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Dental developmental anomalies: An updated review

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Abstract
Introduction: Dental alterations often have esthetic and functional repercussions for patients and can have important psychosocial consequences.
Objective: The aim of this study was to analyze the literature on the most commonly diagnosed dental disorders in pediatric dentistry, which can be classified according to their shape, size, number, structure and position.
Methodology: A general search of the data was carried out in various databases related to this subject, including PubMed, the following Boolean operators were used: shape, size, number, position, structure, treatments AND dental.
Results: Dental anomalies affect the quality of life of patients. Shape anomalies will have more susceptibility to caries due to the extra grooves they present and the challenge in hygiene. Size anomalies cause malocclusions mainly, and are related to the presence of syndromes or systemic diseases. The anomalies of number are genetic in nature, with Mesiodens being the most reported supernumerary. In terms of structure, amelogenesis and dentin genesis imperfect a are reported to be of genetic etiology, affecting the function, sensitivity and esthetics of patients. Position alterations are mostly hereditary in nature, and other alterations of local eruption or products of trauma.
Conclusion: Dental anomalies can significantly affect the patient's quality of life both in function and esthetics, hence the importance of timely diagnosis and treatment for the or facial benefit of the patient.

Keywords: Dental anomalies, shape, size, number, structure, position

1. Introduction
Alterations often have esthetic and functional repercussions for patients and can have important psychosocial consequences [1]. The frequency and type of dental anomalies vary within and between populations, confirming the role of racial factors in the prevalence of dental anomalies [2]. Alterations observed during tooth formation result in dental developmental anomalies that occur in the oral cavity. These dental anomalies can be acquired, congenital or developmental. Their early detection and management are necessary as they affect esthetics and occlusion [3]. Dental anomalies are clinically evident anomalies. They can be the cause of various dental problems. Careful observation and appropriate investigations are required to diagnose the condition and institute treatment [4]. Family history of dental anomalies has been positive in one third of cases [5]. Dental anomalies are relatively common; although their occurrence is not symptomatic, they can lead to various clinical problems in patients. Detailed clinical and radiographic evaluation and counseling during patient visits are a critical factor in assessing the degree of patient difficulty to help the dentist be better prepared for treatment [6]. After reviewing the large number of dental alterations that may represent a challenge in pediatric dentistry, it seems wise to create a source of information for health personnel and for parents, integrating aspects such as their classification: shape, size, number, structure and position. Thus, this work will contribute to the diagnosis of such alterations in all specialties, and can function as an information tool.

2. Materials and Methods

Information was collected from articles published in PubMed, SCOPUS and Google Scholar servers, with emphasis on the last 5 years. The quality of the articles was evaluated based on the standard guidelines, i.e., identification, review, choice and inclusion. The quality of the review was assessed using the measurement instrument for evaluating systemic reviews. Boolean logical operators AND, OR and NOT were used in the search. It was performed with the words "dental alterations", together with the following terms: shape, size, number, position, structure, treatments AND dental. The keywords were used individually, as well as each of them related to each other.

3. Results and Discussion

3.1 Form

3.1.1 Fusion

Treatment of fused teeth is complex, may require a multidisciplinary approach in endodontics, periodontics, oral and maxillofacial surgery, prosthodontics and orthodontics [7]. Management will vary depending on the deciduous nature of the teeth, the degree of caries and the risk of malocclusion development [8]. In cases involving fusion of a supernumerary tooth, minimally invasive conservative procedures that maintain the vitality of the tooth and are esthetically pleasing can be conducted [9].

3.1.2 Gemination

Geminated teeth have an increased risk of developing caries. The aesthetic implications of these dental anomalies can affect a patient's psychosocial development [10].

3.1.3 Taurodontism

Taurodontism is the most common anomaly in the age groups 13 to 19 years being more prevalent in the maxillary first molar and mandibular first molar [11,12]. Gender is not related to recurrent prevalence in approximately 11.8% of the living population [13].

3.1.4 Claw Cuspid

Claw cusp is an odontogenic anomaly that can cause occlusal interference, displacement of the affected tooth, developmental grooves susceptible to caries and speech difficulties [14]. The upper lateral incisors are the most commonly reported teeth with this anomaly at up to 7.5% [14].

There is evidence that direct pulp capping with MTA after pulp involvement of a claw cusp is a suitable treatment option [15].

3.1.5 Dens Invaginatus

The overall prevalence of dens invaginatus is 9.0%, and it has been found most frequently in the mandibular lateral incisor [12].

Its prevalence using cone beam computed tomography has been shown to be higher than previous estimates made with conventional radiographs [16].

There is evidence that conservative root canal treatment can be successfully performed in severe cases of dens invaginatus, requiring root canal treatment [17].

Dental organs that present shape anomalies have a higher probability of developing dental caries, due to the difficulty they present to be properly sanitized. In addition to generating malocclusions due to the irregularity of their surfaces, they are usually aesthetically unpleasing.

3.2 Size

3.2.1 Macrodontia

As macrodontia is a rare condition, its early diagnosis and treatment favors the adequate formation of the dental arches [18].

There are significantly more macrodontia anomalies in males and in children of high socioeconomic status [19].

KBG syndrome is characterized by macrodontia especially of the upper central incisors [20, 21].

3.2.2 Microdontia

According to the literature, among the shape anomalies, Microdontia was found to be the most common alteration [22].

Microdontia has been associated as a dental adverse effect to chemotherapies administered to children with cancer [23].

Patients treated with hematopoietic stem cell transplantation before the age of 3 years have more Microdontia by up to 76.9% [24].

Congenital deafness with labyrinthine aplasia, microtia and Microdontia (LAMM syndrome) is characterized by: bilateral congenital profound sensorineural deafness associated with inner ear anomalies (most often bilateral complete labyrinthine aplasia); microtia (type I) which is typically bilateral (although unilateral microtia and normal outer ears are occasionally observed); and Microdontia (small teeth) [25].

It is an extremely rare autosomal recessive condition caused by bi-allelic mutations in the FGF3 gene [26].

Dental size alterations have been strongly associated in the presence of some syndromes and systemic diseases such as childhood cancer. In general, if these shape alterations are diagnosed and treated early, they can promote proper occlusion.

3.3 Number

3.3.1 Hypodontia or Dental Agnesia

Hypodontia, or dental agenesis, is the most prevalent craniofacial malformation in humans. It may occur as part of a recognized genetic syndrome or as an isolated non-syndromic trait. The overall prevalence of Hypodontia is 6.4%, being highest in Africa, followed by Europe, Asia and Australia with lower prevalence in North America, Latin America and the Caribbean. Excluding third molars, the prevalence of Hypodontia ranges from 1.6 to 6.9% [27].

In individuals with Hypodontia, the teeth that form are smaller than the population average and often show a reduced and simplified shape [28]. Fortunately, the results of implant treatment in patients with severe Hypodontia are promising [29].

Females have a higher prevalence than males and the most affected teeth are the mandibular second premolars, followed by the upper lateral incisors and upper second premolars [30].

Absence of left upper lateral incisors has been significantly associated with unilateral right cleft lip [31].

3.3.2 Hyperdontia

The mesiodens is the most frequent supernumerary tooth. These occur in 0.15% to 1.9% of the population, and their frequency is higher in the premaxilla region [32].

Early diagnosis of supernumerary teeth is essential to prevent malocclusion and misalignment of permanent teeth [33].

According to the literature, males between the ages of 21 and 35 years were more frequently observed to have impacted supernumerary teeth. Included teeth were more frequently observed in the posterior region than in the anterior region [34].

3.3.3 Oligodontia

Oligodontia is a developmental dental anomaly defined by the absence of 6 or more permanent teeth, excluding the third molars. Oligodontia can contribute to masticatory dysfunction, speech disturbance, aesthetic problems, and malocclusion [35]. Numerous genetic mutations have been associated with Oligodontia. Seven genes are currently known to have potential to cause non-syndromic oligodontia. In decreasing order of frequency, PAX9, EDA, MSX1, AXIN2, EDARADD, NEMO, and KRT17 are the seven genes currently known to have potential to cause nonsyndromic Oligodontia [36, 37].

Anomalies of number have been associated with genetic alterations. Statistics show Mesiodens as the most frequent supernumerary teeth, their diagnosis is essential to prevent malocclusions.

3.4 Structure

3.4.1 Dentinogenesis Imperfecta

Dentinogenesis imperfecta is an autosomal dominant disease characterized by severe dentin hypomineralization and altered dentin structure. The dentin extracellular matrix is composed of 90% type I collagen and 10% non-collagenous proteins including dentin sialoprotein (DSP), dentin glycoprotein (DGP) and dentin phosphoprotein (DPP) which are crucial in dentinogenesis [38].

Vitamin D deficiency during tooth development can lead to non-syndromic amelogenesis and dentinogenesis imperfecta, enamel and dentin hypoplasia and dysplasia [39].

Dentinogenesis imperfecta is the rarest anomaly in its category [40], and happens to be a constant finding in the overlapping osteogenesis imperfecta syndrome/Ehlers-Danlos syndromes [41].

It should be kept in mind that early diagnosis and treatment, together with long-term follow-up of dentinogenesis imperfecta in children, remain the best ways to achieve greater psychological well-being of the patient and, consequently, of their quality of life, to decrease the risk of dental fractures and alterations of occlusion and return the facial profile to a more normal appearance, as well as to prevent or treat possible temporomandibular joint problems [42].

3.4.2 Amelogenesis Imperfecta

Optimal treatment in amelogenesis imperfecta consists of an early diagnosis, treatment approach, plus frequent dental check-up visits to prevent progressive occlusal wear or early destruction by caries [43].

It is considered that indirect restorations should be used as early as possible. While adhesive bonding techniques to enamel surfaces in patients with this condition have limited longevity, so further clinical and laboratory studies should be conducted to investigate the performance of minimally invasive indirect restorations bonded to enamel [44].

Patients with amelogenesis imperfecta express concern about esthetics, hypersensitivity, function, and an overall impact on well-being and social interaction. This highlights the importance of the need for early dental treatment of amelogenesis imperfecta [45].

Dental structural anomalies such as dentinogenesis and amelogenesis imperfecta are conditions that have been linked as a genetic defect, mainly causing deterioration in the quality of life of children who suffer from them, affecting aesthetics, sensitivity, dental fractures and occlusion problems.

3.5 Position

3.5.1 Transposition

There is strong evidence that lateral incisor-canine mandibular transposition is an alteration of tooth order and eruptive position probably caused by genetic influences [46].

Similarly, several reports have agreed that maxillary canine transpositions are an alteration of the same nature and are within a multifactorial inheritance model [47].

3.5.2 Ectopia

Ectopic eruption of the first permanent molar is defined as a locally altered eruptive behavior, positioning itself too mesially against the distal aspect of the second upper primary molar during the development of the mixed dentition. The prevalence is 4-6% and affects both sexes equally [48].

Pediatric dentists should learn to diagnose and treat this condition early to allow prevention of future malocclusions and other clinical sequelae.

Ectopic position of an upper permanent first molar results in a local malocclusion within the mixed dentition and occurs when the tooth erupts more mesially to its normal eruption path. Possible treatment options include removal of the temporary second molar and placement of a space maintainer, removal of the temporary second molar and subsequent restoration of the lost space during comprehensive treatment of the malocclusion or implementation of interceptive treatment to disimpact the upper permanent first molar and preserve the arch [49].

3.5.3 Displacement

Throughout infancy and childhood, orofacial trauma occurs in children caused by falls or blows by or against objects. The long-term implications on the development of permanent teeth are poorly understood, even though the oral region is the second most frequently injured area of the body in children under 6 years of age. During this period, the developing permanent teeth may be directly involved after trauma, causing displacement, damage to the tooth germ or a wide range of morph functional alterations [50].

3.5.4 Impaction

Faced with an impacted maxillary anterior tooth, surgical removal of the obstacle can lead to spontaneous eruption of the impacted tooth in most cases, with greater success with a longer follow-up of up to 3 years [51].

A literature review indicated that, the chances of successful eruption of an impacted maxillary incisor after supernumerary extraction are more favorable if: the obstruction is removed in the primary dentition, if the supernumeraries were conical, if the incisor was in the correct position, at the level of the gingival third and if they had incomplete root formation [52].

The most frequently impacted teeth are the maxillary upper canines [33].

The vast majority of positional dental anomalies are related to a genetic issue and are usually a pattern of inheritance, while others are locally altered eruptive behaviors or consequences of trauma. What is really important is the interceptive treatment given in each of them depending on their etiology, to correct alterations that influence orofacial functionality.

4. Conclusion

Dental anomalies can significantly affect the patient's quality of life in a comprehensive manner. Shape anomalies will be more susceptible to develop dental caries due to the extra grooves they present and their difficulty in hygiene. While

size anomalies were associated as a factor of malocclusion and were strongly related to the presence of syndromes or systemic diseases. On the other hand, alterations in number were directly related to genetics, with Mesiodens being the most reported supernumerary. In terms of structure, amelogenesis and dentinogenesis imperfecta have been categorized as a genetic defect and affect the function, sensitivity and esthetics of patients. Finally, the positional alterations are mostly hereditary, and others are local altered eruptions, or the result of trauma, but in all cases the important thing is to intervene in a timely manner to make a proper diagnosis and treatment.

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Conflict of Interest
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