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Original Article

Dentistry Section

Prevalence of Dental Anomalies in Skeletal Malocclusions with Different Growth Patterns in North Indian Population- A Cross-sectional Study

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ABSTRACT

Introduction: Anomalies of the developing dentition occur due to absence or interruption of normal tooth development along with genetic and/or environment influences. Craniofacial development and dental malocclusion is an interplay between a number of factors such as tooth size, arch size and shape, the number and arrangement of teeth, size and relationship of the jaws and related soft tissues including lips, cheeks, and tongue.

Aim: To evaluate the prevalence and distribution of dental anomalies among different skeletal malocclusions and growth patterns in North Indian population.

Materials and Methods: This retrospective cross-sectional study was conducted on pretreatment diagnostic records of 260 patients belonging to the age group of 15-25 years, who had reported to the Out Patient Department (OPD) of Department of Orthodontics, Faculty of Dental Sciences, SGT University, Gurugram, Haryana, India, during the period of April 2012 to December 2020. The analysis was carried out between November 2020 and January 2021. The study sample was grouped into different growth patterns and skeletal malocclusions based on Sella-Nasion-Gonion-Gnathion (SN Go-Gn) and ANB (A point, nasion, B point), Sagittal intermaxillary angle values respectively, which were obtained from the pretreatment lateral cephalometric tracings. The prevalence of dental anomalies was evaluated in each group by examining the pretreatment diagnostic records. Chi-Square/Fisher-Freeman-Halton test were used for statistical analysis.

Results: The prevalence of dental anomalies in the study sample was 65 (25%). The most common anomaly found was over retained deciduous teeth, followed by ectopic eruption with prevalence rate of 30 (11.5%) and 24 (9.2%), respectively. A total of 142 (54.6%) patients had hypodivergent growth pattern, 23 (8.8%) had normodivergent growth pattern and 95 (36.5%) had hyperdivergent growth pattern. 36 (13.8%) patients had skeletal class I malocclusion, 205 (78.8%) had skeletal class II malocclusion and 19 (7.3%) patients had skeletal class III malocclusion. Hypodivergent group showed the highest prevalence of dental anomalies with 38 (26.8%), followed by hyperdivergent group with 23 (24.2%) and normodivergent group were 4 (17.4%). Skeletal class I malocclusion group had the highest number of dental anomalies as 13 (36.1%), followed by skeletal class II malocclusion with 50 (24.4%) and skeletal class III malocclusion group with 2 (10.5%).

Conclusion: Hypodivergent growth pattern and skeletal class II malocclusion were the most prevalent growth pattern and skeletal malocclusion in North Indian population. Dental anomalies were most prevalent in patients with hypodivergent growth pattern and skeletal class I malocclusion. The results of the present study indicate that dental anomalies are associated with certain malocclusions and growth patterns which may contribute to more accurate treatment predictions.

Keywords: Cephalometry, Demographics, Tooth abnormalities

INTRODUCTION

The development of tooth is a complex biological process which involves a series of interactions between the ectoderm and ectomesenchyme. Any disturbance in the epithelium and mesenchyme can alter the normal odontogenesis, resulting in developmental anomaly of teeth. Dental anomalies are abnormalities of size, shape, number, position, structure and eruption pattern of the teeth. There are large variations in the prevalence rate of dental anomalies in patients across different populations. Some studies reported that the prevalence of dental anomalies in orthodontic patients ranges from 5.46% to 39.5%, while in other survey, investigators found that prevalence rate was 74.8% [1-5]. Uslu O et al., reported that 40.3% of orthodontic patients had at least one dental anomaly [6]. In a study conducted in Indian population, 31.26% presented with dental anomalies [7].

Malocclusions have been classified based on craniofacial and occlusal relationships. Often times disturbances in craniofacial and occlusal relationships appear together with dental anomalies, thus complicating the treatment. Numerous anomalies have been reported in orthodontic patients, of which agenesis, impaction, hypodontia and microdontia were the most prevalent [6,8,9]. Basdra EK et al., reported that dental anomalies such as agenesis of upper lateral incisors, peg shaped laterals and impacted canine was found to be associated with Class II Division 2 malocclusion thus indicating a strong genetic influence in the development of this type of malocclusion [10,11]. On the other hand, Class III and Class II Division 1 malocclusions have a pattern of occurrence of anomalies similar to that found in the general population [8]. In a study done by Fernandez CC et al., microdontia was found to be associated with the skeletal class III malocclusion pattern and tooth agenesis was found to be associated with the hypodivergent growth pattern [12]. Takahashi Y et al., suggested that patients with congenitally missing teeth have specific characteristics of craniofacial morphology and growth patterns such as a smaller mandibular plane angle, shorter maxilla, a more prognathic mandible, and increased retroclination of the maxillary and mandibular incisors [13]. Celikoglu M and Kamak H reported that the prevalence of third molar agenesis was more in skeletal class III followed by skeletal class I and II [14].

Dental anomalies are an important part of the problem list for 10% to 20% of patients diagnosed with malocclusion. Dental anomalies are commonly observed among patients with malocclusion than the comparable general population [10]. It is important to treat these anomalies because they can create disturbances in maxillary and mandibular dental arch lengths, occlusions and can complicate dental treatments, such as root canal therapy or tooth extraction.

Despite extensive analysis of various malocclusions, studies relating dental anomalies to specific skeletal and growth malocclusion patterns are scarce. Therefore, the aim of this present study was to evaluate the prevalence and distribution of dental anomalies among different skeletal malocclusions and growth patterns in North Indian population.

MATERIALS AND METHODS

This retrospective cross-sectional study was conducted on 260 patients who had reported to the Out Patient Department of Department of Orthodontics, Faculty of Dental Sciences, SGT University, Gurugram, Haryana, India for their routine fixed orthodontic treatment during the period of April 2012 to December 2020, and the analysis was carried out between November 2020 and January 2021, after approval from the Ethical Committee (SGTU/Exam/SCY/11929).

Inclusion criteria: Pretreatment diagnostic records of patients of age 15-25 years which included initial panoramic radiographs and lateral cephalograms of good quality, dental casts, intraoral photographs and complete clinical history. For every anomaly, the inclusion criteria was that at least one tooth was affected.

Exclusion criteria: Pretreatment diagnostic records of patients who presented with a history of trauma, cleft lip and/or palate, syndromes, endocrine imbalances and/or metabolic disturbances and any systemic disorders were excluded.

The pretreatment diagnostic records of 260 patients were retrieved from departmental data bank and were screened. Information about age, sex and ethnicity of the patients was collected from case history. Pretreatment diagnostic record of each patient was evaluated for the presence of any of the below mentioned dental anomalies-

Tooth number alterations: Agenesis- (including Hypodontia and Oligodontia excluding third molars) and Supernumerary teeth.

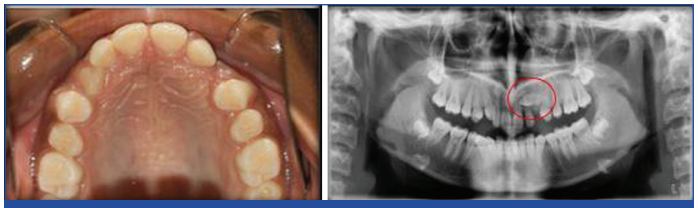
Tooth size alterations: Microdontia [Table/Fig-1] and Macrodontia.

Tooth position alterations: Transposition [Table/Fig-2], Over retention of deciduous teeth [Table/Fig-3] impaction (excluding third molars) [Table/Fig- 4], inversion, ectopic eruption [Table/Fig-5].

Tooth shape alteration: Odontoma, Taurodontism, Talon cusp [Table/Fig-6], Fusion, Gemination and Dens invaginatus, Dens evaginatus.

[Table/Fig-1]: Microdontia-Peg lateral.
[Table/Fig-2]: Transposition. (Images from left to right)

[Table/Fig-3]: Retained deciduous maxillary right and left canine.



[Table/Fig-4]: Impacted teeth.

[Table/Fig-5]: Ectopic eruption.

[Table/Fig-6]: Talons cusp.

Tooth structure abnormalities: Amelogenesis imperfecta, Dentinogenesis imperfecta.

The images of pretreatment lateral cephalogram were taken as Joint Photographic Experts Group (JPEG) Image and using Dental studio NX 2006 Version 6.0 from Nemotec Madrid, Spain, cephalometric analysis was carried out. Based on the values of SN-GoGn and ANB angle obtained from cephalometric analysis, study sample was grouped into different growth patterns and skeletal malocclusions respectively and prevalence of dental anomalies were evaluated in these groups. To characterise growth patterns and skeletal malocclusions two evaluations were used. Based on each evaluation, patients were classified into three groups.

Evaluation 1: Grouping of the total sample into three different growth patterns based on SN-GoGn values i.e., angulation of the Sella-Nasion Plane with the Mandibular Plane (Gonion-Gnathion) and the prevalence and distribution of dental anomalies was recorded in each group [15].

Normodivergent growth pattern (SN-GoGn angle equals 32°)

Hypodivergent growth pattern (SN-GoGn angle less than 32°)

Hyperdivergent growth pattern (SN-GoGn angle greater than 32°)

Evaluation 2: Grouping of the total sample into three different skeletal malocclusions based on the values of sagittal intermaxillary angle (ANB) and the prevalence and distribution of dental anomalies was recorded in each group [15].

Skeletal class I malocclusion (ANB value greater than 0° and less than or equal to 2°)

Skeletal class II malocclusion (ANB value greater than 2°)

Skeletal class III malocclusion (ANB value 0° or less)

STATISTICAL ANALYSIS

Data collected was tabulated using Microsoft excel 2010. Data was analysed using Statistical Package for Social Sciences (SPSS) version 21.0 {IBM SPSS statistics (IBM corp. Armonk, NY, USA released 2011)}. Descriptive statistics of the explanatory and outcome variables was calculated by mean, standard deviation for quantitative variables, frequency and proportion was calculated

for qualitative variables. Chi-Square/Fisher-Freeman-Halton test by cross tabulation was used to compare frequencies. Any p-value less than or equal to 0.05 was considered to be significant for all analyses (two-tailed).

RESULTS

Out of 260 patients, 65 (25%) had one or more dental anomalies. In total 101 dental anomalies were recorded. Among the total sample, 113 (43.5%) patients were males and 147 (56.5%) patients were females and the mean age of the sample was 18.89±3.10 years. The age range of the study population was 15-25 years. A total of 181 patients (69.6%) belonged to the age group of 15-20 years and 79 patients (30.35%) belonged to the age group of 21-25 years [Table/Fig-7]. The most common anomaly found was over retained deciduous teeth, followed by ectopic eruption with prevalence rate of 11.5% and 9.2%, respectively. The prevalence rate of other dental anomalies identified in the present study is given in [Table/Fig-8].

Variable	Number (n)	Percentage (%)
Age range (in years)		
15-20	181	69.6
21-25	79	30.35
Gender		
Males	113	43.5
Females	147	56.5

[Table/Fig-7]: Distribution of patients according to demographic characteristics.

Dental anomalies	n (%)*
Talons cusp	02 (0.8)
Impacted teeth	18 (6.9)
Over retained deciduous teeth	30 (11.5)
Microdontia	07 (2.7)
Hypodontia	17 (6.5)
Transposition	01 (0.4)
Ectopic eruption	24 (9.2)
Supernumerary teeth	01 (0.4)
Odontome	01 (0.4)

[Table/Fig-8]: Distribution of dental anomalies in the study population.
*The percentages have been calculated out of the total sample size of 260. (65 out of 260 patients had dental anomalies and more than one dental anomaly was present in many patients.)

In the present study, 54.6% had hypodivergent growth pattern, 8.8% patients had normodivergent growth pattern and 36.5% patients had hyperdivergent growth pattern. A 13.8% of patients had skeletal class I malocclusion, 78.8% had skeletal class II malocclusion and 7.3% patients had skeletal class III malocclusion [Table/Fig-9].

Variable	Total number of patients (N=260)	Percentage (%)
Growth pattern		
Hypodivergent	142	54.6
Normodivergent	23	8.8
Hyperdivergent	95	36.5
Skeletal classification		
Skeletal class I	36	13.8
Skeletal class II	205	78.8
Skeletal class III	19	7.3

[Table/Fig-9]: Distribution of patients based on growth pattern and skeletal malocclusion.

Hypodivergent group showed the highest prevalence of dental anomalies (26.8%), followed by hyperdivergent group (24.2%) and 17.4% patients had dental anomalies in the normodivergent group. skeletal class I malocclusion group had the highest number of dental anomalies (36.1%), followed by skeletal class II malocclusion group (24.4%) and then skeletal class III malocclusion group (10.5%) [Table/Fig-10].

Variable	Dental anomalies		Total	Chi-square test			
	Present n (%)	Absent n (%)	n (%)	Value	df	p-value	Sig
Growth pattern (n=260)							
Hypodivergent	38 (26.8)	104 (73.2)	142 (100)	0.976	2	0.614	NS
Normodivergent	04 (17.4)	19 (82.6)	23 (100)				
Hyperdivergent	23 (24.2)	72 (75.8)	95 (100)				
Skeletal malocclusion (n=260)							
Skeletal class I	13 (36.1)	23 (63.9)	36 (100)	4.534	2	0.104	NS
Skeletal class II	50 (24.4)	155 (75.6)	205 (100)				
Skeletal class III	02 (10.5)	17 (89.5)	19 (100)				

[Table/Fig-10]: Association of presence or absence of dental anomalies based on growth pattern and skeletal malocclusion.
p=value >0.05 is considered as non-significant (NS)

Most common anomaly found in the hypodivergent group was over retention of deciduous teeth, whereas impaction and ectopic eruption was the most common anomaly in normodivergent group. Most common anomaly found in patients with hyperdivergent growth pattern was ectopic eruption. In the present study, hyperdivergent subjects presented with the highest number of ectopically erupted tooth (12.6%). A 7% of hypodivergent subjects presented with ectopic eruption while 8.7% of normodivergent subjects had ectopic eruption.

Hypodivergent group showed the highest number of over retained deciduous teeth (14.8%). The most common retained deciduous teeth were deciduous maxillary and mandibular right canine in equal numbers. A 4.3% of patients had over retained deciduous teeth in the normodivergent group. An 8.4% of patients had over retained deciduous teeth in the hyperdivergent group with most of the retained deciduous teeth present in the mandibular arch and the most common retained deciduous teeth was maxillary right deciduous canine.

Normodivergent group presented with highest number of microdont teeth (3.5%). The teeth affected in all patients was maxillary left and right lateral incisors who presented with the isolated form of microdontia known as peg lateral.

Skeletal class I malocclusion showed the highest prevalence of impacted teeth (22.2%) with maxillary right canine being the most commonly affected teeth followed by skeletal class II malocclusion (4.9%) with the teeth maxillary right and left canine and maxillary left second premolars being the most commonly affected teeth. There were no impacted teeth reported in skeletal class III malocclusion group. Ectopic eruption showed highest prevalence in skeletal class II malocclusion group (10.2%) with maxillary left canine and mandibular right central incisor being the most common ectopically erupted teeth followed by skeletal class I malocclusion group (5.6%) and skeletal class III malocclusion group (5.3%). Skeletal class I malocclusion group showed the highest prevalence of overretained deciduous teeth (25.0%) followed by skeletal class II malocclusion group (9.8%) and skeletal class III malocclusion group (5.3%). Most common retained deciduous teeth was deciduous maxillary right canine in skeletal class I malocclusion group. Most common retained deciduous teeth in skeletal class II malocclusion group was maxillary right and left deciduous canine and mandibular deciduous right canine and most of the retained deciduous teeth was found in the mandibular arch. In the present study, highest prevalence of microdontia was seen in skeletal class II malocclusion (2.9%). The teeth affected in all patients were maxillary right and left lateral incisor. skeletal class II

malocclusion group had the highest number of hypodontia and the commonly affected teeth was mandibular right and left central incisor. Overretained and impacted teeth were present more in number. Microdontia was very less in number and statistical test was not applicable in other cases of dental anomalies.

A statistically significant association between gender and skeletal malocclusion was noted in the present study (p-value=0.001). The association between presence and absence of impacted teeth with skeletal malocclusion showed highly significant results (p-value=0.002) [Table/Fig-11]. The association of presence or absence of over retained deciduous teeth with skeletal malocclusion showed statistically significant association (p-value=0.037) [Table/Fig-12].

Skeletal malocclusion (n=260)	Impacted teeth		Total n (%)	Fisher-Freeman-Halton exact test			
	Present n (%)	Absent n (%)		Value	df	p-value	Sig
Skeletal class I	08 (22.2)	28 (77.8)	36 (100)	11.451	2	0.002**	HS
Skeletal class II	10 (4.9)	195 (95.1)	205 (100)				
Skeletal class III	0 (0)	19 (100)	19 (100)				

[Table/Fig-11]: Association of presence or absence of impacted teeth based on skeletal malocclusion.
p-value <0.01 is considered Highly Significant (**)

Skeletal malocclusion (n=260)	Over-retained deciduous teeth		Total n (%)	Fisher-Freeman-Halton exact test			
	Present n (%)	Absent n (%)		Value	df	p-value	Sig
Skeletal class I	09 (25)	27 (75)	36 (100)	6.499	2	0.037	S*
Skeletal class II	20 (9.8)	185 (90.2)	205 (100)				
Skeletal class III	01 (5.3)	18 (94.7)	19 (100)				

[Table/Fig-12]: Association of presence or absence of over retained deciduous teeth based on skeletal malocclusion.
p-value <0.05 is considered to be Significant (*)

DISCUSSION

Variations in size, shape, number, position, formation and the composition of enamel and dentin are reflected as an aberration of development which results in dental anomalies. Out of total 65 patients with dental anomalies, 27(41.53%) were males and 38(58.46%) were females. Patil S et al., reported that 36.7% of the patients had dental anomalies [16], while Gupta SK et al., reported that 34.28% presented with developmental dental anomalies on studies done in Indian population [7]. Overall prevalence of dental anomalies in Maharastrian population was found to be 16.7% as reported by Kumar D et al., [17]. A study done on prevalence of oro-dental anomalies among students in Haryana reported 29.1% prevalence rate [18]. The overall prevalence rate of dental anomalies in the present study was found to be lesser when compared to other studies in the literature [19-21]. The variations in the results can be due to racial differences, populations under study, variable sampling techniques and different diagnostic criteria used for identifying and classifying the dental anomalies. The age range of the study population was 15-25 years. The lower age limit of 15 years was chosen for identification of impacted canines [8].

Prolonged retention/over retention is a condition where in the primary tooth is retained beyond the time of normal exfoliation [22]. Over retained deciduous teeth was the most common anomaly found in the present study with a prevalence rate of 11.5%, which was higher than the prevalence rates reported by Javali R and Meti M, (3.23%) and by Faramarzi H et al., (6.88%), respectively [23,24].

Ectopic eruption is a type of positional dental anomaly in which eruption of the teeth does not occur at normal location. Second most common anomaly in the present study was ectopic eruption which had 9.2% prevalence rate. The most common ectopically erupted teeth was maxillary left canine followed by mandibular right lateral incisor. Kumagai E et al., reported a prevalence rate of 5.6% for ectopic eruption of permanent incisors and first molar [25]. The higher prevalence rate for ectopic eruption can be attributed to the fact that, in the present study prevalence of ectopic eruption of all teeth was considered instead of assessing the prevalence rate for specific teeth.

Impaction is the failure of a tooth to erupt into the oral cavity because of a physical barrier in the path of eruption [26]. Impacted teeth was present with a prevalence rate of 6.9%, which was within the range of 5.6-18.8% prevalence rate as reported by various studies in the literature [27-32].

Dental agenesis is defined as the congenital absence of a permanent tooth germ. In the present study, 6.5% presented with congenitally missing teeth. The prevalence of congenitally missing teeth in the present study was within the range of 0.15%-16.2% as reported by various studies in the literature [16,33,34]. A condition where in the teeth are smaller than normal is termed as microdontia [35]. Microdontia was present with a prevalence rate of 2.7%. The prevalence of microdontia as reported by Gupta SK et al., was 2.58% and 2.6% as reported by Yassin SM, which showed similar prevalence rate as that of the present study [7,36].

The dental anomalies which showed a lower prevalence rate in the present study was Talon cusp, supernumerary teeth, transposition, odontoma.

Talon cusp is a dental anomaly with a well-defined morphologically altered cusp-like structure projecting from the cingulum area of the anterior teeth [37]. The prevalence rate of talon cusp was 0.8% in the present study. The prevalence rate for talon cusp reported by Gupta SK et al., was 0.97% and by Gupta P et al., was 0.22% [7,18]. Transposition is the condition in which two teeth have exchanged their positions [35]. The prevalence rate for transposition was 0.4% while Patil S et al., reported a prevalence rate of 0.1% [16]. Supernumerary teeth are extra teeth that develop in addition to the normal series of teeth [35]. In the present study, supernumerary teeth had a prevalence rate of 0.4%, which was lower compared to prevalence rate of 2.40% as reported by Gupta SK et al., 1.2% as reported by Patil S et al., and 1.6% as reported by Patil S and Maheswari S, [7,16,29]. Odontome is a dental anomaly in which lesion is composed of more than one type of tissue and consequently has been called a composite odontoma. The prevalence rate of odontome was 0.4% in the present study as compared to the prevalence rate of 0.2% as reported by Patil S et al., [16].

None of the patients showed macrodontia, taurodontism, dens evaginatus, fusion, gemination and dens invaginatius, amelogenesis imperfecta, dentinogenesis imperfecta.

There was nonsignificant association between presence and absence of impacted teeth on growth pattern and this result was not in agreement with the studies mentioned in literature [27,38]. Singh S et al., reported that patients with canine impaction(s) revealed a trend toward retrognathic maxilla, retrognathic mandible and hypodivergent skeletal relationship [38]. Al Balbeesi HO et al., reported that hyperdivergent male patients and hypodivergent female patients had higher incidence of impacted canine [39].

The disagreement in results can be due to the different population under study and most of the studies have taken into consideration only impacted canines and 3rd molars whereas we were trying to find the association of all the impacted teeth (excluding 3rd molars) identified in the study population with growth pattern. The other impacted teeth found in the present study was maxillary left central incisor, mandibular right central and lateral incisors, mandibular right and left canines, maxillary and mandibular first and second

premolars and maxillary second molar. There were no impacted supernumerary teeth identified in the present study.

Aktan AM et al., reported that the primary mandibular second molars were the most frequently retained deciduous teeth, followed by the right and left deciduous maxillary canines and maxillary second molars [22]. In the present study, deciduous maxillary canines were the most frequently retained teeth.

Hypodivergent group reported the highest number of hypodontia, with mandibular left central incisor being the teeth most commonly affected, whereas mandibular right lateral incisor was the most commonly affected teeth in hyperdivergent group. There was no hypodontia reported in normodivergent group. Fernandez CC et al., reported a higher prevalence of tooth agenesis associated with hypodivergent growth pattern which was in accordance with our present study [12].

Pant BD et al., reported that Class I skeletal malocclusion had highest prevalence of dental anomalies followed by Class III and Class II malocclusion [40]. Oshagh M et al., reported that skeletal class II malocclusion had the highest prevalence of dental anomalies followed by skeletal class I malocclusion and skeletal class III malocclusion in Shiraz orthodontic population which showed similar results to the present study [41]. A statistically significant association between gender and skeletal malocclusion was noted in the present study (p-value=0.002). The association between presence or absence of impacted teeth with skeletal malocclusion showed statistically highly significant results with skeletal class I malocclusion group having the highest number of impacted teeth.

The association of presence or absence of over retained deciduous teeth with skeletal malocclusion showed statistically significant association with skeletal class I malocclusion having the highest prevalence of overretained deciduous teeth.

In the present study, highest prevalence of microdontia was seen in skeletal class II malocclusion (2.9%). The teeth affected in all patients were maxillary right and left lateral incisor. Fernandez CC et al., reported a higher prevalence of microdontia associated with skeletal class III malocclusion [12], where as in our study highest prevalence of microdontia was seen in skeletal class II malocclusion (2.9%).

Limitation(s)

The limitation of the present study was the small sample size which is decreasingly representative of the entire population. Future studies are warranted to investigate the genetic links between dental anomalies and skeletal malocclusion and growth patterns.

CONCLUSION(S)

Hypodivergent growth pattern and skeletal class II malocclusion was the most prevalent growth pattern and skeletal malocclusion respectively in North Indian population. Hypodivergent group showed the highest prevalence rate of dental anomalies among all the three different growth patterns. Skeletal class I malocclusion group had the highest prevalence rate of dental anomalies among all the three different Skeletal malocclusion groups. A 25% of the total sample had dental anomalies. The prevalence of dental anomalies was greater in females than in males in the present study. Over retained deciduous teeth was the commonest dental anomaly found in the present study. The results of this study indicate that dental anomalies were associated with certain growth pattern and skeletal malocclusion. Identifying such associations early may contribute to more accurate treatment predictions.

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