

**BUCHAREST CAROL DAVILA UNIVERSITY  
OF MEDICINE AND PHARMACY  
THE DOCTORAL SCHOOL  
THE DOMAIN OF DENTAL MEDICINE**

**CONSIDERATIONS REGARDING  
THE PATHOLOGY OF  
THE FIRST PERMANENT MOLAR  
DURING THE PERIOD  
OF MIXED DENTITION**

**SUMMARY OF THE DOCTORAL THESIS**

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## ABBREVIATIONS LIST

ISI - international scientific index  
MIH - molar-incisor hypomineralization  
AAT - alpha 1 antitrypsin  
DMFT - Decayed, Missing and Filled Permanent Teeth  
EAPD - European Academy of Pediatric Dentistry  
UK - United Kingdom  
SUA (USA) - the United States of America  
CAST - Caries Assessment Spectrum and Treatment  
M1 - the first permanent molar  
N - number of subjects  
P - lingual  
V - buccal  
M - mesial  
O - occlusal  
O-M - mesial-occlusal  
O-D - distal-occlusal  
O-V - buccal-occlusal  
O-P - lingual-occlusal  
OPG - ortopantomography  
ATM - TMJ - the temporomandibular joint

### **Metadata**

The doctoral thesis includes the list of published scientific papers, the list of abbreviations, the introduction, the general part of the thesis, the personal contributions, the bibliography and the appendices. The thesis has 140 pages, of which 25 deal with the general background and 87 convey the personal contributions. The bibliography lists 205 references in 20 pages. The doctoral thesis provides illustrative and relevant images represented by 34 tables and 56 figures, of which 34 are graphs.

## **INTRODUCTION**

Patients in the field of pediatric dentistry present a various pathology that requires specialized oral-dental treatment. The specific therapeutic difficulty in dealing with such patients stems from the behavioral traits characteristic to their age, from the dento-alveolar morphological particularities, as well as from the potentially long duration of the treatments.

From among the scientific objectives intended for solving in this research, we focus on establishing the status of the first permanent molar during the period of mixed dentition on Romanian urban population together with determining the subjects' interest in good oral and dental health. Further scientific objectives are quantifying the consequences of extensive coronal destruction and early extractions of the first permanent molar during the period of mixed dentition.

For the dentist, the importance of the first permanent molar remains indisputable, as it is the most important prosthetic pillar and the first proof of permanent dental occlusion, hence the selection of this research topic.

## **GENERAL PART OF THE DOCTORAL THESIS**

Chapter 1 presents data from the literature regarding the eruption, morphology and role of the first permanent molar, while Chapter 2 showcases data from the literature on the pathology of the first permanent molar during the period of mixed dentition, with reference to: structural changes, dental caries, caries with pulp involvement, and consequences of the first permanent molar early loss in this period. Such data are provided alongside with representative original iconography, consisting of 18 images.

## **PERSONAL PART OF THE DOCTORAL THESIS**

This part of the thesis begins with the presentation of the working hypothesis and the general objectives of the research. The research aims at answering questions on whether or not to retain the permanent molars with various complicated conditions on the dental arch, trying to establish if the extraction of such teeth during mixed dentition is indicated or contraindicated.

As a general objective, we set out to establish whether the conditions of these teeth could also be influenced by the particularities of the development period.

The results obtained in research for this thesis were compared to the results presented in similar studies in the specialized literature.

This part of the thesis continues with the presentation of the general research methodology. The evaluation of the subjects was performed in a private dental clinic by a single evaluator, specialized in Pediatric Dentistry (the PhD student). Inclusion criteria: subjects in the stage of mixed dentition, attended by a next-of-kin or legal guardian giving their informed consent, in written form, for including the child in the study. Exclusion criteria: mental and metabolic diseases, congenital malformations affecting the oral cavity. In certain cases, complementary examinations such as periapical radiographs or ortopantomographies (OPGs) were performed for a more accurate diagnosis.

### **Chapter 3**

#### **Study 1: Clinical - statistical study on the first permanent molar pathology during mixed dentition**

**The working hypothesis:** this research was carried out on a group of children from urban schools in the capital of the country, who were treated in the private dental clinic; children with elevated educational level regarding oral health and high socio-economic status, so we considered that we should encounter a low prevalence of structural changes, carious lesions and early extractions of first permanent molars during the mixed dentition.

**The purpose of the study:** assessing the pathological status of the first permanent molar in mixed dentition, including the impact of its early loss in the studied age groups.

**The specific objectives:** highlighting the consequences of various ailments in the absence of adequate treatment and quantifying the consequences of extensive tooth structure destructions and tooth extractions.

**Material and method:** the study was carried out on 87 subjects in their period of mixed dentition, after obtaining prior informed consent from relatives/legal guardians; 44 of them were female and 43 male. The results were statistically analyzed and compared to results presented in similar studies. The subjects were grouped according to the following age intervals: 5-6 years, 6-7 years, 7-8 years, 8-9 years, 9-10 years, 10-11 years, 11-12 years, and a group older than 12 years including 3 subjects who still had mixed dentition.

*We analysed:*

- the eruption of the first permanent molars by age group and depending on the sex of the subjects;

- the hypomineralization lesions of the first permanent molars by age group and sex: their location at the level of each first permanent molar, their location on tooth surfaces and the prevalence of the forms of such changes (mild, moderate, severe);

- the presence of dental caries and of caries with pulp involvement, as well as their location on teeth and on dental surfaces (only for dental caries), by age group and sex;

- we also highlighted the first permanent molars without structural changes or carious lesions and without extractions;

- the distribution of early extractions of the first permanent molar by age group and according to the sex of the subjects.

**Results:**

**Table III.1.** Distribution of subjects by sex

Sex of the subjects		
Sex	N	%
Female	44	50.6
Male	43	49.4
Total	87	100

N: number of subjects.

**Table III.2.** Distribution of subjects by age groups

Age groups of the subjects		
Age group	N	%
5-6 years	4	4.6
6-7 years	16	18.4
7-8 years	15	17.2
8-9 years	16	18.4
9-10 years	10	11.5
10-11 years	18	20.7
11-12 years	5	5.8
>12 years	3	3.4
Total	87	100

N: number of subjects.

*Results regarding the eruption of the first permanent molar:*

The incomplete eruption of the first permanent molar was predominant in the age groups ranging 5-7 years, decreasing in percentage as the age of the subjects increased, and the complete eruption was more frequent in the age groups ranging 7-11 years. Given the p-value = 0.0001, these results are statistically significant.

**Table III.3.** Eruption of the first permanent molar by age groups

Eruption of permanent M1 by age groups						
Age groups	Incomplete		Complete		Total	
	N	%	N	%	N	%
5-6 years	4	19.1	0	0	4	4.6
6-7 years	14	66.7	2	3.0	16	18.4
7-8 years	2	9.5	13	19.7	15	17.2
8-9 years	1	4.7	15	22.7	16	18.4
9-10 years	0	0	10	15.2	10	11.5
10-11 years	0	0	18	27.3	18	20.7
11-12 years	0	0	5	7.6	5	5.8
>12 years	0	0	3	4.5	3	3.4
Total	21	24.1	66	75.9	87	100
Chi square test; $p = 0.0001$						

M1: the first permanent molar; N: number of subjects.

In relation to sex, the results show that incomplete eruption was predominant in males (52.4%, as compared to complete eruption with a prevalence of 48.5%), as compared to female subjects for whom complete eruption was predominant (51.5%, compared to incomplete eruption, with a prevalence of 47.6%).

**Table III.4.** Eruption of the first permanent molar depending on the sex of the subjects

Eruption of permanent M1 by sex						
Sex	Incomplete		Complete		Total	
	N	%	N	%	N	%
Female	10	47.6	34	51.5	44	50.6
Male	11	52.4	32	48.5	43	49.4
Total	21	24.1	66	75.9	87	100
Chi square test; $p = 0.756$						

M1: the first molar; N: number of subjects.

*Results regarding structural changes such as enamel hypomineralization:*

Of the total number of subjects without such structural changes, 57.7% were male and 42.3% were female. No statistically significant differences in severity were determined by sex ( $p = 0.216$ ).

**Table III.5.** Structural changes of permanent M1 depending on the sex of the subjects

Structural changes of permanent M1 (hypomineralization) by sex										
Sex	Mild		Moderate		Severe		No modifications		Total	
	N	%	N	%	N	N	N	%	N	%
Girls	17	68	4	50	1	50	22	42.3	44	50.6
Boys	8	32	4	50	1	50	30	57.7	43	49.4
Total	25	28.7	8	9.2	2	2.3	52	59.8	87	100
Chi square test; $p = 0.216$										

M1: the first molar; N: number of subjects.



**Table III.6.** Structural changes of permanent M1 by age groups

Structural changes of permanent M1 (hypomineralization) by age										
Age group	Mild		Moderate		Severe		No modifications		Total	
	N	%	N	%	N	%	N	%	N	%
5-6 years	0	0	0	0	0	0	4	7.7	4	4.6
6-7 years	12	48	1	12.5	0	0	3	5.8	16	18.4
7-8 years	4	16	3	37.5	0	0	8	15.4	15	17.2
8-9 years	6	24	3	37.5	1	50	6	11.5	16	18.4
9-10 years	1	4	1	12.5	0	0	8	15.9	10	11.5
10-11 years	1	4	0	0	1	50	16	30.8	18	20.7
11-12 years	1	4	0	0	0	0	4	7.7	5	5.8
>12 years	0	0	0	0	0	0	3	5.8	3	3.4
Total	25	28.7	8	9.2	2	2.3	52	59.8	87	100

Chi square test; **p = 0.007**

M1: the first molar; N: number of subjects.

Out of all the subjects, 59.8% did not present these changes. The total prevalence of structural changes such as enamel hypomineralization at the level of the first permanent molars is 40.2%. Considering the value of  $p = 0.007$ , the results obtained, analyzed by age groups, are statistically significant.

**Table III.7.** The number of first permanent molars with structural changes (hypomineralization) by age group of the subjects

The number of permanent M1 with hypomineralization changes by age group												
Age group	One molar (3.6)		16 and 26		36 and 46		16, 26, 36 and 46		No affected molar		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
5-6 years	0	0	0	0	0	0	0	0	4	7.7	4	4.6
6-7 years	0	0	2	20	8	80	3	23.1	3	5.8	16	18.4
7-8 years	0	0	4	40	1	10	2	15.4	8	15.4	15	17.2
8-9 years	1	50	3	30	1	10	5	38.5	6	11.5	16	18.4
9-10 years	0	0	0	0	0	0	2	15.4	8	15.4	10	11.5
10-11 years	1	50	0	0	0	0	1	7.7	16	30.8	18	20.7
11-12 years	0	0	1	10	0	0	0	0	4	7.7	5	5.8
>12 years	0	0	0	0	0	0	0	0	3	5.8	3	3.4
Total	2	2.3	10	11.5	10	11.5	13	14.9	52	59.8	87	100

Chi square test; **p = 0.002**

M1: the first molar; N: number of subjects.

In 14.9% of cases all first permanent molars were affected by this type of structural changes, and in 59.8% of cases we did not find any location for such changes in these teeth. As regards the impact on maxillary versus mandibular molars, there were no differences, it was equal, 11.5%, but there were significant differences regarding the number of molars with hypomineralization per subject in relation to age ( $p = 0.002$ ).

Regarding the location of these changes according to sex, the situation with all molars affected was more frequent in females than in males, 69.2% versus 30.8%. Regarding the damage to the maxillary molars, the males showed a higher prevalence as compared to the females, 60% versus 40%, and, at mandibular level, the prevalence was higher in female subjects, 70% versus 30% in the males. A single molar affected was reported in two female subjects. Obvious differences were observed in the number of teeth affected per subject by sex, but they were statistically insignificant.

**Table III.8.** The surfaces of the first permanent molar with structural changes (hypomineralization) by the age groups of the subjects

M1 surfaces with structural changes (hypomineralization) depending on age												
Age group	Occlusal		Occlusal and buccal		Occlusal, lingual and buccal		All surfaces		No surface		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
5-6 years	0	0	0	0	0	0	0	0	4	7.7	4	4.6
6-7 years	11	64.7	2	33.3	0	0	0	0	3	5.8	16	18.4
7-8 years	2	11.8	2	33.3	2	28.6	1	20	8	15.4	15	17.2
8-9 years	2	11.8	2	33.3	4	57.1	2	40	6	11.6	16	18.4
9-10 ani	1	5.9	0	0	0	0	1	20	8	15.4	10	11.5
10-11 years	0	0	0	0	1	14.3	1	20	16	30.8	18	20.7
11-12 years	1	5.9	0	0	0	0	0	0	4	7.7	5	5.8
>12 years	0	0	0	0	0	0	0	0	3	5.8	3	3.4
Total	17	19.5	6	6.9	7	8.0	5	5.7	52	59.9	87	100
Chi square test; $p = 0.002$												

M1: the first permanent molar; N: number of subjects.

The category with no affected surfaces was the most frequent, 52 subjects, representing 59.7% of the total, followed, in descending order, by occlusal location in 17 subjects, 19.5%, then by occlusal, lingual and buccal location in 7 subjects, 8%, then occlusal and buccal location in 6 subjects, 6.9%, and location on all dental surfaces in 5 subjects, 5.7%. Statistically significant differences were determined regarding the number of affected surfaces in relation to age ( $p= 0.002$ ), see Table III.8.

On the whole, considering the 5 study categories regarding the location of these structural defects, the percentages were similar, 50.6% for the female sex, respectively, 49.4% for the males. Taking into account the value of  $p = 0.349$ , these observations are statistically insignificant, see Table III.9.

**Table III.9.** The surfaces of the first permanent molar with structural changes (hypomineralization) depending on the sex of the subjects

M1 surfaces with structural changes (hypomineralization) by sex												
Sex	Occlusal		Occlusal and buccal		Occlusal, lingual and buccal		All surfaces		No Surface		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Girls	12	70.6	3	50	4	57.1	3	60	22	42.3	44	50.6
Boys	5	29.4	3	50	3	42.9	2	40	30	57.7	43	49.4
Total	17	19.5	6	6.9	7	8.0	5	5.7	52	59.9	87	100

Chi square test;  $p = 0.349$

M1: the first permanent molar; N: number of subjects.

*Results regarding the dental caries of the first permanent molar:*

The absence of carious lesions was more frequent in the first age groups, thus, the number of children without dental caries in the 6-7 years age group represented 26.5%, and those in the 7-8 years and 8-9 years age groups, each represented 14.7%. Statistically significant differences ( $p = 0.004$ ) were determined regarding the number of first permanent molars affected by dental caries per subject in relation to age, see Table III.10.

**Table III.10.** Distribution of dental caries in M1 by age groups of the subjects

Distribution of dental caries of M1 by age groups												
Age group	All M1 without dental caries		All M1 with dental caries		One M1 with dental caries		Two M1 with dental caries		Three M1 with dental caries		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
5-6 years	4	11.8	0	0	0	0	0	0	0	0	4	4.6
6-7 years	9	26.5	2	8.33	1	12.5	4	26.7	0	0	16	18.4
7-8 years	5	14.7	9	37.5	0	0	1	6.7	0	0	15	17.2
8-9 years	5	14.7	6	25	3	37.5	2	13.3	0	0	16	18.4
9-10 years	3	8.8	2	8.3	3	37.5	2	13.3	0	0	10	11.5
10-11 years	4	11.8	4	16.7	0	0	5	33.3	5	83.3	18	20.7
11-12 years	3	8.8	1	4.2	1	12.5	0	0	0	0	5	5.8
>12 years	1	2.9	0	0	0	0	1	6.7	1	16.7	3	3.4
Total	34	39.1	24	27.6	8	9.2	15	17.2	6	6.9	87	100

Chi square test;  $p = 0.004$

M1: the first permanent molar; N: number of subjects.

The distribution of dental caries of the first permanent molars in relation to the sex of the subjects is as follows: the situations with one affected first permanent molar and two affected first molars per subject were more frequent in boys than in girls (62.5% vs 37.5 %, respectively 53.3% vs 46.7%), situations with four affected first molars per subject were more frequent in girls (54.2%), and those with three affected first molars were equally distributed among boys and girls (50%). The absence of dental caries was more frequent in females, in a percentage of 52.9%, as compared to the males with a frequency of 47.1%.

**Table III.11.** The distribution of dental caries in the M1 according to the sex of the subjects

Distribution of M1 dental caries according to sex												
Sex	All M1 without dental caries		All M1 with dental caries		One M1 with dental caries		Two M1 with dental caries		Three M1 with dental caries		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Girls	18	52.9	13	54.2	3	37.5	7	46.7	3	50	44	50.57
Boys	16	47.1	11	45.8	5	62.5	8	53.3	3	50	43	49.43
Total	34	39.1	24	27.6	8	9.2	15	17.2	6	6,9	87	100

Chi square test;  $p = 0.933$

M1: the first permanent molar; N: number of subjects.

**Table III.12.** The distribution of dental caries on the surfaces of the first permanent molar depending on the age of the subjects

Distribution of dental caries on permanent M1 surfaces according to age																		
Age	O		M-O		D-O		B-O		L-O		L		B		M		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
5-6 years	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	12.5	4	4.6
6-7 years	7	24.1	0	0	1	10	0	0	0	0	0	0	0	0	8	25	16	18.4
7-8 years	6	20.7	1	16.7	3	30	0	0	0	0	0	0	0	5	15.6	15	17.2	
8-9 years	3	10.3	2	33.3	3	30	2	28.6	0	0	1	100	0	0	5	15.6	16	18.4
9-10 years	4	13.8	1	16.7	0	0	1	14.3	0	0	0	0	1	100	3	9.4	10	11.5
10-11 years	6	20.7	2	33.3	2	20	3	42.9	1	100	0	0	0	0	4	12.5	18	20.7
11-12 years	2	6.9	0	0	0	0	1	14.3	0	0	0	0	0	0	2	6.3	5	5.8
>12 years	1	3.5	0	0	1	10	0	0	0	0	0	0	0	0	1	3.1	3	3.4
Total	29	33.3	6	6.9	10	11.5	7	8.0	1	1.1	1	1.1	1	1.1	32	36.8	87	100

Chi square test;  $p = 0.800$

O: occlusal location; M-O: mesial-occlusal location; D-O: distal-occlusal location; B-O: buccal-occlusal location; L-O: lingual-occlusal location; L: lingual location; B: buccal location; M: mesial location; N: number of subjects, M1: the first molar.

As about the distribution of dental caries on the surfaces of the first permanent molar according to sex, almost similar rates were found for the occlusal and distal-occlusal locations. The mesial-occlusal location was more common in boys than in girls (83.3% versus 16.7%), while the buccal-occlusal and mesial locations were more common in girls than in boys (57.1% versus 42.9% and 53.1% versus 46.9%).

*Results regarding the caries with pulp involvement in the first permanent molar:*

The high prevalence of cases where dental caries with pulp involvement are absent is worth noting, representing 80.5% of all investigated children. Significant differences were recorded in the prevalence of cases lacking caries with pulp involvement in relation to the age of the subjects ( $p = 0.0001$ ), see Table III.13.

**Table III.13.** Distribution of M1 caries with pulp involvement by subjects' age groups

Distribution of M1 caries with pulp involvement by age groups										
Age group	All M1 without caries with pulp involvement		One M1 having caries with pulp involvement		Two M1 having caries with pulp involvement		Three M1 having caries with pulp involvement		Total	
	N	%	N	%	N	%	N	%	N	%
5-6 years	4	5.7	0	0	0	0	0	0	4	4.6
6-7 years	16	22.9	0	0	0	0	0	0	16	18.4
7-8 years	15	21.4	0	0	0	0	0	0	15	17.2
8-9 years	13	18.6	0	0	2	28.6	1	50	16	18.4
9-10 years	9	12.7	0	0	1	14.3	0	0	10	11.5
10-11 years	8	11.4	6	75	4	57.1	0	0	18	20.7
11-12 years	4	5.7	0	0	0	0	1	50	5	5.8
>12 years	1	1.4	2	25	0	0	0	0	3	3.4
Total	70	80.5	8	9.2	7	8.0	2	2.3	87	100

Chi square test;  $p = 0.0001$

M1: the first permanent molar; N: number of subjects.

The lack of pulp pathology, similar to dental caries, was slightly more frequent in girls (51.4%) than in boys (48.6%), table III.14.

The situation of two first permanent molars affected by caries with pulp involvement per subject was more frequent in males than in females, 57.1% versus 42.9%, and the rest of the analyzed situations were equally distributed between the sexes, 50%. The absence of caries with pulp involvement, similar to dental caries, was slightly more encountered in females, in a percentage of 51.4%, as compared to males, with a frequency of 48.6%.

**Table III.14.** The distribution of M1 caries with pulp involvement according to the sex of the subjects

Distribution of M1 caries with pulp involvement according to sex										
Sex	All M1 without caries with pulp involvement		One M1 having caries with pulp involvement		Two M1 having caries with pulp involvement		Three M1 having caries with pulp involvement		Total	
	N	%	N	%	N	%	N	%	N	%
Girls	36	51.4	4	50	3	42.9	1	50	44	50.6
Boys	34	48.6	4	50	4	57.1	1	50	43	49.4
Total	70	80.5	8	9.2	7	8.0	2	2.3	87	100
Chi square test; $p = 0.979$										

M1: the first permanent molar; N: number of subjects.

*Results regarding permanent M1 extractions:*

In what concerns the distribution of extractions according to sex, out of the total of 87 subjects, two female subjects and three male subjects had only one molar extracted, and only one subject presented two extracted molars, this being a female. In 81 subjects, we did not encounter any extraction of a first permanent molar.

The prevalence of the first permanent molar extraction was 6.87%. Of the 87 investigated children, 81 (93.13%) did not have this tooth extracted. The extraction of a single molar was seen in a small percentage, 5.7%, the extraction of two molars was recorded in a very small percentage, 1.1%, and the extraction of three or four molars was not encountered (Table III .15).

**Table III.15.** Distribution of the first permanent molar extractions by age group

Distribution of M1 extractions by age groups of the subjects									
Age group	No extractions of M1		One M1 extracted		Two M1 extracted		Total		
	N	%	N	%	N	%	N	%	
5-6 years	4	4.9	0	0	0	0	4	4.6	
6-7 years	16	19.8	0	0	0	0	16	18.4	
7-8 years	15	18.5	0	0	0	0	15	17.2	
8-9 years	15	18.5	1	20	0	0	16	18.4	
9-10 years	9	11.1	1	20	0	0	10	11.5	
10-11 years	16	19.8	1	20	1	100	18	20.7	
11-12 years	4	4.9	1	20	0	0	5	5.8	
>12 years	2	2.5	1	20	0	0	3	3.4	
Total	81	93.1	5	5.7	1	1.1	87	100	
Chi square test; $p = 0.570$									

M1: the first permanent molar; N: number of subjects.

## Discussions: au

When investigating the eruption of the first permanent molar by age group and sex of subjects, we can state that, in relation to sex, the values of the two categories analyzed, incomplete eruption and complete eruption, were close, around the value of  $50\pm 2.4\%$ . Looking at the eruption of this tooth by age group, in the first 3 years of the age interval of 5-12 years, incomplete eruption prevailed, in a percentage of 95.3%; in the age range of 8-9 years, the incomplete eruption was reduced in percentage, 4.7%, and in the following interval, of 9-12 years, we did not encounter any such situation. Complete eruption was dominant in the age range of 8-11 years, in a percentage of 84.9%.

Structural changes such as enamel hypomineralization was the second aspect we analyzed. The data obtained regarding the distribution of these defects show a total prevalence of 40.2%. Of these defects, the mild form represented 28.7%, the moderate form 9.2% and the severe form 2.3%. Subjects in the age range of 6-7 years presented 50.5% of the total structural changes.

Regarding the affected dental surfaces, the occlusal location was the most frequent, 19.5%, representing almost half of the total locations. As about the number of affected teeth, the category with two first molars affected was the most frequent, representing 23% of all cases with hypomineralization. The mandibular first permanent molars were affected more frequently than the maxillary ones. In relation to sex, the percentage values were close, of around  $50\pm 0.6\%$ .

A systematic review shows a variable frequency of such disorders, ranging from 2.4% in Germany to 40.2% in Brazil, this maximum prevalence being identical to that in this study [53].

Few studies have investigated the distribution of enamel hypomineralization lesions according to the number of tooth surfaces affected, as was done in this research.

Although cross-sectional cohort studies are needed to better describe the prevalence and characteristics of enamel hypomineralization of the first permanent molar in the Romanian pediatric population, the results of the present research show that the mixed dentition period is susceptible for the occurrence of these lesions, a situation which requires early detection for rapid implementation of treatment strategies.

The third aspect evaluated in this study on the status of the first permanent molar was the distribution of dental caries and dental caries with pulp involvement. The obtained results showed a total prevalence of 60.9% for dental caries, the most frequent situation being the one with four affected molars, 27.6%, followed by the situation with two affected

molars, 17.2%. The category with the least frequency that we analyzed, with a percentage of 6.9%, was the one with three affected molars. In relation to sex, the total values of the distribution of dental caries by age groups were close to each other,  $50\pm 0.57\%$ .

This study showed that the tooth surfaces with a high prevalence in location of the dental caries were: the mesial surface, 36.8%, followed by the occlusal surface, 33.3%, these two representing 70.1% of the total locations.

Looking at the distribution of caries with pulp involvement, the obtained results showed a total prevalence, for the evaluated age groups, of 19.5%, a much reduced prevalence compared to the prevalence of dental caries.

The most frequent situations were those with one or two molars affected by caries with pulp involvement. In relation to the sex of the subjects, the total percentage values were close, being around  $50\pm 0.6\%$ .

According to the analyzed references and taking into account the results obtained in this study, we can state that caries is the most common pathological condition in the first permanent molars during the period of mixed dentition.

The fourth aspect regarding the status of the first permanent molar that we evaluated was the distribution of the extractions of these teeth by age groups and according to the sex of the subjects. By analyzing this aspect, we found that the number of extractions was very low, there were only five subjects who had one first permanent molar extracted, and only one subject who presented two first permanent molars extracted, which accounted for 6.87% from the total number of investigated children. It turns out that 81 subjects out of a total of 87 (93.13%) did not present any first permanent molar extracted, which is a particularly important positive aspect.

The results we obtained showed certain similarities to the results presented in other studies, but also revealed several differences. These differences could stem from race, or unerupted teeth, or premature loss of first permanent molars. The obtained results demonstrate that the first permanent molars can be considered possible indicators of oral health during the period of mixed dentition.

## **Chapter 4**

### **Study 2: Clinical - statistical study on the impact of the first permanent molar early loss**

Like in the previous study, our **working hypothesis** was the fact that the research was carried out on a group of children from urban schools in the capital of the country who



had received treatment in private practice, who were from families with higher socio-economic and educational standards regarding oral health; we took into account the fact that we would have to deal with a reduced frequency of occlusion changes and vertical and sagittal migrations of teeth following early extractions of the first permanent molars during the period of mixed dentition.

**The purpose of the study** was to evaluate the more frequently affected or unaffected age groups, and to evaluate the prevalence of these potentially consecutive disturbances that affect functional occlusion, physiognomy, TMJ, mandibular kinematics and quality of life.

**The specific objectives:** to establish the location of these conditions, if they are present on both dental arches or on dental hemiarches, to determine if and how they affect the evaluated subjects and/or their relatives, if they are unilateral or bilateral, and if they have negative effects on facial aesthetics.

**Material and method:**

The study was conducted on 77 subjects in their period of mixed dentition, aged between 5 and 13 years, who were students in urban schools. First, the informed consent form was signed by the relatives in order to be able to use a series of clinical data and possibly photographic and radiographic images in this study. Gender-wise distribution was 41 girls and 36 boys. The subjects were arranged in the following age groups: 5-6 years, 6-7 years, 7-8 years, 8-9 years, 9-10 years, 10-11 years, 11-12 years and an age group older than 12, with 2 subjects who still had mixed dentition.

Among the 77 evaluated subjects, 10 had one first permanent molar extracted, 5 had two extracted molars and 2 subjects had three extracted molars.

We used the same criteria for inclusion of subjects in this study, and also the same criteria for exclusion of subjects. We selected subjects who attended public or private schools. The evaluations were carried out in the presence of relatives, by the same investigator.

We analysed the following:

- the prevalence of disturbances by age groups and depending on the sex of the subjects;
- vertical and sagittal migrations following the early loss of the first permanent molar;
- occlusion changes following the early loss of the first permanent molar:
  - tilts and rotations of neighboring teeth,

- the openings to interdental spaces, modification of the occlusal plane;
- repercussions on the temporomandibular joint (TMJ):
  - lateral mandibular deviation during mouth opening/closing,
  - facial asymmetries, joint subluxations, joint and facial pain, headaches,
  - otological symptoms, masticatory muscle discomfort,
  - noises or pops when opening or closing the mouth, difficulty opening the mouth;
  - dysfunctional occlusal contacts.

The statistical analysis was identical to the one in the previous study.

**Results:**

Regarding the prevalence of vertical migrations, we determined three categories of situations: the first category in which there was no vertically migrated first permanent molar, in 81.82% of cases (63 subjects); the second category presented a single vertically migrated first molar, in 12.99% of cases (10 subjects), a situation with low potential of favoring occlusal changes, easily corrected with appropriate treatment; and the last category, in which there were two vertically migrated first permanent molars, in 5.19% of cases (4 subjects), also a remediable situation before the occurrence of occlusion disorders. Depending on gender, the percentages were similar.

**Table IV.1.** Vertical migrations of the first permanent molars

M1 Vertical migrations		
Vertical migrations	N	%
0 molars	63	81.82
1 molar	10	12.99
2 molars	4	5.19
Total	77	100

M1: the first permanent molar; N: number of subjects.

**Table IV.2.** Vertical migrations of the first permanent molars depending on the sex of the subjects

M1 Vertical migrations by sex						
Vertical migrations	Female		Male		Total	
	N	%	N	%	N	%
0 molars	33	80.49	30	83.33	63	81.82
1 molar	5	12.20	5	13.89	10	12.99
2 molars	3	7.32	1	2.78	4	5.19
Total	41	100	36	100	77	100

Chi square test; p = 0.663

M1: the first permanent molar; N: number of subjects.

**Table IV.3.** Vertical migrations of first permanent molars by age groups of the subjects

M1 Vertical migrations by age								
Age group	0 molars		1 molar		2 molars		Total	
	N	%	N	%	N	%	N	%
5-6 years	4	6.35	0	0	0	0	4	5.19
6-7 years	15	23.81	0	0	1	25.00	16	20.78
7-8 years	12	19.05	0	0	1	25.00	13	16.88
8-9 years	11	17.46	6	60.00	0	0	17	22.08
9-10 years	5	7.94	1	10.00	0	0	6	7.79
10-11 years	14	22.22	1	10.00	2	50.00	17	22.08
11-12 years	1	1.59	1	10.00	0	0	2	2.60
>12 years	1	1.59	1	10.00	0	0	2	2.60
Total	63	100	10	100	4	100	77	100
Chi square test; p = 0.110								

M1: the first permanent molar; N: number of subjects.

Looking at the distribution of the vertical migrations of the first permanent molars during the period of the mixed dentition on the analyzed age groups, we encountered two situations: with a single first permanent molar migrated, 10 subjects out of a total of 77, the prevalence of 12.98%; and the situation with two first permanent molars migrated, 4 subjects out of a total of 77, prevalence of 5.19%. The most affected age group with a single migrated molar was 8-9 years old, with 6 subjects out of a total of 10, the prevalence of 60%, and the age group of 10-11 years, with 2 subjects out of a total of 4, prevalence of 50%, see Table IV.3.

In what concerns the sagittal migrations, in 79.22% of the cases (61 subjects) there were no such migrations of the adjacent teeth to the edentulous spaces, in 15.29% of the cases (12 subjects) the second premolars presented sagittal migrations and in a percentage of 5.19% of cases (4 subjects) the second permanent molars presented sagittal migrations. The very high rate of no sagittally migrated teeth demonstrates that these disturbances were very rare, Table IV.4.

**Table IV.4.** Sagittal migrations following early loss of first permanent molars

Sagittal migrations following early loss of M1		
Sagittal migrations	N	%
No migration	61	79.22
Premolar 2	12	15.59
Molar 2	4	5.19
Total	77	100

M1: the first permanent molar; N: number of subjects.

**Table IV.5.** Sagittal migrations following the early loss of first permanent molars depending on the sex of the subjects

Sagittal migrations following the early loss of M1 according to sex						
Sagittal migrations	Female		Male		Total	
	N	%	N	%	N	%
No migration	34	82.93	27	75.00	61	79.22
Premolar 2	5	12.20	7	19.45	12	15.59
Molar 2	2	4.88	2	5.56	4	5.19
Total	41	100	36	100	77	100
Chi square test; p = 0.665						

M1: the first permanent molar; N: number of subjects.

Sagittal migrations were more frequent in males, 9 subjects out of the total of 36, in a percentage of 25.01%, as compared to females with 7 subjects out of the total of 41, in a percentage of 17.08%. The category with no teeth affected by sagittal migrations occurs more frequently in females, in a percentage of 82.93% (34 subjects), as compared to males in a percentage of 75% (27 subjects), see Table IV.5.

**Table IV.6.** Sagittal migrations following the early loss of first permanent molars by age groups of the subjects

Age group	No migration		Premolar 2		Molar 2		Total	
	N	%	N	%	N	%	N	%
5-6 years	4	6.56	0	0	0	0	4	5.19
6-7 years	16	26.23	0	0	0	0	16	20.78
7-8 years	13	21.31	0	0	0	0	13	16.88
8-9 years	17	27.86	0	0	0	0	17	22.08
9-10 years	6	9.84	0	0	0	0	6	7.79
10-11 years	5	8.20	12	100	0	0	17	22.08
11-12 years	0	0	0	0	2	50	2	2.60
>12 years	0	0	0	0	2	50	2	2.60
Total	61	100	12	100	4	100	77	100
Chi square test; p = 0.197								

M1: the first permanent molar; N: number of subjects.

As about sagittal migrations by age groups of the subjects, the situation with no permanent teeth with sagittal migrations was the most common, 79.22%, 61 subjects out of a total of 77, most subjects being part of the age group of 8-9 years, 17 subjects (27.88%) out of the total of 61. This situation was absent in the age group of 11-12 years and in the

age group of over 12 years. The sagittal migration of the second premolar was seen in 12 subjects belonging to the age group of 10-11 years, these being all the sagittal migrations evaluated in the case of the second premolar. The sagittal migrations of the permanent second molar were less frequent, with two subjects for each age group, the 11-12-year-old and the older than 12-year-old, according to the data in Table IV.6.

For vertical and sagittal migrations, the assessment was performed on the maxilla and mandible as a whole, due to their small number. We believe that these results, which show a reduced number of vertical and sagittal migrations following the early loss of the first permanent molar, are due to the short-term follow-up of the subjects.

**Table IV.7.** Occlusal changes following early loss of first permanent molars in the mixed dentition

Occlusal changes following early loss of M1		
Occlusal changes	N	%
No modifications	39	50.65
Tilts and rotations	17	22.08
Openings to interdental spaces	13	16.88
Changes to the occlusal plane	8	10.39
Total	77	100

M1: the first permanent molar; N: number of subjects.

The changes in occlusion following the early loss of the first permanent molar in the mixed dentition have the following prevalence: the tilts and rotations of the teeth adjacent to the edentulous spaces, 22.08% (17 subjects out of the total of 77), the openings to interdental spaces 16.88% (13 subjects out of the total of 77) and changes to the occlusal plane 10.39% (8 subjects out of a total of 77), see Table IV.7. These occlusion changes, accounted for separately, were associated as follows: 13 subjects out of the 17 with dental tilts and rotations also presented openings to interdental spaces, and 8 of them also presented changes in the occlusal plane.

**Table IV.8.** Changes in occlusion following the early loss of first permanent molars according to the sex of the subjects

Occlusal changes following the early loss of M1 according to sex						
Occlusal changes	Female		Male		Total	
	N	%	N	%	N	%
No modifications	22	53.66	17	47.22	39	50.65
Tilts and rotations	11	26.83	6	16.67	17	22.08
Openings to interdental spaces	5	12.20	8	22.22	13	16.88
Changes to the occlusal plane	3	7.32	5	13.89	8	10.39
Total	41	100	36	100	77	100

Chi square test;  $p = 0.393$

M1: the first permanent molar; N: number of subjects.

Among the changes in occlusion, dental tilts and rotations were more frequent in females as compared to males (26.83% versus 16.67%), and changes in the occlusal plane and the openings to interdental spaces were more frequent in males versus females, 13.89% versus 7.32% and 22.22% versus 12.20%, see Table IV.8.

**Table IV.9.** Changes in occlusion following the early loss of first permanent molars by age group of subjects

Occlusal changes following early M1 loss by age group										
Age group	No modifications		Tilts and rotations		Openings to interdental spaces		Changes to the occlusal plane		Total	
	N	%	N	%	N	%	N	%	N	%
5-6 years	4	10.26	0	0	0	0	0	0	4	5.19
6-7 years	16	41.04	0	0	0	0	0	0	16	20.78
7-8 years	12	30.78	1	5.88	0	0	0	0	13	16.88
8-9 years	2	5.12	7	41.18	5	38.46	3	37.5	17	22.08
9-10 years	0	0	2	11.76	2	15.38	2	25	6	7.79
10-11 years	3	7.68	5	29.41	6	46.15	3	37.5	17	22.08
11-12 years	2	5.12	0	0	0	0	0	0	2	2.60
>12 years	0	0	2	11.76	0	0	0	0	2	2.60
Total	39	100	17	100	13	100	8	100	77	100

Chi square test;  $p = 0.508$

M1: the first permanent molar; N: number of subjects.

The absence of occlusal changes following the early loss of the first permanent molar in the mixed dentition was found in 39 subjects out of 77 (50.65%), with the highest prevalence in the age ranges of 6-7 years, with 16 subjects (41.04%) and 7-8 years, with 12 subjects (30.78%). Conversely, these occlusion changes were present in all subjects in the 9-10 years age group and in the age group of older than 12.

Dental tilts and rotations present in 17 subjects out of the 77, 22.08%, are found most frequently in the age range of 8-9 years, in 7 subjects, 41.16% of all those affected, and in the age group of 10-11 years, in 5 subjects, 29.41% of all those affected. Openings to interdental spaces, present in 13 subjects out of the 77 (16.88%), were more frequent in the 10-11 years age group, in 6 subjects, 46.15% of the total affected ones, and in the 8-9 years age group, in 5 subjects, 38.46% of all those affected. The changes in the occlusal plane present in 8 subjects out of the 77 (10.39%) are found most frequently in the age groups of 10-11 and 8-9 years, 3 subjects each, 75% of their total, and in the group aged 9-10 with 2 subjects, 25% of their total. These results, which show a fairly small number of occlusal changes following the early loss of the first permanent molar during the period of mixed dentition, are due to the short-term follow-up of the subjects.

**Table IV.10.** Repercussions on the temporomandibular joint (TMJ) following the early loss of the first permanent molars in the mixed dentition

Repercussions on TMJ following early loss of M1		
	N	%
No repercussions	45	58.42
Lateral mandibular deviations	15	19.50
Dysfunctional occlusal contacts	17	22.08
Total	77	100

TMJ: temporomandibular joint; M1: the first permanent molar;  
N: number of subjects.

In what regards the repercussions on the TMJ following the early loss of the first permanent molars during the period of the mixed dentition, we only encountered lateral mandibular deviations and dysfunctional occlusal contacts. Dysfunctional occlusal contacts were seen in 17 subjects (22.08% of their total), lateral mandibular deviations in 15 subjects (19.50% of their total), and 45 subjects (58.42%) did not have such disturbances, see Table IV.10. These changes, accounted for separately, were associated as follows: 15 subjects out of the 17 with dysfunctional occlusal contacts also presented lateral mandibular deviations.

Looking at these repercussions, a higher prevalence is observed in females, in a percentage of 24.39% (10 subjects), as compared to males with a percentage of 13.85% (5 subjects). Dysfunctional occlusal contacts were also more frequently encountered in females, in a percentage of 24.39% (10 subjects), as compared to males, in a percentage of 19.44% (7 subjects). The category with no TMJ repercussions had higher frequency in males, 66.71% (24 subjects out of the total of 36), as compared to females, 51.22% (21 subjects out of the total of 41), see Table IV.11.

**Table IV.11.** Repercussions on the temporomandibular joint following the early loss of the first permanent molars in the mixed dentition depending on the sex of the subjects

Repercussions on TMJ following the early loss of M1 according to sex						
Repercussions on TMJ	Female		Male		Total	
	N	%	N	%	N	%
No repercussions	21	51.22	24	66.71	45	58.42
Lateral mandibular deviations	10	24.39	5	13.85	15	19.50
Dysfunctional occlusal contacts	10	24.39	7	19.44	17	22.08
Total	41	100	36	100	77	100

Chi square test;  $p = 0.143$

TMJ: temporomandibular joint; M1: the first permanent molar;  
N: number of subjects.

Regarding the repercussions on the TMJ following the early loss of the first permanent molars during the period of mixed dentition on the age groups of the evaluated subjects, the highest frequency of lateral mandibular deviations occurs in the age group of 10-11 years, in 5 subjects (33.34% of their total), and the lowest frequency was seen in the age groups of 11-12 years and in the age group of over 12 years, 1 subject for each (6.61% of their total, each group). Dysfunctional occlusal contacts showed the highest prevalence in the age group of 10-11 years, in 7 subjects (41.12% of their total), and the lowest prevalence was encountered in the age group of 11-12 years and in the age group of older than 12 years, a single subject for each (5.88% of their total, each group), see Table IV.12.

Regarding the lack of repercussions on the TMJ following the early loss of the first permanent molar during the period of mixed dentition, this situation was encountered in 45 subjects out of the 77 (58.42%), with the highest prevalence found in the age ranges of 6-7 years with 16 subjects (35.62%) and 7-8 years with 13 subjects (28.66%). Conversely, these disturbances were present in all subjects from the age groups of 9-10 years, 11-12 years and from the age group of older than 12 years. No statistically significant differences could be highlighted ( $p = 0.626$ ), Table IV.12.

**Table IV.12.** Repercussions on the temporomandibular joint (TMJ) following the early loss of the first permanent molars by age groups of the subjects

Repercussions on TMJ following the early loss of M1 by age groups								
Age group	No repercussions		Dysfunctional occlusal contacts		Lateral mandibular deviations		Total	
	N	%	N	%	N	%	N	%
5-6 years	4	8.88	0	0	0	0	4	5.19
6-7 years	16	35.62	0	0	0	0	16	20.78
7-8 years	13	28.66	0	0	0	0	13	16.88
8-9 years	7	15.54	6	35.28	4	26.66	17	22.08
9-10 years	0	0	2	11.76	4	26.66	6	7.79
10-11 years	5	11.20	7	41.16	5	33.33	17	22.08
11-12 years	0	0	1	5.88	1	6.61	2	2.60
>12 years	0	0	1	5.88	1	6.61	2	2.60
Total	45	100	17	100	15	100	77	100

Chi square test;  $p = 0.626$

TMJ: temporomandibular joint; M1: the first permanent molar;  
N: number of subjects.



The results show a reduced number of repercussions on the TMJ following the early loss of the first permanent molars during the mixed dentition period, and they occur in the second part of this period, possibly due to the short-term follow-up of the subjects.

#### **Discussions:**

The vertical migrations following the early loss of the first permanent molar during the period of mixed dentition had a very low prevalence, only 18.18%. What is remarkable is the high percentage of subjects without vertical dental migrations, 81.82%. The vertical migrations following the early loss of the first permanent molar in the mixed dentition are egressions and extrusions, changes that favor occlusal disturbances. In the case of egression, it was shown that the maxillary first molars have greater egression potential as compared to the mandibular first molars [55, 56].

There are studies that showed that the over-eruption of the opposing tooth was the main consequence of the loss of the first permanent molar in the mixed dentition [55].

In what concerns the assessed sagittal migrations, the prevalence was also very low, 20.78%. It can be concluded that both types of migration had low prevalence, which is why no statistically significant differences were reported.

The migrations of the teeth adjacent to the edentulous spaces can be followed by their rotations and single tooth crossbites [57].

The encountered occlusion disturbances following the early loss of the first permanent molars presented the following frequency: dental tilts and rotations 22.08%, openings to interdental spaces 16.88%, and changes in the occlusal plane 10.39%. In 50.64% of cases, such conditions were not present. Occlusion disturbances have the third highest prevalence among oral pathologies, after dental caries and enamel hypomineralization, hence they rank third in the priorities of oral health [66].

The encountered repercussions on the temporomandibular joint following the early loss of the first permanent molars showed the following frequency: lateral mandibular deviations 19.50% and dysfunctional occlusal contacts 22.08%. In 58.42% of the cases, such disturbances were not seen.

## **CHAPTER 5**

### **CONCLUSIONS AND PERSONAL CONTRIBUTIONS**

#### **Conclusions**

Enamel hypomineralization should not be confused with other hereditary or acquired structural anomalies. Hypomineralization is the most frequent structural disturbance in the

first permanent molars and should be considered a public health issue due to its frequent occlusal location, the rapid destruction of dental hard tissues and the high risk for overlapping dental caries.

The very high prevalence of dental caries (60.9%) in the first permanent molar during the period of mixed dentition is an aspect that dentists who treat children and pedodontists should be aware of, as it calls for periodic examination of patients in order to quickly implement the appropriate treatment so as to avoid the occurrence of complications that stem from lack of adequate therapy or unfavorable evolution of the disease.

The high percentages of first permanent molars without pulp pathology and without dental extractions during the period of mixed dentition can demonstrate the parents' high degree of responsibility and their awareness of the need for oral-dental treatments during this period; as well as this, it proves the professionalism of pedodontists and dentists in what concerns the dental treatments performed.

The reduced number of vertical and sagittal migrations of teeth stemming from the early loss of the first permanent molar may be due to the short evaluation period following the extractions, the rapid establishment of appropriate treatment and the oral health education of the family members. This aspect is also supported by the fact that most of the consecutive occlusion changes we evaluated were reduced in percentage.

The obtained observations regarding the pathological status of the first permanent molars during the period of mixed dentition are relevant and useful for current clinical practice. Periodic examination and early detection of various pathologies at the level of these teeth are particularly important for the management of children's oral health during the period of mixed dentition.

These studies present certain limitations due to the short evaluation period, therefore we believe that future studies and the analysis of other variables could validate the consequences of the early extraction of the first permanent molars in the mixed dentition.

### **Personal contributions**

They mainly consist in the design of the research directions, the methodology used in research and the results obtained in the studies carried out.

The analysis of enamel hypomineralization on the number of affected first permanent molars per subject, on the dental surfaces, on the age groups and according to sex, the statistical significance of the results obtained ( $p \leq 0.05$ ) and their comparison with those presented in other studies constitute a unique study in Romanian specialised literature (Chapter 3).

Analysis of the distribution of dental caries and of caries with pulp involvement by number of teeth and by dental surfaces (only in the case of dental caries), as well as the distribution and prevalence of extracted first permanent molars during the period of mixed dentition, by age groups and sex of the subjects, alongside with the statistical significance of the obtained results yield a complex and complete study with certain unicity in Romanian literature (Chapter 3).

The evaluation of sagittal and vertical dental migrations, occlusion changes and repercussions on the temporomandibular joint following the early loss of the first permanent molar during the period of mixed dentition, by age group and according to the sex of the subjects, represents yet another unique study in the Romanian specialised literature (Chapter 4).

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## LIST OF PUBLISHED SCIENTIFIC PAPERS

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