AXIAL MODIFICATIONS OF PERMANENT LOWER MOLARS AFTER PREMATURE LOSSES OF TEMPORARY MOLARS

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AXIAL MODIFICATIONS OF PERMANENT LOWER MOLARS AFTER PREMATURE LOSSES OF TEMPORARY MOLARS (Abstract): Aim: The aim of our study was to determine the impact of premature loss of temporary lower molars upon the longitudinal axis of the first and second permanent molars. Material and Methods: The study groups included 61 patients, 6-9 year olds with premature loss of primary molars and a control group of 24 patients with intact temporary teeth. We evaluated the angle between longitudinal axis of first and second lower permanent molars and occlusal plane. Results. It was observed that premature loss of lower second deciduous molar modifies more the vertical axis of first and second permanent molars than the premature loss of first lower primary molar. Reducing space occurs mainly through mesial inclination of molars that separates the edentulous breach. Temporary loss of both lower first molars on the same quadrant causes an accelerated eruption of both premolars increasing the prevalence of eruption sequence: “4-5-3-7”. Conclusions: The preservation of the occlusal morpho-functional complex using space maintainers mainly when the premature loss of the second primary molars occurs is the best interceptive treatment option. Keywords: PREMATURE LOSS, AXIAL MODIFICATION, PERMANENT LOWER MOLARS, DENTAL CARIES, TEMPORARY TEETH.

The first one who debated upon the subject of premature loss of temporary teeth were Hutchinson and Davenport as early as the 1880s (1,2). The concept was defined as the exfoliation of deciduous teeth on the arch with more than 12 months prior to the normal eruption period of permanent teeth, exceeding the limits of normal variability of temporary teeth exfoliation sequences (3).

The most frequent causes that trigger the premature loss of temporary teeth are: untreated complicated dental cavities, traumatisms and premature root resorption. The premature loss of temporary teeth, as a consequence of untreated dental cavity of temporary teeth may lead to serious tridimensional dental, dento-dental, dento-alveolar, occlusal and variably skeletal lesions. Thus, we control the migration of permanent teeth during intra-maxillary or oral eruption, the consequence being dento-alveolar incongruence. There may also appear super-eruptions of antagonist teeth, arch narrowing, reverse toothing, premature contacts and occlusal interferences (4). Studies have shown that the premature
Loss of temporary molars mainly determines the distal migration of temporary canines. In this case, mesial displacement of permanent molars or their version cannot occur (5). Greater effects appear at the moment of the premature loss of second temporary molars, as they serve as a guide for the eruption of the permanent molar (6). The premature loss of second temporary molars – mainly mandibular – determines a shrinking of the arch length due to mesial inclination of permanent molars, compromising the „lee-way space” by affecting the posterior support area (7). The radiologic exam is mandatory for these patients. Although the cone beam computed tomography (CBCT) has progressively become a radiological method or reference in the oro-maxillo-facial sphere, the orthopantomography still represents a routine exam for children under 12 and not only. It thus represents a simple and economical way that uses a low radiation dose in comparison with the CBCT and allows a rapid quantitative and qualitative analysis both of the bone and the dental structures, allowing at the same time the quantification of the inclination degree of permanent molars in the context of the premature loss of temporary molars.

The main purpose of this study is to determine the impact of premature loss of mandibular temporary molars on the longitudinal axis of the permanent molars. A secondary objective is to verify whether there appear important modifications in the eruption sequence of the successors and the way the axis of the permanent molars is influenced.

MATERIAL AND METHODS
The study included 85 orthopantomographies of subjects aged 6 to 9 who reported to the Clinic of Pediatric Dentistry, Iasi. Out of these, 61 (71.8%) patients showed a premature loss of a lower temporary molar (study group) and 24 (28.2%) had intact dentition (control group). The study group was re-divided in all possible subgroups depending on the premature unilateral or bilateral loss of temporary molars. The precondition for the selection of subjects was that the incisors and permanent molars were intact. All patients received the required treatment and their written, informed and motivated approval was obtained.

All orthopantomographies were made at a single radiologic center by the same experienced technician in ideal conditions, using the radiologic device PaX-Uni3D(Vatech)®. At the moment of the orthopantomography the patients needed to have relaxed lips, a correct position of the head in relation to the chin support and the Frankfort plane needed to be parallel with the horizontal plane. Low quality, improper films or those with artifacts were excluded from the study from the beginning and the valid ones were saved digitally. Measurements were made by a single examiner using the Easy Dent 4 Viewer® software.

The orthopantomographies were processed by tracing the following structures (fig. 1):

- the occlusion plane – tangent line to vestibular cuspids of temporary molars/premolars and disto-vestibular cusp of lower right/left permanent molar;
- the axis of primary permanent molar (M1) – the line passing through the center of the crown and the center of radicular bifurcation;
- the eruption axis of the second permanent molar (M2) – the line passing through the middle of the crown and the center of the starting point of the radicular bifurcation.
Fig. 1. Orthopantomographic aspect of premature loss of temporary molars

We thus evaluated the angle formed between the longitudinal axis of the first and second permanent molar and the occlusal plane in both lower quadrants. The software used for the data analysis was Statistical Package for the Social Sciences (version 20.0; SPSS, Chicago, III). We calculated the frequency and descriptive parameters (mean value, standard error, standard deviation, the minimum and maximum values) for each group. We used the t-student test to compare each group with the control group. The t-pairs test was used to compare the first permanent lower molars (M1) axes with second permanent lower molar (M2) axes of the two quadrants. The error limits used in the statistic interpretation are of 5% and the reliability range was of 95%.

In order to identify the possible errors during measurements we selected 25 radiographies. Measurements were repeated for the same radiographies and the t-paired test was used for the first and second measurement. No statistically significant difference was identified between the two measurements (p>0.05).

**RESULTS**

Out of the total 85 orthopantomographies analyzed, 45 (53%) patients were males (with an age average of 7.29) and 40 (47%) patients were females (average age 7.38). As far as the age distribution of subjects is concerned, there is a prevalence of patients aged 7 to 8 with an average age of 7.33.

In our study a total of 75 lower temporary molars were lost prematurely due to untreated dental cavities. The cumulated frequency of first temporary molar (m1t) and second temporary molar (m2t) losses shows a value of m1t close to m2t (37 (49.5%) for m1t and 38 (50.5%) of m2t).

From the point of view of angulation, the mesial-version mean for the control group of lower permanent M1 is of 80.38 ° (variation 69°-87°) and for lower permanent M2 of 69.74 ° ( variation 50°-84°).

By analyzing the influence of unilateral premature loss of lower temporary molars on the inclination of permanent molar we may notice that the loss of lower m1t has very little influence on the axis of lower permanent molars (mean inclination of 80.078°, with a variation between 73° and 85.4° for M1 respectively a mean inclination of 65.47° with a variation between 50° and 81.50° for M2). The loss of lower m2t determines an accentuated mesial-version of permanent molars (angular mean value of 77.29 ° with a variation between 65.40° and 85.50° for permanent M1 and
aXial modifications of permanent lower molars after premature losses of temporary molars

respectively a mean value of 64.24° with a variation between 30° and 83° for permanent M2). In case of loss both of m1t and of m2t, the angle between the longitudinal axis and the occlusal plane will increase close to the values of the control group up to mean angular values of 79.275° for M1 and of 68.75° for M2 (fig. 2).

The influence of bilateral premature loss of lower temporary molars on the inclination of permanent molars determines a mesial version of permanent molars in cases of bilateral loss of m2t (mean angular values being of 72.25° for M1 and of 60.91° for M2). Bilateral loss of both m1t and m2t influences positively the axis of permanent molars, determining in these cases a slight overhang towards the distal (mean angular values being of 81.15° for M1 and of 74.75° for M2) (fig.3).
Using the *t*-test we compared the axes of permanent molars, in the case of reunited global groups with premature loss of lower m1t, of lower m2t and of lower m1t+m2t, namely with the axes of permanent molars on the same side of the control group. The only statistically relevant situation is the loss of lower m2t which influences both permanent M1 axis and the permanent M2 axis (tab. I).

**TABLE I**

Results of the comparison between the group with premature loss of m2t and the control group

<table>
<thead>
<tr>
<th>Groups compared</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower M1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>m2t global</td>
<td>36</td>
<td>76.189</td>
<td>6.5877</td>
<td>1.098</td>
<td>0.021*</td>
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<td>4.8021</td>
<td>0.9802</td>
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<tr>
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<td></td>
<td></td>
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</tr>
<tr>
<td>m2t global</td>
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<td>65.431</td>
<td>11.789</td>
<td>1.9648</td>
<td>0.04*</td>
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<tr>
<td>m1t global</td>
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<td>4.7743</td>
<td>0.8311</td>
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<tr>
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<td>80.863</td>
<td>4.069</td>
<td>0.8306</td>
<td></td>
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<tr>
<td>Lower M2</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
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<td>68.129</td>
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<td>1.7816</td>
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<tr>
<td>Lower M1</td>
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<td></td>
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<tr>
<td>m1t+m2t global</td>
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<tr>
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<td>68.129</td>
<td>8.7279</td>
<td>1.7816</td>
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</tbody>
</table>

*Significant difference < 5.0%*

The correlative analysis between M1 axis and M2 axis in the two quadrants was made by comparison to the control group, using the *t*-test for pairs (*t*-pairs). In both cases there is a moderate correlation, but statistically significant between the M1 and M2 axes (axis right M1 & axis right M2, *r*=0.321, *p*=0.01; axis left M1 & axis left M2, *r*=0.510, *p*=0.000).

**DISCUSSIONS**

The premature loss of temporary molars has as a main consequence the reduction of the space requires for the eruption of premolars and for the correction of small frontal dento-alveolar incongruence which is normally accomplished due to the leeway-space (8). The greatest amount of space lost is due to the inclination of permanent molars towards the mesial. This inclination depends mainly on the dental age at the moment of the extraction but also on the sequence/periodicity of eruption (9-11).

Based on the analysis using the software we could observe with higher accuracy the angle formed by the longitudinal axis of the permanent molars with the occlusal plane and we could thus estimate a mean value, a minimum, maximum value and a standard deviation for the control group. A similar study which was conducted using an older technique, namely by tracing the teeth images and structures on tracing paper using a black pencil and the measurement of angles with the protractor,
considers that, for instance, the correct position of lower molar 1 is at an angle that ranges from $+80^\circ$ to $+100^\circ$ (12). The values we obtained for the lower M1 are similar with those in the previous study: the mean value being of $+80.38^\circ$ with a variation between $+69^\circ$ to $+87^\circ$. These aspects are relevant from the point of view of the inter-relation between the moment of premature loss of m2t and the moment of initiation of eruption of the first permanent molar. The context of premature loss of second temporary molar occurred after the initiation of clinical eruption of the first permanent molar.

Many longitudinal studies for a period from 2 to 8 months on children aged 6 to 9 with premature loss of the first lower temporary molar concluded that the shrinking of the mesial space from the second molar is due mainly to the distal displacement of the temporary canine and less to the migration or inclination of permanent molars (13-16). These results are also confirmed by us, since the axes of the lower permanent molars were very little influenced after the loss of first temporary molars, being comparative with the values obtained for the control group. Thus, the mean angular value for lower M1 at the control group was of $80.38^\circ$, while in case of m1t loss the mean value was of $80.07^\circ$, and for lower M2 at the control group the mean angular value was of $69.74^\circ$ as compared to the mean angular value in case of m1t loss of $65.45^\circ$.

Many studies (9-11,16) showed that the premature loss of second temporary molars determines a greater loss of leeway-space than in the case of first temporary molar, due both to the bigger difference in the mesio-distal diameter and to the fact that the first and second permanent molar lose the contact point and follows the trend of all teeth to lean mesially. This is also proved by our study by the much lower angular mean values for permanent mandibular molars in case of premature loss of the second mandibular temporary molar as compared to the mean angular values from the control group.

As a matter of fact, the only instance in our study which is statistically significant is the loss of lower m2t which influences the axis of both lower permanent molars, a logical consequence if we take into consideration the dynamic particularization of the alveolar and maxillary skeletal and mandibular growth and development on the age groups studied.

Another interesting aspect to analyze is the loss of both lower temporary molars on the same quadrant. A study conducted by Leroy R. et al (17) in 2009, showed that at the moment of cavity deterioration of both lower temporary molars and their loss subsequent to the cavity damage, the ideal eruption sequence „3-4-5-7” is reversed, increasing the prevalence of the eruption sequence „4-3-5-7”, „4-3-7-5” and „4-5-3-7”. Thus there occurs an accelerated eruption of both premolars. This is also confirmed by us in the present study through the increase of the mean angular values between the longitudinal axis of the permanent molars and the occlusal plane close to the mean angular values of the control group, leading to their distal overhang.

The moderate correlation between the axes of first and second molars in the same quadrant suggests the fact that any molar premature loss may have an impact on the entire dento-maxillary apparatus and may have later repercussions in the development of dento-maxillary anomalies.

The theme studied by us requires further complex clinico-radiological studies.
with a powerful analytical-statistical approach with a higher number of subjects, ecological repartition on genders and age stages and by using the advanced measurement techniques of CBCT type.

CONCLUSIONS

Our study proves one more time the problematic of the premature loss of lower second temporary molar, leading to a necessity to conduct more studies in this field. Its pathology fails to be limited in an intra-arch context due to the extrusion potential of second maxillary temporary molar which may generate premature contacts, occlusal interferences and may lead to the Thielemann effect on the long term (diagonal syndrome) affecting the opposite articulation. The modification of the eruption sequence following the premature loss of temporary molars is a phenomenon which needs consideration, especially when an interceptive treatment is adopted, with the preservation of the occlusal morpho-functional complex using space maintainers.

Acknowledgments

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**NEWS**

**LITERATURE REVIEW CONCERNING THE LOCAL DRUG DELIVERY SYSTEMS IN THE TREATMENT OF PERIODONTITIS**

In periodontitis, in order to complement non-surgical therapy, there are multiple options of antimicrobials (metronidazole, chlorhexidine, minocycline, doxycycline, tetracycline), which can be locally delivered into the mucosa. These antimicrobials are used in periodontal pockets and can inhibit or eliminate periodontal-pathogenic micro-organisms as well as modulate the inflammatory response of tissues. Currently, limited data are available regarding the relationship between effect, efficacy and clinical status of the periodontium. A review realized by a group of researchers aimed to evaluate the effect and the efficacy of different types of local drug delivery systems in clinical parameters of periodontology. Researched papers using MEDLINE via PubMed, and LILACS databases related to five types of local drug delivery systems (chlorhexidine gluconate, doxycycline hyclate, metronidazole gel, minocycline ointment and tetracycline fibers) were reviewed aiming to address the mechanism of action and the evidence of clinical effectiveness of adjunctive use of these antimicrobials following surgical and/or non-surgical therapies. Inclusion criteria defined that articles must be randomized controlled trials performed in humans and published between 1996 and 2014. The adjunctive use of local drug delivery systems with controlled release properties may provide a defined, but limited, beneficial response on periodontal pockets. Local drug delivery as an active treatment or maintenance therapy depends on clinical findings, responses to treatment described in the literature, desired clinical outcomes, and patients’ dental and medical histories, including their past usage of antimicrobials (Da Rocha HA, Silva CF, Santiago FL, Martins LG, Dias PC, De Magalhães D. Local Drug Delivery Systems in the Treatment of Periodontitis: A Literature Review. *J Int Acad Periodontol.* 2015; 17 (3) : 82-90).

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