Research on dental caries in the mixed dentition as a risk factor in the dynamics of malocclusions

Doctoral thesis abstract

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The results obtained during doctoral studies are also due to the fact that I was awarded a scholarship between July 2014 and November 2015 through the "Program of Excellence in multidisciplinary doctoral and postdoctoral research in chronic diseases", contract no. HRD/159/1.5/S/133 377, financed from the European Social Fund through the Sectoral Operational Programme Human Resources Development 2007-2013.

The thesis contains 199 pages, 154 figures, 139 tables, and 330 bibliographic references.

The abstract includes selective iconography and bibliography, but their numbering and content in the thesis are preserved.

**Keywords:** dental caries, mixed dentition, dentomaxillary abnormalities, malocclusions, permanent molars, premature loss, condylar asymmetry, amoxicillin-anionicclay composites, orthodontic mini-implants.
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6.1. Reasons for choosing the topic
In recent years we have witnessed that increasingly more children patients with mixed dentition presented a considerably more diseases affecting the temporary or young permanent molars due to dental caries. This was due to the imbalance between the increase in the number of general cariogenic risk factors (e.g. poor parental education) and local (poor oral hygiene, irregular dental visits, diet high in sugar and fat, low in fibers, vitamins and essential minerals, irregular fluoridation) and the lack of national programs promoting oral health.

6.2. Aims and objectives of research
The aim of this dissertation was a thorough analysis of the relationship between dental caries in mixed dentition and dentomaxillary abnormalities.

The main objective of the doctoral research was to determine whether dental caries in mixed dentition may influence the development of certain dentomaxillary abnormalities and to study the way the intra-arch, inter-arch and articular changes occur in this context.

The data related to the selection, examination and assessment of patients were included in a database created in the interval 2012-2016 at the Department of Pediatric Dentistry and Orthodontics, Faculty of Dentistry, Iași "Gr. T. Popa” University of Medicine and Pharmacy.
6.3. Research directions

Based on the presented specific objectives the following research directions were formulated:

1. Retrospective transversal study of a representative group of early mixed dentition patients in order to determine:
   - the frequency of dental caries and dentomaxillary abnormalities;
   - the association of caries risk with dentomaxillary abnormalities;
   - determination of the degree of malocclusion by Dental Aesthetic Index (DAI);
   - the extent of tooth destruction by dental caries of each monitored tooth and the type of dentomaxillary abnormality most commonly developed.

2. Transversal orthopantomography study to analyze permanent molars in the context of premature loss of molars, its practical purpose being a sine-qua-non for the harmonious development of the stomatognathic system of the future adult.

3. Transversal orthopantomography study to identify the influence of premature loss of the mandibular molars on the condylar and ramal mandibular vertical asymmetry.

4. Study on the textural properties of the antibiotic modified composites for use in oral diseases, implicitly in reducing the caries in mixed dentition.

5. Clinical study by careful selection of the most appropriate treatment plan and orthodontic appliances, key to a successful treatment of the consequences of premature loss of temporary molars and early loss of permanent first molar.
6.4. Material and method

The number of patients in the study groups varied according to each conducted study. The following general inclusion criteria were used:
- patients presenting to the Pediatric Dentistry Clinic in the interval between January 2005-September 2015;
- early mixed dentition patients (age 6-9 years);
- patients with caries lesions in the temporary and permanent teeth, with or without premature loss of temporary teeth;
- patients presenting a wide range of dentomaxillary abnormalities;
- compliant patients whose legally empowered parents/caregivers signed and dated the informed consent.

Exclusion criteria:
- Uncooperative and noncompliant patients;
- Patients who did not want to participate throughout the entire study period;
- Patients with dental age over 9 years;
- Patients with dental dystrophies, labio-maxillary-palatine clefts or genetic/endocrine syndromes.

The study group originally consisted in a total of 1054 patients, with ages ranging from 5 to 14 years, who presented to the Pediatric Dentistry Clinic in the interval January 2005 - September 2015 with a wide range of diagnosed disorders.
Chapter 7. Study on the association of dental caries with dentomaxillary abnormalities in children in northeastern Romania

7.1. Introduction
Dental caries remains a major public health problem, its management still requiring a high proportion of the healthcare budget, reason why continued efforts are necessary to find solutions to prevent this disease [15,19,22,32,42]. Just as with other chronic diseases with high prevalence in the population, the actual data on dental caries incidence and prevalence (60-75% for temporary and 20-40% for permanent teeth in mixed dentition children) were obtained through epidemiological studies [9,17,10,23,31].

7.2. Aim of the study
This study aimed to investigate the pathology of dental caries and dentomaxillary abnormalities in the mixed dentition in a group of children with malocclusion from northeastern Romania.

7.3. Material and method
The study group originally consisted in a total of 1054 patients, with ages ranging from 5 to 14 years, who presented to the Pediatric Dentistry Clinic in the interval January 2005 - September 2015 with a wide range of diagnosed disorders.

After applying the inclusion and exclusion criteria, the study group included 600 patients. For each participant included in the study the following documents and medical information were analyzed: observation sheet, orthopantomography, intra/extraoral
photographs and study models. Data were collected by a single trained and calibrated dentist.

The criterion for registration of caries experience was according to WHO guidelines [205], using dmft index for temporary teeth and DMFT index for permanent teeth both on study models and intraoral photographs.

Increased caries risk was assessed by using the German treatment guidelines for young teeth (table 7.1). They have defined the individual caries risk based on dmft and DMFT indices according to child age group. Criteria 1 to 4 were used for children with primary dentition and criteria 4-5 for children with mixed dentition [203]. In the present study, an increased caries risk was considered when dmft/DMFT > 5.

| Table 7.1. Caries risk according to the German treatment guidelines for young teeth [206] |
|----------------------------------|----------------------------------|
| 1  Up to 3 years               | Caries, dmft>0                    |
| 2  Up to 4 years               | dmft>2                           |
| 3  Up to 5 years               | dmft>4                           |
| 4  Up to 6-7 years             | dmft, DMFT>5 or D/T>0            |
| 5  Up to 8-9 years             | dmft, DMFT>7 or D/T>2            |
| 6  Up to 10-12 years           | DMFS>0                           |

dmft = number of decayed, missing and filled temporary teeth
DMFT = number of decayed, missing and filled permanent teeth

Occlusal examination was done on study models in static occlusion. All irregularities in sagittal, transverse and vertical plane were recorded. Depending on severity and prognosis of orthodontic treatment, malocclusions were analyzed in the three planes, in concordance with the major symptom, as suggested by the Klink-Keckmann and Bredy [207].

5
For each patient DAI index modified for mixed dentition was calculated without taking into account the number of missing visible teeth, maxillary and mandibular canines and premolars.

7.4. Results
7.4.1. Frequency distributions by gender, area of residence and abnormalities of the study group

Of the 600 analyzed subjects, 291 (48.5%, mean age 7.31±0.6) were female and 309 male (51.5%, mean age of 7.45±0.8), 318 (53%, mean age 7.41±0.55) resided in rural and 282 (47%, mean age 7.37±0.47) in rural areas. The most common abnormalities were: in sagittal plane class II/1 incisor malocclusion (40.0%) (Fig. 7.3), in vertical plane deep bite (54.0%) (Fig. 7.4) and in transverse plane dental crowding (55.0%) (Fig. 7.5).

<table>
<thead>
<tr>
<th></th>
<th>normal overjet</th>
<th>cl. II/1</th>
<th>cl. II/2</th>
<th>cl. III</th>
</tr>
</thead>
<tbody>
<tr>
<td>rural</td>
<td>25.5%</td>
<td>35.1%</td>
<td>26.6%</td>
<td>12.8%</td>
</tr>
<tr>
<td>urban</td>
<td>16.0%</td>
<td>44.3%</td>
<td>28.3%</td>
<td>11.3%</td>
</tr>
<tr>
<td>female</td>
<td>16.5%</td>
<td>40.2%</td>
<td>32.0%</td>
<td>11.3%</td>
</tr>
<tr>
<td>male</td>
<td>24.3%</td>
<td>39.8%</td>
<td>23.3%</td>
<td>12.6%</td>
</tr>
<tr>
<td>total group</td>
<td>20.5%</td>
<td>40.0%</td>
<td>27.5%</td>
<td>12.0%</td>
</tr>
</tbody>
</table>

![Fig. 7.3. Frequency of malocclusion in sagittal plane](image-url)
**Fig.7.4.** Frequency of malocclusion in vertical plane

**Fig.7.5.** Frequency of malocclusion in transverse plane
7.4.2. Determination of dental status by DMFT/dmft and DMFS/dmfs indices

DMFT/dmft value ranged from 0 to 11 with those in the 0-5 range being most common. The overall mean value of DMFT/dmft index as quantitative variable was 3.64±2.686.

For abnormalities in sagittal plane, the mean values of DMFT/dmft were 2.95±2.314 and 3.66±2.762, respectively, no statistically significant differences being found between mean values of DMFT/dmft index for class II/1 versus (vs) class II/2 incisor malocclusion.

For abnormalities in vertical plane, the mean values of DMFT/dmft indices were 3.41±2.543 and 3.50±2.543, respectively, and statistically significant differences were found between the mean values recorded in patients with vs without deep bite.

For abnormalities in transverse plane, the mean values of DMFT/dmft indices were higher (4.97±3.010 and 4.65±2.792, respectively) or lower (2.63±1.915, respectively) compared to the mean values for normal bite (3.67±3.279). Multiple statistically significant differences in mean values of DMFT/dmft index were found between patients with dental crowding and dental spacing associated with abnormalities in transverse plane.
7.4.3. High DMFT/dmft index values as risk factors for the development of various types of malocclusion

The presence of malocclusion in three planes is not influenced by high DMFT/dmft values (DMFT/dmft > 5) except for the combined diagnoses of narrowing and crossbite/lateral crossbite, and crowding and spacing, respectively.

The relative risk of patients with DMFT/dmft index > 5 is subunitary for Class II/1 and Class II/2 incisor type abnormalities in sagittal plane (statistically insignificant) and Class III incisor type ones (statistically significant, p = 0.019). The relative risk of abnormalities in vertical plane in patients with DMFT/dmft > 5 is statistically insignificant. For some abnormalities in transverse plane the subunitary risk is statistically significant in patients with crowding (p = 0.001) and tooth spacing (p = 0.001). For the combined diagnoses of crowding and crossbite/lateral crossbite and crowding and spacing, respectively, the relative risk of patients with DMFT/dmft index > 5 is supraunitary, over 2.5, and statistically significant (p = 0.000).

7.4.5. Assessment of the degree of affection by dental caries in the teeth in the Korkhaussupporting zone and permanent first molars

Both the temporary teeth (canine, first and second molars) and the permanent first molars were studied in order to assess the degree of affection by dental caries. The affection by dental caries was characterized by the 3 diagnoses of DMFT/dmft index, namely decayed, missing, or filled tooth. Obviously, the
teeth on the upper arch were much less affected by dental caries than those on the lower arch, the recorded differences being statistically significant (chi-square = 8.98, p = 0.002).

Similarly, the group of teeth 16, 53, 63, 26-46, 83, 73, 36 was less affected by dental caries, namely less than 10%. Tooth 36 was the most vulnerable, being affected in 10% of patients and the less affected were teeth 26, 83 and 73, in only 2.5% of patients. In this group of tooth a trend of greater damage to teeth on one arch or the other could not be detected, the differences not being statistically significant (chi-square = 1.11, p = 0.292). The percentage of affected teeth on the upper arch was 4.1% compared to 6% on the lower arch, which is only slightly higher.

7.5. Discussions

Patients aged 6 to 9 years presented to the Iasi Pediatric Dentistry Clinic mainly for correction of increased overjet, dental crowding and frontal deep bite.

A high frequency of dental caries was found in children with mixed dentition and normal overjet and overbite.

The prevalence of deep bite and dentoalveolar incongruity by crowding (secondary and/or primary and secondary) could be explained by a quadratic circumstantialtrinomial: the progressive craniofacial prcterogenetic evolution of neurocranium and regressive for viscerocranium, open demographic policy (exogamy), caries in the primary dentition (generally in temporary molars) as "key risk factor", predictor for health and quality of permanent dentition, quality of life
of the child and future adolescent and young adult [209] [210].

In our study, lower DMFT/dmft mean values were recorded for abnormalities in sagittal plane compared to those in patients with normal overjet.

Also, lower mean values of DMFT/dmft indices were recorded for abnormalities in vertical plane compared to those in patients with normal overbite, being also a relatively protective factor against the development of these abnormalities.

It once again validates the theory according to which there is a close relationship between dental caries and occurrence dentoalveolar incongruity by dental crowding. The well-known mechanism is the premature loss of temporary teeth due to untreated dental caries, which later determines subsequent migration of adjacent, antagonist and successor teeth.

7.6. Conclusions

- A high frequency of dental caries was found in children with mixed dentition and normal overjet and overbite.
- DMFT/dmft indices, the most reliable predictor of caries activity in mixed dentition had lower mean values in patients with tooth spacing and higher in patients presenting crowding: crowding and crowding/crossbite/lateral crossbite and crowding and regional spacing, respectively.
- Temporary molars on the lower arch were significantly more affected by caries process compared to the teeth on the upper arch.
Chapter 8. Orthopantomography study on the inclination of permanent molars in the context of premature loss of temporary molars

8.1. Introduction

The first to speak about premature loss of temporary teeth were Hutchinson and Davenport as early as in 1880 [211.212]. The concept was defined as temporary teeth exfoliation more than 12 months before the normal age of permanent teeth eruption, beyond the normal variation in the time of exfoliation sequence of the temporary teeth [188]. The most common causes that trigger premature loss of temporary teeth are: untreated complicated caries (conventional caries, early childhood caries (ECC) and severe early childhood caries (SECC), trauma and premature root resorption. Premature loss of temporary teeth, as a consequence of untreated complicated dental caries, can lead to dental, dento-dental, dentoalveolar, occlusal and possibly skeletal lesions.

Radiological examination is mandatory in these patients. Although Cone Bean CT (CBCT) has gradually become a reference method in the oromaxillofacial area, maxillo-mandibular orthopantomography (OPG) is still the routine examinations in children under 12 years and beyond.

8.2. Aim of the study

The main aim of this study was to determine the impact of premature loss of molars on the longitudinal axis of the permanent molars.
8.3. Material and method

The study included 100 orthopantomograms of some patients with chronological age 6 to 9 years who presented to the Iasi Pediatric Dentistry Clinic. Of these, 76 (76%) patients presented premature loss of at least one temporary molar (study group) and 24 (24%) had intact dentition (control group). The study group was further subdivided in all possible subgroups, depending on the unilateral or bilateral premature loss of maxillary or mandibular molars (Table 8.1).

All orthopantomograms were made at a single radiology center by the same experienced technician, under ideal conditions, using the PAX-Uni3D (Vatech)® imaging system. At the time the panoramic radiographs were taken, patients were in relaxed-lip position, correct position of the head in relation to chin rest, and Frankfurt plane made parallel to the horizontal plane.

Processing of panoramic radiographs implied the tracing of the following structures (Fig.8.1):

- right/left occlusal plane–line tangent to the vestibular cusps of temporary molars/premolars or lower left/right temporary molars (in the case of loss of both temporary upper molars on the same quadrant);
- axis of upper/lower permanent first molar (M1) - line through the center of the crown and center of root bifurcation;
- eruption axis of the upper/lower permanent second molar (M2) - line through the center of the crown and center of the starting point of root bifurcation.
Fig. 8.1. Orthopantomographic appearance of premature loss of temporary molars

8.4. Results

Of the 100 panoramic radiographs analyzed, 55 were taken from male patients and 45 from female patients (Fig.8.2). In terms of age-group distribution, most patients were aged 7 to 8 years, and mean age was 7.29 years (Fig.8.3, table 8.2).

Fig 8.2 . Study group structure by sex Fig 8.3. Study group structure by age
Fig 8.6. Influence of unilateral premature loss of lower temporary molars on permanent molar inclination where m1t - temporary first molar, m2t - temporary second molar, M1 - permanent first molar, M2 - permanent second molar, inf - lower arch.

Fig 8.7. Influence of bilateral premature loss of lower temporary molars on permanent molar inclination where m1t - temporary first molar, m2t - temporary second molar, M1 - permanent first molar, M2 - permanent second molar, st - left side, dr - right side.
Fig 8.8. Influence of premature unilateral loss of upper temporary molars on permanent molar inclination, where m1t - temporary first molar, m2t - temporary second molar, M1 - permanent first molar, M2 permanent second molar.

<table>
<thead>
<tr>
<th></th>
<th>m1t</th>
<th>m2t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ax M1</td>
<td>92.264</td>
<td>93.96875</td>
</tr>
<tr>
<td>Ax M2</td>
<td>116.68455</td>
<td>114.4875</td>
</tr>
</tbody>
</table>

Fig 8.9. Influence of premature bilateral loss of upper temporary molars on permanent molar inclination, where m1t - temporary first molar, m2t - temporary second molar, M1 - permanent first molar, M2 permanent second molar.

<table>
<thead>
<tr>
<th></th>
<th>m1t+</th>
<th>m2t+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ax M1</td>
<td>92.264</td>
<td>95.13</td>
</tr>
<tr>
<td>Ax M2</td>
<td>116.68455</td>
<td>121.33</td>
</tr>
</tbody>
</table>

The only instance of statistical significance wasthe loss of lower temporary m2 (on quadrants III and IV) influencing the axis of permanent M1 and M2, otherwise logical if the dynamic particularization of
alveolar, maxillary and mandibular skeletal growth and development in the studied age groups are considered.

Fig 8.10. Correlation M1 axis/ M2 axis for the lower arch, were M1- permanent first molar, M2- permanent second molar, inf - lower arch, st- left side, dr- right side

Fig 8.11. Correlation M1 axis/ M2 axis for the upper arch, were M1- permanent first molar, M2- permanent second molar, inf - lower arch, st- left side, dr- right side

8.5. Discussions
Many 2- to 8-month longitudinal studies in children aged 6 to 9 years with premature loss of first temporary lower molar concluded that mesial space
reduction of the temporary second molar is mainly due to distal displacement of the temporary canine and less to inclination or migration or permanent molars [185.190-193].

Many studies have shown that premature loss of temporary second molars causes a greater loss in leeway-space compared to that of temporary first molars, both due to the difference in mesiodistal diameter and to the fact that the permanent first and second molars lose their contact points and follow the tendency of all teeth to mesialize or become mesially inclined. This is proven in our study by the much lower mean angular values for the permanent maxillary and mandibular molars in case of premature loss of mandibular or maxillary temporary second molar compared to the mean angular values of the control group. However, in our study the only circumstance of statistical significance was the loss of lower temporary m2 influencing the axes of the lower permanent first and second molars.

The moderate correlation between the axes of the first and second molars in the same quadrant suggests that any premature first molar loss may have an impact on the entire dentomaxillary system and later can have repercussions in development of dentomaxillary abnormalities.

8.6. Conclusions
- Premature loss of the temporary first molar does not negatively influence the permanent molars in terms of their inclination in mesial direction; more over premature loss of temporary maxillary first molar
would cause an accelerated eruption of the first premolar with compensatory distoversion.

- Premature loss of temporary second molars causes a greater loss in leeway-space compared to that of temporary first molar, both due to the difference in mesiodistal diameter and to the fact that permanent first and second molars lose their contact points and follow the trend of all teeth to mesialize and become mesially inclined.

- The induced changes are not only at intra-arch but also at inter-arch level given the potential of temporary maxillary second molar to egress, and thus to generate premature contacts, occlusal interferences, and on medium and long term may lead to Thielemann-Godan effect (diagonal syndrome).
Chapter 9. Orthopantomography study on the influence of premature loss of the temporary mandibular molars on condylar and ramal vertical asymmetry

9.1. Introduction

Prevalence of temporomandibular joint dysfunction in children is difficult to determine, but the preventive and interceptive treatment is a must in the management of the dentomaxillary and skeletal abnormalities that may develop [221].

Premature loss of temporary teeth, as a result of untreated dental caries in temporary teeth causes serious three-dimensional disturbances in the dental arch and of occlusion. Thus, there may be local changes (delays or accelerations of permanent teeth eruption), intra-arch changes (migration of permanent teeth with loss of space, dental arch narrowing, crowding, tooth impaction), inter-arch changes (supraeruptions of antagonist teeth, dental arch narrowing, crossbite, premature contacts and occlusal interferences) and last but no least intraarticular changes which on medium of long term may determine temporomandibular dysfunctions [171-173].

Condylar cartilage is the major site involved in mandibular growth, which is also a crucial factor in the success of orthodontic treatment in young patients. Changes in the length of vertical ramus and condylar process reflect normal mandibular growth [223-226] or pathological changes in the temporomandibular joint (TMJ) [227].
Although in recent years the studies on condylar asymmetry are increasingly numerous, so far no study aimed at assessing the effect of premature loss of temporary mandibular molars on condylar asymmetry [199.230-238].

9.2. Aim of the study
The main aim of this study was to determine the impact of premature loss of temporary lower molars on the height of condyle and mandibular ascending ramus and if in these circumstances it is associated with asymmetric condyles.

9.3. Material and method
The study included 159 orthopantomograms (OPG) of subjects aged 6 to 10 years who presented to the Iasi Pediatric Dentistry Clinic. The orthopantomograms included in this study were taken from the medical records of patients who required dental or orthodontic treatment, thus not being subjected to additional radiation.

Patients were divided into two groups: (1) 127 patients with premature loss of at least one temporary lower molar (study group), and (2) 32 with intact dentition (control group). The study group was further divided in all possible subgroups according to the unilateral or bilateral premature loss of temporary molars (Table 9.1).

Habets et al. investigated the relationship between condylar asymmetry and temporomandibular joint dysfunction and introduced a method for the assessment of condylar and mandibular ascending ramal asymmetries [239.240]. This method has been used by us
in the present study and it consists in the comparison of the vertical heights of the two mandibular condyles and ascending rami (Fig. 9.1).

**Fig. 9.1.** Measurement method described by Habets et al. Identification of O1, O2 points – the most lateral points of the left/right ascending ramus. **Line A** - tangential to the right/left ascending ramus, **Line B** - perpendicular to A at the highest point of the right/left condyle

**Measurement a:** 1. **right/left** condylar height (CH) 2. **right/left** ascending ramal height (RH) 3. **right/left** CH + RH

Digital measurements were made by single examiner (E.C) using *PlanmecaRomexis Viewer 3.0.1* software. All measurements were in millimeters.

To calculate condylar asymmetry, ascending ramal asymmetry and condylar and ascending ramal asymmetry indices (AI) the formulas suggested by the same author were used:

\[
\text{CAI} = \left( \frac{CH_{dr} - CH_{st}}{CH_{dr} + CH_{st}} \right) \times 100; \quad \text{RAI} = \left( \frac{RH_{dr} - RH_{st}}{RH_{dr} + RH_{st}} \right) \times 100; \quad \text{CRAI} = \left( \frac{CRH_{dr} - CRH_{st}}{CRH_{dr} + CRH_{st}} \right) \times 100;
\]

where CH – condylar height; RH - mandibular ascending ramal height; CRH = CH + RH; dr- right side (quadrant IV) , st-left side (quadrant III),

22
9.4. Results

Of the 159 orthopantomograms analyzed, a total of 93 (58.55%) were taken from male and 66 (41.5%) from female patients (Fig. 9.2). In terms of age distribution age, most patients were aged 8 and 9 years, mean age being 7.58 years (Fig. 9.3, table 9.2).

![Fig. 9.2. Age distribution of the study group](image)

![Fig. 9.4. Premature loss of temporary molars – comparative statistics](image)

m1t – temporary mandibular first molar; m2t – temporary mandibular first second molar
Fig. 9.5. Comparative mean values of the calculated parameters, where m1t - premature loss of temporary mandibular first molar, m2t - premature loss of temporary mandibular second molar, m1t + m2t - premature loss of temporary mandibular second molar on the same side; st-left, dr-right, CAI-condylar asymmetry index; RAI-ascending ramal asymmetry index; CRAI-condylar and ascending ramal asymmetry index

Table 9.25. Descriptive statistical analysis and comparisons of the calculated parameters

<table>
<thead>
<tr>
<th>Calculated parameters</th>
<th>Control group</th>
<th>Study group</th>
<th>p-value</th>
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<td>Female</td>
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CAI-condylar asymmetry index; RAI-ascending ramal asymmetry index; CRAI-condylar and ascending ramal asymmetry index; SD – standard deviation; NS – statistically insignificant
Table 9.26. Descriptive statistics and comparisons of the parameters calculated for the 2 groups

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<tr>
<th>Calculated parameters</th>
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<th>SD</th>
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CAI - condylar asymmetry index; RAI - ascending ramal asymmetry index; CRAI - condylar and ascending ramal asymmetry index; SD - standard deviation; NS - statistically insignificant; SS - statistically significant.

Table 9.27. Descriptive statistics and comparisons of the CAI for the 2 groups

<table>
<thead>
<tr>
<th>Calculated parameters</th>
<th>Study group</th>
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<th>SD</th>
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</tbody>
</table>

CAI - condylar asymmetry index; st - left side; dr - right side; SD - standard deviation; NS - statistically insignificant; SS - statistically significant.

9.5. Discussions

The present study is the first to investigate condylar and mandibular ascending ramal asymmetry, using Habets’ method on panoramic radiographs in patients with premature loss of temporary lower molars [239]. The reliability of this method has been demonstrated [233-239]. He found that the vertical differences at the level of mandibular condyles and mandibular ascending rami between the left and right sides of the panoramic radiographs are less than 3% if
the positions are changed to less than 1 cm from their initially centered position. In our study the mean condylar asymmetry index (CAI) of the control group was 3.60 ± 3.68, reflecting a slight asymmetry between the two condyles. This was logical because the control group was not a group with neutral, eugnatic occlusion (dental and skeletal class I, normal divergence of facial growth, excellent overbite and overjet, and perfect interdigitation of the posterior teeth). Unilateral and even bilateral premature loss of temporary mandibular second molar plays a very important role in the three-dimensional status of occlusion and implicitly of condylar symmetry. Condylar asymmetry index reaches a peak around the age of 8, being thus correlated with the most favorable time for the premature loss of temporary molars, the mean age of all subjects enrolled in the study being 7.58 years.

9.6. Conclusions

- Unilateral and even bilateral premature loss of temporary mandibular second molar plays a very important role in the three-dimensional status of occlusion and implicitly of condylar symmetry;
- Symmetry of mandibular ascending rami is not significantly affected by the absence of lower molars;
- Condylar asymmetry reaches a peak value around the age of 8 being correlated with most favorable time for the premature loss of temporary molars.
Chapter 10. Synthesis and characterization of amoxicillin-anionic clay composites with possible uses in oral diseases and implicitly in decreasing the caries risk in mixed dentition.

10.1. Introduction
Nowadays researchers' attention focuses on the development of delivery systems of non-toxic, biocompatible drugs aimed at improving the efficacy of the drugs and at controlling their release profile.

10.2. Descriptive and analytical data
Hydrotalcite (mineral that can be easily crushed into a white powder similar to talc) is a magnesium aluminum hydroxycarbonate, in the literature being known as LDH (layered double hydroxide with stratified structure).

The basic structure of LDH is similar to that of brucite [Mg(OH)₂], which consists of hexagonal close packing of hydroxyl ions with alternate octahedral sites occupied by Mg²⁺-ions.

Several studies suggest that these LDH-based composites—that could form the basis for a well-defined drug release system. By controlling the point/site of drug release it is possible to determine the pharmacokinetic
profile by selecting the metal ions in the LDH composite host layers, thus improving the long-term stability and storage of drugs [269.270].

10.3. Methods for obtaining LDH-like structures

![Diagram of synthesis process]

Fig. 10.2. Experimental scheme of synthesis of LDH-like materials

![Diagram of protocol]

Fig. 10.3. Scheme of the experimental protocol for obtaining LDH-based nanostructured composites
10.5.3. Study of textural properties of amoxicillin-anionic clay composites

Fig. 10.4. SEM image of LDH

Fig. 10.5. SEM image of FeLDH

Fig. 10.6. SEM image of Amox-LDH

Fig. 10.7. SEM image of Amox-FeLDH
10.6. Discussions

The variability of layered double hydroxides makes possible the synthesis of new materials with special properties of use as advanced materials in numerous applications with worldwide impact in the field of dentistry. Furthermore, being “smart materials” layered double hydroxides can be self-assembled under specific conditions using their characteristic structural memory effect property.

Hybrid nanostructures based on amoxicillin-hydrotalcite-type anionic clays were synthesized using coprecipitation and reconstruction of the original structure as methods of synthesis.

The texture of LDHs and intercalated compounds was studied in view of determining the way guest amoxicillin molecules were intercalated between hydrotalcite layers.
10.7. Conclusions

- An important research direction in nanostructured materials is related to LDH-like materials due to their nature, structure and specific properties.
- Scanning electron microscopy showed that the typical disk-type morphology of LDH is characteristic to clay, while a solid, compact, nonporous structure is formed in amoxicillin-LDH composites.
- Due to the new textural properties of LDH-like anionic clay-amoxicillin composites obtained in laboratory, they could be used in dental medicine for sealing the permanent first molars, orthodontic bracket bonding and in the treatment of caries in the permanent first and second molars with the ultimate goal of reducing the risk of caries in mixed dentition.
Chapter 11. Treatment of the premature loss of temporary molars and early loss of permanent first molar

Below are presented some clinical cases in which the premature loss of temporary teeth or early loss of permanent first molar due to untreated dental caries overlapped with other dentomaxillary abnormalities. Patients sought treatment relatively late, when the consequences had already developed, requiring an individualized approach for the interception, stopping and integrated-unitary treatment of these complications.

11.1. Case 1. Modern technique for maxillary molar distalization with the Frog appliance

![Fig.11.1. Photostatic frontal and profile examination at beginning of treatment](image)

![Fig.11.2. Photostatic endo-oral examination at beginning of treatment](image)
Fig. 11.4. Orthopantomography and teleradiology examination before treatment

Fig. 11.5. Intraoral appearance after placement of orthodontic appliances

Fig. 11.6. Intraoral appearance after 10 months of treatment

Fig. 11.11. Intraoral appearance at the end of active orthodontic treatment

Fig. 11.12. Extraoral appearance at the end of active fixed orthodontic treatment
11.3. Case 3. Second molar uprighting after early loss of a permanent mandibular first molar

Fig. 11.26. Photostatic frontal and profile examination at beginning of treatment

Fig. 11.27. Photostatic endo-oral examination at beginning of Treatment

Fig. 11.28. Orthopantomography and teleradiology examination before treatment

Fig. 11.30. Uprighting of tooth 37: insertion of Sander supraelastic spring and mini-implant
11.5. Discussions

Frog appliance, used in the first case, was placed 10 to 12 mm apical to the occlusal surface of the maxillary first molar, parallel to the occlusal plane. This way, the resulting force vector passes through the center of resistance of the first molar [321]. The goal was to distalize the permanent molars so that to obtain the space needed for aligning the ectopic upper canines into the upper dental arch. A lip-bumper was used for permanent molar distalization in the lower arch. Unfortunately the patient was noncompliant, missing the routine checkups. However, a bodily distalization of the permanent first molar, 3 mm on each side of the upper arch. Distal inclination was minimal, only 3° [322].

As seen in the presented case 3, the ideal therapeutic approach of the permanent first molar syndrome seems to be the mesialization of the permanent second and third molars and toothless gap closure without biological sacrifice. The procedure is not simple, given the strong roots and the significant apex displacement, if the initial mesial inclination of the permanent second molar is also taken into account. A30°- 40° second molar inclination corresponds to an apical displacement of only 11 mm for uprighting [326].
11.6. Conclusions

- The Frog appliance proved to be effective and noninvasive in the bilateral molar distalization, but patients should be advised to return for regular checkups, otherwise this noncompliance-dependent device will become ineffective. It is essential that both the child and his/her parents/caregiver to comply with treatment.

- Second molar uprighting is a very difficult orthodontic treatment. The use of a mini-implant is needed to achieve molar uprighting, movement of a given tooth, to reduce the number of unwanted side effects and eventually to improve patient’s esthetics. A thorough clinical-systemic and radiological assessment of the patient and a careful selection of the most suitable orthodontic appliance are keys to successful treatment.
Chapter 13. Implication for research and practice

The present research brings additional evidence that caries in mixed dentition is a major orodental, psychosociosomatic and community health problem. It is still a major public health problem, its management still requiring a high proportion of the healthcare budget, reason why continued efforts are necessary to find solutions to prevent this disease.

The first study aimed at investigating the pathology of dental caries and dentomaxillary abnormalities in the mixed dentition in a group of children with malocclusions from northeastern Romania. Future studies in other ethnic groups and geographic areas should be performed to check for similitudes with the results of our study. This study suggests the need to develop national health education programs for the prevention of dental caries, which are a risk factor in the development of dental malocclusion.

The aim of the second study was to evaluate the impact of premature loss of temporary molars on the longitudinal axis of the permanent molars. The research perspective is a longitudinal study on a larger group of patients and over a longer period of time to assess the impact of premature loss of temporary molars on the longitudinal axis of the permanent molars.

The main goal of the third study was to determine the impact of premature loss of temporary lower molars on condylar and mandibular ascending ramal height and if in these circumstances the patients presented asymmetrically developed condyles. This study topic requires further complex clinical-radiological studies (CBCT) and an analytical-statistical study of a
representative sample in terms of ecological, gender and age-group distribution. Of interest would also be a differentiated clinical/laboratory assessment of the cases according to the initial absence of TMJ asymmetry, preexisting TMJ asymmetry, TMJ asymmetry acquired by premature loss on an initially relatively symmetric background and TMJ asymmetry acquired by premature loss on an initially relatively asymmetric background.

The fourth study dealt with the textural properties of composites modified by the addition of antibiotics. The research perspective is represented by clinical trials aimed at quantifying caries risk reduction by the use of amoxicillin-anionic clay composites in various dental procedures (sealing, brackets procedures, restorative treatments).

The last study presented four clinical cases in which the premature loss of temporary teeth or early loss of the permanent first molar overlapped with other dentomaxillary abnormalities. Further studies are needed to thoroughly evaluate patients clinically-systemically and radiologically and to carefully select of the most suitable orthodontic appliance, precondition of a successful treatment.
Selective bibliography


