ORIGINAL ARTICLE

Prevalence of dental anomalies in various malocclusions

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Introduction: The purpose of this study was to evaluate the prevalence of dental anomalies in different orthodontic malocclusions. **Methods:** Based on pretreatment diagnostic records, 900 orthodontic patients were classified as Class I (n = 358), Class II (n = 325), Class II Division 2 (n = 51), or Class III (n = 166). The occurrence rates of each dental anomaly were calculated as percentages of the total sample. Differences in incidence rates of each dental anomaly by sex and malocclusion were analyzed by using chi-square, Fisher exact, and z tests. The Mann-Whitney U test was used to determine whether there were significant differences in the occurrence of dental anomalies by age. **Results:** It was found that 40.3% of patients (n = 363) had at least 1 dental anomaly. Agenesis was the most common (21.6%), followed by dens evaginatus (6.2%), invaginatus (5.0%), pulp stones (4.2%), and impaction (2.9%). No statistically significant correlations were found between dental anomaly and type of malocclusion, with the exception of impaction and short or blunt roots ($P < 0.01$ and $P < 0.05$, respectively). The Mann-Whitney U test indicated no significant difference in dental anomalies by age. **Conclusions:** A remarkably high rate of dental anomalies was recorded in orthodontic patients; therefore, orthodontists should carefully examine pretreatment records for dental anomalies to include their management in the treatment planning. (Am J Orthod Dentofacial Orthop 2009;135:328-35)

Dental anomalies can result from many factors, both genetic and environmental. Although defects in certain genes are the most influential, etiological events in the prenatal and postnatal periods have also been blamed for anomalies in tooth dimension, morphology, position, number, and structure.[1-5] Whereas several studies have investigated the prevalence of various dental anomalies, only a few have addressed the issue in relation to orthodontic malocclusions. Lind[6] showed that 3.6% of 1717 Swedish orthodontic patients had supernumerary teeth. Rose[7] reported that 4.3% of 6000 orthodontic patients aged 7 to 14 had at least 1 congenitally missing tooth. Kotsomitis et al[3] reported a 29.7% prevalence of ectopic eruption and and an 8.4% prevalence of agenesis in 202 orthodontic patients. Thongudomporn and Freer[8] investigated the prevalence of dental anomalies in 111 orthodontic patients and found that 74.8% had at least 1 dental anomaly, with invagination the most common. McCulloch et al[9] investigated dens evaginatus and warned orthodontists to be aware of this condition, particularly to include the anomalous tooth in decisions regarding extraction. Endo et al[10] evaluated hypodontia using panoramic radiographs of 3358 Japanese orthodontic patients aged 5 to 15 and found a prevalence rate of 8.5%. Basdra et al[4,11] reported that Class II Division 2 malocclusions are closely related to congenital tooth anomalies, and Class III subjects showed significantly higher rates of congenital tooth anomalies than did those with Class II Division 1 malocclusions.

Although orthodontic patients have been reported to have high rates of dental anomalies, orthodontists often fail to consider this.[8,12-14] If not detected, dental anomalies can complicate dental and orthodontic treatment; therefore, their presence should be carefully investigated during orthodontic diagnosis and considered during treatment planning. Because of the distinct characteristics of each malocclusion, we aimed to investigate the prevalence of dental anomalies in a group of orthodontic patients and to derive admonitory clinical suggestions.

MATERIAL AND METHODS

Pretreatment diagnostic records—panoramic and periapical radiographs, dental casts, intraoral photographs, and dental histories—of 900 white subjects

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(352 male, 548 female) were retrieved from the archives of the orthodontic department of Ankara University in Turkey. The subjects were classified into 4 groups by malocclusion type, as follows.

1. Class I (ANB angle 0° to 4°, Class I molar relationship): n = 358 (39.8%) (130 male, 228 female).
2. Class II (ANB angle >4°, Class II molar relationship): n = 325 (36.1%) (129 male, 196 female).
3. Class II Division 2 (ANB angle >4°, Class II molar relationship, deepbite): n = 51 (5.7%) (21 male, 30 female).
4. Class III (ANB angle <0°, Class III molar relationship): n = 166 (18.4%) (72 male, 94 female).

The mean age of the patients was 15.4 ± 3.7 years (range, 12.9-22.1 years). All subjects were in the permanent dentition and had pretreatment panoramic and periapical films taken by the same technician using the same x-ray device (Siemens, OP10E, Palomex Instrumentarium, Tuusula, Finland) and the same standardized method. Patients with syndromes, severe medical histories, extractions of any permanent teeth, teeth with incomplete roots, endodontic or prosthodontic treatment, or trauma to any tooth before orthodontic treatment were excluded.

The following dental anomalies were investigated.

1. Agenesis: a congenital absence of a permanent tooth or germ.
2. Dens invaginatus: a developmental malformation resulting from invagination of the crown or root surface before calcification.[15]
3. Dens evaginatus (talon cusp): an uncommon developmental aberration of a tooth resulting in the formation of a supernumerary tubercle that extends from the occlusal aspect of an otherwise normal tooth.[9,16]
4. Impaction: a tooth that is not expected to erupt completely into its normal functional position based on clinical and radiographic assessments (Fig 1).[17]
5. Taurodontism: a condition in which the tooth trunk is elongated and the floor of the pulp chamber is displaced apically with proportionately shortened roots.[18]
6. Pulp stone: a calcified mass in the dental pulp of a healthy, diseased, or unerupted tooth (Fig 1).[19]
7. Microdontia: an inherited condition that produces at least 1 disproportionately small tooth.[20]
8. Dilaceration: a deviation or bend in the linear relationship between tooth crown and root; an angulation or sharp curve of 90° or more in the root or crown of a developed tooth.[15]
9. Enamel hypoplasia: a hereditary condition in which the dental enamel shows either a break in continuity or surface loss, often because of insufficient calcification.[21]
10. Short or blunt roots: developmentally short, blunt dental roots.[22] Roots as long as or shorter than the crowns in the incisors and visually evaluated as short, blunt roots bilaterally in the posterior teeth were recorded as short or blunt roots.
11. Supernumerary teeth: teeth that appear in addition to the regular number of teeth.
12. Ectopic eruption: eruption of a tooth in an abnormal position.[23]

Fig 1. Panoramic radiograph showing several dental anomalies: pulp stones in the first molars, impacted maxillary right central incisor, congenitally missing maxillary lateral incisors, and agenesis of the third molars.

All records were examined by the same clinician (S.E.), who has 10 years of professional experience, to eliminate interexaminer differences.

Statistical analysis

Repeatability was tested on 20 randomly selected subjects examined at least 2 weeks after the initial examination. Kappa coefficients were calculated to determine the reliability of determining each dental anomaly in the 2 evaluation periods.

Numbers of patients and rates of dental anomalies were calculated for the overall study sample, and by sex and malocclusion type. Chi-square, Fisher exact, and z tests were conducted to determine the statistical significance of dental anomalies by sex and malocclusion type, and the Mann-Whitney U test was used to determine whether there were significant differences in the occurrence of dental anomalies by age. Statistical analysis was performed with SPSS software for Windows (version 11.0, SPSS, Chicago, Ill).

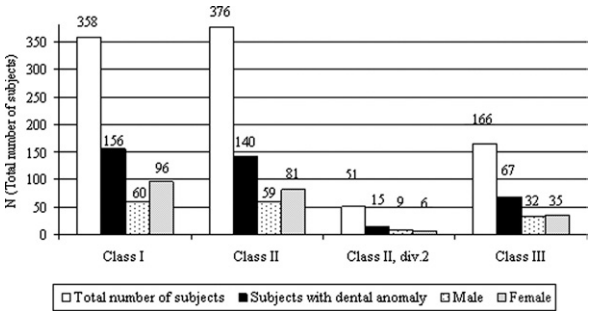

Fig 2. Distribution of subjects with dental anomalies in each malocclusion group.

RESULTS

A kappa score of 1, which indicated perfect agreement between the first and second evaluations, was observed for each dental anomaly with the exception of dens evaginatus (kappa score, 0.77; substantial agreement). This showed the reliability of the recordings.

A total of 363 subjects (40.3%) had at least 1 dental anomaly, and 537 (59.7%) had no anomalies. Figure 2 illustrates the number of subjects with at least 1 dental anomaly in each malocclusion group. The overall distribution of dental anomalies and the distribution by sex are given in Table I. The dental anomalies were statistically independent of sex, but microdontia and ectopic eruption were observed only in the female subjects. The Mann-Whitney U test indicated no significant difference in dental anomalies regarding age.

The most prevalent dental anomaly was agenesis, observed in 21.6% of the sample. The rate of agenesis was higher in males than in females, but the difference was not statistically significant (Table I). Dens evaginatus was more prevalent than dens invaginatus (6.2% and 5.0%, respectively). Rates for both were higher in females than in males, but the differences were not statistically significant. Impaction was found in 2.9% of patients and supernumerary teeth in 0.3%.

Table II shows the distribution of dental anomalies by malocclusion group. Impaction was significantly lower in the Class II and Class II Division 2 groups than in both the Class I and Class III groups.

Agenesis had a high frequency in all malocclusion groups (17.6%-24.7%). Dens invaginatus and dens evaginatus were less common in the Class III group when compared wth the other groups. Impaction showed a statistically significant difference between Class I and Class II ($P < 0.01$), and between Class II and Class III ($P < 0.05$), but it was not observed in the Class II Division 2 group. The rate of short or blunt roots was statistically different between the Class I and Class II Division 2 groups ($P < 0.05$); the highest rate was in the Class II Division 2 group (3.9 %) when compared with the other groups.

Table III shows the number of patients with 2 or more dental anomalies in each malocclusion group. Accordingly, the z and Fisher exact (performed for the value of any cell <5) tests showed no statistically significant difference between the groups for multiple dental anomalies and sex, although the highest rates were observed in the Class I (8.4%) and Class III (7.2%) groups. Moreover, a marked difference was observed between the Class I and Class II groups ($P < 0.07$), and the Class II Division 2 group showed a higher rate than did the Class II group.

Figure 3 shows the ranking of the dental anomalies in regard to the total number of teeth. Agenesis of the third molars was the most frequent anomaly (n = 421).

Dens invaginatus was found most frequently in the maxillary lateral incisors (n = 75), whereas dens evaginatus was observed most in the maxillary canines (n = 57). Pulp stones were observed most often in the maxillary right first (n = 20) and second molars (n = 13). A total of 8 impacted maxillary right canines was observed.

Table IV shows the distribution of dental anomalies by region. The rates of agenesis were highest in the maxillary posterior region (15.7%), followed by the mandibular posterior region (12.8%) and the mandibular anterior region (0.2%). The differences in the rates of agenesis between the maxillary posterior region and the maxillary anterior and mandibular posterior regions were statistically significant ($P < 0.05$ and $P < 0.001$, respectively). Noticeably, supernumerary teeth, ectopic eruptions, dens invaginatus, and dens evaginatus were found only in the maxillary anterior region. Impaction rates were also significantly higher in the maxillary anterior region (1.8%) than in the other regions. Taurodontism was observed only in the maxillary and mandibular posterior regions, and the rate of pulp stones was also higher in these regions. Pulp stones were observed at statistically higher rates in the maxillary molar region when compared with the maxillary anterior ($P < 0.05$), mandibular anterior ($P < 0.01$), maxillary premolar ($P < 0.001$), mandibular premolar ($P < 0.001$), and mandibular molar ($P < 0.001$) regions.

DISCUSSION

Because of differences in the reported prevalences of anomalies in various racial and ethnic groups, we planned to investigate the frequencies in a sample of white orthodontic patients.[18,24,25] In this study, 40.3% of the total study group had at least 1 dental anomaly.

Table I. Distribution of dental anomalies by sex and results of chi-square and Fisher exact tests

	Male (M) (n = 352)		*Female (F) (n = 548)*			*M + F (n = 900)*	
Anomaly	*n*	*%*	*n*	*%*	P	*n*	*%*
Agenesis	86	24.4	108	19.7	0.093 NS	194	21.6
Dens invaginatus	17	4.8	28	5.1	0.851 NS	45	5.0
Dens evaginatus	20	5.7	36	6.6	0.591 NS	56	6.2
Impaction	11	3.1	15	2.7	0.735 NS	26	2.9
Taurodontism	3	0.9	6	1.1	0.721 NS	9	1.0
Pulp stone	18	5.1	20	3.6	0.287 NS	38	4.2
Microdontia	—	—	6	1.1	—	6	0.7
Dilaceration	10	2.8	19	3.5	0.604 NS	29	3.2
Enamel hypoplasia	2	0.6	2	0.4	0.646 NS	4	0.4
Short or blunt roots	7	2.0	4	0.7	0.121 NS	11	1.2
Supernumerary teeth	2	0.6	1	0.2	0.564 NS	3	0.3
Ectopic eruption	—	—	5	0.9	—	5	0.6

NS, Not significant; *P* values equal to or less than 0.05 were considered significant.

Table II. Distribution of subjects with dental anomalies in each malocclusion group and z test

	Class I (n = 358)		*Class II (n = 325)*		*Class II Div 2 (n = 51)*		*Class III (n = 166)*		
Anomaly	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	P
Agenesis	81	22.6	63	19.4	9	17.6	41	24.7	NS
Dens invaginatus	19	5.3	18	5.5	3	5.9	5	3.0	NS
Dens evaginatus	26	7.3	20	6.2	3	5.9	7	4.2	NS
Impaction	15	4.2	4	1.2	0	0	7	4.2	I-II† II-III*
Taurodontism	4	1.1	3	0.9	0	0	2	1.2	NS
Pulp stone	18	5.0	12	3.7	0	0	8	4.8	NS
Microdontia	2	0.6	3	0.9	0	0	1	0.6	NS
Dilaceration	10	2.8	11	3.4	1	2.0	7	4.2	NS
Enamel hypoplasia	3	0.8	1	0.3	0	0	0	0	NS
Short or blunt roots	2	0.6	6	1.8	2	3.9	1	0.6	I-II 2*
Supernumerary teeth	2	0.6	1	0.3	0	0	0	0	NS
Ectopic eruption	2	0.6	2	0.6	0	0	1	0.6	NS

NS, Not significant; *P* values equal to or less than 0.05 were considered significant.
*$P < 0.05$; $^{\dagger}P < 0.01$.

Thongudomporn and Freer[8] reported a higher rate of 74.78% in a study of 111 orthodontic patients and explained this finding, which was higher than previous random sample studies, as a result of orthodontic patients' tendency to have more dental anomalies than the general population. However, they did not classify orthodontic malocclusions as we did according to distinct skeletodental characteristics.

Statistically significant correlations were not observed between sex and dental anomalies, with the exception of microdontia and ectopic eruption, seen only in females. There were more female subjects in the total sample and in the study groups. Some authors found statistically insignificant differences,[8,10] whereas others reported significant differences by sex for certain dental anomalies.[4,26,27]

Table III. Distribution of subjects with 2 or more dental anomalies in each malocclusion group and results of chi-square and Fisher exact tests

	Class I n = 358 (130 M, 228 F)		*Class II n = 325 (129 M, 196 F)*		*Class II Div 2 n = 51 (21 M, 30 F)*		*Class III n = 166 (72 M, 94 F)*		
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	P
Male	11	8.5	6	4.6	1	4.8	7	9.7	NS
Female	19	8.3	10	5.1	2	6.7	5	5.3	NS
Total	30	8.4	16	4.9	3	5.9	12	7.2	NS

NS, Not significant; *M,* male; *F,* female; *P* values equal to or less than 0.05 were considered significant.

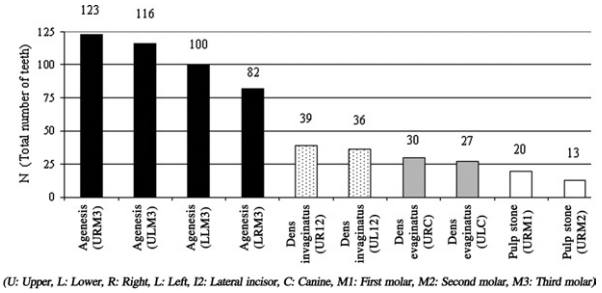

Fig 3. Distribution of the teeth most affected by dental anomalies.

The Mann-Whitney U test showed no statistically significant difference in dental anomalies in regard to age, but the lack of statistically significant age differences might be because age distribution was concentrated around the mean (15.4 ± 3.7 years); this might have caused reduced statistical power. Consequently, it was suggested that the number of congenital tooth anomalies might become more pronounced with age, as they become more recognizable.[4]

Subjects with Class II Division 2 malocclusion were separated from the Class II pool and studied separately, because they have a distinct skeletodental pattern.[28] The literature indicated strong genetic influences for this malocclusion, which has a low prevalence rate, between 2.4% and 4.8%.[28] It was also shown that Class II Division 2 malocclusions are related to gene-controlled dental anomalies.[4,28,29] Basdra et al[4] found a higher rate (56.6%) of congenital tooth anomalies in 267 Class II Division 2 malocclusions, but we found 29.4% in our study.

No malocclusion group had statistically significant multiple dental anomalies (2 or more) in this study. However, te Class I group had the highest rate, followed by the Class III, Class II Division 2, and Class II groups. Similarly, Basdra et al[11] reported that the occurrence rate of all congenital tooth anomalies was significantly higher in Class III subjects when compared to Class II Divison 1.

The finding of agenesis of the third molar as the most frequent dental anomaly agrees with the literature; absence of the third molars is the most common agenesis in the general population.[30] In this study, excluding the third molar, agenesis was observed most frequently in the maxillary right lateral incisor (2.6%). Endo et al[10] reported an agenesis rate of 4.8% for maxillary right lateral incisors in Japanese orthodontic patients. In the literature, excluding third molars, the prevalence of agenesis is between 0.3% and 10.1%.[10] Orthodontic patients are more likely to have agenesis than the general population.[12,14] It was also reported that hypodontia is diagnosed more often in white patients.[31] Only a few studies in the literature have compared the frequency of tooth agenesis by region.[21,32] In or study, agenesis was most prevalent in the maxillary and mandibular posterior regions, followed by the maxillary anterior region, and the maxillary and mandibular premolar regions; it was least prevalent in the mandibular anterior region.

The prevalence of dens invaginatus in this study (5%) was higher than rates reported in general population studies (2.0%-2.95%).[15,33,34] The higher rate might be attributed to orthodontic malocclusions; this would support the finding of Thongudomporn and Freer[8] of a significantly higher rate of dens invaginatus (26.1%) in a group of mixed orthodontic patients. The maxillary lateral incisors have been reported to be the most affected by dens invaginatus.[8,15,33,35] This agrees with our results. Thongudomporn and Freer[8] reported a 26.1% incidence of dens invaginatus in the maxillary incisors, and Grahnen et al[33] reported a 43% incidence in the maxillary lateral incisors. Although dens invaginatus is not common, there can be severe difficulties related to tooth anatomy during endodontic treatment[15,35]; therefore, an orthodontist should be aware of this dental anomaly in making decisions about extractions. On the other hand, dental invagination is not considered a risk factor for apical root resorption during orthodontic tooth movement, although invaginated

Table IV. Distribution of dental anomalies in anterior and posterior regions

	Maxillary anterior (3-3)		*Mandibular anterior (3-3)*		*Maxillary premolar*		*Mandibular premolar*		*Maxillary molar*		*Mandibular molar*	
Anomaly	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Agenesis	23	2.6	2	0.2	18	2.0	13	1.5	141	15.7	115	12.8
Dens invaginatus	45	5.0	—	—	—	—	—	—	—	—	—	—
Dens evaginatus	56	6.2	—	—	—	—	—	—	—	—	—	—
Impaction	17	1.8	—	—	3	0.3	7	0.7	1	0.1	1	0.1
Taurodontism	—	—	—	—	—	—	—	—	6	0.6	3	0.3
Pulp stone	7	0.7	3	0.3	4	0.4	8	0.9	32	3.6	12	1.3
Microdontia	—	—	—	—	—	—	—	—	6	0.7	—	—
Dilaceration	4	0.4	1	0.1	21	2.33	0.3	—	—	—	—	—
Enamel hypoplasia	4	0.4	—	—	—	—	—	—	—	—	—	—
Short or blunt roots	—	—	—	—	2	0.2	1	0.1	4	0.4	4	0.4
Supernumerary teeth	3	0.3	—	—	—	—	—	—	—	—	—	—
Ectopic eruption	5	0.5	—	—	—	—	—	—	—	—	—	—

3-3, Canine to canine.

teeth have malformed roots more often than noninvaginated teeth.[36]

Dens evaginatus occurs most commonly in people of Mongoloid origin, with an average incidence of 2.2%,[9,37] and a higher prevelance in the maxillary incisors was reported.[26] We found a higher prevalence (6.2%) of dens evaginatus in white orthodontic patients, most frequently in the maxillary canines. Early diagnosis of dens evaginatus is important so that loss of vitality during orthodontic therapy can be prevented, and treatment alternatives can be considered—ie, esthetic restorations or a full crown, with or without root canal therapy.[38] In the orthodontic treatment plan, extraction of a tooth involving dens evaginatus might be considered so that the anomalous tooth, rather than an unaffected one, is extracted.

Impaction was found in 2.9% of the total study sample, and the most frequently impacted tooth was the maxillary right canine. Impaction was observed more frequently in the maxilla than in the mandible. According to the literature, impacted permanent maxillary canines occur in 1% to 3% of the population.[4,39] Statistically significant differences in impaction rates were observed between malocclusion groups, with the Class II and Class II Division 2 groups having the lowest rates. However, Basdra et al[4] reported a high rate in impacted canines (33.5%) in 267 subjects with Class II Division 2 malocclusion. Malocclusions show great variability; this might explain the different results, and low numbers of subjects might be another factor. Two main theories have been suggested to explain impaction: the guidance and the genetic theories.[40] The guidance theory is based on local predisposing causes that interfere with the path of eruption when labial impaction is related to space requirements, whereas the genetic theory considers a genetic cause for impaction, such as palatally impacted maxillary canines. Impacted maxillary canines often appear with other dental abnormalities that were reported to be linked genetically,[41,42] and the associated dental features such as aplasia and small lateral incisors allow the clinician to make an early diagnosis of the eruption disturbance.[40,43]

The prevalence of taurodontism was found to be 1.0% in the total study sample, observed only in the maxillary and mandibular molar regions. Darwazeh et al[18] found a higher rate of 8.0% in Jordanian dental patients and in 4.4% of the teeth examined, and the maxillary second molar was the most commonly affected tooth. Different results might be related to racial variations.

We found pulp stones in 4.2% of our subjects; this was not statistically different among the malocclusion groups. Hamasha and Darwazeh[19] described the prevalence of pulp stones in a sample of 814 dental patients and reported it to be 22% of the teeth examined. Pulp stone incidence was not significantly different in different age and sex groups; the first and second molars were most commonly affected, a similar finding to this study. Subay et al[44] investigated histologically the dental pulp tissue of 2 extrusive force applications and showed large and numerous pulp stones in the serial sections (17.5% of all subjects), although they concluded that extrusive forces did not cause significant pathologic changes in pulp tissue, and a correlation between pulp stones and orthodontic force application was not evident. However, a pulp stone is a small mineralized structure that can be located in the pulp

canal or chamber and might complicate endodontic therapy.

Microdontia was observed in 0.7% of the total study sample and only in female subjects, although its prevalence was previously reported to be 1.5% to 2%.[20]

Recent studies support the view that dilaceration might be a true developmental anomaly that is not related to trauma.[15] Diagnosing dilaceration is particularly important during root canal treatment, extraction, and orthodontic movement.[8] In our study, dilaceration was observed in 3.2% of all subjects, with the highest frequency in the Class III patients. In an earlier study, Thongudomporn and Freer[8] reported root dilaceration in 1.8% of 111 orthodontic patients, and Hamasha et al[15] observed dilacerations in 3.78% of 4655 teeth examined from 814 dental records.

Enamel hypoplasia was observed only in the maxillary anterior region, and the highest rate was in the Class I and Class II groups; this might be related to the higher numbers of subjects when compared with the other groups.

Short or blunt roots were observed in 1.2% of all orthodontic patients; this is close to the findings of previous studies, between 1% and 10%.[22] The highest rate was observed in the Class II Division 2 group (3.9%), clinically a significant finding. It was reported that patients with short or blunt roots before treatment underwent significant root shortening during orthodontic treatment, and patients with a dental anomaly had a significantly greaer root resorption than did patients with no dental anomaly.[45] It was also reported that intrusion of teeth for deepbite correction causes about 4 times more root resorption than extrusion,[46] and Class II Division 2 patients were reported to have significantly reduced tooth sizes[28]; this should also be considered carefully in orthodontic force application in patients with these malocclusions.

Supernumerary teeth were observed in 0.3% and ectopic eruption in 0.6% of the total study sample; both occurred only in the maxillary anterior region. Hyperdontia ranges from 0.1% to 3.8% in various populations[47] and was reported to be 1% to 3% in white people.[48] The most common site of supernumerary teeth is the maxillary anterior region, and the incidence of malocclusion among children with hyperdontia was reported to be 83.3%.[49] The prevalence of ectopic eruption was reported to vary according to race and region.[24,25,50,51]

Associations between various tooth anomalies have been reported to be clinically relevant, and early diagnosis of an anomaly might indicate an increased risk for others.[22,43] Therefore, orthodontic diagnosis and treatment planning should be made precisely, including extraction of an anomalous tooth rather than a normal one in the case of arch-length inadequacy. We found significant rates of dental anomalies in orthodontic patients, whereas the literature shows different rates of dental anomalies in orthodontic patients that might be associated with the great variability of each malocclusion, environmental factors, genetic influences, different definitions of dental anomalies, sample differences, and individual variations.

CONCLUSIONS

1. Significant numbers of orthodontic patients had at least 1 dental anomaly (40.3%).
2. Except for impaction, which had a significantly lower rate in Class II and Class II Division 2 patients, and short or blunt roots, which had the highest frequency in Class II Division 2, there were no statistically significant associations between dental anomalies and orthodontic malocclusion groups.
3. Dental anomalies can be detected easily by a careful inspection of routine orthodontic diagnostic records, and their management should be considered in treatment planning.

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