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Congenital grooves and cervical enamel projections on the teeth and their relation to periodontal status

G.V. Prashanth[1], D.V. Nagarathna[2*] and Melba D'Souza[2]

[1]Department of Periodontics, Al Ameen Dental College, Athani Road, Bijapur-586108 Karnataka, India and [2]Department of Periodontics, A.J. Institute of Dental Sciences, Kuntikana, NH-17, Mangalore-575 004 Karnataka, India

Abstract: *Background:* Periodontitis is primarily a dental plaque induced inflammatory disease, local factors that facilitate the accumulation of bacteria may contribute to the progression of the disease. Periodontal disease is not a single entity nor is there a single causative factor that elicits a consistent periodontal response. Dental abnormalities such as palatal grooves and cervical enamel projections (CEPs) can act as a predisposing factor to the initiation of localized periodontal destruction. *Objectives:* 1. To evaluate the presence of developmental grooves and CEP in the anterior and posterior teeth. 2. To study their relationship to periodontal health. *Methodology:* The study included 1700 subjects of both genders. The presence of palatal grooves and CEPs were detected by visual perception and the suspected area was probed to measure the depth of the groove or enamel extension. The periodontal condition of the area was also examined and the statistical analysis was performed. *Results:* The prevalence rate of palatal grooves on the central incisor and lateral incisor was 1.8% and 9% respectively while 1.1% had enamel extensions on the molar teeth, all of which were associated with gingivitis or periodontitis. *Conclusion:* Grooves and projections in the cervical area caused increased plaque accumulation and might be considered a secondary etiological factor in periodontal breakdown and hence should be taken into consideration during periodontal examination and therapy.

Keywords: Cervical enamel projections; Palatal grooves; Periodontitis

Introduction

Biologists, anatomists and research workers have observed the presence of developmental abnormalities in relation to teeth and the dental arch. Periodontists are concerned with the relation of these developmental abnormalities to the surrounding environment. More frequently, an endodontist comes across the abnormalities of teeth and may fail to recognize the etiology for the pathologically involved tooth, and may treat the concerned teeth only endodontically, which may unfortunately result in failure.

The region of the maxillary lateral incisor is an area of embryologic hazard. A great number of major and minor malformations occur in this area such as cleft palate, globulomaxillary cyst, missing teeth, supernumerary teeth, peg shaped lateral incisors and dens in dente. Another anomaly or variant occurring in the upper lateral incisor area is the disto-lingual groove. This type of anomaly is also found less frequently, on the palatal aspect of the maxillary lateral incisor and central incisors. A morphologically similar defect has also been reported on the facial aspect of maxillary central incisors and has been associated with chronic inflammatory periodontal disease [1].

Evidence of such anomalies in prehistoric and medieval eras has also been reported. In a collection of teeth dating between 2500 and 1000 BC, Brabant recorded prevalence of 12% to 21% of palatal grooves in both lateral and central maxillary incisors and a range of 6.3% to 14% in lateral incisors alone [2]. Factors related to tooth anatomy including enamel projections and palatal grooves have been associated with attachment loss. A cervical enamel projection (CEP) is defined as a dipping of enamel from the cement-enamel junction of a molar toward and often into the furcation area [3]. Although reports vary, about 15% to 24% of mandibular molars and 9% to 25% of maxillary molars have cervical enamel projections. Considering both arches, they are most likely to be found on buccal

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surfaces of second molars [4]. Strong associations have been shown for the presence of CEPs and furcation involvements based on cross-sectional evaluations of extracted teeth. The fact that the presence of enamel in these locations prevents connective tissue attachment has been thought to predispose the involved areas to periodontal breakdown [5]. Different workers have used terminologies such as radicular lingual groove, palatogingival groove, distopalatal groove and lingual developmental groove [6]. Kovacs, an anthropologist called such a tooth as 'syndesmocoronoradicular tooth' [7].

Lingual grooves usually begin in the central fossa, cross the cingulum and extend for various distances and directions down the root [7]. The origin of these grooves may due to the unfolding of the enamel organ and the epithelial sheath of Hertwig [8]. These grooves are of periodontal hazards and act as etiological factors for the development of localized periodontal disease by the accumulation of plaque and calculus in the depth of the groove, making mechanical plaque control at these sites difficult. In addition, these anatomical abnormalities are problematic for periodontal instrumentation [9]. Simon et al. also suggested that these defects may cause periodontal complications as a result of endodontic involvement in which bacteria in the pulp canal extend into the groove, causing chronic inflammation [10]. Therapeutic procedures have been suggested in these areas such as saucerization and odontoplasty using composite materials [11].

A study by Grewe et al. generated the largest sample size (5230 extracted molars) and found the CEP prevalence to be 25.2% in mandibular molars and 15.8% in maxillary molars. Furthermore, they found the most common site as the buccal side of the mandibular second molar [12]. The present comprehensive study was designed to examine a large number of cases and evaluate the extent of the presence of developmental grooves and CEPs, both in the anterior and posterior teeth in the dental arch and also to study their relationship to periodontal health to the areas concerned. This may add further to our knowledge regarding the embryologic abnormalities and their injurious influence on the periodontium.

Material and Methods

A cross-sectional study was conducted to assess the prevalence of periodontitis in patients with developmental grooves and/ or enamel projections. This study included 1700 subjects of both genders [1292 males and 408 females] who were examined at the Department of Periodontology at Bapuji Dental College and Hospital for a period of one year. The sampling was carried out based on the following inclusion and exclusion criteria.

Inclusion criteria: Patients with developmental grooves and/or enamel projections.

Exclusion criteria: Physically and mentally challenged patients. Patients with systemic disorders where probing was contraindicated.

Ethical Clearance: The study was reviewed and ethical clearance was provided by the ethical committee of Bapuji Dental College and Hospital, Davangere.

Methodology: This study included 1700 subjects of both genders [1292 males and 408 females]. Subjects belonged to the age group of 15-56 yrs. A convenient sampling method was used for this study. A complete intra-oral examination was carried out using a mouth mirror and a probe. William's graduated probe was used to identify any developmental grooves and/or CEPs and to assess the periodontal health status in these regions. Whenever visually there was evidence of a groove, the probe was passed along the enamel apically in the concerned area after completion of thorough oral prophylaxis around the tooth. A CEP was identified when on probing, the probe extended apically past the cervical line without any catch. The groove or CEP was measured and all the obtained data were entered in a proforma.

Periodontal status of the concerned area was assessed by the following indices.

- Plaque assessment was done by: Turesky-Gilmore-Glickman modification of the Quigley- Hein Plaque Index.

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- Periodontal status was assessed by : Russell's Periodontal Index (score 4 was eliminated due to unavailability of radiographs)
- Mobility was assessed by: Miller's Index for tooth mobility

Statistical analysis: The obtained data was analysed by descriptive statistics. It included the mean, standard deviation and percentage distribution of the anatomical conditions observed.

Results

The mean values and standard deviations of the central incisors, lateral incisors and molars regarding the length of the groove and enamel projection, pocket depth, plaque index, periodontal index score and Millers index were recorded.

Central incisor: Buccal aspect: The number of subjects with grooves were 25, of which 20 were male subjects and 5 were female subjects. The percentage rate was 1.5%. The percentage rate for male subjects was 1.55%. The percentage rate for female patients was 1.25%. The mean groove length was 3.5 mm with a standard deviation of 0.74 mm. The mean pocket depth was 1.7 mm with a standard deviation of 0.70 mm. The mean plaque index score was 1.2 with a standard deviation of 0.94. The mean periodontal index score was 1.4 with a standard deviation of 1.45. The Miller Index was zero.

The prevalence ratio between male and female subjects was not significant. Of the 25 cases with grooves on the buccal aspect of central incisors, 5 cases had no plaque accumulation, 14 had only flecks around the cervical margin, 3 had a band of plaque 1 mm in width circumferentially, and 3 had a plaque index score of 3, 5 had a periodontal index score of 0, 8 had a periodontal index score of 1, 10 had a periodontal index score of 2 and 2 had a periodontal index score of 6. Of the subjects examined, 2 had groove lengths of 2 mm, 10 cases had groove length of 3 mm, 11 cases had groove length of 4 mm and 2 cases had groove lengths of 5 mm.

Central Incisor: Palatal aspect: The number of subjects with grooves were 31, of which 27 were male subjects and 4 were female subjects. The percentage rate was 1.8%. The percentage rate for male subjects was 2%. The percentage rate for female patients was 0.9%. The mean groove length was 4.7 mm with a standard deviation of 1.37 mm. The mean pocket depth was 2.8 mm with a standard deviation of 1.37 mm. The mean plaque index score was 1.9 with a standard deviation of 0.8. The mean periodontal index score was 1.8 with a standard deviation of 1.69. The mean Miller Index was 0.3 with a standard deviation of 0.67.

The prevalence ratio between male and female subjects was not significant. Of the 31 cases with grooves on the palatal aspect of central incisors, none had a plaque index score of zero, 10 had plaque index scores of 1, 10 had plaque index scores of 2 and 11 had plaque index score of 3. There were 4 patients with groove length of 3 mm, 14 with groove length of 4 mm, 9 with groove length of 5 mm, 3 with groove length of 6 mm, and 1 with groove length of 9 mm. 19 cases had a periodontal index score of 1, 8 had a periodontal index score of 2, 2 had a periodontal index score of 6 and 2 had a periodontal index score of 8.

Lateral Incisor: Buccal aspect: No developmental grooves were observed on the buccal aspect.

Lateral Incisor: Palatal aspect: The number of subjects with palatal grooves were 153, of which 122 were male subjects and 31 were female subjects. The percentage rate was 9%. The percentage rate for male subjects was 9.5%. The percentage rate for female patients was 7.5%. The mean groove length was 3.9 mm with a standard deviation of 0.9 mm. The mean pocket depth was 2.3 mm with a standard deviation of 0.88 mm. The mean plaque index score was 1.9 with a standard deviation of 0.86. The mean periodontal index score was 2.0 with a standard deviation of 1.24. The mean Miller Index was 0.1 with a standard deviation of 0.49.

The prevalence ratio between male and female subjects was not significant. Of the 153 cases with palatal grooves on lateral incisors, none had a plaque index score of zero, 48 had plaque index scores of 1, 82 had plaque index

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scores of 2 and 23 had a plaque index score of 3. There were 5 patients with groove length of 2 mm, 42 patients with groove length of 3 mm, 65 with groove length of 4 mm, 37 with groove length of 5 mm, and 2 with groove length of 7 mm. None had a periodontal index score of 0, 44 cases had a periodontal index score of 1, 99 had a periodontal index score of 2, 6 had a periodontal index score of 6 and 4 had a periodontal index score of 8. No developmental abnormal grooves were noticed on the molars.

Enamel extension: The number of subjects with enamel extension on molars were 19, of which 14 were male subjects and 5 were female subjects. In 15 cases, the extension was on the buccal aspect and in 4 cases was on the palatal/lingual aspect of molars. The percentage rate was 1.1%. The percentage rate for male subjects was 1.08%. The percentage rate for female patients was 1.22%. The mean enamel extension was 3.7 mm with a standard deviation of 1.1 mm. The mean pocket depth was 4.5 mm with a standard deviation of 2.46 mm. The mean plaque index score was 2.6 with a standard deviation of 0.67. The mean periodontal index score was 2.5 with a standard deviation of 2.25. The mean Miller Index was 0.2 with a standard deviation of 0.40.

Of the 19 cases with CEP, 2 had plaque index scores of 1, 3 had plaque index scores of 2 and 14 had a plaque index score of 3. 10 cases had a periodontal index score of 1, 4 had a periodontal index score of 2 and 5 had a periodontal index score of 6. 12 patients had CEP of 3 mm, 2 had CEP of 4 mm, 3 had CEP of 5 mm and 2 had CEP of 6 mm. The mesial and distal aspect of the teeth showed no such developmental abnormalities.

Table-1: Detailing type of anomaly on teeth, prevalence, percentage and means of groove length, enamel extension, pocket depth, Plaque Index score, Periodontal Index score and Miller Index score

Type of anomaly on the teeth	No. of patients with anomaly			Grooves or CEP length (mm)	Pocket depth (mm)	Plaque Index score	Periodontal index score	Millers Index score
	No.	%						
Groove on central incisor: Buccal aspect	25	1.5	X	3.5	1.7	1.2	1.4	0
			Sd	0.74	0.7	0.94	1.45	0
Groove on central incisor: Palatal aspect	31	1.8	X	4.7	2.8	1.9	2.0	0.3
			Sd	1.37	1.2	0.8	1.9	0.67
Groove on lateral incisor: Buccal aspect	-	-	-	-	-	-	-	-
Groove on lateral incisor: palatal aspect	153	9	X	3.9	2.3	1.9	2	0.1
			Sd	0.9	0.88	0.86	1.24	0.49
Enamel extension on molar	19	1.1	X	3.7	4.5	2.6	2.5	0.2
			Sd	1.4	2.46	0.67	2.25	0.4
Anomaly on other teeth	-	-	-	-	-	-	-	-

Discussion

Factors related to tooth anatomy including palatal grooves and cervical enamel projections may contribute to the initiation of periodontal disease. Since the etiology of periodontal disease is bacterial, factors that enhance bacterial accumulation or allow ingress of bacteria into the periodontium such as anatomical aberrations may be causative for gingival inflammation, attachment loss and bone loss [4]. The palatal groove originates on the maxillary incisors in the region of the cingulum, extending towards and most frequently ending at the CEJ. Occasionally the groove extends past the CEJ towards the root apex [10]. Researchers have reported radicular grooves to be present in 3.9% of their subjects, primarily on the lingual

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surface of the maxillary lateral incisor. Less than 1% of maxillary central incisors showed radicular grooves on the buccal and/or lingual surfaces. Others report the prevalence of 0.79-21% in both maxillary incisors and 1.9-14% in lateral incisors alone [13].

The presence of a groove from the crown extending apically at the gingival margin can impede the removal of plaque. These grooves may act as funnels for the accumulation of microbial plaque in the depth of the groove, where they are inaccessible to both patient and clinician. In many instances, periodontal attachment and bone loss can be found at these sites. The prognosis for teeth with palatal grooves with apical extension is poor [13]. Cervical enamel projections are the focal apical extension of the coronal enamel beyond the normally smooth cervical margin onto the root of the tooth. They are flat ectopic deposits of enamel that are triangular in shape and tapering in form, extending apically into the furcation area [3].

Masters and Hoskins were the first to suggest the association of the CEP with periodontal disease [14]. Most studies agree with them on the positive association between CEPs and furcation involvement, except those by Lieb et al. and Zee et al [15-16]. The presence of CEP as a predisposing factor for initiation of localized periodontal alterations is well established. The form of attachment formed in these areas was described by Goldstein as 'locus minori resistente' and has been hypothesized that it would constitute an area of less resistance to plaque-associated inflammatory degradation, predisposing the area to increased probing depths. This fact reinforces the importance of adequate oral hygiene as the presence of a CEP suggests a poorer clinical outcome. Ectopic enamel removal is generally recommended during periodontal surgeries to allow new attachment to form. Nonetheless, when the CEP was removed in conjunction with a regenerative procedure, the healing was better than in similar teeth without CEP [17].

The present comprehensive study was designed to examine a large population to find out the prevalence of developmental abnormal grooves and enamel extension in different teeth in the dental arch, their distribution in male and female population, and their relationship to periodontal health status with an anticipation that this study may further increase our knowledge regarding the incidence of such abnormalities, distribution and their influence on the periodontal tissues. In this study, out of 1700 subjects, 1292 were male and 408 were female subjects. 1.5% out of the examined subjects showed grooves on the buccal aspect of the central incisor. Not all the cases had an increased plaque accumulation, probably due to the fact that the buccal grooves were more easily cleaned by oral hygiene procedures. Also as the length of the buccal groove increased there was an increased incidence of gingival disease and periodontal breakdown. There has been only one isolated case report earlier on the presence of the buccal groove and its association with periodontal disease [18]. In our study, there was no prevalence of presence of buccal grooves on lateral incisors.

All of the 31 cases and 153 cases who had palatal grooves on maxillary central incisors and maxillary lateral incisors respectively were shown to have either gingivitis or periodontitis. It was also shown that as the groove length increased, there was also an increased occurrence of periodontal breakdown and higher plaque accumulation. This study showed a prevalence rate for the presence of palatal grooves on the central incisor and lateral incisor of 1.8% and 9% respectively. This is in accordance with studies wherein authors reported the prevalence of 0.79-21% in both maxillary incisors and 1.9-14% in lateral incisors alone [13].

1.1% had enamel extensions on the molar teeth in the present study. This is much less than earlier reports wherein 15% to 24% of mandibular molars and 9% to 25% of maxillary molars had CEPs [4]. All of these teeth showed either gingivitis or periodontitis and those with deeper enamel extensions had periodontal breakdown. Through a literature review, Cecilia, Correia and Rocha confirm the influence of CEP on the onset of periodontal disease, pointing out the importance of recognizing this projection to make an early diagnosis [9]. This study fortifies the view that grooves and projections

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in the cervical area caused increased plaque accumulation and might be considered a secondary etiological factor in periodontal breakdown and attachment loss. They are therefore considered as hazards to the maintenance of periodontal health which would therefore require corrective therapy to prevent periodontal breakdown.

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*All correspondences to: Dr. Nagarathna D.V., Professor, Department of Periodontics, A.J. Institute of Dental Sciences, Kuntikana, NH-17, Mangalore-575 004 Karnataka, India. E-mail: nagarathnahande@gmail.com

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