/age group.

<table>
<thead>
<tr>
<th>SCORE BEWE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No dental hard tissues loss</td>
</tr>
<tr>
<td>1</td>
<td>Low enamel loss</td>
</tr>
<tr>
<td>2</td>
<td>Distinct defect, hard dental tissue loss&lt;50% surface area</td>
</tr>
<tr>
<td>3</td>
<td>Distinct defect, hard dental tissue loss&gt;50% surface area</td>
</tr>
</tbody>
</table>

The database was created using Microsoft Office EXCEL 2007. The data statistical processing was performed using software SPSS 17 (SPSS Inc, SUA). The statistical data were presented as mean values and standard deviations. P<0.05 was considered as having statistically significant result.
VII.3. RESULTS AND DISCUSSIONS

The results regarding the prevalence of dental erosions and their distribution in relation to sex, age groups, dental surfaces, dental groups, sextants, are presented in the next graphs.

The prevalence for all study group was 6% (fig.7.4.).

A difference related to dental erosions prevalence was observed between males (7%) and females (4%) (fig.7.5.a-b).

![Prevalence of dental erosions](image1)

![Prevalence of dental erosions related to patients sex](image2)

Fig.7.4. Prevalence of dental erosions

Fig.7.5.a-b. Prevalence of dental erosions related to patients sex
Related to age groups, prevalence of dental erosions is 6% for age group 18-25, 4% for age group 26-35 and 8% for patients over 35 years (fig. 7.6.a-c).

Related to erosive ethiological factors, 75% of patients with dental erosions are associated with consume of beverages and soft drinks. The consume of sport drinks is observed for 8% patients with dental erosions, a similar value with patients under erosive medication and patients with GERD (gastro-esophageal reflux disease) (fig. 7.8.).

Related to dental surfaces, highest values of prevalence of dental erosions are 23% for lateral buccal dental surfaces and 16% for buccal anterior maxillary teeth (fig. 7.11.).
Fig. 7.12. Prevalence of dental erosions related to ethiological factors

Related to ethiological factors (fig. 7.12.), 32% from total number of dental erosions are observed to patients consuming sport drinks, 21% to patients frequent consume of beverages, soft drinks and fruit juices, 19% to patients under erosive medication, and 14% to patients with GERD.

The distribution of BEWE indices (severity of dental erosions) related to the investigated factors is presented in the next graphs.

The BEWE mean value is higher for females (5.2) than males (4.7) (fig. 7.13.). Patients over 35 years are associated with highest BEWE mean value (8), followed by age 26-35 (7) and age 18-25 (4,1) (fig. 7.14.).

The sextants S4 and S6 present highest BEWE mean value (1.25) (fig. 7.15.).

Related to ethiological factors, patients associated with sport drink consume present highest mean BEWE values (9), followed by medication (8), beverages (4,2) and GERD (4) (fig. 7.16.).
The statistical study aimed to confirm or deny the null hypothesis regarding the absence of statistical differences regarding prevalence and severity of dental erosions between different clinical-biological indices.

Statistical analysis regarding prevalence of dental erosions related to sex
(dental erosion study group)

Table 7.III. Mann-Witney, Wilcoxon tests. Grouping variable: Sex

<table>
<thead>
<tr>
<th>Test Statisticsa</th>
<th>VAR00008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mann-Whitney U</td>
<td>576.000</td>
</tr>
<tr>
<td>Wilcoxon W</td>
<td>1479.000</td>
</tr>
<tr>
<td>Z</td>
<td>-0.625</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>0.532</td>
</tr>
</tbody>
</table>

Table 7.III. indicates Mann-Whitney test, with U value 576, and p = 0.532 > 0.05. This result confirms the absence of statistically significant differences between mean values BEWE for males and females.

Statistical analysis regarding prevalence of erosions related to age group
(dental erosion study group)

Non-parametric Kruskal Wallis test was applied for all age groups to confirm or deny the existance of significant statistically differences between age groups.

Table 7.IV.a. Kruskal Wallis. Prevalence of dental erosions related to age groups

<table>
<thead>
<tr>
<th>Test Statisticsab</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>8.875</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>0.012</td>
</tr>
</tbody>
</table>

a. Kruskal Wallis Test
b. Grouping Variable: Age groups

Statistically significant differences were obtained for the three age groups (table 7.IV.a). Mann Whitney test was applied for each pair of age groups.
Statistical analysis regarding prevalence of erosions related to age group (dental erosion study group)

Table 7.b. Kruskall-Wallis test. Prevalence of dental erosions related to dental groups

<table>
<thead>
<tr>
<th>Test Statistics&lt;sup&gt;a,b&lt;/sup&gt;</th>
<th>NrErosions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>81.614</td>
</tr>
<tr>
<td>df</td>
<td>5</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

<sup>a</sup> Kruskal Wallis Test  
<sup>b</sup> Grouping Variable: Dental groups

The results of Mann-Whitney test show significant statistically differences between the investigated dental groups (table 7.V.b.).

Statistical analysis regarding prevalence of erosions related to age group (dental erosions study group)

Table 7.VI.a. Mann-Whitney, Wilcoxon tests. Beverages vs. medication

<table>
<thead>
<tr>
<th>Test Statistics&lt;sup&gt;b&lt;/sup&gt;</th>
<th>NrEroziuni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mann-Whitney U</td>
<td>162.000</td>
</tr>
<tr>
<td>Wilcoxon W</td>
<td>183.000</td>
</tr>
<tr>
<td>Z</td>
<td>.000</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>1.000</td>
</tr>
<tr>
<td>Exact Sig. [2*(1-tailed Sig.)]</td>
<td>1.000&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Not corrected for ties.  
<sup>b</sup> Grouping Variable: FactorEroziv

Table 7.VI.a indicates Mann-Whitney test, with U value 162.000, and p = 1.000 > 0.05. This result confirms the absence of statistically significant differences between mean values BEWE for beverages and medication.

Table 7.VI.b. Mann-Whitney, Wilcoxon tests. Beverages vs. sports drinks

<table>
<thead>
<tr>
<th>Test Statistics&lt;sup&gt;b&lt;/sup&gt;</th>
<th>NrEroziuni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mann-Whitney U</td>
<td>36.000</td>
</tr>
<tr>
<td>Wilcoxon W</td>
<td>1521.000</td>
</tr>
<tr>
<td>Z</td>
<td>-3.168</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.002</td>
</tr>
<tr>
<td>Exact Sig. [2*(1-tailed Sig.)]</td>
<td>.001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Not corrected for ties.  
<sup>b</sup> Grouping Variable: FactorEroziv

Table 7.VI.b. indicates Mann-Whitney test, with U value 36.000, and p=0.002< 0.05. This result confirms the existance of statistically significant differences between mean values BEWE for ethiological factors beverages and sport drinks. and females.
Our study shows reduced values of dental erosions prevalence (6%) comparing with literature data related to adolescents and young adults: Arnadottir&col. (23.2% în Islanda), Bardsley&col. (27.1% în Marea Britanie), van Rijkom&col. (16% în Olanda), Vargas-Fereira&col. (7.2% în Brazilia), Kumar&col. (8.9% în Brazilia), Wang&col. (23.2% în China), Okunseri&col. (39% în SUA), Margaritis&col. (50% în Grecia) /10, 30, 169, 229, 287, 290, 299/.

Related to ethiological factors, 75% patients consume frequently beverages and soft drinks, result sustained by the literature data.

Al-Dlaigan&col. (2001) show that 80% adolescents consume beverages with 23% high and frequent consumers (>2/ săptămână) /2/. Chrysanthakopoulos NA (2012) assessed the prevalence and the associated ethiological factors in Greece on adolescents /52/. The results show a high rate of dental erosions (33.8%) associated with high frequency of beverages and fruit juices and with rinsing habits before to swallow. Curcă&Danilă (2010) investigated prevalence and severity of noncariogenic lesions using Smith&Knight indices on 614 pacienţi with age over 18 years /58/. 2.9% from noncariogenic lesions with indice 1 are dental erosions, percent that increases to 7.9% for noncariogenic lesions with indice 2. 20% noncariogenic lesions with indice 3 Smith &Knight are dental erosions. From patients that consume alcohol, 87% are affected by dental erosions with high rate of indice 3, comparing with only 50% in control group. Micu Magdalena – Ioana (2010) reports a 7.6% frequency of pure dental erosions related to all noncariogenic lesions found in patients over 18 /206/. Ganns C&col. (2001) found a prevalence of 11.6% in Germany, while O’Brien (1993) found 30% in Great Britain /95/.

Kunzel&col. (2000) found specific localisation of dental erosions to buccal surfaces of lateral and central incisive of dental erosions in study group of childrens that consume high quantities of orange juices /171/. Also O’Brien (1993) found frequent localisation of dental erosions to buccal and oral dental surfaces to adolescents and young adults that consume beverages and fruit juices /225/. Vered Y&col. (2014) performed an epidemiological BEWE-based study regarding prevalence and distribution of dental erosions in 500 adolescents and young adults /291/. The results show the presence of dental erosions on over 50% subjects with 10% having dental erosions more than half of dental surfaces. Mean value of BEWE increased with age and erosive diet. Holbrook WP. &col. (2014) found 30.7% prevalence of dental erosions for age group 15 ani (38.3% males, 22.7% females) and BEWE mean values 1.00 for males and 0.42 for females (p<0.001) /132/. Valorile BEWE au prezentat diferenţe semnificative statistic comparativ cu vârsta 12 ani (19.9% băieţi, 11% fete) cu scoruri medii BEWE de 0.22 pentru băieţi şi 0.079 pentru fete.

The correlation between beverage consume and prevalence of dental erosions are explained by superior content of phosphoric acid compared to citric acid, malic acid, lactic acid phosphoric acid in cola drinks, with higher erosive potential /303/. The consume of energy drinks, especially during physical exercises is also associated to increased prevalence and severity of dental erosions /136/.
VII.4. CONCLUSIONS

- The prevalence of dental erosions is reduced in Romania (6%) with higher values for males (8%) and lower values for females (4%).

- Related to age group, highest values of dental erosions frequency are associated to patients over 35 years (8%) and lowest values for patients in age group 26-35 (4%).

- Related to localisation, most affected are sextants S4 and S6, buccal surfaces of lateral teeth and buccal surfaces of anterior maxillary teeth, and mandibular molars and bicusps.

- Related to ethiological factors, most affected by dental erosions are patients with high consume frequency of beverages and soft drinks.

- Related to severity, the distribution is balanced with 33% for mild dental erosions, 33% for moderate dental erosions and 33% for severe dental erosions.

- Higher BEWE mean values BEWE are associated to patients high consumers of sport drinks (BEWE 9), while patients high consumers of beverages have 4,5. Highest BEWE values are encountered to females (5.2), patients over 35 years (8.00), sextants S4 and S6 (BEWE 1.25) and erosive medication (BEWE 8.00).
CHAPTER VIII. STUDY IN VITRO REGARDING EROSION PROCESSES INDUCED BY ACID AGENTS

VIII.1. AIM OF STUDY

The aim of study was to investigate the topography and to analyse chemically the enamel submitted to the action of various acid agents in the presence and absence of acquired salivary pellicle.

VIII.2. MATERIALS AND METHOD

The study group included 15 unaffected teeth extracted from orthodontic or periodontal reasons extrași din motive ortodontice sau parodontale (Fig. 8.1.). The teeth were sectioned in three slices using diamond discs (Komet Dental, Brasseler GmbH&Co, Germania), under water cooling (Fig. 8.2.). The samples were immersed for 7 days in artificial saliva AFNOR, changed at every 24 hours. For each tooth one sample was maintained as control: 1 minute in distilled water, followed by 4 hours immersion in artificial. Another sample was immersed for 12 hours in acid agents: Red Bull, green tea Lipton, apple juice Auchan, mineral water Borsèc, lemon juice (Fig. 8.3.). The last sample was submitted to a cycle demineralisation-remineralisation three times: demineralisation by immersion in acid solution for 1 minute, followed by remineralisation in artificial saliva for 4 hours. These protocols were selected to simulate the real conditions acid beverages consume in oral cavity. After each demineralisation the samples were washed in distilled water.

The solutions pH: 3,4 for Red Bull, 3,0 for Lipton – green tea, 3,4 for apple juice, 3,2 for mineral water, 2,4 for lemon juice.

Fig. 8.1. Teeth in study group

Fig. 8.2. Slices of teeth after sectioning

Fig. 8.3 Acid solutions used in study
After samples preparation, these were analysed to investigate surface topography, using electronic microscope VEGA II LSH, TESCAN Cehia; the chemical analysis was performed using EDX detector QUANTAX QX2, BRUKER/ROENTEC Germany (Fig. 8.4.).

Fig. 8.4. Electronic microscope and EDX detector

VIII.3. RESULTS AND DISCUSSIONS

The figures 8.5., 8.6., 8.7. present aspects of enamel for control samples, samples under continuous immersion and alternative immersion in apple juice as erosive agent.

For samples immersed in apple juice the erosion was moderate as observed in figures 8.6. and 8.7.

The figures 8.8., 8.9., 8.10. present aspects of enamel for control samples, samples under continuous immersion and alternative immersion in green tea as erosive agent.
For samples immersed in apple juice the erosion was moderate, similar with apple juice study group, as observed in figures 8.9. and 8.10.

The figures 8.11., 8.12., 8.13. present aspects of enamel for control samples, samples under continuous immersion and alternative immersion in apple juice as erosive agent.

For samples immersed in apple juice the areas of erosion alternated with unaffected enamel, as observed in figures 8.12. and 8.13.

The figures 8.14., 8.15., 8.16. present aspects of enamel for control samples, samples under continuous immersion and alternative immersion in lemon juice as erosive agent.
In the study group with continuous immersion in lemon juice, a pronounced dissolution of enamel prisms was observed with the exposure of interprismatic enamel areas (Fig. 8.15.); this aspect is different from study group with alternative immersion (Fig. 8.16.) with more reduced demineralisation areas.

The figures 8.17., 8.18., 8.19. present aspects of enamel for control samples, samples under continuous immersion and alternative immersion in Red Bull as erosive agent.

The enamel samples immersed in acid solution in the absence of acquired salivary pellicle were associated with severe dissolution of enamel areas with chipped aspect (Fig. 8.18.). The enamel samples immersed in acid solution in the presence of acquired salivary pellicle (obtained by previous immersion in artificial saliva) were associated with intact enamel areas with mild erosion in the adjacent areas (Fig. 8.19.).
The mean values of Ca and P (wt%) in enamel surfaces for all study groups are presented in table 8.XVI.

<table>
<thead>
<tr>
<th>Ions concentration (wt%)</th>
<th>Apple juice</th>
<th>Green tea</th>
<th>Mineral water</th>
<th>Lemon juice</th>
<th>Red Bull</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ca</td>
<td>P</td>
<td>Ca</td>
<td>P</td>
<td>Ca</td>
</tr>
<tr>
<td>Control</td>
<td>2.65</td>
<td>2.67</td>
<td>1.84</td>
<td>3.56</td>
<td>2.65</td>
</tr>
<tr>
<td>Continuous immersion in acid solution</td>
<td>0.13</td>
<td>2.20</td>
<td>0.39</td>
<td>2.24</td>
<td>9.58</td>
</tr>
<tr>
<td>Alternative immersion in acid solution and saliva</td>
<td>1.25</td>
<td>2.51</td>
<td>1.69</td>
<td>2.83</td>
<td>1.07</td>
</tr>
</tbody>
</table>

It was observed a tendency for the decrease of Ca and P ions levels following immersion in acid solutions.

For all five acid solutions, the values of Ca and P ions concentrations were closer to control group for alternative immersion study group comparing with continuous immersion study group (Figurile 8.20-8.25).

Fig.8.20. Ca and P variation in enamel for control, solution, test. Apple juice as acid solution.

Fig.8.21. Ca and P variation in enamel for control, solution, test. Green tea as acid solution.

Fig.8.23. Ca and P variation in enamel for control, solution, test. Mineral water as acid solution.

Fig.8.24. Ca and P variation in enamel for control, solution, test. Lemon juice as acid solution.

Fig.8.25. Ca and P variation in enamel for control, solution, test. Red Bull as acid solution.
Values were statistically analysed using Mann-Whitney, Anova and Bonferoni tests. Tables 8.XX.a-b present the results of Mann-Whitney test for comparison of calcium ions concentration in solution study group and test study group immersed in RedBull.

<table>
<thead>
<tr>
<th>lot</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enamel/Ca solution</td>
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<td>3.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Enamel/Ca test</td>
<td>5</td>
<td>8.00</td>
<td>40.00</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
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**Test Statistics**

<table>
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<tr>
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<th>Enamel/Ca</th>
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<tr>
<td>Mann-Whitney U</td>
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<td>Wilcoxon W</td>
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<td>-2.611</td>
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<td>Asymp. Sig. (2-tailed)</td>
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</tr>
<tr>
<td>Exact Sig. [2*(1-tailed Sig.)]</td>
<td>.008a</td>
</tr>
</tbody>
</table>

a. Not corrected for ties.

b. Grouping Variable: lot

Statistically significant results were obtained when comparing the concentration of calcium ions in solution study group and test study group (p=0.009 < 0.05).

Statistically significant results were obtained when comparing the concentration of calcium ions in solution study group and test study group (p=0.009 < 0.05).
Tables 8.XXVI.a-b present the result of Anova test used to compare the P ions concentration between solution study group and test study group immersed in lemon juice.

Table 8.XXVI. Anova test. Comparison of Ca and P levels between control, solution study group and test study group. Acid agent- juice lemon

<table>
<thead>
<tr>
<th>Anova</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>enamel Between Groups</td>
<td>355.777</td>
<td>2</td>
<td>177.889</td>
<td>88944.333</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>.024</td>
<td>12</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>355.801</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>enamel Between Groups</td>
<td>21.619</td>
<td>2</td>
<td>10.809</td>
<td>4567.394</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>.028</td>
<td>12</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>21.647</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>enamel Between Groups</td>
<td>23.569</td>
<td>2</td>
<td>11.784</td>
<td>6148.435</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>.023</td>
<td>12</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>23.592</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>enamel Between Groups</td>
<td>8.577</td>
<td>2</td>
<td>4.289</td>
<td>4765.185</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>.011</td>
<td>12</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>8.588</td>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With p<0,05 the statistical test demonstrates the existance of statistically significant differences between the study groups.

Table 8.XXIX presents the results of Anova test for comparison between Ca and P ions concentration in control group, solution study group and test study group immersed in mineral water.

Table 8.XXIX. Anova test. Comparison of Ca and P levels between control, solution study group and test study group. Acid agent- mineral water

<table>
<thead>
<tr>
<th>Anova</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>enamel Between Groups</td>
<td>23.569</td>
<td>2</td>
<td>11.784</td>
<td>6148.435</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>.023</td>
<td>12</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>23.592</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>enamel Between Groups</td>
<td>8.577</td>
<td>2</td>
<td>4.289</td>
<td>4765.185</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>.011</td>
<td>12</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>8.588</td>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With p<0,05 the statistical test demonstrates the existance of statistically significant differences between the study groups.

Table 8.XXXII presents the results of Anova test for comparison between Ca and P ions concentration in control group, solution study group and test study group immersed in green tea.
Table 8.XXXII. Anova test. Comparison of Ca and P levels between control, solution study group and test study group. Acid agent - green tea

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca enamel</td>
<td>8.967</td>
<td>2</td>
<td>4.483</td>
<td>2861.809</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>.019</td>
<td>12</td>
<td>.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8.986</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P enamel</td>
<td>4.372</td>
<td>2</td>
<td>2.186</td>
<td>2676.939</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>.010</td>
<td>12</td>
<td>.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4.382</td>
<td>14</td>
<td></td>
<td></td>
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<tr>
<td>Total</td>
<td>24.886</td>
<td>14</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

With p<0.05 the statistical test demonstrates the existence of statistically significant differences between the study groups.

Table 8.XXXV presents the results of Anova test for comparison between Ca and P ions concentration in control group, solution study group and test study group immersed in apple juice.

Table 8.XXXV. Anova test. Comparison of Ca and P levels between control, solution study group and test study group. Acid agent - apple juice

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca enamel</td>
<td>1.325</td>
<td>2</td>
<td>.663</td>
<td>17.500</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>.454</td>
<td>12</td>
<td>.038</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.779</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P enamel</td>
<td>.277</td>
<td>2</td>
<td>.139</td>
<td>168.510</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>.010</td>
<td>12</td>
<td>.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>.287</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36.051</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With p<0.05 the statistical test demonstrates the existence of statistically significant differences between the study groups.

Numerous in vitro and in vivo researches assessed the erosive potential of different drinks and foods.

The chelating properties of citric acid can increase the erosive process in vivo by the interaction with saliva, apart from direct demineralisation and mineral dissolution from hard dental tissues /202/. Some experimental in vitro studies demonstrated more powerful action of citric acid comparing with phosphoric acid for similar titratable acidity /302/.

The content of Ca and P of drinks is an important factor that influences concentration gradient in local environment from tooth surface. The adding of Ca and P salts in acid drinks conducted to promising results regarding the prevention of dental erosions /16, 26, 174/.

The sport drinks have powerful erosive activity especially when consumed during physical training sessions and associated with dehydration their erosive activity is more pronounced /136/.
Regarding topographic changes, the results obtained by our study, following immersion of enamel samples unprotected by acquired salivary pellicle in acid solutions, are similar with literature data /202/.

Drinks pH has a direct influence on the dissolution rate of enamel. The phosphoric acid, citric acid and Na citrate are frequently found in beverages and sport drinks /51/. The acids with chelating properties can produce dissolutions even at high levels of pH /289/.

The content of Ca and P in foods and drinks influences local environment but despite the effect of reducing progression, not always the minerals addition can completely prevent the initiation of dental erosions /186/.

In this context the results obtained by personal study have important clinical implications for dental practitioners.

**VIII.4. CONCLUSIONS**

1. The concentrations of Ca and P ions decreased after immersion in the tested acid solutions;

2. Highest decrease of Ca and P ions from enamel surfaces was recorded for immersion in lemon juice, followed by Red Bull, mineral water, apple juice and green tea;

3. The presence of acquired salivary pellicle offered protection to enamel surfaces, as Ca and P concentrations were less diminished comparing with the enamel surfaces immersed in acid solutions in the absence of acquired salivary pellicle.
CAPITOL IX. THE EVALUATION OF THE EROSION EFFECT OF SOME BEVERAGES FOR ATHLETES AND THE PROTECTIVE EFFECT OF SOME REMINERALIZING PRODUCTS ON HARD DENTAL TISSUES

IX.1. THE AIM OF STUDY:

I. To determine pH and viscosity of three drink sports used to sustain physical training

II. To assess and compare the effects of these sport drinks on surface hardness of enamel and dentine

III. To assess and compare the effects of the three sport drinks on enamel and dentine after remineralisation cycles with fluor-based products.

IX.2. MATERIALS AND METHOD

The three sport drinks used in study are as follows: Gatorade liquid (Pepsico), energising tablets Isostar lemon (Isostar) CytoMax orange powder (CytoSport). The sport drink Isostar was obtained by dissolving a tablet in 250 mL pure water (Borsec, Romaqua Group), and sport drink CytoMax was obtained by dissolving one powder measure (25 mg) in 250 mL pure water (Borsec, Romaqua Group).

The sport drinks pH was determined using electronic pH-meter (Hanna pH 210). 10 measurement were performed for each sport drink reporting mean value.

The reological study was performed using Anton Paar, Physica MCR 501 with Peltier system of temperature regulating (figure 9.1.). The temperature was regulated in a range -40 -200°C. The measurement were performed using a geometry with cylinders.

The flow curves were performed using a shear rate between 0.001-100 1/s, at a temperature 37 °C and a time 5 minutes.

The study group used 33 unaffected teeth extracted for orthodontic reasons. The teeth were maintained in distilled water. The teeth were sectioned using diamond discs (Komet Dental, Brasseler GmbH&Co, Germania), under water cooling, aiming to obtain 2 horizontal slices (2 mm thickness). These slices were cut buccal-oral in two halves, obtaining four slices for every tooth. The dental sections were divided randomly in two groups: study group I included 40 samples, study group II included 90 samples. In study group I 10 samples
were maintained continuously in artificial saliva, as control group (control group 1), 10 samples were submitted to the erosive action of sport drink Isostar (Isostar): 5 series of 3 minutes immersion in sport drinks on 2 hours daily, for 14 days (study group 2). Another 10 samples were submitted to the erosive action of sport drink CytoMax (CytoSport): 5 series of 3 minutes immersion in sport drink on 2 hours daily, for 14 days (study group 3); another 10 samples were submitted to the erosive action of sport drink Gatorade (Pepsico): 5 series of 3 minutes immersion 2 hours daily, for 14 days (study group 4).

Between erosive action of sport drinks, slices were maintained in artificial saliva. Artificial saliva for this study was AFNOR standard S90-701, with pH 8,67 and next composition: NaCl 0,7g/L; KCl 1,2 g/L; Na2HPO4 0,26 g/L; NaHCO3 1,5g/L; KSCN 0,33 g/L; uree 1,35 g/L. The times of immersion in sport drinks were chosen to simulate the administration conditions during daily sport training. Each sample was immersed in same quantity (15 mL) of tested drink, and these were changed after each immersion. The artificial saliva was changed daily. In study group II, 30 samples were submitted to the previous immersion protocol in Gatorade (study group 2), 30 samples were submitted in CytoMax (study group 3), 30 samples were submitted to the previous immersion protocol in Isostar (group 4), but for 10 samples in each study group, previous to first immersion, was applied toothpaste Colgate Total® for 3 minutes (Colgate Company) (subgroup a), to 10 samples fluor gel Densell Company for 1 minute (subgroup b), and to 10 samples MI Paste Plus for 3 minutes (GC Company) (subgroup c).

The prepared samples were submitted to the analysis of surface microhardness for enamel and dentine using digital devices CV 400 DAT (Namicon) (figure 9.2.).

The microhardness was tested using Vickers method to compare variation of mechanical properties of anisotropic materials /259/.

The measuring were performed using a testing device with diamond head at 136° angle and 2,5 mm diameter. Indentation were performed with 50 g force with a minimal distance between two consecutive indentation 1 mm. The number of indentation for each sample was 3, with mean value recorded after 3 measurements. The criteria for an indentation were as follows: sharp on diagonal edges, uniform, without unregular areas in tested areas (figure 9.3.). The microhardness was calculated after formula: D=1854,4·F/d² (N/mm²) (D=Vickers microhardness, F= test force, d= lengh of diagonal edge).
IX.3. RESULTS AND DISCUSSIONS

The pH values of the three tested drinks were: 4.01 for Isostar, 4.74 for CytoMax, 3.23 for Gatorade.

The flow curves for all tested sport drinks are presented in graph 9.4.

The mean values of viscosity for all sport drinks are presented in table 9.III.

Table 9.III. Viscosity mean values

<table>
<thead>
<tr>
<th>Shear Rate(s⁻¹)</th>
<th>Gatorade (mPa·s)</th>
<th>Isostar (mPa·s)</th>
<th>CytoMax (mPa·s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0681</td>
<td>6.66</td>
<td>4.64</td>
<td>64.6</td>
</tr>
<tr>
<td>0.1</td>
<td>2.58</td>
<td>0.239</td>
<td>58.2</td>
</tr>
<tr>
<td>0.147</td>
<td>2.82</td>
<td>0.618</td>
<td>52.7</td>
</tr>
<tr>
<td>0.215</td>
<td>2.21</td>
<td>1.56</td>
<td>44.6</td>
</tr>
<tr>
<td>0.316</td>
<td>1.18</td>
<td>1.24</td>
<td>33.8</td>
</tr>
<tr>
<td>0.464</td>
<td>1.1</td>
<td>1.09</td>
<td>25.7</td>
</tr>
<tr>
<td>0.681</td>
<td>1.16</td>
<td>1.11</td>
<td>19</td>
</tr>
<tr>
<td>1</td>
<td>0.778</td>
<td>0.648</td>
<td>14</td>
</tr>
<tr>
<td>1.47</td>
<td>0.948</td>
<td>0.773</td>
<td>10.4</td>
</tr>
<tr>
<td>2.15</td>
<td>0.901</td>
<td>0.808</td>
<td>8.6</td>
</tr>
<tr>
<td>3.16</td>
<td>0.915</td>
<td>0.827</td>
<td>6.91</td>
</tr>
<tr>
<td>4.64</td>
<td>0.892</td>
<td>0.785</td>
<td>5.91</td>
</tr>
<tr>
<td>6.81</td>
<td>0.906</td>
<td>0.795</td>
<td>5.15</td>
</tr>
<tr>
<td>10</td>
<td>0.902</td>
<td>0.798</td>
<td>4.57</td>
</tr>
<tr>
<td>14.7</td>
<td>0.915</td>
<td>0.821</td>
<td>4.05</td>
</tr>
<tr>
<td>21.5</td>
<td>0.94</td>
<td>0.847</td>
<td>3.67</td>
</tr>
<tr>
<td>31.6</td>
<td>0.953</td>
<td>0.86</td>
<td>3.36</td>
</tr>
<tr>
<td>46.4</td>
<td>0.984</td>
<td>0.891</td>
<td>3.14</td>
</tr>
<tr>
<td>68.1</td>
<td>1.04</td>
<td>0.943</td>
<td>2.99</td>
</tr>
<tr>
<td>100</td>
<td>1.08</td>
<td>1.05</td>
<td>2.84</td>
</tr>
</tbody>
</table>
Highest viscosity value was recorded for sport drink CytoMax, followed by Gatorade and Isostar.

The mean values and standard deviations of microhardness values are specified in table 9.V.

Table 9.V. Mean values and standard deviations of hardness values in study group I (MPa)

<table>
<thead>
<tr>
<th>Statistic</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control saliva dentin</td>
<td>10</td>
<td>55.40</td>
<td>59.10</td>
<td>57.2300</td>
<td>.27731</td>
</tr>
<tr>
<td>Isostar I dentin</td>
<td>10</td>
<td>173.40</td>
<td>219.80</td>
<td>203.0500</td>
<td>3.25833</td>
</tr>
<tr>
<td>CytoMax I dentin</td>
<td>10</td>
<td>35.80</td>
<td>37.20</td>
<td>36.5600</td>
<td>.11944</td>
</tr>
<tr>
<td>Isostar I enamel</td>
<td>10</td>
<td>173.00</td>
<td>174.70</td>
<td>173.8000</td>
<td>.15986</td>
</tr>
<tr>
<td>CytoMax I enamel</td>
<td>10</td>
<td>47.00</td>
<td>47.60</td>
<td>47.3000</td>
<td>.11944</td>
</tr>
<tr>
<td>Gatorade I enamel</td>
<td>10</td>
<td>173.90</td>
<td>174.90</td>
<td>174.4000</td>
<td>.15986</td>
</tr>
</tbody>
</table>

The mean values of enamel microhardness after immersion in sport drinks were lower than control group (mean value 113.8 after immersion in Isostar, 110.3 after immersion in CytoMax and 105.6 after immersion in Gatorade). The same tendency was recorded for dentine microhardness (mean value 36.56 after immersion in Isostar, 37.13 after immersion in CytoMax and 22.90 after immersion in Gatorade). The highest values of microhardness were recorded for Isostar and lowest values were recorded for Gatorade both for enamel and dentine.

The statistical analysis was performed using Kruskal Wallis test for dentine microhardness. The statistical results show statistically significant differences between the four study groups with p = 0.0001 < 0.05 (tables 9.VII.a-b.).
The mean values and standard deviations of microhardness values are specified in table 9.V.

Table 9.XXV. Mean values and standard deviations of hardness values (MPa) in study group II

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
<td>Statistic</td>
<td>Statistic</td>
<td>Statistic</td>
<td>Std. Error</td>
</tr>
<tr>
<td>IsostarII pastad dentine</td>
<td>10</td>
<td>25.50</td>
<td>26.70</td>
<td>26.1300</td>
<td>.13085</td>
</tr>
<tr>
<td>IsostarII pastad enamel</td>
<td></td>
<td>34.90</td>
<td>36.40</td>
<td>35.7000</td>
<td>.17575</td>
</tr>
<tr>
<td>IsostarII fluor dentine</td>
<td></td>
<td>45.10</td>
<td>46.90</td>
<td>45.0000</td>
<td>.18148</td>
</tr>
<tr>
<td>IsostarII fluor enamel</td>
<td></td>
<td>203.10</td>
<td>205.50</td>
<td>158.3000</td>
<td>.22657</td>
</tr>
<tr>
<td>IsostarII Mi Paste dentine</td>
<td>10</td>
<td>44.00</td>
<td>46.60</td>
<td>46.0600</td>
<td>.29740</td>
</tr>
<tr>
<td>IsostarII Mi Paste enamel</td>
<td></td>
<td>154.80</td>
<td>162.60</td>
<td>204.0000</td>
<td>.80567</td>
</tr>
<tr>
<td>CytomaxII Pastad dentine</td>
<td>10</td>
<td>55.00</td>
<td>57.90</td>
<td>41.2600</td>
<td>.29061</td>
</tr>
<tr>
<td>CytomaxII Pastad enamel</td>
<td></td>
<td>185.00</td>
<td>188.30</td>
<td>186.9600</td>
<td>.33106</td>
</tr>
<tr>
<td>CytomaxII fluor dentine</td>
<td></td>
<td>64.90</td>
<td>67.90</td>
<td>56.5300</td>
<td>.32457</td>
</tr>
<tr>
<td>CytomaxII fluor enamel</td>
<td></td>
<td>224.30</td>
<td>244.70</td>
<td>202.1600</td>
<td>1.73917</td>
</tr>
<tr>
<td>CytomaxII Mi Pastad dentine</td>
<td>10</td>
<td>39.80</td>
<td>42.40</td>
<td>66.1300</td>
<td>.27536</td>
</tr>
<tr>
<td>CytomaxII Mi Paste enamel</td>
<td></td>
<td>187.70</td>
<td>219.00</td>
<td>234.6600</td>
<td>3.60753</td>
</tr>
<tr>
<td>GatoradeII Pastad dentine</td>
<td>10</td>
<td>38.70</td>
<td>40.30</td>
<td>33.7000</td>
<td>.21554</td>
</tr>
<tr>
<td>GatoradeII Pastad enamel</td>
<td></td>
<td>129.80</td>
<td>131.90</td>
<td>130.7600</td>
<td>.24459</td>
</tr>
<tr>
<td>GatoradeII fluor dentine</td>
<td></td>
<td>33.10</td>
<td>34.20</td>
<td>39.8300</td>
<td>.11832</td>
</tr>
<tr>
<td>GatoradeII fluor enamel</td>
<td></td>
<td>145.90</td>
<td>146.70</td>
<td>138.9600</td>
<td>.09452</td>
</tr>
<tr>
<td>GatoradeII Mi Pastad dentine</td>
<td>10</td>
<td>38.50</td>
<td>39.10</td>
<td>39.5300</td>
<td>.06333</td>
</tr>
<tr>
<td>GatoradeII Mi Paste enamel</td>
<td></td>
<td>138.30</td>
<td>139.50</td>
<td>146.2600</td>
<td>.13013</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The use of MI Paste and fluoride gel previous to immersion in Isostar conducted to higher microhardness values of enamel and dentine (204.00 Mpa and 46.06 MPa, respectively 158.30 Mpa and 45.00 Mpa, comparing to values associated to use of toothpaste before immersion in sport drinks (35.70 Mpa și 26.13 MPa). Highest enamel and dentine microhardness values were recorded for the use of MI Paste before immersion in sport drinks (234.66 MPa and 66.13 Mpa), followed by the use of fluoride gel (202.16 MPa și 56.53 Mpa) and toothpaste (186.96 and 41.26 Mpa).

The results of Anova test for dentine microhardness values showed statistically significant differences with p = 0.0001 < 0.05 (table 9.XXVII).
Table 9.XXVII. Anova test. Comparison between dentine hardness values

<table>
<thead>
<tr>
<th>Remineralisation dentine</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>11307.358</td>
<td>8</td>
<td>1413.420</td>
<td>2714.699</td>
<td>.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>42.173</td>
<td>81</td>
<td>.521</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11349.531</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Statistically significant differences were recorded between the all remineralisation products with two exceptions: between the use of toothpaste and the use of MI Paste before immersion in Gatorade and between the use of fluoride gel and the use of MI Paste before immersion in Isostar.

The microhardness values for enamel were analysed with Anova test. The results showed statistically significant differences with p = 0.0001 < 0.05 (tables 9.XXIX.a-b.).

Table 9.XXIX.a-b. Anova test. Comparison of enamel hardness values

<table>
<thead>
<tr>
<th>Remineralisation enamel</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>269536.921</td>
<td>8</td>
<td>33692.115</td>
<td>1787.317</td>
<td>.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1526.904</td>
<td>81</td>
<td>18.851</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>271063.825</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Statistically significant differences were recorded for all remineralisation products with exception of the use of fluoride gel before immersion in Isostar and Cytomax.

The epidemiological studies reports direct relation between excessive consume of soft drinks and the increase of dental erosions prevalence /212,160/. The erosive properties of beverages, fruit juices, sport drinks are associated significantly with pH values, acidity, content of flour and phosphorus ions and enamel surface microhardness /195/. The erosive properties of liquids are also associated to titratable acidity, acid quantity temperature and buffering properties /142, 257, /.

The in vitro studies demonstrate that low pH beverages produce erosion to the level of hard dental tissues /104,174,176 /. Also all tested sport drinks in personal research showed erosive potential on enamel and dentine, sustaining the literature data/151/.

In personal study the sport drinks with lowest pH had the highest erosive potential while drinks with high pH, reduced titratable acidity and higher concentrations of calcium, phosphat and fluore ions present reduced erosive potential /210/.

The samples analysed by flow curves present inverse relation between viscosity and shear rate due to high water quantity /166/. In personal study the sport drink with highest viscosity (Gatorade) is not associated with highest erosive potential on enamel and dentine. This result demonstrates that clearance rate does not influence the erosive properties of beverages.

The citric acid and phosphoric acid present pronounced erosive effect on hard dental tissues due to chelating properties on calcium ions/203,259,260/. The erosive potential of sport drinks tested in personal study is also explained by the content of citric acid.

MI Paste plus combines milk phosphoproteins with calcium phosphate. The agent CPP stabilises calcium ions and phosphat ions forming complexes with fast adsorption. The same concept is associated to Recaldent product.
The classification of erosive potential of various beverages and foods accordingly to their pH, titratable acidity, calcium, phosphat and fluor ions is complicated, if not impossible. Also it must be considered behavioural factors and biological factors (eat and drinking habits, diet content of fruits and vegetables, oral hygiene practices) and biological factors (salivary rate, buffering ability, acquired pellicle, teeth anatomy).

**IX.4. CONCLUSIONS**

1. Highest pH value was found for sport drink CytoMax, followed by Isostar and Gatorade.
2. Highest viscosity value was recorded for sport drink CytoMax, followed by Gatorade and Isostar.
3. All three tested sport drinks determined the significant decrease of enamel and dentine microhardness, as effect of their erosive potential on enamel and dentine.
4. Gatorade was associated with highest erosive effect on enamel and dentine, followed by CytoMax and Isostar.
5. The use of fluor toothpaste, fluor gel MI Paste (caseine, calcium phosphate, fluor) previous to immersion in sport drinks, reduced the erosive effects of sport drinks both for enamel and dentine.
6. The most protective effect on enamel and dentine was recorded for MI Paste Plus, followed by fluoride gel (fluoride gel Densell) and tooth paste (Colgate total).
7. Enamel microhardness associated to the previous use of remineralisation products was significantly higher than dentine microhardness.
CHAPTER X. STUDY REGARDING KNOWLEDGES AND ATTITUDES OF DENTISTS ON DIAGNOSTIC AND TREATMENT OF DENTAL EROSIONS

X.1. AIM OF STUDY

The aim of study was to assess the knowledges and attitudes of dentists from Iassy regarding diagnostic and therapeutical management of dental erosions.

X.2. MATERIALS AND METHOD

A questionnaire was sent to 79 dentists working in private dental practices in Iassy. The informations regarding sex, age, experience were collected.

The questionnaire included, in first part, 15 questions regarding attitudes in diagnostic of dental erosions, experience about prevalence, ethiological factors, preventive and therapeutical means used, options regarding treatment techniques and materials.

Second part included a dental erosions clinical case with photos and anamnesis data and questions regarding their preventive-therapeutical options and restoration type.

The dentists were classified in three classes of experience: 64 dentists with 0-5 years experience, 6 dentists with 6-10 years experience and 9 dentists with over 10 years experience (fig 10.1.). The age range was 25-58 years, and the sex distribution was 23 males, 56 females (fig 10.2.).

The collected data were recorded, analysed and expressed using Microsoft Excel.

10.3. RESULTS AND DISCUSSIONS

The distribution of dentists opinions in entire study group and related to the experience category (1-5 years; 6-10 years; over 10 years) is presented in the next graphs.

QUESTIONS I- Diagnostic attitude and experience regarding prevalence< distribution and ethiological factors.

I.1. Do you record dental erosions in clinical papers?

85% dentists record dental erosions, 100% for 6-10 years experience, 88% for 0-5 years experience and only 56% for dentists over 10 years experience (fig.10.3.a-b).
1.2. What system do you use to record and assess dental erosions?

81% dentists use a simple system to assess dental erosions; 13% do not use any system, only 6% use a complex system for the recording of dental erosions (Smith&Knight, BEWE etc) (fig.10.4.a).
Simple assessing systems are used by 88% for 1-5 years experience, 67% for 6-10 years experience and only 44% for dentists over 10 years experience. Complex assessing systems are used by 66% 6-10 years experience and over 10 years experience, 67% for 6-10 years experience and only 44% for dentists over 10 years experience (fig.10.4.b).

**1.8. From your experience, do you consider that actually prevalence of dental erosions increased comparing with 5-10 years ago?**

44% dentists consider that prevalence of dental erosions increased if reported to 5-10 years ago, 56% can’t appreciate and only 3% consider that prevalence of dental erosions remained at same level (fig.10.10.a).
The opinion that prevalence of dental erosions increased was accounted for 38% dentists with 0-5 years experience, 33% dentists with 6-10 years experience, 78% dentists over 10 years; it can’t be appreciated for 59% dentists with 0-5 years experience, 67% dentists with 6-10 years experience, 22% dentists with over 10 years experience (fig.10.10.b).

I.9. From your experience, what dental group do you consider as most affected by dental erosions?

67% dentists consider that mandibular molars are most affected by occlusal dental erosions, while 44% dentists consider that maxillary anterior teeth are most affected by cervical erosions (fig.10.11.a).
I.11. Did you identified most probable ethiological factor of dental erosions?

59% dentists could not identify in most cases the ethiological factor of dental erosions after anamnesis and clinical examen, 33% dentists identify only occasionally, 8% identify rarely the ethiological factor (fig.10.13.a).
Related to dentists with 0-5 years experience, 59% dentists can identify usually the probable ethiological factor, 34% identify occasionally, 6% identify rarely. Related to dentists with over 10 years experience, 78% dentists can identify usually the probable ethiological factor, while 22% identify rarely. (fig.10.13.b).

**QUESTIONS II - THERAPEUTICAL ATTITUDE, TECHNIQUES AND MATERIALS USED FOR THERAPY OF DENTAL EROSIONS**

**II.1. Do you treat always, sometimes, never dental erosions?**

42% dentists treat always the diagnosed dental erosions, 33% dentists treat some of the diagnosed dental erosions, and 25% send patients to specialists if diagnose complex pathology of dental erosions (fig.10.18.a).
The dental erosions are treated always by 47% from dentists with 0-5 years experience, 33% from dentists with over 10 years experience; the diagnosed dental erosions are treated but not all by 25% dentists with 0-5 years experience and by 44% dentists with over 10 years experience (fig.10.18.b).

II.4. For patients with dental erosions what type of preventive/therapeutical measures do you used?(scale from 1 to 8): A.Advices about oral hygiene; B.Advices about diet; C.Correction of salivary rate; D. Fluoride mouthwashes; E. Fluoride gels; F. CPP-ACP products (Recaldent, Tooth Mooth); G. Chlorhexidine mouthwashes/gels; H. Correction of systemic factors implied in dental erosions ethiology.
The advices about oral hygiene (17%) and diet (16%) and fluoride mouthwashes (13%) with are the most used preventive/therapeutical measures for patients with dental erosions. There is no significant differences between dentists related to experience regarding the investigated preventive and therapeutical measures (fig.10.21.a-b).
II. Do you treat cervical erosive lesions always, sometimes, never?

67% dentists treat always and 33% treat sometimes cervical dental erosions (fig.10.23.a).

Regarding cervical erosive lesions and related to experience, 72% dentists with 0-5 years experience treat always, 28% sometimes; 56% dentists with over 10 years experience treat always, 44% sometimes (fig.10.23.b).
II.7. What kind of materials do you use in treatment of dental erosions? (scale from 1 to 7): A. Amalgam; B. Hibrid composite resins; C. Compomers; D. Glassionomer cements; E. Ceramic veneers; F. Metal or ceramo-metal crowns.

![Material use in restorative therapy of dental erosions (study group)](image)

![Material use in restorative therapy of dental erosions (experience)](image)

In the treatment of dental erosions, amalgam is most used by 17% dentists, followed by composite resins (16%), compomers (16%) s glassionomer cements (15%). Dentists with 0-5 years experience used most frequently glassionomer cements (18%), dentists with 6-10 years experience used most frequently composite resins (19%), and dentists with over 10 years experience used most frequently composites flow (19%) (fig.10.24.a-b).

Despite increasing focus of researchers on dental erosions, Dugmore&Rock (2003) proved that most dentists motivate occasionally or rarely patients to treat this pathology /68/. 

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Mulic A&col. (2010; 2012) identified an improper level of informations regarding dental erosions and erosive wear from dentists to patients included in risk categories /214, 215, 216/.

The personal study proved that actually the dentists working in private practices in rare aware on the importance of dental erosion pathology, diagnostic possibilities and treatment. However most dentists do not use a specific indices system to record dental erosion. Also there are no uniform opinions regarding distribution of dental erosions in relation to parameters like sex and age. However most dentists are aware that dental erosions predominate to males patients age 15-25, associated with high consume of beverages and soft drink, result similar with literature data /93, 189/.

The result of personal study sustain the results of Sabahipour L.&Bartlett D(2009) which found that most dentists in Great Britain use composite resins as materials for the therapy of dental erosions, while in Europe this percent reduces to 33%, 50% decide not to treat teeth affected by dental erosions, and 10% treat with ceramo-metal crowns /261/.

10.4. CONCLUSIONS

- Most dentists in private dental cabinet in Iassy are aware of the importance to diagnose and treat dental erosions.
- The ethiological factors is detected most by dentists with experience over 10 years (78%).
- Dentists consider that most affected teeth are mandibular molars (occlusal erosions) and anterior maxillary teeth (cervical erosions).
- The preventive-therapeutical measures related to oral hygiene advices, diet advices, fluoride mouthwashes are largely used both by dentists under 5 years experience and dentists over 10 years experience.
- In therapy of dental erosions, amalgam is most used by 17% dentists, followed by composite resins (16%), compomers (16%) glassionomer cements (15%).
GENERAL CONCLUSIONS

- The dental erosion prevalence is low (6%) with higher values (8%) in the male population and smaller values (4%) in the female population.

- In relation to the age group, the highest values of dental erosion prevalence (8%) are found at patients older than 35 years; the lowest values of dental erosion prevalence are found at patients between the ages of 18 to 25 years (4%).

- In relation to etiological factors, the highest values of dental erosion prevalence were found at patients associated with consume of beverages and soft drinks; 75% of the patients sample with dental erosion patients frequent consume beverages, soft drinks and fruit juices.

- The highest mean BEWE values were found at patients consuming sport drinks (BEWE 9); patients associated with consume of beverages and soft drinks have mean BEWE 4.5. The BEWE mean value is higher for females (BEWE 5.2), patients over 35 years (BEWE 8.00), the sextants S4 and S6 (BEWE 1.25) and patients under erosive medication (BEWE 8.00).

- Highest decrease of Ca and P ions from enamel surfaces was recorded for immersion in lemon juice, followed by Red Bull, mineral water, apple juice and green tea;

- The presence of acquired salivary pellicle offered protection to enamel surfaces, as Ca and P concentrations were less diminished comparing with the enamel surfaces immersed in acid solutions in the absence of acquired salivary pellicle.

- Highest pH value was found for sport drink CytoMax, followed by Isostar and Gatorade.

- Gatorade was associated with highest erosive effect on enamel and dentine, followed by CytoMax and Isostar

- The use of fluor toothpaste, fluor gel MI Paste (caseine, calcium phosphate, fluor) previous to immersion in sport drinks, reduced the erosive effects of sport drinks both for enamel and dentine.

- The most protective effect on enamel and dentine was recorded for MI Paste Plus, followed by fluoride gel (fluoride gel Densell) and tooth paste (Colgate total).

- Most of the private dental practitioners in Iași are well aware of the importance of diagnosing and treatment of the tooth erosion.

- Preventive measures (advice on oral hygiene, diet, and the use of mouth wash that contain fluoride) are widely used by all three groups (0-5, 6-10, 10+ experience).

- In the dental erosion therapy, the amalgam material is the most used by 17% of the people questioned, followed by composite resins (16%), compomer material (16%)
and CGI (15%). Dentists with 0-5 years of experience use most of the time CGI (18%), the ones with 6-10 years of experience use composite resins (19%) and the ones with over 10 years of experience use composite flow (19%).
SELECTIVE BIBLIOGRAPHY


