Abstract: Controlling the eruption and development of dentitions is fundamental for a good oral health. The early diagnosis and adequate treatment of occasional developmental disorders are essential to achieve occlusal, functional and esthetic harmony. Abnormality is the term used for classification of alterations and is the most common developmental anomaly in humans. Even though several factors causing tooth malformations have been identified, many are still partially understood, thus requiring a more thorough study. Anyway, the available knowledge provides bases to attempt the early diagnosis of tooth abnormalities, to allow the adoption of preventive and effective therapeutic approaches.

Keywords: Diagnosis; Agenesis; Orthodontics.

Introduction
Abnormality is the term used to classify any alteration in human teeth, and tooth agenesis is the complete or partial absence of teeth and their embryonic primordia. It may be or not related to traumatic, nutritional and infective factors, viral diseases as rubella and some endocrine disorders, however, heredity is considered the main etiologic factor of tooth agenesis. Tooth agenesis is the most common developmental abnormality in humans, and the reported prevalence in the literature ranges from 20.7% to 25% of the population. Epidemiological studies report lower prevalence in individuals of African descent compared to Caucasoid and Asian, yet in general the females are more affected than males. Excluding the third molars, teeth most affected by this anomaly, the prevalence of agenesis is nearly 7.8%, affecting primarily the mandibular second premolars, followed by the maxillary lateral incisors and maxillary second premolars. The unilateral occurrence is predominant, except for agenesis of maxillary lateral incisors, in which the bilateral occurrence is more frequent than the unilateral.  

In addition to the high prevalence of agenesis, the mandibular second premolar may also present a significant delay in development, especially when there is agenesis of other permanent tooth. The onset of calcification usually occurs around 3 years of age and may be suppressed up to 6 years, yet there are reports of radiographic appearance of the second premolar after 9 years up to 13 years. The early diagnosis is fundamental for prevention of maxillomandibular disorders, allowing the establishment of clinical and orthodontic management in adequate age. Controlling the eruption and development of the mixed and permanent dentitions is paramount for a good oral health. The early diagnosis and adequate treatment of developmental disorders are essential for the achievement of occlusal, functional and esthetic harmony. Even though several factors responsible for tooth abnormalities have been identified, many are still partially understood, requiring more thorough investigations. This paper presents treatment possibilities in the context of early diagnosis and opportune treatment by presentation of a
Figure 1. Diagnosis based on facial (A–C) and occlusal analysis (D–H), complemented by images of initial dental casts (I–M), panoramic radiograph (N), lateral cephalogram (O) and periapical radiographs of maxillary (P-R) and mandibular incisors (S-U): young patient, Pattern I (normal growth), good facial relationships. In the mixed dentition, onset of second transitory period, the patient presented bilateral Class I occlusal relationship, with absence of tooth bud of the maxillary left second premolar and divergence of crowns of maxillary lateral incisors and consequent diastemas. The prognosis was favorable, yet with interception.

Case Report

The individual L.B.S was referred for orthodontic evaluation by the pediatric dentist after achievement of a follow-up panoramic radiograph (Figure 1N) at the age of 7 years 10 months, which revealed agenesis of the maxillary left second premolar. At this period the individual was in the mixed dentition stage, in the early second transitional period yet with some characteristics of the inter transitional period, with divergence of crowns of maxillary right and left lateral incisors, as a consequence of the eruption of maxillary right and left canines, which was characteristic at this period yet required attention. The individual complained about small diastemas in the maxillary anterior region.

At eight years of age complete orthodontics records were obtained from the individual for treatment diagnosis and planning. The face presented normal characteristics (Figures 1A - 1C) in both frontal and lateral views, with bilateral Class I occlusal relationship, in the second transitional period with exfoliation of deciduous mandibular right and left canines, besides good shape of the dental arches (Figures 1D - 1M). The lateral cephalogram confirmed the balanced growth pattern (Figure 1O). The evaluation of periapical radiographs of maxillary and mandibular incisors evidenced normal conditions of the anterior teeth (Figures 1P - 1U). Follow-up with the pediatric dentist since three years of age was beneficial for the lack of caries or enamel hypomineralization.

After compilation of examinations the diagnosis was reached: young patient, Pattern I, with good facial relationships. In the second transitory period of the mixed dentition the patient presented bilateral Class I occlusal relationship, absence of the tooth bud of the maxillary left second premolar and divergence of crowns of maxillary lateral incisors and consequent diastemas. The prognosis was favorable, involving interceptive orthodontic treatment.

Considering the early diagnosis of the anomaly, three treatment options could be considered. The first would be to monitor the growth and eruption until the complete permanent dentition and perform orthodontic treatment maintaining the deciduous maxillary left second molar if it did not exfoliate; when this occurred, probable orthodontic re-treatment and implant placement at the site of the maxillary left second premolar. The second option would be late treatment after growth completion, with extraction of deciduous maxillary left second molar and implant placement at the side of the maxillary left second premolar at completion of orthodontic treatment.

The early diagnosis and normal characteristics of the face allowed a third option, with interceptive orthodontic management with extraction of the deciduous maxillary left second molar to allow spontaneous mesial migration of the maxillary left first molar. This option was supported by the parents, who preferred the intervention without the need of implants after growth completion.

One year and five months after extraction of the deciduous maxillary left second molar, at the age of nine years five months the individual was in the late second transitional period, the maxillary left first molar had undergone spontaneous mesial movement and the individual presented bilateral Class I occlusal relationship, with absence of tooth bud of the maxillary left second premolar and divergence of crowns of maxillary lateral incisors and consequent diastemas. The prognosis was favorable, yet with interception.
maxillary right second premolar was erupting, with tendency of maxillary midline deviation to the left side (Figures 3D - 3H). New orthodontic records – dental casts, panoramic radiograph and lateral cephalogram – were requested at this stage for planning of corrective orthodontic treatment (Figures 3I - 3O), eighteen months after extraction of the deciduous maxillary left second molar and follow-up of eruption of the permanent teeth, with the chief objective to allow spontaneous mesial migration of the maxillary left first molar.

The corrective orthodontic mechanics was initiated by direct total bonding in the maxillary arch (Brackets Prescription Capelozza II), which determines a reduced angulation for the maxillary canines (5 degrees). The maxillary first molars received bonded tubes, with specific individualization of the tube for the maxillary left first molar, which presented absence of angulation (zero degree) and rotation, which is necessary for finalization with Class II molar relationship, different from the tube used for the maxillary right first molar, which exhibited five degrees of angulation and ten degrees of rotation. The premolars on the right side were not included in the mechanics, because they were well positioned (reference unit) and might serve as parameter for the opposite side.

Leveling in the maxillary arch was continued until stainless steel .018” archwire, combined to bends for anterior intrusion and hooks soldered on the mesial aspect of maxillary canines to allow retraction mechanics on the left side, with the dental arch immobilized on the right side, for correction of maxillary midline (Figures 4A – 4E). At this stage, six months after treatment onset, with the maxillary midline nearly corrected, the patient was re-evaluated and it was decided to include the mandibular arch in the treatment to enhance the overbite. Follow-up periapical radiographs were also requested at this stage to quantify the biological costs, which revealed degree of resorption compatible with the orthodontic mechanics performed so far (Figures 5A – 5C).

The mandibular arch received brackets Prescription Capelozza I, with bonded accessories including the mandibular right and left first molars. Leveling in the mandibular arch was continued until the stainless steel .018” archwire and Class III elastic mechanics was used on the left side to aid the
anchorage loss. Open and closed section coils were placed in
the maxillary arch, respectively to open and maintain space for
addition of composite resin to the lateral incisors (mesial and
distal) and mesial aspect of canines, which presented alteration
in shape, a common simplification in individuals with tooth
agenesis (Figures 6A - 6E). At this stage, final radiographs
were requested, including panoramic radiograph (Figure 6F),
lateral cephalogram (Figure 6G) and periapical radiographs of
maxillary (Figures 6H - 6I) and mandibular incisors (Figure 6J)
for treatment finalization. The total time of corrective treatment
was twenty months, ending at the age of eleven years and four
months.

The lateral incisors were increased in the same day of
removal of fixed appliances, and retainers were placed in both
arches, comprising a maxillary Hawley plate and mandibular 3x3
fixed retainer. The final orthodontic records (Figures 7A - 7M)
confirmed maintenance of facial relationships after interception
and orthodontic treatment, finalizing the case with Class I
occlusal relationship (molar and premolar) in the right side and
Class I canine and Class II molar relationships in the left side.
These relationships were stable in the follow-up at one year and
three months after appliance removal (Figures 8A - 8H).

Discussion

The early diagnosis of abnormalities allows the selection
of preventive and effective therapeutic approaches. The first
panoramic radiograph of a child should be obtained at the
age of 6-7 years. This simple examination allows diagnosis of
tooth abnormalities of shape, size, number and position. The
child should be included in a program for follow-up of growth
and eruption by pediatric dentists and orthodontists, so that
therapeutic measures may be indicated for individuals with
abnormalities.

There is enough evidence in the literature suggesting a
dominant role of genes in the etiology of dental anomalies,
in addition to ethnicity.1,3,8,10,16 Tooth agenesis is commonly
associated with other types of abnormalities including
microdontia, ectopia (ectopic palatal eruption of maxillary

Figure 4. Six months after treatment onset, the maxillary
arch was leveled with stainless steel .018” archwire,
combined to bends for anterior intrusion and hooks
soldered on the mesial aspect of maxillary canines to
allow retraction mechanics on the left side, with the
dental arch immobilized on the right side, for correction
of maxillary midline. At this stage, it was decided to
include the mandibular arch in the treatment to enhance
the overbite.

Figure 5. Follow-up periapical radiographs were
requested six months after onset of mechanics to
quantify the biological costs, which revealed degree
of root resorption compatible with the orthodontic
mechanics performed so far.

Figure 6. Intraoral photographs (A-E) before removal
of fixed appliances. Note the open and closed section
coils placed in the maxillary arch, respectively to open
and maintain space for addition of composite resin to
the lateral incisors (mesial and distal) and mesial aspect
of canines, which presented alteration in shape, a
common simplification in individuals with tooth agenesis.
The panoramic radiograph (F) evidence adequate
parallelism between the tooth roots, except for the
maxillary left canine and first premolar. The lateral
cephalogram (G) revealed correct position of incisors
in their bone bases, and the periapical radiographs
of maxillary (H-I) and mandibular incisors (J) exhibited
acceptable biological cost.
canines, tooth transposition, distal angulation of mandibular second premolars and ectopic eruption of maxillary first molars), infraocclusion of deciduous molars, delayed tooth development and generalized enamel hypoplasia.

When an anomaly is diagnosed, a higher prevalence of associated anomalies is expected. The clinical implication of associated dental anomalies is very relevant, because the early diagnosis of a dental anomaly may call the clinician’s attention to the possibility of development of other associated anomalies in the same patient or other family members, thus allowing the early diagnosis and appropriate orthodontic intervention.

The agenesis of maxillary second premolar is less frequent than others, as the mandibular second premolar and maxillary lateral incisor, yet it affects 1.5% of the general population.

Individuals with congenitally missing premolars are challenging for the orthodontic diagnosis. Since the deciduous second molar is usually much larger than the permanent second premolar, the therapeutic approach may include early extraction, in order to reduce the edentulous space by spontaneous migration of the permanent first molar.

The decision between maintaining the deciduous tooth, for probable replacement with implants after growth completion, or extracting the deciduous tooth for space closure with spontaneous migration of adjacent teeth should take into consideration the craniofacial growth pattern of the child. The interaction between pediatric dentists and orthodontists is fundamental for the correct diagnosis and adoption of interceptive measures, so that the early diagnosis of this anomaly may be beneficial to the individual.

The early diagnosis allows treatment in adequate timing, establishing an individualized therapy, providing greater potential of stability. In the treated case the spontaneous migration was considered fundamental for the stability and to reduce the complexity of the future orthodontic treatment. Attention should be given to the tendency of maxillary midline deviation, which usually occurs in cases with asymmetric extractions, always to the same side of tooth extraction. In the present clinical case, this tendency of deviation was manifested during follow-up of occlusal development, yet in insufficient magnitude to justify the immediate management. Whenever possible, the orthodontic appliance should be placed after exfoliation of all deciduous teeth, which minimizes the treatment time and reduces the biological costs.

Even though the literature and clinical practice demonstrate that it is not prudent to lose dental arch perimeter and length in individuals with more horizontal growth pattern, this mechanotherapy was adequate in this case because the problem was unilateral. The good health of the hemiarch with normal number of teeth would maintain the vertical dimension and avoid counterclockwise mandibular rotation.
Another important clinical observation in individuals with agenesis is the analysis of morphology of present teeth, considering that they tend to present alterations in size and shape, a phenomenon known as morphological simplification. In this patient the lateral incisors presented this alteration of shape and size, requiring corrective intervention. This association between dental anomalies is relevant for the early diagnosis by the pediatric dentist, allowing preventive and interceptive therapeutic approaches.

Conclusion

When a tooth abnormality is diagnosed, it is expected to find a higher prevalence of other associated abnormalities. The clinical implication of associated dental anomalies is very relevant, because the early diagnosis of a dental anomaly may call the clinician’s attention to the possibility of development of other associated anomalies in the same individual or other family members. The interdisciplinary treatment is relevant, especially between Orthodontics, Restorative Dentistry and Pediatric Dentistry, to solve problems of agenesis of permanent teeth, achieving favorable esthetic and functional outcomes in the long term.

References