ORTHODONTIC TREATMENT NEEDS IN MIXED DENTITION - FOR CHILDREN OF 6 AND 9 YEARS OLD

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ABSTRACT:
Early identification of a developing malocclusion and initiation of simple orthodontic therapy procedure represent ways to prevent or reduce the number of late orthodontic treatments, which can be complex, lengthy and costly. We aimed to assess the need for interceptive therapy of dentomaxillary anomalies on a group of 147 children, 69 of age 6 years old and 78 of age 9 years old, which called for an orthodontic or pedodontic treatment during 2014-2015 in 4 private offices in Craiova. We observed a high prevalence of caries in temporary and young permanent dentition (52.98% for age 6 years old and 37.17% for age 9 years old) and of early loss of temporary teeth (17.39% for age 6 years old and 23.07% for age 9 years old). The need for orthodontic treatment was high or very high for 10.13% of the children age 6 years old and 24.35% of the children age 9 years old, and small or moderate for 13.03% of children age 6 years old and 33.33% of the children age 9 years old. IOTN can be a valuable tool in identifying, planning and interception of potential dentomaxillary malocclusions.

Keywords: early loss of temporary teeth; malocclusions; prevention and interception in orthodontics.

INTRODUCTION:
Need to establish an orthodontic treatment in children is increased, varying according to the literature between a quarter and a third of this population group members [1,2,3,4]. In many cases the development of dentomaxillary anomalies can be early detected, since temporary or mixed dentition [5,6], but many doctors assess subjects in orthodontic terms only after completion of dental permutuation. Thus they refuse an interceptive treatment to such patients, which performed correctly can reduce on the one hand the risk of developing major dental mismatch, severe malocclusions or some facial asymmetries (the potential of skeletal growth modification is higher at younger ages); on the other hand it reduces the need for complex or lengthy orthodontic treatments, providing a more stable therapeutic results [7,8,9]. The interception of malocclusions promotes a better oral health care and decreases the risk of dental caries [10,11].

There were described several indices able to identify people who need orthodontic treatment and to minimize the subjectivity related to the diagnosis [12]. Shaw and co-workers (1995) [13] divided occlusal indices into five different categories: indices for diagnosis, epidemiological, orthodontic treatment need, treatment outcome, and orthodontic treatment complexity indices. Most of them relate to permanent dentition. The best known and used is Index of Orthodontic Treatment Need
(IOTN), because it is easily reproducible and the recording of all the relevant features of malocclusion can be done in a minute amount of time [14]. This index has been recommended and widely used for patients in the full permanent dentition stage but not in the mixed dentition stage [3]. So the IOTN has two separate components, a clinical component called the Dental Health Component (DHC) and an Aesthetic Component (AC). The Dental Health Component of IOTN is divided into five grades, with Grade 1 indicating no treatment is required and Grade 5 showing great need for treatment (Brook and Shaw, 1989) [15]. The occlusal trait with the highest score indicates the grade in which the malocclusion belongs to determining the degree of treatment needs. Regarding the aesthetic component it relies on a series of 10 photographs of different malocclusion arranged according to their attractiveness (from the least to the most attractive). In the original study the scale for AE assessment was determined by Evans & Shaw (1987) [16] for a lot of children of age 12 years old. In 2014 Mohamed et al. [1] tried to assess whether IOTN may find utility in interception, by assessing occlusal changes in the frontal maxillary and mandible in a group of children aged 8-10 years old, concluding that IOTN is effective in identifying dentomaxillary anomalies linked to increased overjet and overbite or to the presence of crossbite.

Specific index for mixed dentition that allows early detection of developing malocclusion is the index for preventive and interceptive orthodontic need, IPION, described by Coetzee (1997) [17]. IPION consists in recording of various occlusal traits that have scores depending on their severity. The trait scores are then added, yielding a total score that indicates the need for preventive or interceptive orthodontic treatment [3]. The index does not show the real prevalence of malocclusion, however, because there are severe malocclusions that can not benefit from preventive or interceptive treatment, which according to this index, have a low score [3]. It may be possible because of the small number of studies that have dealt preventive and interceptive orthodontics over the years and of the growing interest in this subject in recent years (Karaiskos et al., 2005 [3]; Silkestrand, 2007 [2] Sandoval and colab.2010 [18]; Borre 2013 [19]; Mohamed et al. 2014 [1]).

The purpose of the present study was to investigate by means of some occlusal parameters analysis how necessary is a preventive or interceptive orthodontic treatment in several dental offices with private practice in Craiova, for children aged 6 and 9 years old. The two age groups were chosen because at 6 years of age starts the mixed dentition phase, and within this phase the age of 9 years old marks the beginning of canin-premolar group eruption, when it completes the arch and harmonious implanting of permanent teeth into the alveolar arch and anterior and lateral guidance in eccentric motion of the mandible [20].

MATERIAL AND METHOD
The study was conducted during 2014-2015 in four private dental offices in Craiova with orthodontics and pedodontic activity. Were targeted children aged 6 and close to 9 years old, resulting in a sample of 147 children for which informed consent was obtained from caregivers in order to use clinical data records and analysis of study models and dental radiographs.

In order to determine the necessity of establishing a preventive or interceptive orthodontic treatment depending on the age
they were valued for each child from the study group more clinical parameters which are shown in Table 1 by two different examiners.

<table>
<thead>
<tr>
<th>6 year olds</th>
<th>9 year olds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caries</td>
<td>Caries</td>
</tr>
<tr>
<td>Early loss</td>
<td>Early loss</td>
</tr>
<tr>
<td>Molar relationship</td>
<td>Molar relationship</td>
</tr>
<tr>
<td>Overjet</td>
<td>Overjet</td>
</tr>
<tr>
<td>Overbite</td>
<td>Overbite</td>
</tr>
<tr>
<td>Anterior crossbite</td>
<td>Anterior crossbite</td>
</tr>
<tr>
<td>Posterior crossbite</td>
<td>Posterior crossbite</td>
</tr>
<tr>
<td>Open bite</td>
<td>Open bite</td>
</tr>
<tr>
<td></td>
<td>Submerged teeth</td>
</tr>
<tr>
<td></td>
<td>Active frenum</td>
</tr>
</tbody>
</table>

Table 1. Analyzed clinical parameters

Molar relationship appreciation was based on Angle occlusal classification of malocclusions [21].

The overjet was assessed in millimetres as the distance between the edge of the upper central incisor and the labial surface of the lower central incisor measured in millimeters. Overjet between 0.1 and 3 mm was considered as normal, greater than 3 mm was considered as increased, and 0 mm was taken as edge to edge. The open bite was measured in millimeters as the perpendicular distance from the edge of the central lower to the upper central incisor edge. The calculated IOTN scores of the 6 and 9 year old children were mainly based on labial segment of the upper and lower arches. The occlusal traits that were scored upon were the overjet, anterior crossbite, posterior crossbite, overbite and open bite.

For conformity assessment between clinical examinations results, the intra-examiner agreement was set at 10%.

The collected data were statistically analyzed with the dedicated software (SPSS 16.0, Chicago, IL, USA). Differences between groups were calculated using the Mann Whitney UU test and for correlations among the groups the Pearson test was used. All results were tested for statistically significant differences between age groups and genders using the χ2 test [22]. Inter- and intra-examiner agreement was evaluated using the weighted kappa statistic.

RESULTS

69 patients of the subjects included in the study were aged around 6 years old (6 years ± 3 months) and about 78 around 9 years old (9
years ± 6 months). Within the 6 years old group, 39 (56.52%) were girls and 30 boys (43.48%) and from those of age 9 years old, 41 (52.56%) were girls and 37 boys (47.44%).

**Caries:** In the 6-year-old group, 24% of children had caries affecting 1 tooth and 28.98% had caries affecting more than 1 tooth; in the 9 years old group, 16.66% had caries affecting 1 tooth and 20.51% had caries affecting more than 1 tooth (table 2).

The most affected tooth by carries was primary second molar: for 6 years old in 39.47%, and for 9 years old 37.70% (table 3).

### Early loss of temporary teeth:
12 of the 6 years old subjects (17.39%) and 18 of the 9 years old (23.07%) had early loss for ≥ 1 tooth. The most commonly missing teeth were the primary first molars (43.75%), followed by the primary canines (31.25%) for the 6 years old; in the 9 years old, the primary canines (46.15%) were most commonly missing, followed by the primary first molars (19.23%) (table 4).

<table>
<thead>
<tr>
<th>No. of teeth</th>
<th>No. (and %) of 6 years old</th>
<th>No. (and %) of 9 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>32 (47.02%)</td>
<td>49 (62.82%)</td>
</tr>
<tr>
<td>1</td>
<td>17 (24%)</td>
<td>13 (16.66%)</td>
</tr>
<tr>
<td>≥1</td>
<td>20 (28.98%)</td>
<td>16 (20.51%)</td>
</tr>
</tbody>
</table>

Table 2. Number of teeth affected by caries

<table>
<thead>
<tr>
<th>Tooth affected</th>
<th>No. (and %) of 6 years old</th>
<th>No. (and %) of 9 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary incisors</td>
<td>6 (7.89%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Primary canines</td>
<td>5 (6.57%)</td>
<td>7 (11.47%)</td>
</tr>
<tr>
<td>Primary first molars</td>
<td>23 (30.26%)</td>
<td>18 (29.50%)</td>
</tr>
<tr>
<td>Primary second molars</td>
<td>30 (39.47%)</td>
<td>23 (37.70%)</td>
</tr>
<tr>
<td>Permanent first</td>
<td>12 (15.78%)</td>
<td>13 (21.31%)</td>
</tr>
</tbody>
</table>
Table 3. Teeth most commonly affected by caries

<table>
<thead>
<tr>
<th>Tooth affected</th>
<th>No. (and %) of 6 years old</th>
<th>No. (and %) of 9 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary canine</td>
<td>5 (31.25%)</td>
<td>12 (46.15%)</td>
</tr>
<tr>
<td>Primary first molar</td>
<td>7 (43.75%)</td>
<td>9 (34.61%)</td>
</tr>
<tr>
<td>Primary second molar</td>
<td>4 (15.00%)</td>
<td>5 (19.23%)</td>
</tr>
</tbody>
</table>

Table 4. Teeth most commonly affected by early loss

<table>
<thead>
<tr>
<th>Classification</th>
<th>No. (and %) of 6 years old</th>
<th>No. (and %) of 9 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not measurable</td>
<td>22 (31.88%)</td>
<td>2 (2.56%)</td>
</tr>
<tr>
<td>Class I</td>
<td>31 (44.92%)</td>
<td>42 (53.84%)</td>
</tr>
<tr>
<td>Class II</td>
<td>12 (17.39%)</td>
<td>28 (35.89%)</td>
</tr>
<tr>
<td>Class III</td>
<td>4 (5.79%)</td>
<td>6 (7.69%)</td>
</tr>
</tbody>
</table>

Molar relationship: For 6 years old group 22 subjects (31.88%) could not be included in a class of malocclusion by Angle because they had no erupted first permanent molars, and for 9 years old group 2 patients (2.56%) to which early extraction of first permanent molars did not allow the assessment of this relationship. Of the 47 children of 6 years old group with molar relations, 62.3% had a class I malocclusion, 32.1% class II and 5.7% class III by Angle, and of the 76 subjects of 9 years old group 53.84% showed class I malocclusion, 35.89% class II and 7.69% class III after Angle (table 5).
**Overjet:** 7 of 6 years old subjects (10.14%) showed an increased overjet, while for the group of 9 years old the number was much higher, 43 subjects (55.12%) (Figure 1).

![Figure 1. Number of children with overjet](image1)

**Overbite:** 5 subjects of 6 years old and 37 subjects of 9 years old (47.43%) presented an increased overbite (7.24%) (Figure 2)

![Figure 2. Number of children with overbite](image2)

**Openbite:** 12 of subjects of 6 years old (17.39%) and 9 of the subjects of 9 years old (11.53%) were diagnosed with open bite (Figure 3).

![Figure 3. Number of children with open bite](image3)
Crossbites: There were found to be more common in the anterior segment than the posterior segment for both groups. In the 6 years old group 5.79% (4 subjects) exhibited anterior crossbite. In the 9 years old group 14.10% (11 subjects) exhibited more than 1 tooth in crossbite.

Posterior crossbites occurred in 4.34% (3 subjects) of the 6 years old children, while in the 9 years old children the percentage was 8.97% (7 subjects).

Submerged teeth and active fraenum: For the 9 years old group the percentage of subjects with submerged teeth and active fraenum was very small 2.56% (by 2 subjects for each anomaly).

The IOTN score were mainly based on occlusal alterations in the labial segment of the upper and lower arches. 10.13% of the children from the 6 years old group and 24.35% of the children from the 9 years old group have a high or very high need of orthodontic treatment (table 6).

<table>
<thead>
<tr>
<th>IOTN scores</th>
<th>No. (and %) of 6 years old</th>
<th>No. (and %) of 9 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 No need for treatment</td>
<td>53 (76.81%)</td>
<td>33 (42.30%)</td>
</tr>
<tr>
<td>2 Little need for treatment</td>
<td>3 (4.34%)</td>
<td>5 (6.41%)</td>
</tr>
<tr>
<td>3 Moderate need for treatment</td>
<td>6 (8.69%)</td>
<td>21 (26.92%)</td>
</tr>
<tr>
<td>4 Great need for treatment</td>
<td>5 (7.24%)</td>
<td>14 (17.94%)</td>
</tr>
<tr>
<td>5 Very great need for treatment</td>
<td>2 (2.89%)</td>
<td>5 (6.41%)</td>
</tr>
<tr>
<td>Total</td>
<td>69 (100%)</td>
<td>78 (100%)</td>
</tr>
</tbody>
</table>

Table 6. Distribution of IOTN in relation to labial segment malocclusion

DISCUSSIONS:
Interceptive orthodontic treatment is generally defined as treatment aimed to eliminate or reduce unfavourable ongoing signs of malocclusion, thus providing favourable conditions for normal growth [2]. There are conflicting views over the need for early orthodontic intervention. Those who are against treatment in mixed dentition argue the existence of clinical situations where the interceptive treatment does not eliminate the need for curative treatment [23] and the shortening of the treatment duration for 2-3
years if its onset is delayed after the eruption of premolars and permanent second molars [5,24]. They sustain that by delaying is can be lost the moment when the skeletal growth can be influenced, the dental alveolar can be guided and bad habits deconditioning is the least difficult [10,11,24,25]. The need for a complex fixed orthodontic treatment is significantly reduced [23,26] and may have an adverse effect on dental health and surrounding tissues [24]. According to the American Academy of Paediatric Dentistry (AAPD) [27], factors we should keep in mind when choosing the initating of and orthodontic treatment in mixed dentition period are: chronological/mental/emotional age of the patient and the patient’s ability to understand and cooperate in the treatment; intensity, frequency, and duration of an oral habit, parental support for the treatment, compliance with clinician’s instructions, craniofacial configuration, craniofacial growth, concomitant systemic disease or condition, accuracy of diagnosis appropriateness of treatment, timing of treatment.

Among the clinical parameters that we considered necessary to investigate for determining which would be the need for preventive or interceptive methods of dentomaxillary anomalies, caries were a common symptom. 52.98% of patients in 6 years old group and 37.17% in 9 years old group had at least one tooth affected by decay. This percentage is below the World Health Organization report, according to which 60-90% of the school population is affected by caries [28], but the result should rather be considered with caution given the low addressability to private dental offices for treatment of dental injuries on deciduous teeth. It must not be forgotten that caries are among the etiological factors of early loss of deciduous teeth [29]. In our study population-based sample 17.39% of subjects in 6 years old group and 23.07% in 9 years old group showed early loss of more than 1 tooth, these percentages being consistent with data reported in the Romanian literature [30]. In turn early loss of temporary teeth can have varying effects such as shortness of dental arch [10] up to 4 mm [31]; early loss of temporary canines can lead to the collapse of the mandibular anterior region with subsequent collapse of the maxillary anterior region [31] and the emergence of incongruency of permanent front teeth [10,32], to ectopic eruption [33], staying in impaction of permanent canine or incisive line diversion [32]; early loss of second temporary molar can result into migration in the sagittal plane of the first permanent molar and a molar relationship of class II or III [34].

In this study the majority of the children were found to be Class I after Angle, 62.3% of children in 6 years old group and 53.84% in 9 years old group, like other previous Romanian studies that found class I malocclusions as the most common [35-36]. Although the proportion of subjects with malocclusion class II and III, ranked second and third as the frequency, is much lower, this subjects are candidates for interceptive orthodontic treatment if only to prevent dental class III to become skeletal [37], or to reduce the risk of injuries to the upper incisors in patients with malocclusion class II [38].

The other analyzed occlusal parameters (previously presented), the overjet, overbite, open bite, depending on the severity and the simple presence of the cross bite, may represent themselves the reason for initiating orthodontic treatment in mixed dentition. Thus at this stage of development of teeth the overbite and overjet may increase with the eruption of
permanent incisors [39], but if overcoat degree is bigger than 5 mm, we might suspect an evolution towards covered deep bite [5]. Detrimental effects of a deep bite include TMJ problems [40], attrition of the anterior teeth, direct trauma of the palatal gingiva and periodontal problems [41]. A deep bite could also restrict the development of the mandibular anterior dentoalveolar process, which is difficult to subsequently treat [24]. Open bite may be accompanied by multiple functional disorders: atypical swallowing of protrusion type [42], oral breathing, chewing [43] and phonetic [44] disorders.

Anterior cross bite untreated cause attrition to the labial surface of the upper incisor, fractures or mobility of incisor teeth, gingival recession or temporomandibular joint dysfunction [45-46]. Untreated lateral cross bite is one of the etiological factors of a narrow jaw [47], a facial asymmetry [48], or TMJ dysfunction through asymmetric condylar growth or as a result of the side slide of the mandible [49-50].

IOTN scores mainly based on occlusal changes in labial segment of the upper and lower arches that we analyzed was 10.13% for children in 6-year old group and 24.35% for children in 9-year old group. The IOTN value for 9-year old group is very similar to that found by Karaiskos et al. (2005) [3] of 28% for the same age group based on calculation of IPION and smaller than the percentage of 33% identified by Kerosuo et al. (2008) [51] or Al Nimri and Richardson (2000) [52] based on IOTN determination.

CONCLUSIONS
1. It is possible to identify early development of progressive malocclusion symptoms since the onset of mixed dentition.
2. They can be highlighted by IOTN and are in agreement with the acronym 'MOCDO' - missing, overjet, cross bite, displacement and overbite.
3. Early treatment of these changes can create a normal occlusal relationship and a balanced neuromuscular environment at an early age which helps the normal growth of the facial skeleton.
4. IOTN can be a valuable tool in identifying, planning and interception of potential malocclusions.
Acknowledgment
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2) Silkestrand S. Interceptive orthodontic care in Uppsala County. A retrospective study on frequency of interceptive treatment, treatment approaches and treatment providers. Stockholm, 2007 [Thesis].