

## Developmental Defects Affecting Teeth and their Restorative Management

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### Abstract

Tooth development or Odontogenesis is a kinetic dependent process mediated via epithelial-mesenchyme interactions between ectomesenchymal cells originating from cephalic neural crest cells and the first pharyngeal arch ectoderm. Developmental disturbances of the teeth June manifest as variations in number, position, size, shape, eruption or structure. The study of dental anomalies is important in order to diagnose and further formulate a better treatment plan for the patient. The main goals of managing developmental abnormalities are early diagnosis and improvement of appearance and function by preserving the dentition and preventing further complications. The present review article explains about various developmental disturbances which occur in the oral cavity.

**Keywords:** Enamel; Aesthetic; MTA; Endodontic

### Introduction

The three types of dental hard tissues; enamel; dentine and cementum; are formed through specialized cellular and biochemical pathways. These highly complex mechanisms are controlled by genes and influenced by epigenetic and environmental factors. Abnormalities of the developmental pathways June result in reduced quantity of tissue produced and/or poor quality of mineralization. The clinical importance of variations of tooth number; size and shape is seen in many dental disciplines. Early diagnosis allows optimal patient management and treatment planning; with intervention at an appropriate time to prevent complications in development and so reduce the later treatment need [1]. Understanding the process of dental morphogenesis and the variations in outcomes is an important contribution to the multidisciplinary clinical team approach to treatment [2].

Developmental disturbances of the teeth June manifest as variations in number; position; size; shape; eruption or structure. The treatment plan for the various congenital and hereditary disturbances depends upon the structural; functional and aesthetic requirements and the influencing factors such as the age of the patient; type of dentition; associated abnormalities etc. must be taken into consideration [3].

While complete cleaning and shaping of the root canal system is essential for successful endodontic therapy; internal anatomy and morphology of the root-canal system can present unexpected challenges. These developmental disturbances June present certain anatomical challenges for successful completion of restorative procedures.

### Developmental Alterations of Teeth

#### Hypodontia

Hypodontia; or tooth agenesis; is the most prevalent craniofacial malformation in humans. The condition refers to the developmental failure of six or fewer teeth. It is rare in deciduous dentition. In the permanent dentition third molars are the most commonly affected teeth followed by second premolars and lateral incisors. Another common feature of Hypodontia is the ectopic positioning of the permanent teeth. Panoramic radiographs will show absence of erupted teeth in the jaw [4].

The treatment goals are to keep the remaining teeth; recover function and aesthetics; improve speech; and re-establish the emotional

and psychological well-being of the patient. Conventional fixed prosthesis offer an excellent option for the restoration of aesthetics and function in majority of such patients [5].

#### Hyperdontia

Supernumerary teeth or Hypodontia is an additional tooth; teeth or tooth like structures that either erupt or remain erupted in addition to the 20 deciduous and 32 permanent teeth. It occurs more frequently in the permanent dentition and has a high predilection for the maxilla especially in the anterior region. A supernumerary tooth in the maxillary anterior incisor region is termed as Mesiodens [6]. An accessory fourth molar is called as a Distomolar or Distodens.

Supernumerary teeth either remain clinically silent or are diagnosed as a chance finding during radiographic examinations. An anterior occlusal or periodical radiograph using paralleling technique and panoramic view (Ortho Pantograph) are the most useful radiographic investigations to visualize supernumerary teeth [7]. Standard of care is early removal of accessory tooth during the time of early mixed dentition [8]. Permanent teeth that fail to erupt are treated best by surgical exposure followed by orthodontic eruption [1,9].

#### Microdontia

According to Boyle; Microdontia is defined as small teeth; whose crowns are short and normal contact areas between the teeth are frequently missing. True microdontia is uncommon but June occurs as an isolated finding in Downs's syndrome and pituitary dwarfism. Maxillary lateral incisor is affected most frequently and typically appears as a peg shaped crown overlying a root that often is of normal length [10].

Treatment of dentition is not necessary unless desired for aesthetic considerations. With recent advances in restorative materials; a

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Received: 27-May-2022, Manuscript No: JOHH-22-65094, Editor assigned: 01-Jun-2022, PreQC No: JOHH-22-65094(PQ), Reviewed: 15-Jun-2022, QC No: JOHH-22-65094, Revised: 20-Jun-2022, Manuscript No: JOHH-22-65094(R), Published: 27-Jun-2022, DOI: 10.4172/2332-0702.1000320

Citation: Ajay G (2022) Developmental Defects Affecting Teeth and their Restorative Management. J Oral Hyg Health 10: 320.

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number of options are now available to alter the morphology which includes direct composite build-ups; indirect composite resin veneers; porcelain veneers and resin-bonded porcelain crowns [11].

### Macrodontia

Microdontia is a rare dental anomaly and is a term that has been made to refer to dental gigantism and June be made in reference to a large population. Macrodonia June cause problems with aesthetics and crowding if there is discrepancy between the dimensions of the teeth and size of the jaw. Generalized microdontia can also cause malocclusion along with disfigurement [12].

Treatment of dentition is not necessary unless desired for aesthetic considerations. The early detection and treatment of microdontia cases can avoid problems with aesthetics; crowding and caries which can arise from the incise grooves on microdontia teeth [11].

### Gemination

Gemination occurs when a single tooth bud attempts to divide resulting in two completely or incompletely separated crowns with a single root or root canal. Clinically these patients present with poor aesthetics; high degree of caries; and periodontal problems. This anomaly June also is associated with syndromes such as Chondroectodermal dysplasia and Achondrodysplasia [13].

Treatment of choice is determined by the patient's particular needs; the teeth involved; and the degree of involvement. Endodontic therapy can also be performed along with strict oral hygiene measures to maintain periodontal health [14].

### Fusion

Fusion: An uncommon anomaly of the dental hard tissues and June cause clinical problems related to appearance; spacing; and periodontal conditions. Fusion occurs more frequently in the mandible. Literature suggests that fusion has a higher incidence of occurrence in deciduous dentition than in permanent dentition. Fused teeth June be characterized by one pulp chamber divided into two root canals; two independent endodontic systems; or one common pulp canal. According to the radiographs; the fused teeth have two distinct roots; with no connection between the pulp chambers and the canals [15].

An accurate clinical and radiographic examination combined with the knowledge of endodontic features of this anatomic situation is necessary to perform the diagnosis. Owing to the abnormal shape and size of crown and root; as well as misalignment; treatment usually requires a multidisciplinary approach to address both the endodontic and aesthetic issues [15,16].

### Concrescence

Concrescence is a form of fusion in which the union is only in the cementum of adjacent teeth. It is more frequently noted in maxillary molars. Concrescence leads to loss of gingival architecture resulting in development of funnels that June cause plaque accumulation; which further results in periodontal tissue destruction [17]. Due to the lack of enamel involvement; the crowns of the affected teeth; if they erupt; appear absolutely normal. Concrescence June defy radiographic detection as well; they June be misdiagnosed as simple radiographic overlap or superimposition of teeth. Radiographs taken at multiple angulations June aid in diagnosis [17,18].

Patients with concrescence often require no treatment unless the union interferes with eruption. Surgical removal is recommended in

such cases. If normal complements of teeth are present and fusion does not extend apically; sectioning can be attempted [17,19].

### Accessory cusps

This includes Cusp of Carrabelle; Talons cusp and Dens Vaginitis.

Carrabelle's cusp is a type of accessory cusp which June vary in size and shape; and composed of enamel; dentine with or without pulpal extension. It is located on the palatal surface of the mesiolingual cusp of a maxillary molar [20]. It varies from a definite cusp to a small indented pit or fissure. Patients with cusp of Carrabelle require no treatment unless a deep groove is present between the accessory cusp and the surface of the mesiolingual cusp of the molar. These deep grooves should be sealed to prevent carious involvement.

Talon Cusp is a well delineated additional cusp that is located on the surface of an anterior tooth and extends to at least half the distance from the cemento-enamel junction to the incise edge. It occurs predominantly on maxillary lateral or central incisor and canines. Its occurrence in deciduous dentition is rare. It projects from the lingual surface of the affected tooth and forms a three-pronged pattern that resembles an eagle's talon. Radio graphically the cusp is seen overlying the central portion of the crown and includes enamel and dentin. Only a few cases demonstrate visible pulpal extensions on dental radiographs. Patients with talon cusp on the mandibular teeth often require no treatment. Talon cusp on maxillary teeth interferes with occlusion and must be removed. Grinding of the cusp followed by fluoride varnish application can be considered [21].

Dens vaginitis is a cusp like elevation of the enamel located in the central groove or lingual ridge of the buccal cusp of premolar or molar teeth. Deciduous molars are less frequently involved. It consists of enamel and dentin whereas pulp might be present in half of the cases. It often creates occlusal interferences which can pose a clinical problem. In addition to pulpal pathosis it can result in dilacerations; displacement; tilting or rotation of teeth. Radio graphically the occlusal surface exhibits a tuberculation appearance and often a pulpal extension is seen in the cusp. In the affected teeth; removal of cusps is often indicated but attempts to preserve the vitality of the tooth have met only with partial success. Elimination of opposing occlusal interferences with removal of minimum dentin and treatment of the area with stannous fluoride is recommended. In teeth with vital pulp; selective reduction of the opposing occluding teeth can be done or; in a situation where the tubercle has fractured; can be sealed with a resin. In case of pulpal exposure during the early phase of root development; Mineral Trioxide Aggregate (MTA) pulpotomy is suggested [21]. If the pulp is necrotic; MTA root end barrier in the case of the immature apex and conventional root canal treatment should be performed on mature tooth [22].

### Dens invaginatus

Dens invaginatus is a developmental anomaly resulting from an invagination in the surface of a tooth crown before its calcification. Bhaskar describes two variations of dens invaginatus; Coronal type and Radicular type. Mandibular first premolars and second molars are especially prone to develop the radicular variety. Compared to coronal type in radicular type; pulpal necrosis and apical lesions are more commonly associated? Clinically; it is identified as a deep palatal pit and it is difficult to diagnose until proper clinical examination is carried out. Most of the time it is usually detected with the help of intraoral periapical radiographs. Untreated cases of dens invaginatus lead to abscess formation; cyst development; tooth displacement and

internal resorption. Radio graphically the affected tooth demonstrates an enlargement of the root [23]. Close examination often reveals a dilated invagination lined by enamel with opening of the invagination situated along the lateral aspects of the root [21].

The management of dens invaginatus includes simple prophylactic restorations to conventional endodontic treatment or extractions; depending on the type of invagination; function and aesthetics; and morphology of the root canal [21].

### Ectopic enamel

It refers to the presence of enamel in unusual locations; mainly the tooth roots. The most widely known are enamel pearls. They are hemispheric structures that June consist entirely of enamel or contain underlying dentin or pulp tissues. In addition to enamel pearls; cervical enamel extensions also occur along the surface of tooth roots. In rare cases; they June occur within dentin and in these cases; they are referred to as intra-dental; interdental; or intra-dentinal enamel pearls [21,24].

Radio graphically enamel pearls appear as well-defined radio opaque nodules along the root surface. Mature internal pearls appear as well-defined circular areas of radio density extending from the DEJ into the coronal dentin. In the radiographic examination; the enamel pearl might be confused with dental calculus which can hinder correct diagnosis [21,25].

Meticulous oral hygiene should be maintained in an effort to prevent localised loss of periodontal support [21].

### Taurodontism

Taurodontism is a morpho-anatomical change in the tooth shape; in which the roots are reduced in size and the body of the tooth is enlarged. Affected teeth will appear rectangular and exhibit pulp chambers with increased apico-occlusal height and a bifurcation close to the apex [26].

Taurodontism has been classified as:

- Mild (Hypertaurodontism)
- Moderate (Mesotaurodontism) and
- Severe (Hypertaurodontism); according to the degree of apical displacement of the pulpal floor.

It June be unilateral or bilateral and affects permanent teeth more frequently than deciduous teeth. Molars are most frequently involved [21].

A Taurodontism will show wide variation in its shape and size of the pulp chamber; varying degrees of obliteration and canal configuration; apically positioned canal orifices; and the potential for additional root canal systems [3].

Taurodontism appearance is a very characteristic condition and is best visualized on radiographs. Involved teeth presume a rectangular shape relatively tapering towards the roots. The pulp chamber is exceedingly large with a greater apico-occlusal height than normal and lacks the usual constriction at the cervical region of the teeth with exceedingly short roots. The trifurcation or bifurcation June is few millimetres above the apices of the roots [26].

Patients with Taurodontism require no specific treatment. From an endodontist's point of view; Taurodontism presents as a challenge during negotiation; instrumentation and obscuration during root canal treatment. A modified filling technique; which consists of combined

lateral compaction in the apical region with vertical compaction of the elongated pulp chamber; has been proposed [26].

### Hypercementosis

Hypercementosis is a non-neoplastic deposition of excessive cementum that is continuous with the normal radicular cementum. It can be isolated; involve multiple teeth or appear as a generalised process. Mandibular molars are the most frequently affected teeth followed by mandibular and maxillary second premolars and mandibular first premolars. It occurs predominantly in adults and its frequency increases with age. Studies have also suggested the occurrence of hyper-cementosis in patients with Paget's disease. The only practical clinical significance of Hypercementosis is the difficulties that June be encountered in extracting such teeth [21,27].

Radio graphically; affected teeth demonstrate a thickening or blunting of the root; but the exact amount of increased cementum is difficult to determine because cementum and dentin have similar radio densities. The enlarged root is surrounded by radiolucent PDL space and an adjacent intact lamina Dura. Overgrown cementum is usually continuous with the normal radicular cementum and contained within the boundaries of the periodontal ligament and lamina dura [21,27].

Patients with Hypercementosis usually require no treatment. It is stated that; clinically; Hypercementosis June directly influences the root canal treatment because the clinician needs to know the limits for root canal shaping and filling. The clinician should evaluate the necessity of adapting the usual endodontic therapy approach to ensure all principles of endodontic and reach treatment success [28].

### Dilaceration

Dilaceration is an abnormal angulation or bend in the root or less frequently the crown of a tooth. Mandibular third molars are most commonly affected followed by maxillary second premolars and mandibular second molars. Dilaceration can occur anywhere along the length of the tooth; i.e. the crown; the cement-enamel junction; along the root or the root apex [21]. The clinical appearance of this deformity in succedanea's permanent tooth depends on the developing stage at which the injury occurred [29].

Dilaceration of a crown can be visually observed in the mouth; however; radiographic examination is required to diagnose dilaceration of the root. The direction of root dilaceration should be considered in two planes and they can be categorized as mesial; distal; labial/buccal or palatal/lingual [29].

The treatment of dilacerated tooth varies according to its severity. Extraction is indicated when necessary for normal eruption of the succedanea's tooth. Patients with minor dilacerations of the permanent teeth require no therapy [21].

The prognosis of dilacerated teeth that require endodontic treatment varies according to the severity of the deformity and the practitioner's skills [30].

### Accessory roots

It refers to the development of an increased number of roots on a tooth compared with that classically described in a dental anomaly. Any tooth can develop accessory roots and involvement has been seen in both permanent and deciduous dentition [21].

Although conventional radiographic views provide only two-dimensional images; they are fundamental and valuable examination

tools in the detection of accessory roots and root canals. Bifurcation of the root canal can be detected with meticulous observation for the dimensional regularity of the pulpal space. Abrupt diminishing or the appearance of a break point in the root canal usually indicates a bifurcation [31].

No treatment is required for supernumerary roots; but its detection is of critical importance when endodontic treatment or exodontia has to be undertaken. It is also necessary to search for accessory canals; because failure to detect them can further affect the endodontic treatment [21].

### Amelogenesis imperfecta

Amelogenesis Imperfecta encompasses a complicated group of conditions that demonstrate developmental alterations in the structure of the enamel in the absence of a systemic disorder. At least 14 different hereditary subtypes of amelogenesis imperfecta exist; with numerous patterns of inheritance and a wide variety of clinical manifestations [21].

In Hypoplastic Amelogenesis Imperfecta; the basic alterations centre on inadequate deposition of enamel matrix. In the generalized pattern; pinpoint to pinhead sized pits are scattered across the surface of the teeth. Buccal surfaces of the teeth are affected more severely and the pits June be arranged in rows and columns. In the localized pattern the affected teeth demonstrate horizontal rows of pits; a linear depression or one large area of Hypoplastic enamel surrounded by a zone of hypo calcification. Radio graphically; the affected teeth contrast well with the underlying dentin.

In Hypo maturation Amelogenesis Imperfecta; the enamel matrix is laid down appropriately and begins to mineralize; however there is a defect in the enamel's crystal structure. Affected teeth are normal in shape but exhibit a mottled; opaque white brown yellow discolouration. The enamel is softer than normal and tends to chip from underlying dentin. Radio graphically; the affected dentin exhibits a radio-density that is similar to dentin

In Hypo calcified Amelogenesis Imperfecta; the enamel matrix is laid down appropriately but no significant mineralization occurs. In both the patterns of hypo calcified amelogenesis imperfecta the teeth are appropriately shaped on eruption; but the enamel is very soft and easily lost. On eruption the enamel is yellowish-brown or orange but often becomes stained brown to black and exhibits rapid calculus apposition. In the hypo calcified AI the density of enamel and dentin are similar radio graphically.

In Amelogenesis Imperfecta with Taurodontism the enamel appears as mottled yellow-white to yellow-brown. Pits are seen frequently on the buccal surfaces of the teeth [21].

The clinical implications of AI vary according to subtype and its severity; but the main problems are aesthetics; dental sensitivity and loss of vertical dimension. Full length crowns or dentures often become the only satisfactory approach. Many less severe cases can be improved by the placement of full crowns or facial veneers on clinically objectionable teeth [21].

### Dentin genesis imperfecta

Dentin genesis imperfecta is a hereditary developmental disturbance of the dentin in the absence of any systemic disorder.

All the teeth in both the dentitions are affected. The dentitions have blue to brown discolorations often with distinctive translucency.

The enamel frequently separates easily from the underlying defective dentin. Once exposed the dentin often demonstrates significantly accelerated attrition. Radio graphically the teeth have bulbous crowns; cervical constriction; thin roots and early obliteration of root canals and pulp chambers [21].

Obliteration of the pulp chambers and root canals in teeth that develop abscesses makes endodontic therapy difficult; if not impossible. If conventional therapy is not an option; periapical curettage and retrograde root filling is another possible alternative; but is not recommended for teeth with short roots [32].

### Dentin dysplasia

Dentin Dysplasia (DD) is a rare defect of dentin development with an autosomal dominant pattern of inheritance; which June present with either mobile teeth or pain associated with spontaneous dental abscesses or cysts. Shields et al proposed a classification that divided dentin dysplasia into two main classes based on the clinical and radiographic appearance:

- Type I (DD1): Dentin Dysplasia
- Type II (DD2): Anomalous Dysplasia of Dentin [33]

In dentin dysplasia type I the deciduous teeth demonstrate little or no detectable pulp and roots are markedly short or absent radio graphically. Small crescent shaped pulp chambers are another feature seen radiographically.

In dentin dysplasia type II the radiographic changes include bulbous crowns; cervical constrictions; thin roots and early obliteration of the pulp. In the permanent teeth the pulp chambers exhibit significant enlargement and apical extension. This altered pulpal anatomy has been described as thistle-tube shaped or flame shaped [21].

In patients with DD type I; preventive care is of utmost importance. Meticulous oral hygiene must be established and maintained. Conventional endodontic therapy requires mechanical creation of canal paths and has been successful in teeth without extremely short roots. Periapical curettage and retrograde amalgam seals have demonstrated short term success. DD type II demonstrates similar problems and meticulous oral hygiene practices should be practiced. Because the pulp chambers are not usually completely obliterated; endodontic therapy is accomplished more readily [21].

### Regional Odontodysplasia (Ghost Teeth)

Regional Odontodysplasia (RO) is a rare developmental anomaly involving both mesodermal and ectodermal dental components in a group of contiguous teeth [34].

It is an uncommon finding that occurs in both the dentitions and exhibits no racial predilection and a slight female predominance. Many of the affected teeth fail to erupt and the erupted teeth demonstrate small irregular crowns that are yellow to brown often with a very rough surface. Caries and associated periapical inflammatory lesions are fairly common. The most frequent clinical symptoms after eruption of teeth with RO are gingival swelling; periapical infection and abscess formation in the absence of caries [21,34].

Radio graphically the altered tooth demonstrates extremely thin enamel and dentin surrounding an enlarged radiolucent pulp; resulting in a pale wispy image of the tooth; hence the term "GHOST TEETH" [21].

The basic approach to treatment of regional Odontodysplasia is

directed towards retention of altered teeth whenever possible; to allow for appropriate development and preservation of the surrounding alveolar bone. Endodontic therapy on non-vital teeth that have sufficient hard tissue to allow restoration has been performed successfully [21].

## Conclusion

Developmental anomalies of teeth are clinically evident abnormalities and are mostly asymptomatic. They can be the cause of various dental problems; hence careful observation and thorough investigations are required to diagnose the condition and formulate an adequate treatment plan.

Treatment of most cases is simple involving restorative procedures to re-establish aesthetics and functions. In a few complicated cases the endodontist's June need to seek the help of other specialists to resolve complications and thus arrive at a better treatment plan.

Though the developmental disturbances are many; their treatment is relatively simple and requires a thorough understanding of the pathology and etiopathogenesis for their proper resolution and prognosis.

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