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Prevalence of developmental defects of enamel in children visiting a university hospital in Chennai - a retrospective study

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Abstract: The developmental defects of the enamel (DDE) may be the alternation of enamel that may affect an area of one surface or may be widespread affecting all the surface of the teeth. Early diagnosis of developmental defects of the enamel can prevent the child from having an impact on oral health. The aim of this study was to determine the prevalence of developmental defects of enamel in children visiting a university hospital in the Chennai population. This was a retrospective study done under a University setting. It was seen that 334 patients had Developmental Defects of Enamel. The data was collected from June 2019 to March 2020. The data was tabulated and entered in excel and the data was analysed using SPSS package software. The overall prevalence of the DDE was found to be 47%. The most common deformity was Hypoplasia (24.3%) and the least common deformity was Molar Incisal Demineralisation and Amelogenesis Imperfecta (0.9%). The most common tooth affected was maxillary left central incisor (5.1%) and the least common deformity was found in mandibular right first premolar and primary dentition (0.3%). There was a statistically significant association between DDE and buccal surface of teeth. It indicates the need for educating the population about the risk factors for the DDE.

Keywords: Enamel defects, Hypoplasia, Diffuse Opacity, Demarcated Opacity, Innovation, Molar Incisal Hypomineralisation, Children.

INTRODUCTION

Oral health plays a very important role in the general well-being of individuals, and parents' behavior and attitudes influence the oral health of their children (Gurunathan and Shanmugaavel, 2016). The developmental defects of the enamel (DDE) may be defined as the alteration of enamel that may affect an area of one surface or may be widespread affecting all the surfaces throughout its full thickness (Subramanyam et al., 2018). Opacity is a hypo-mineralization defect involving alteration in the translucency of enamel. Hypoplasia is a quantitative defect associated with a reduced thickness of enamel and appears as grooves or pits. These enamel defects can have a significant impact on esthetics, tooth sensitivity and occlusal function. They may be quantitative in nature that is manifested as a deficiency in adequate thickness of enamel or qualitative in nature as enamel opacities (Wright, 2000).Fluoride when present in optimal quantities is known to prevent caries by various mechanisms but more predominantly by deposition of calcium fluoride crystals which is more resistant to demineralisation (Somasundaram et al., 2015),('Fluoride, Fluoridated Toothpaste Efficacy And Its Safety In Children - Review', 2018). DDE is associated with a wide spectrum of etiologic factors including systemic, genetic, local, and environmental conditions (Mihaela, Pasareanu and Maxim, 2011). Enamel defects have significant impact on oral health and esthetics and act as a predisposing factor for caries (Jeevanandan, 2017). Most epidemiological studies have shown that the frequencies of DDE are on rise in all populations streaming their clinical significance and evidence for public health initiatives (Govindaraju and Jeevanandan, 2017a).

The prevalence of DDE ranged from 6.7% to 67.1% in the developed countries and from 27% to 66.2% in the developing countries. Chauhan et al., (Chauhan and Chauhan, 2013) in 2013 assessed the prevalence and presentation of the DDE of healthy school children residing in hills of Himachal Pradesh, India, and reported to be 66.2%. Gisoo et al., (Gisoo and Mohseni, 2010) (2010) found a significant association between systemic illness during the first 5 years of life and the prevalence of DDE. Mihaela et al., (Mihaela, Pasareanu and Maxim, 2011),reported a significant association between intake of drugs or chemicals during the first 5 years of life and

prevalence of DDE. Enache et al., (Enache, Maxim and Păsăreanu, 2010) reported a significant association between nutritional status and prevalence of DDE.

The knowledge of the epidemiology of enamel defects is important in order to provide basic information within a community or country and between countries; and help in educating the population (Jeevanandan and Govindaraju, 2018). It is also important since it may contribute to the assessment and monitoring of environmental or systemic factors and for detecting possible etiological factors responsible for the occurrence of the enamel defects (Robles et al., 2013).

Previously our team has conducted numerous cross sectional studies (Jeevanandan, 2017), (Govindaraju and Jeevanandan, 2017a), (Govindaraju and Jeevanandan, 2017b), (Somasundaram et al., 2015), (Jeevanandan and Govindaraju, 2018), clinical trials (Govindaraju, Jeevanandan and Subramanian, 2017), (Ravikumar, Jeevanandan and Subramanian, 2017),(Panchal, Jeevanandan and Subramanian, 2019), (Christabel and Gurunathan, 2015), (Packiri, 2017), in-vitro studies (Gurunathan and Shanmugaavel, 2016), (Govindaraju and Gurunathan, 2017), case studies (Subramanyam et al., 2018) and literature reviews ('Fluoride, Fluoridated Toothpaste Efficacy And Its Safety In Children - Review', 2018), (Nair et al., 2018) over the past 5 years. Our department is passionate about research we have published numerous high quality articles in this domain over the past years (Abraham et al., 2005; Devaki, Sathivel and BalajiRaghavendran, 2009; Neelakantan et al., 2010, 2015; Arja et al., 2013; Ramshankar et al., 2014; Sumathi et al., 2014; Surapaneni and Jainu, 2014; Surapaneni, Priya and Mallika, 2014; Ramamoorthi, Nivedhitha and Divyanand, 2015; Manivannan et al., 2017; Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018; J et al., 2018; Ravindiran and Praveenkumar, 2018; Malli Sureshbabu et al., 2019; Mehta et al., 2019; Krishnaswamy et al., 2020; Samuel, Acharya and Rao, 2020; Sathish and Karthick, 2020)Hence, this time, an attempt has been made to evaluate the prevalence of developmental defects of enamel in children visiting university in the Chennai population under 6-18 years old.

METHODS AND MATERIALS

Ethical Approval: The ethical approval for the retrospective study was obtained from the university ethical review board (Approval no: SDC/SIHEC/2020/DIASDATA/0619-0320).

Data analysis: After reviewing the records of 86000 patients, a total of 334 records which satisfied the inclusion and exclusion criteria were included in the study. Simple random sampling was done to obtain the study sample. Population type was patients with age groups of 6 to 18 years. The patient records between June 2019 and March 2020 were reviewed and analysed. Cross verification was done by referring case sheets and photographs. All the incomplete & unreliable data was excluded. The Inclusion criteria was patients within age groups of 6 to 18 and patients with any systemic conditions or syndromes were excluded. The study was carried on in a university set up. The internal validity of the study was set by following proper sampling and also by strictly adhering to the protocols for examination of the case sheets for verification of cases with developmental enamel defects.

Statistical Analysis: After Excel tabulation, the data was transferred to SPSS. The analysis was done using SPSS version 19. Descriptive statistics were used to correlate the data. The dependent variables were Hypoplasia, Diffuse opacity and Demarcated opacity. The independent variables were age and gender. The collected data was imported to SPSS and the chi square test was done. The level of significance was set at 0.05.

RESULTS AND DISCUSSION

In the present study where 334 patients were examined, 50.30% were Males and 49.70% were Females [Figure 2]. The overall prevalence of the DDE was found to be 47% (155 patients). The prevalence of DDE was found to be higher in Males (51.61%) when compared to Females (48.39%) [Figure 3]. The most common tooth affected by the defect was Maxillary Left Central Incisor (5.1%) and the least common tooth was Mandibular Right First Premolar (0.3%) [Table 1]. The most common Site/Surface was the Labial surface (17.86%) and the least common affected surface was the mesial surface (0.3%) [Figure 4]. The most common deformity was hypoplasia (24.3%) and the least common deformity was Molar Incisal Hypomineralisation and Amelogenesis Imperfecta (0.9%) [Figure 5].

Hypoplasia (13.47%) was the highest type of deformity among the gender of the patients. Chi square test was performed and association between Type of deformity and Gender was not found to be statistically significant (P=0.293) [Figure 6]. The DDE was most common among the Male patients (23.95%). Chi square test was performed and association between DDE and Gender was found not to be statistically significant (P = 0.655) [Figure 7]. Hypoplasia (11.96%) was the highest type of deformity among the buccal surface affected by the DDE. Chi square test was performed and association between Surfaces and Type of deformity among patients with DDE was found to be statistically significant (P = 0.000) [Figure 8].

The developmental defects of enamel can be defined as any alteration or disturbances during the process of odontogenesis (Nelson et al., 2010). According to their clinical appearance, DDE has been classified as Demarcated opacity, Diffuse opacity and Hypoplasia (Ravikumar, Jeevanandan and Subramanian, 2017). The

absence of malnutrition and well-functioning healthcare during early childhood, may have contributed to a lower DDE prevalence. Frontal DDE led to aesthetic problems in every fourth case. Thus, the majority did not worry about the deviant appearance of their front teeth. Notably, the dentists were significantly more concerned than the patients. Consequently, the dentists must be careful not to transmit their opinion concerning appearance to the patients.

Isolated enamel opacity does not usually lead to an increased risk for caries; however it may be a significant esthetic problem. Enamel hypoplasia is not only a cosmetic problem, but it could also be a retentive area which favors bacterial plaque accumulation and results in increased caries susceptibility. Increased wear and tooth sensitivity lead to pain and discomfort for the child (Salanitri and Seow, 2013) . Enamel hypoplasia may also be predictive of similar disturbances in the permanent dentition. Yellow - brown defects have lower Knoop hardness values and greater porosity than the white defects and normal enamel (Rodd, Boissonade and Day, 2007). Hypomineralized permanent first molars demonstrate changes in pulpal innervation and vascularity, and also show immune cell accumulation which is indicative of an inflammatory pulpal response (Jälevik and Klingberg, 2002). The porous exposed subsurface enamel and the dentine may favor bacterial penetration into the dentine resulting in chronic inflammation of the pulp, which makes the use of local analgesia less efficient thus making the treatment painful, especially when immature teeth with large pulps are involved (Brogårdh-Roth and Matsson, 2011). Even intact enamel of hypomineralized molars may be very sensitive to air, cold or warmth and children often avoid brushing the sensitive molars (Jälevik and Klingberg, 2002). It is difficult for the children with intellectual disabilities to maintain good oral hygiene by themselves. They have impaired teeth - brushing ability and less patience due to their motor, sensor and learning disabilities (Slayton et al., 2001). Children can be more susceptible to dental caries if they reside at home and their parents are comforting them with cariogenic snacks (Wong et al., 2014). Oral health promotion programs should be aimed at centers and schools for children with intellectual disabilities and should include the regular use of oral health services, oral hygiene education and dietary counseling (Wong et al., 2014) .

In the present study, the prevalence of DDE in children aged 6-18 years was found to be 47%. On literature search, the least prevalence of DDE reported was 6.7% Pasareanu et al., among 600 school children aged between 8 years and 11 years from lasi (Păsăreanu and Florea, 2001) and the highest prevalence of DDE reported was 67.1% Sujat et al., among 1,024 school children aged 16 years from the island of penang, Malaysia (Sujak, Abdul Kadir and Dom, 2004).

In our study, the prevalence of defects was found to be higher in Males (51.61%) compared to Females (48.39%) which was similar to the findings of Hussian et al.,(Nik-Hussein et al., 2018). In the study conducted by Ramesh et al., the prevalence of defects was slightly higher in females (90.7%) as compared to males (87.9%) which was contradictory to our study (Ramesh et al., 2011). The most common tooth affected by the defect was Maxillary Left Central Incisor (5.1%) and the least common tooth was Mandibular Right First Premolar (0.3%) which was similar to the findings of Ravindran et al.,(Ravindran and Saji, 2016) and the report by Montero et al.,(Montero, Douglass and Mathieu, 2003) stated that the posterior teeth were twice most commonly affected which is contradictory to our present study.

The most affected surface was Labial surface (17.7%) and the least common affected surface was the mesial surface (0.3%) wherease Ruiz et al., stated the defects were involving less than one-third of the tooth surface and incisal (33%) which is contraindicatory to our study (Ruiz et al., 2013).

Robes et al.,(Robles et al., 2013) found that the most common type of DDE to be Demarcated opacity was not similar to the present study while our study states that the most common deformity was Hypoplasia (24.3%) and the least common deformity was Molar Incisal Hypomineralisation and Amelogenesis Imperfecta (0.9%).

The prevalence of Molar Incisal Hypomineralisation was found to be (0.9%) in the present study which was contraindicatory to the study conducted by Gomez et al.,(Martínez Gómez et al., 2012) reported that the 17.85% had MIH and Sonmez et al.,(Sönmez, Yıldırım and Bezgin, 2013) reported that the prevalence of MIH in their study was found to be 7.77%.

Vello et al.,(Velló et al., 2010) and Faria et al (Corrêa-Faria et al., 2013) reported a significant association between the prevalence of the DDE and age which is not similar to our present study. Funakoshi et al., (Funakoshi, Kushida and Hieda, 1981) reported the significant association between the tooth number, surface of the tooth with the DDE which is similar to the present study.

Although the clinical significance of enamel defects is well known, the pathogenesis of the defects is still being studied. While the range of environmental insults that can damage the enamel organ have been identified, the threshold for damage, and the relative susceptibility of the enamel organ at the various stages of development have not been well researched. . Therefore, despite major advancement in knowledge regarding the nature of the defects and the genes involved in enamel and dentine defects, further research is required. Additionally, as enamel defects are currently managed by treating the symptoms, future research should also focus on development of suitable techniques and aesthetic restorative materials that can bond effectively to defects enamel and dentine.

CONCLUSION

In conclusion, the overall prevalence of the DDE was found to be 47%. The high prevalence of developmental enamel defects found in Male patients compared to Females, association between DDE, Type of deformity and Gender was not found to be statistically significant. association between Buccal Surfaces and Type of deformity among patients with DDE was found to be statistically significant. In view of the prevalence of DDE and the fact that enamel hypoplasia constitutes a risk factor for future ECC, enamel defects should be included as a dental health indicator in epidemiological studies of children.

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Table 1: Table showing distribution of Developmental Defects of Enamel in individual teeth represented in FDI system of notation. Highest prevalence was seen in Maxillary left permanent central incisor.

Site (FDI System) that had DDE	FREQUENCY	PERCENTAGE (%)
0- No defect	179	53.6%
11/ 12/ 13	13/ 5/ 8	3.9%/ 1.5%
14/ 15	2/ 1	0.6%/ 0.3%
16	12	3.6%
21/ 22/ 23	17/ 2/ 8	5.1%/ 0.6%/ 2.4%
24/ 25	3 / 2	0.9%/ 0.6%
26	11	3.3%
31/ 32/ 33	4/ 3/ 3	1.2%/ 0.9%/ 0.9%
34/ 35	4/ 2	1.2%/ 0.6%
36	12	3.6%
41/ 42/ 43	5/ 2/ 2	1.5%/ 0.6%/ 0.6%

44/ 45	1/ 3	0.3%/ 0.9%
46	10	3.0%
52/ 53	2/ 1	0.6%/ 0.3%
54/ 55	3/ 3	0.9%/ 0.9%
62/ 63	1/ 2	0.3%/ 0.6%
73	2	0.6%
All Teeth	3	0.9%

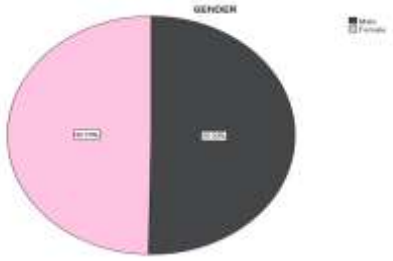

Fig. 1: Pie chart showing distribution of Gender of the patient. Black color represents the Male patients and Pink color represents the Female patients. Male (50.30%) and Females (49.70%) among the study population.

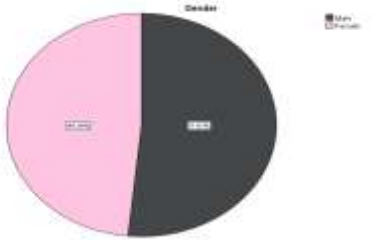

Fig.2: Bar chart showing distribution of patients with Developmental Defects of Enamel (DDE), according to Gender of the patient. Black color represents the Male patients and Pink color represents the Female patients. The DDE was most common among the Male patients (51.61%) and least common among the Female patients (48.39%). Hence, the prevalence of DDE was higher among the Male patients compared to Female patients.

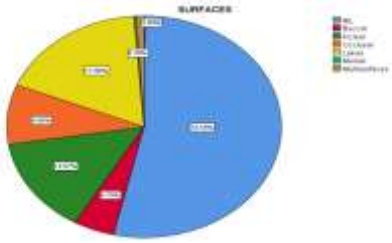

Fig.3: Pie chart showing distribution of patients with Developmental Defects of Enamel, according to surfaces affected by DDE of the patients. The most common Site/Surface was the Labial surface (17.66%) and the least common affected surface was the mesial surface (0.30%) . Hence, the prevalence of surfaces affected by the DDE was higher among the Labial surface compared to other surfaces of the teeth.

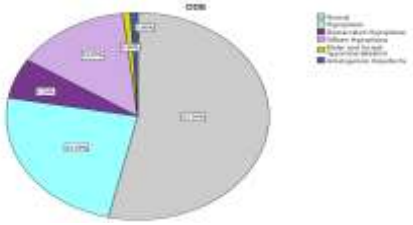

Fig.4: Pie chart showing distribution of patients with Developmental Defects of Enamel, according to the type of deformity in patients with DDE. The most common deformity was hypoplasia (24.3%) and the least common deformity was Molar Incisal Hypomineralisation and Amelogenesis

Imperfecta (0.9%). Hence, the prevalence of type of deformity in patients with DDE was higher among hypoplasia compared to other types of deformity.

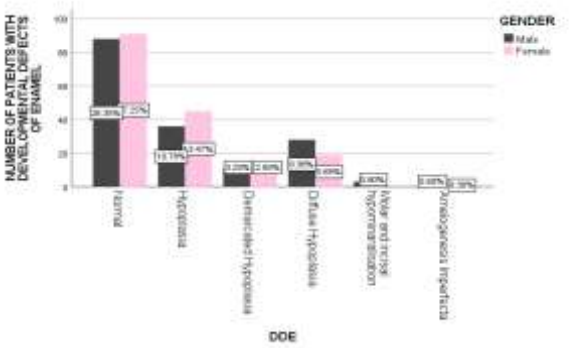

Fig.5: Bar chart showing association between gender and various types of enamel deformity. X axis represents the number of patients with Type of Deformity. Y axis represents the number of patients with DDE. Hypoplasia was the highest type of deformity noticed among females (Pink) and Diffuse Hypoplasia was the highest type of deformity noticed among males (Black). Chi square test was performed and association between Type of deformity and Gender was not found to be statistically significant. P Value= 0.293 (P>0.05), hence not statistically significant.

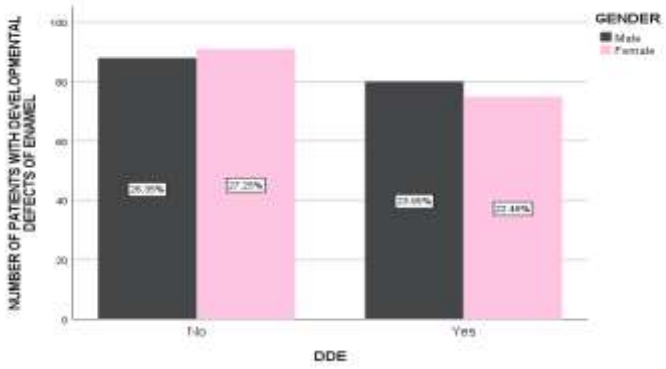

Fig.6: Bar chart showing association between DDE and Gender. X axis represents the distribution of the number of patients with and without DDE . Y axis represents the number of patients with DDE. The DDE was most common among the Male patients (Black) compared to female patients (Pink). Chi square test was performed and association between DDE and Gender was found not to be statistically significant. P Value = 0.655 (P>0.05), hence not statistically significant.

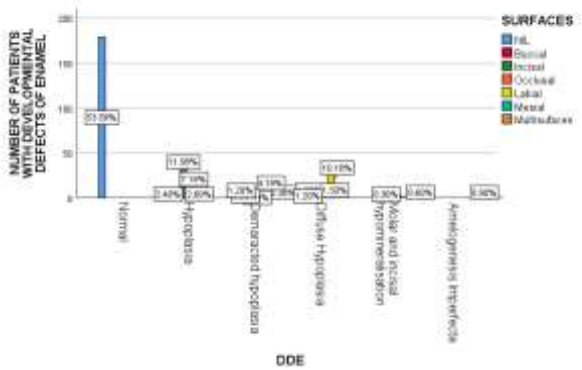

Fig.7: Bar chart showing association between Teeth surfaces and Type of deformity among patients with DDE. X axis denotes the Surfaces affected by DDE. Y axis denotes the type of deformity. Hypoplasia was the highest type of deformity among the buccal surface (Red) affected by the DDE. Chi square test was performed and association between Surfaces and Type of deformity among patients with DDE was found to be statistically significant. P value= 0.000 (P>0.05), hence statistically significant.