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# Prevalence and Distribution of Dental Anomalies in Patients Aged 6–40 Years: A Retrospective Radiographic Study

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## Abstract

***Background:*** This study aimed to retrospectively evaluate the distribution of dental anomaly groups in pediatric and orthodontic patients using panoramic radiographs and to determine their frequency of occurrence.

***Methods:*** The study included panoramic radiographs from non-syndromic patients aged between 6 and 40 years who presented to the orthodontic and pediatric dentistry clinics. Patients with a history of traumatic injury, syndromic patients, patients with no clear radiographic image, patients with previous orthodontic treatment and extracted teeth, and third molars with a wide range of morphological and positional variations were excluded. Dental anomalies were evaluated according to the following criteria: number, size, structure, position, and shape.

***Results:*** A total of 1084 panoramic radiographs fulfilling the inclusion criteria were analyzed. The prevalence of anomalies was found to be 14.72%. While 47.2% of the patients with anomalies were male, 52.8% were female. The most common anomaly observed was positional anomalies, and the most common anomaly subgroup was found to be impacted teeth. Following positional anomalies, the most common anomaly was numerical anomalies, and hypodontia was found to be the most common anomaly in the numerical anomaly subgroup.

***Conclusion:*** These findings emphasize the importance of early and regular radiographic screening of pediatric and orthodontic patients to identify developmental abnormalities, such as impacted teeth and hypodontia, which might otherwise go unnoticed. Early diagnosis can guide timely orthodontic or surgical interventions, potentially reducing the complexity of future treatment.

***Keywords:*** Orthodontics, pediatric dentistry, prevalence, retrospective studies, tooth abnormalities

### What is already known on this topic?

- *Dental anomalies are relatively common in children and adolescents.*
- *They can negatively affect occlusion, eruption patterns, and orthodontic treatment planning.*
- *The reported prevalence of dental anomalies varies by population and diagnostic method.*

### What this study adds on this topic?

- *Provides updated prevalence data from a large pediatric and orthodontic patient sample.*
- *Highlights the distribution and frequency of specific anomalies such as impacted teeth, hypodontia, and supernumerary teeth.*
- *Emphasizes the importance of early radiographic diagnosis for effective clinical management.*

## INTRODUCTION

Dental anomalies are a common congenital malformation that may manifest as isolated findings or as part of a syndrome.[1] Dental anomalies can be classified according to a number of criteria, including size, shape, number, structure, and the presence of eruption or exfoliation alterations.[2] A number of factors, both local and systemic, may be responsible for these developmental anomalies. Such influences may begin at any point prior to or following birth and may therefore affect deciduous or permanent teeth.[3] This condition can manifest in both the deciduous and permanent dentition

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periods and is characterized by a localized anomaly affecting a single tooth or multiple teeth. It is not uncommon for more than 1 dental anomaly to be observed in the same patient.[4] The genetic basis for dental anomalies has been well demonstrated by a polygenic model of inheritance. The discontinuous distributions of tooth morphology and agenesis are illuminated by the polygenic nature of these traits. Such traits may manifest as phenotypic discontinuity at the end of a constant distribution.[5]

Dental anomalies may manifest as isolated lesions or as part of a syndrome, and may be of minor or major clinical significance. In the majority of cases, these lesions are asymptomatic and can be identified fortuitously on radiography.[6] A comprehensive examination of dental anomalies is imperative for the prevention of malocclusion, cosmetic deformities, periodontal issues, dental caries, and complications during tooth extraction and root canal treatment. In addition to clinical examinations, radiographic observations are of significant value in the differential diagnosis of these anomalies.[7] It has been documented that the prevalence of dental caries is considerably higher in pediatric patients with dental anomalies in both primary and permanent dentition. This is attributed to an elevated plaque formation rate and a deficiency in oral hygiene, which are observed in these patients compared to those without anomalies.[8,9]

Variations in tooth number, size, and shape are especially important to identify in pediatric and orthodontic patients, as these anomalies typically manifest during the formative years of dental development. Identifying such anomalies early on not only allows for timely and appropriate intervention but also plays a pivotal role in guiding normal craniofacial and occlusal development. If left undiagnosed or untreated in young patients, these anomalies can lead to more severe malocclusions, aesthetic concerns, speech problems, and functional limitations later in life. Early diagnosis enables clinicians to implement preventive and interceptive strategies, thereby minimizing the need for complex or invasive procedures in the future. Therefore, systematic screening for and awareness of dental anomalies during childhood and adolescence are essential components of comprehensive pediatric and orthodontic care, ultimately improving long-term oral health outcomes and quality of life.[10,11]

There are many studies investigating the prevalence of dental anomalies in children from different populations.[4,6,12-15] However, few have specifically focused on patients receiving orthodontic or pediatric dental care, who often present with distinct diagnostic and treatment needs. In light of this information, the aim of this study was to determine the frequency, distribution, and type of dental anomalies in patients who applied to Tekirdağ Namık Kemal University Oral and Dental Health Application and Research Centre Orthodontics and Pediatric Dentistry Clinics.

## MATERIAL AND METHODS

Approval was obtained from the Tekirdağ Namık Kemal University Non-Interventional Clinical Research Ethics Committee in accordance with the Principles of the Declaration of Helsinki, as set out in the decision dated May 30, 2023, numbered 2023.107.05.26, before starting the study. The study retrospectively evaluated panoramic radiographs taken during examinations of patients aged 6-40 who applied to the Oral and Dental Health Application and Research Centre at Tekirdağ Namık Kemal Faculty of Dentistry's Pediatric Dentistry and Orthodontics departments between 2021 and 2023, in terms of dental anomalies. The age range was determined to include pediatric and orthodontic patients. Informed consent forms were obtained from all patients, as well as from all participants under the age of 18. However, no additional consent was required due to the retrospective nature of the study.

Patients with a history of traumatic injury, syndromes, unclear radiographic images, previous orthodontic treatment, extracted teeth, or third molars with wide-ranging morphological and positional variations were excluded from the study. Dental anomalies were evaluated based on the number, size, structure, position, and shape of the anomalies. Dental anomalies were categorized and evaluated as shown in the table (Table 1).

All panoramic radiographs were taken using a single device (Carestream CS 8100 SC 4th generation digital panoramic cephalometric x-ray system, Carestream Dental LLC, Atlanta, GA, USA). The data obtained from the evaluated radiographs were recorded in an Excel table. This table included information on the patient's gender and age, the type of anomaly, the tooth numbers where the anomaly was seen, jaw information, and other anomaly types and relevant tooth numbers in the same patient, if applicable. Following a 1-month interval, 250 panoramic radiographs were randomly selected and re-evaluated.

In this study, the sample size was calculated to determine the prevalence of dental anomalies among pedodontics and orthodontics patients aged 6-40 years. The mean prevalence was determined as $P = .1779$ (17.79%) based on 3 different prevalence values reported in the literature (10%, 18.67%, and 24.7%).[6,22,23] The sample size was found to be a minimum of 789 individuals based on a prevalence of 17.79%, assuming a of 95% CI and a relative error margin of 15%. However, a total of 1084 individuals were included in the study to increase statistical power, enable the detection of rare dental anomalies, and allow for subgroup analyses.

Data were analyzed using the IBM SPSS V23 program. The distribution of anomaly types according to gender and age groups was examined using Fisher's exact test with Monte

**Table 1. Dental Anomalies Types and Subtypes**

| Dental Anomalies | |
|---|---|
| Shape anomalies | **Taurodontism**, a tooth morphology with an enlarged pulp chamber, apically displaced furcation, and no cervical constriction.[16]<br>**Dens invaginatus**, a tooth anomaly caused by enamel invagination before calcification, leading to a deep groove or pocket in the crown.[17]<br>**Peg-shaped lateral** is an undersized, tapered, maxillary, small, lateral incisor.[16]<br>**Gemination** determined as twin teeth, twin formations, joined teeth, fused teeth or dental twinning is commonly seen in the maxillary anterior area.[18]<br>**Root dilaceration** defined as a deviation or bend in the linear relationship of a tooth to its root.[19] |
| Size anomalies | **Microdontia**, teeth smaller than normal.<br>**Macrodontia**, enlargement of the teeth compare to normal.[16] |
| Number anomalies | **Hypodontia**, or tooth agenesis, corresponds to the absence of 1 or more teeth during the developmental stage.[20]<br>**Oligodontia** is defined as the congenital absence of 6 or more permanent teeth, excluding third molars.[16]<br>**Mesiodens** is a supernumerary tooth located in the midline between the 2 maxillary central incisors.[21]<br>**Supernumerary teeth** that appear in addition to the regular number of teeth.[14] |
| Position anomalies | **Impacted teeth** are teeth that do not erupt properly into the mouth due to obstruction or lack of space.[16]<br>**Ectopic eruption**, eruption of a tooth in an abnormal position.[14]<br>**Transposition** is a dental anomaly where 2 adjacent teeth exchange their normal positions in the dental arch.[4] |

Carlo correction. Pairwise comparisons were performed using a Bonferroni-corrected Z-test. The results of the analyses were presented as a frequency (percentage) for categorical variables and as a mean ± standard deviation or a median (minimum-maximum) for quantitative variables. Intra-rater agreement was assessed using Cohen's Kappa coefficient. The significance level was set at $P < .05$.

## RESULTS

A total of 1675 panoramic radiographs taken between 2021 and 2023 were analyzed, with 1084 being included in the study. Dental anomalies were identified in 159 of the 1084 panoramic radiographs analyzed (14.7%). Of these patients, 52.8% were female and 47.2% were male. The mean age of patients with dental anomalies was found to be 18.48 years (Table 2).

When the distribution of dental anomalies was analyzed according to the number of patients and teeth, the anomaly group with the highest prevalence was found to be position anomaly (7.29%). Within the position anomaly subgroup, the anomaly with the highest prevalence was impacted tooth (7.01%). The second most prevalent anomaly group was number anomaly (6.93%), with hypodontia (3.97%) being the most prevalent subgroup. A total of 307 anomalies were found in teeth (Table 3).

**Table 2. Analysis of Data by Gender and Age**

| | Frequency | |
|---|---|---|
| | n | % |
| Male | 75 | 47.2 |
| Female | 84 | 52.8 |
| Total | 159 | 100 |
| Age | **Mean ± SD** | **Median (min-max)** |
| | 18.48 ± 8.14 | 16 (6-41) |

SD, standard deviation.

A statistically significant difference ($P = .023$) was observed in the distribution of anomaly groups according to gender. While the shape anomaly rate was 12% in men, it was 25% in women. The group that showed a gender-based difference in anomaly groups was shape anomaly (Table 4).

Of the 159 patients, 12.4% had 1 dental anomaly, 2.1% had 2, and 0.2% had 3. There was no statistically significant difference between these groups according to gender ($P = .713$). The distribution of anomalies across all cases also showed no statistically significant difference ($P = .933$). The

**Table 3. Prevalence and Frequency of Dental Anomaly Types and Subtypes by Number of Patients and Teeth**

| Types and Subtypes of Anomalies | Number of Patients | | Number of Teeth | | Prevelance |
|---|---|---|---|---|---|
| | n | % | n | % | (%) |
| Shape anomalies | 30 | 18.9 | 37 | 12.1 | 2.77 |
| Taurodontism | 1 | 0.6 | 2 | 0.7 | 0.1 |
| Dens Invaginatus | 1 | 0.6 | 1 | 0.3 | 0.1 |
| Peg-shaped lateral | 22 | 13.8 | 27 | 8.8 | 2.03 |
| Gemination | 1 | 0.6 | 1 | 0.3 | 0.1 |
| Root dilaceration | 5 | 3.1 | 6 | 2 | 0.46 |
| Size anomalies | 3 | 1.9 | 4 | 1.3 | 0.28 |
| Microdontia | 1 | 0.6 | 3 | 1 | 0.1 |
| Macrodontia | 2 | 1.3 | 1 | 0.3 | 0.18 |
| Number anomalies | 74 | 46.5 | 166 | 54.1 | 6.83 |
| Hypodontia | 43 | 27.0 | 78 | 25.4 | 3.97 |
| Oligodontia | 4 | 2.5 | 51 | 16.6 | 0.37 |
| Mesiodens | 11 | 6.9 | 12 | 3.9 | 1.01 |
| Supernumerary teeth | 16 | 10.1 | 25 | 8.1 | 1.48 |
| Position anomalies | 79 | 49.7 | 100 | 32.6 | 7.29 |
| Impacted teeth | 76 | 47.8 | 97 | 31.6 | 7.01 |
| Ectopic eruption | 1 | 0.6 | 1 | 0.3 | 0.1 |
| Transposition | 2 | 1.3 | 2 | 0.7 | 0.18 |
| Total | 159 | 100 | 307 | 100 | 14.67 |

**Table 4. Distribution of Dental Anomaly Types by Gender**

| Dental Anomalies | Male n (%) | Female n (%) | Total n (%) | P* |
|---|---|---|---|---|
| Size anomaly | 3 (4) | 0 (0) | 3 (1.9) | .023 |
| Position anomaly | 33 (44) | 45 (53.6) | 78 (49.1) | |
| Number anomaly | 39 (52) | 34 (40.5) | 73 (45.9) | |
| Shape anomaly | 9 (12)[a] | 21 (25)[b] | 30 (18.9) | |

a-b: There is no difference between groups with the same letter.
*Pearson Chi-square test.
~Multiple response;.

**Table 5. Distribution of Dental Anomaly Groups by Gender**

| Dental Anomaly Group | Male | Female | Total | P |
|---|---|---|---|---|
| No dental anomaly | 433 (85.2) | 492 (85.4) | 925 (85.3) | .713* |
| 1 dental anomaly | 65 (12.8) | 69 (12) | 134 (12.4) | |
| 2 dental anomalies | 10 (2) | 13 (2.3) | 23 (2.1) | |
| 3 dental anomalies | 0 (0) | 2 (0.3) | 2 (0.2) | |
| Total | 75 (14.8) | 84 (14.6) | 159 (14.7) | .933** |

*Fisher's exact test with Monte Carlo correction.
**Pearson Chi-square test; frequency (percentage).

rate of anomalies was 14.8% in males and 14.6% in females (Table 5).

Examining the anomalies on the right and left sides of the upper and lower jaws reveals that the most common anomaly in the maxilla on the right side is an impacted tooth, followed by hypodontia and the peg lateral type. In the maxilla, the most common anomaly on the left side was an impacted tooth, followed by a peg-shaped lateral incisor and hypodontia. In the mandible, hypodontia was the most common anomaly on the right side, followed by impacted and permanent teeth. On the left side of the mandible, hypodontia was the most common type of anomaly, followed by carious and impacted teeth (Figure 1).

When the number of teeth with anomalies was evaluated according to age group, a statistically significant difference was observed. The types of anomaly for which differences were seen according to age group were ectopia, hypodontia, mesiodens, and oligodontia (Table 6). The Cohen's Kappa coefficient was calculated as 0.934. A statistically significant and excellent level of agreement was obtained between the 2 evaluations.

## DISCUSSION

In the present study, the prevalence of dental anomalies was examined in relation to age, gender, and other anomalies in pediatric and orthodontic patients. The prevalence of dental anomalies was found to be 14.7%. The prevalence of dental anomalies reported in the literature ranges from 1.8% to 64.1%.[6,13-15,20,22-27] These differences in prevalence may be due to racial differences and genetic and environmental factors within population groups, as well as differences in sample size.

When similar studies involving the Thrace region are examined, a study evaluating individuals aged 6-15 years found the prevalence of dental anomalies to be 10%, while another study evaluating individuals aged 12-60 years found the prevalence to be 5.2%.[22,28] Although the populations were similar, the slightly higher rate in the study may be because the age range was set at 6-40 years, covering both pediatric and orthodontic patients. As orthodontic patients have a higher prevalence of dental anomalies associated with various malocclusions, including these patients in the study

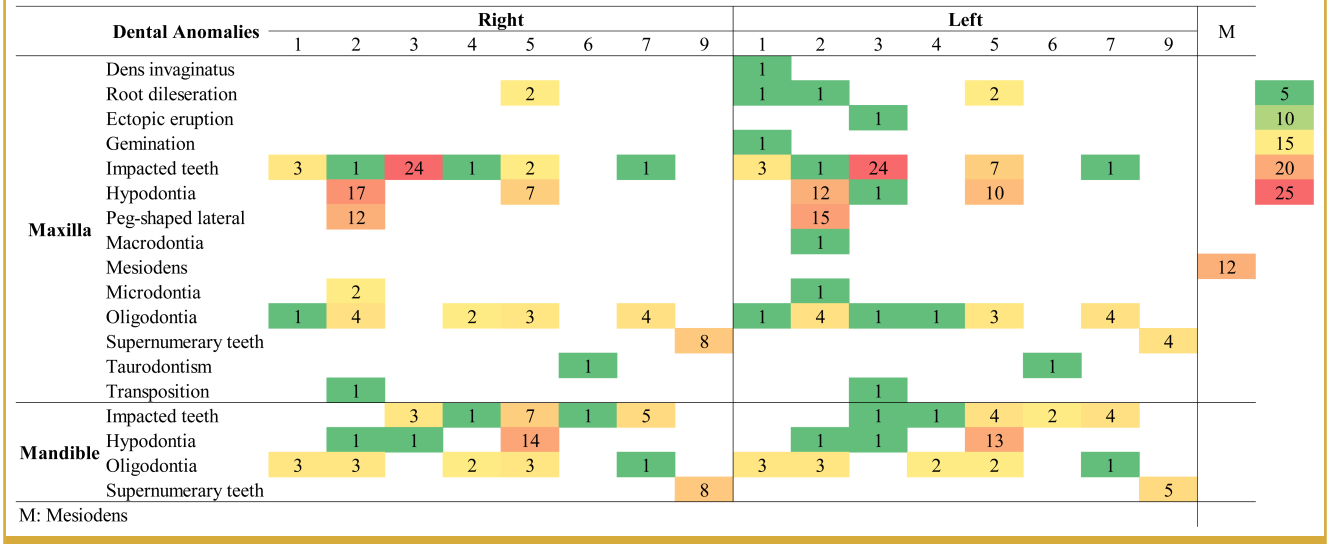


Figure 1. Distribution of dental anomalies in maxilla and mandible.

**Table 6. Distribution of Dental Anomalies According to Age Groups**

| | 6–10 Years | 11–20 Years | 21–30 Years | 31–40 Years | *P** | |
|---|---|---|---|---|---|---|
| Dental anomalies | 0 | 0 | 0 | 0 | **<.001** | |
| Dens invaginatus | 0 | 1 | 0 | 0 | | 10 |
| Root dilaceration | 0 | 3 | 0 | 3 | | 20 |
| Ectopic eruption | 1[a] | 0[b] | 0[ab] | 0[ab] | | 30 |
| Gemination | 0 | 1 | 0 | 0 | | 40 |
| Impacted teeth | 4 | 69 | 15 | 9 | | 50 |
| Hypodontia | 12[a] | 40[b] | 14[ab] | 12[ab] | | 60 |
| Peg-shaped lateral | 1 | 15 | 5 | 6 | | 70 |
| Macrodontia | | 1 | | | | |
| Mesiodens | 5[a] | 7[b] | 0[b] | 0[ab] | | |
| Microdontia | 2[a] | 1[b] | 0[ab] | 0[ab] | | |
| Oligodontia | 0[ab] | 40[b] | 11[ab] | 0[a] | | |
| Supernumerary teeth | 0 | 14 | 10 | 1 | | |
| Taurodontism | 0 | 0 | 2 | 0 | | |
| Transposition | 0 | 2 | 0 | 0 | | |

* Fisher's exact test with Monte Carlo correction.
**Pearson Chi-square test; frequency (percentage).

increased the overall prevalence, as was seen in previous studies.[29,30]

Studies examining types of dental anomalies generally determined that position and number anomalies were prevalent, with hypodontia and impacted tooth subtypes being particularly common.[4,23,28,31,32] In this study, the most frequently observed were position anomalies, and the impacted tooth subtype was found to be at the highest rate. These findings are consistent with those of AlHudaithi et al[20], and Ku et al.[33] In the country, the impacted tooth subtype was detected at the highest rate in the study of Bilge et al[34] in the Eastern Anatolia region. Another study of the Thrace region produced similar results to this study. The most common finding was impacted teeth (position anomaly), followed by hypodontia (number anomaly).[28]

Examining the relationship between dental anomaly types and gender revealed no significant correlation; the anomaly rate was 14.6% in women and 14.8% in men, a difference that was not statistically significant ($P=.933$). However, shape anomalies in particular were reported at a significantly higher rate in female individuals (25%) compared to male individuals (12%) ($P=.023$). This result suggests that some dental anomalies may be related to gender. Another study found no significant relationship between other anomaly types and gender. However, it was found that the talon tubercle, a subtype of shape anomaly, was significantly more common in women than in men.[35] Pallikari et al,[6] found a significant difference in the distribution of dental anomalies according to gender. This situation points to contradictory results arising from differences in factors such as the sample group, age range, and ethnicity of the studies. Therefore, while gender may be a contributing factor in some types of dental anomaly, it is not the sole determining factor in terms of general prevalence.

Most patients had only 1 dental anomaly. Three dental anomalies were seen in only 2 female patients. These findings are similar to the study by Pallikari et al.[6] Both studies indicate that it is unlikely that more than 2 types of dental anomaly will occur simultaneously in the same patient.

Examining the distribution of dental anomalies in the maxilla and mandible reveals that the right and left canines are the most commonly impacted teeth in the upper jaw. Meanwhile, the right upper lateral incisors are the teeth most commonly missing in cases of hypodontia, the second most common dental anomaly. Dindar ve Atay,[28] consistent with the study, found that the most impacted tooth was the maxillary canine and the most missing tooth was the maxillary lateral. Fernandez et al,[31] Aldhorae et al,[30] and Pallikaraki et al[6] identified the upper left canine as the most common impacted tooth. In addition, Fernandez et al[31] reported the upper right lateral incisors as the most commonly missing teeth, while Pallikaraki et al[6] found that the most commonly missing teeth were the mandibular first premolars and maxillary premolars.

A study of pediatric patients in Australia found that tooth absence was the most common anomaly. Mandibular premolars were the most affected (42.0%), followed by upper lateral incisors (27.5%).[26] Özveren and Atay[22] reported that second premolars and lateral teeth were the most common missing teeth in the maxilla and second premolars in the mandible. The difference in the types of anomalies and teeth observed in the studies may be due to variations in age range and population, as well as the inclusion or exclusion of orthodontic patients. In studies conducted with a younger age range, some teeth could not be identified as impacted due to the tooth eruption process.[22,23] Studies involving orthodontic patients generally found a high rate of impacted teeth.[29-31]

When the distribution of dental anomalies is examined according to age groups, it is seen that the anomalies are most numerous in the 11-20 age group. This situation can be related to the fact that the study includes orthodontic patients. Orthodontic treatments are usually started in the late mixed or early permanent dentition period. Since this stage coincides with the maximum growth period, it is very important in the orthodontic treatment of skeletal and dental problems that benefit from growth. Therefore, it can be said that the recognition of various orthodontic anomalies such as crowding, impacted or missing teeth, and skeletal problems, as well as the application to the orthodontics department, are mostly in this age range.

In a study evaluating dental anomalies in orthodontic patients aged 8-30, the patients were divided into 2 groups: those aged 8-10 and over 10 years old, and it was determined that dental anomaly types were higher in those over 10 years old.[32] These findings are consistent with those of the study. In this study, dental anomalies were predominantly distributed among the 11-20 and 21-30 age groups.

This radiological retrospective study has several limitations that may affect the generalizability and accuracy of the findings. Since the data were collected from a single geographic region, the results may not reflect the prevalence of dental anomalies in broader populations, limiting their external validity. The retrospective nature of the study restricts control over data quality, and potential selection bias may arise as the sample likely consists of patients seeking dental care, which could overestimate anomaly prevalence.

To improve generalizability and explore regional differences in the prevalence of dental anomalies, future studies should involve larger, multicenter populations. Using advanced imaging methods, such as cone-beam computed tomography, and adopting prospective study designs could enhance diagnostic accuracy and improve the understanding of anomaly progression.

## CONCLUSION

The present study evaluated the prevalence and distribution of dental anomalies in pediatric and orthodontic patients, and their relationship with demographic factors. The prevalence of dental anomalies was found to be 14.7%, with impacted teeth, categorized as position anomalies, being the most prevalent type of anomaly. Hypodontia was the second most prevalent anomaly, with maxillary lateral incisors and mandibular second premolars being among the teeth most frequently absent. While gender did not demonstrate a significant effect on the overall prevalence, shape anomalies were found to be significantly higher in females. The age group with the highest prevalence of anomalies was 11-20 years old, which supports the finding that orthodontic visits frequently occur during this period. The findings indicate that there may be significant differences in the distribution of dental anomalies according to population characteristics, age group, and treatment needs; therefore, regional studies are important for early diagnosis and treatment planning.

**Data Availability Statement:** The data that support the findings of this study are available on request from the corresponding author.

**Ethics Committee Approval:** This work was approved by the Ethics Committee of Tekirdağ Namık Kemal University, with the approval number 2023.107.05.26 and date May 30, 2023.

**Informed Consent:** Written informed consent was obtained from all patients who participated in this study.

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