

PREVALENCE OF DEVELOPMENTAL ROOT ANOMALIES IN AN INDIAN POPULATION

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Abstract

Introduction :Root anomalies such as labiokingival or palatokingival grooves as well as cervical enamel projections and enamel pearls may predispose teeth to periodontal disease as they are plaque retentive and difficult to instrument. Labiokingival and palatokingival grooves develop as a result of an infolding of the Hertwig's epithelial root sheath(HERS) in maxillary incisors while cervical enamel projections and enamel pearls are extensions of enamel found on the root surface predominantly in the furcation area of molars. These defects harbour plaque and lack of periodontal attachment predisposing the tooth to pulpitis or periodontal disease.

Aim:To determine the prevalence of developmental root anomalies in extracted permanent incisors and molars.

Materials and methods: 200 extracted human teeth comprising of central incisors(n=20), lateral incisors(n=20) and molars(n=160)observe the following anomalies : Labiokingival groove , Palatokingival groove, cervical enamel projection and enamel pearl using a pair of magnification loupes (2.5x). Labiokingival groove were investigated from labial aspect of central incisors. Palatokingival groove were investigated from palatal aspect of central incisors. Enamel pearls were observed for all the sample teeth while the cervical enamel projection were observed for the maxillary and mandibular molars.

Results: It was observed that there was no prevalence of labiokingival groove which may be attributed to variation among races. Palatokingival groove were found mostly in mid palatal region of central(1%) and lateral incisors.(1%). Cervical enamel projection were present in both maxillary and mandibular molars.Most probably present in buccal aspect of mandibular molars (3%).Teeth with grade 1 CEP were found frequently on buccal aspect of both maxillary(2.5%) and mandibular(3%) molars .

Conclusion: The present study concludes that palatokingival groove were present with prevalence about 1% and cervical enamel projection were present on the buccal aspect of maxillary and mandibular molars(1.75%) when compared with other two anomalies.

Keywords:

Cervical enamel projection, enamel pearl, labiokingival groove,palatokingival groove.

Introduction:

The tooth is a specialized part of the human body, understanding the development of which is enigmatic and still challenging. The successful development of the tooth depends on a complex reciprocal interaction between the dental epithelium and underlying ectomesenchyme. The interaction involves a complex series of molecular signals, receptors and transcription control systems.[1] Disturbance of the epithelium and mesenchymal interactions can markedly alter the normal odontogenesis leading to the developmental anomaly of teeth. Depending on the developmental stage in which the alteration has taken place, different anomalies can take place such as anomalies of number, structure, size , shape including colour. [2] This may be due to local or systemic factors.and may begin before or after birth, affecting deciduous and/or permanent teeth.[3] More than 300 genes have been known to be expressed in teeth that are responsible for odontogenesis .Defects in these genes have been found to be one of the reasons for alteration of the morphology of tooth.[4] Environmental

factors such as chemotherapy, radiation therapy and trauma may also affect the morphology of the developing roots.[5] Developmental root anomalies may also occur due to an infolding of Hertwig epithelial root sheath[HERS] or deposition of its remnants on the root resulting in developmental defects such as labiogingival groove ,palatogingival groove,cervical enamel projection and enamel pearl.

The palato-gingival groove (PGG) or radicular lingual groove is a developmental anomaly which occur due to an infolding of the inner enamel epithelium and Hertwig's epithelial root sheath creating a groove that extends from the cingulum of maxillary incisors towards the apex of the root.[6] It is usually found on the palatal aspect of central incisors and runs towards either the mesial,distal or midpalatal region. The funnel-like shape of the palato-gingival groove promotes the accumulation of difficult-to-remove plaque and calculus, which can be challenging to both patient and dentist.[7] Furthermore, a direct communication between the pulp and the periodontium can lead to pulpal diseases.[8] As a microscopic analysis is required to analyze the communication between the pulp and periodontium, it can lead to diagnostic dilemmas as they mimic endo-perio lesions.If the defect remains unchecked, it can precipitate a series of periodontal consequences such as attachment loss, periodontal pocket formation, and progressive bone loss. In addition, endodontic involvement secondary to bacterial invasion from these catchment areas can predispose to the development of combined endodontic – periodontal lesions.[9,10] Early identification of this anomaly is vital to preventing plaque penetration into the groove holistically managed it consequences arise due to the defect. [11]

Similar to the Palatogingival groove ,groove that seen on the labial aspect are referred to as labiogingival groove.They are present in the central and lateral incisors which was described by Brin and Ben Bassat in 1989 in a population survey of 1880 Israeli school children.They found labiogingival groove in 126, with 6.5% prevalence on atleast one central incisors. Both grooves appears as an enamel depression close to the cemento-enamel junction with varying depth and It can be identified with use of an explorer or periodontal probe. The gingival margins closely follows the enamel contour appearing almost normal in shallow groove while in the deep groove ,it acquires an irregular contour because of extrusion of the gingival tissue into defect.[12,13]

Enamel which is normally restricted to the anatomic crowns of human teeth may be found ectopically on the root, either as cervical enamel projections or enamel pearls Cervical enamel projection is an anatomical anomaly in which the enamel is projected towards the furcation areas. [14] In healthy periodontium , the epithelial junction is about 0.97 mm while in cervical enamel projection , epithelial junction becomes large [15,16]. They are flat ,ectopic deposits of enamel apical normal to cemento-enamel junction in molar furcation areas.These enamel deposits usually have a triangular shape and a tapering form, extending apically into furcation areas. They are most commonly found at the buccal surfaces of mandibular molars[17]. Atkinson suggested that the anatomy and location of CEP might act as probable causes for rapid pocket formation as [18] the enamel covering the CEP prevents the formation of a connective tissue attachment. Instead, the gingival tissue adjoining the CEP is attached to the tooth by epithelial attachment, which is less resistant to the insult of bacterial plaque.

Enamel pearl is defined as an ectopic globule of enamel that is firmly attached to the tooth root. The enamel pearl anomaly was first described in 1824 by Linder and Linder[19] and also has been referred to as an enameloma, enamel droplet, enamel nodule, enamel exostoses and enamel globule. It is found commonly on the roots of maxillary molars, especially the third molars adjacent to the furcation or furrow of the root . The structure of the enamel in ectopic enamel projections are characterized as normal, but with considerable variations and irregular features that are most likely related to its ectopic development,in both cervical enamel projection and enamel pearl, ameloblasts retain their enamel competence, resulting in prolonged (cervical enamel projections) or delayed (enamel pearls) ectopic enamel production. Advanced localized periodontal destruction has been associated with cervical enamel projections and enamel pearl, predisposing to attachment loss.[20]

Materials and methods :

200 human extracted teeth were collected which included central incisors, lateral incisors and molars. The labiogingival groove were investigated from labial aspect of central incisors while palatogingival groove were investigated from the palatal aspect .Enamel pearls were observed for all the sample teeth while the cervical enamel projection were observed for the maxillary and mandibular molars which were graded according to classification given by Masters and Hoskins:

Grade I: The enamel projection extends from the CEJ of the tooth toward the furcation entrance.

Grade II: The enamel projection approaches the entrance to the furcation. It does not enter the furcation and therefore no horizontal component is present.

Grade III: The enamel projection extends horizontally into the furcation.

Teeth were cleaned and debrided in running water and 2% hydrogen peroxide. Gross deposits werer removed by using an ultrasonic scaler. The examination was performed with the aid of magnifying loupes(2.5x) for the better visualisation of root anomalies, which was observed by both investigators.

Results:

TOOTH	SITE	FREQUENCY OF PGG(%)	FREQUENCY OF LGG(%)
CENTRAL INCISORS	Mesiopalatal	0	0
	Mid palatal	1(n=2)	0
	Distopalatal	0	0
LATERAL INCISORS	Mesiopalatal	0	0
	Mid palatal	1(n=2)	0
	Distopalatal	0	0

Table 1

	LOCATION	CEP-GRADE 1(%)	CEP-GRADE 2(%)	CEP-GRADE 3(%)
MAXILLARY MOLAR	Buccal	2(n=4)	0.5(n=1)	0
	Mesiopalatal	0.5(n=1)	0	0
	Distopalatal	0	0	0
MANDIBULAR MOLAR	Buccal	3(n=6)	1(n=2)	0
	Mesiopalatal	0	0	0
	Distopalatal	0	0	0

Table 2

Figure 1



A)

B)

C)

Discussion:

Out of 200 extracted teeth, labiogingival groove were absent. The palatogingival groove(1%; n=1) was seen in mid palatal region in both central and lateral incisors(fig 1:C) which extending from cervical to CEJ ,no associated with dental caries and extending into enamel and dentin. Cervical enamel projection were found to be similarly prevalent in both maxillary and mandibular molars frequently on the buccal aspect. Teeth with Grade I CEP(fig 1:A) were present on the buccal aspect of maxillary molar(2%; n=4) and mandibular molar.(3%; n=6) .Teeth with Grade II CEP(fig 3:C) showed 0.5%(n=1) in maxillary molar and 1% (n=2)in mandibular molar . There was no prevalence of enamel pearls in this study.

Although the dental anatomy is fundamentally important in clinical practice, it seems that little attention has been paid to the anatomical factors of the external root surfaces. In general, greater emphasis is placed on the coronal anatomy, whereas the root anatomy is usually limited to the number and shape of the roots or number and anatomy of the root canals. However, profound knowledge of the external root anatomy also seems to be imperative for performing adequate periodontal instrumentation.Periodontitis is primarily a dental plaque induced inflammatory disease but the local factors that facilitate the accumulation of bacteria may contribute to the progression of the disease. Factors such as tooth anatomy and restorative/endodontic considerations have been linked to gingival inflammation and attachment and tooth loss. [21]

The tube-like channel of PGG serves as an ideal locus for plaque and calculus accumulation, thus acting as a secondary local etiologic factor, encouraging the development of periodontal disease.Its clinical and radiographic examination mimics endo-perio lesions leading to diagnostic dilemma, ineffective treatment attempts and treatment failures.The lower prevalence may be because of low specificity of this observational study because the presence of radicular PGGs without loss of attachment may not have been detected with inspection and probing. Further study with the use of cone beam computer tomography (CBCT) and in-vitro studies are required for more accurate results.[22]

Similarly, little attention has been given to the LCVG deformity. An important goal in dentistry is early prevention of disease of the oral cavity and teeth. As LCVG deformity could have future implications that may be expressed as a local gingival disease,caries and possible esthetic problems, it is important to record LCVG presence and severity in the routine dental examination and to raise awareness in patients and their caregivers.

Eliyahu Mass found that the prevalence of 4.5% of LCVG in maxillary central incisors was similar to the frequency of 6.5% found by Brin and Ben-Bassat¹⁴ in their study of 1,880 children. In the present study ,there is was prevalence of labiogingival groove which could be attributed to variation among races.[24]

Of all anatomic factors, the CEP is probably the most common and associated with attachment loss in the molar furcation area. Knowledge of the possible direct communication between the dental pulp and periodontium through accessory canals that connect the pulp chamber floor to the furcation, the risks of inducing inflammatory changes in the dental pulp through this passage is also evident. CEP difficult bacterial plaque removal, becoming a local factor in the development of gingivitis, and after, periodontal disease. Therefore, such anomaly should be removed down to the crestal bone level by cauterization to facilitate periodontal maintenance other suggested procedures include odontoplasty, osteoplasty, and regenerative procedures may be required to treat several bone defects promoted by CEP. [25]

Lima and Hebling reported that CEP structure is very peculiar for not to have connective tissue attachment, but a long junctional epithelium, which facilitates the development of inflammatory periodontal disease, and furcation involvement of molars.[26]

Also, Leite *et al.*, demonstrated that the incidence of CEP was greater on the buccal and lingual surfaces than the mesial and distal surfaces of permanent molars. Furthermore, the incidence was more frequently in maxillary molars than in mandibular molars.[27]

The origin of the projection is due to an increase in the functional activity of ameloblasts, probably due to the absence of apoptosis, and it may be pathogenically related to paradental cysts, contributing to the formation of endoperiodontal lesions and making the site propitious for the induction of furcation and endodontic lesions. The region in which the CEP lies presents numerous natural irregularities that when exposed may facilitate the accumulation of plaque and hinder root scaling procedures, contributing to the progression of the periodontal disease. The condition of periodontal disease in the acute phase can lead to unnecessary endodontic treatment and the correct diagnosis of the presence of CEPs is necessary to perform appropriate treatment.

Risnes studied 8854 extracted molars in Norway and reported that 2.28% presented enamel pearls, which were reported to occur more commonly on the roots of maxillary molars, especially third molars, followed by the roots of mandibular molars.[28]

Pederson found a higher prevalence of enamel pearls in Eskimos (9.7%) than in other races (1.1 and 5.7%).[29] The findings of Darwazeh and Hamasha, who reported that the enamel pearl occur in 2.32% (48 of 2064) of permanent molars when detected radiographically.[30]

Bhusari found that the prevalence of CEPs in molars was 11.9%. CEPs were found more frequently in the mandibular than in the maxillary molars. The association between CEP and FI (87.5%) was statistically significant. This favors the view of the possible role played by such anomalies in the progression of periodontal diseases[31]

Conclusion:

The present study attempts to evaluate the frequency of occurrence of various developmental root anomalies in an Indian population. It was noted that cervical enamel projection were seen on buccal aspect of both maxillary and mandibular molars. Palatogingival groove were frequently occurring when compared with other two anomalies. Developmental anomalies of teeth are clinically evident abnormalities. They may be the cause of plaque accumulation and periodontal problems. The knowledge of these anomaly as well as early diagnosis is fundamentally important for the maintenance of teeth with this morphological change. Careful observation and appropriate investigations are required to diagnose the condition.

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