PRESENCE, DISTRIBUTION, AND ASSOCIATION OF DENTAL ANOMALIES: A CLINICAL AND RADIOGRAPHICAL STUDY

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ABSTRACT

Background and Aim: Dental anomalies can cause several oral problems. The objectives of this study were to investigate the distribution of dental anomalies and identify the association among these anomalies in a Turkish population.

Material and Method: The study included 1100 persons who visited the Faculty of Dentistry. The subjects were examined clinically and radiographically for dental anomalies by one observer. Descriptive statistics and chi-square test was used to evaluate for statistical assessment.

Result: In total, 34,169 teeth were examined. Five hundred (45.7%) subjects had at least one dental anomaly, 118 (10.7%) had more than one anomaly, and 482 (43.6%) had no dental anomaly. The percentage of dental anomalies was 56.4. The anomalies were statistically independent of gender (P=0.086). Impaction (26.2%) was the most common dental anomaly. Macrodontia and concrescence were not identified. Significant relationships were noted between the presence of agenesis and the presence of microdontia (P=0.008), supernumerary teeth (P=0.03), and impaction (P=0.01). Further, the presence of taurodontism and presence of dilaceration were significantly correlated (P=0.00).

Conclusion: The percentage of impaction, microdontia, and amelogenesis imperfecta dilacerations, and taurodontism were different in this sample than in the previously studied populations, possibly because of racial differences. Furthermore, diminishing the arch size may contribute to higher frequency of impaction. This finding may be the sign of dietary characteristics of present population. The correlation analysis indicates that some dental anomalies may have common genetic bases and/or developmental processes.

Key words: Dental Anomalies, Epidemiology

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INTRODUCTION

Dental anomalies are caused by both genetic and environmental factors, and researchers have recognized a growing number of genes associated with early tooth morphogenesis. These anomalies may occur in combination with other anomalies and some of them, such as taurodontism, are even considered markers of underlying genetic diseases. Detailed investigation of dental anomalies is essential to prevent malocclusion, cosmetic deformities, periodontal problems, caries, and difficulties during tooth extraction and root canal treatment. In addition to clinical examinations, radiographic observations play an important role in the differential diagnoses of these anomalies.

Although many reports presented the frequencies of various dental anomalies, their methodologies were different, yielding conflicting results. In some studies, the prevalence of dental anomalies was investigated in only children, orthodontic patients, persons with cleft lip and/or cleft palate, or those with syndromes. Some researchers reported the prevalence of only one dental anomaly, whereas others presented the prevalence of different dental anomalies. In a few studies, the prevalence was determined only radiographically, whereas in others, both clinical and radiographic examinations were used. The wide variation in the reported prevalence may be explained by the differences in the cohorts and races, identification criteria and methods, and sampling techniques in these studies. The detection of several anomalies such as dilacerations, dens invaginatus, impaction and taurodontism cannot possible without radiographic examination. Therefore, in researches of dental anomalies, radiographic examination is indispensable. In some cases, dental anomalies such as dilaceration, dens invaginatus, talon cusp, taurodontism, impacted teeth, macrodontia, gemination, and fusion were not included in the analysis. In the studies that covered different dental anomalies, the associations among these anomalies were not analyzed. Identification of the associations among dental anomalies may provide new information about their etiologies and genetic bases. The aims of this study were to analyze the distribution of dental anomalies and identify the association among these anomalies in a Turkish population.

SUBJECTS AND METHODS

Between October and December 2010, 1,100 (552 male and 548 female) persons who visited the Faculty of Dentistry of Selçuk University (Konya, Turkey) for dental checkups were examined clinically and radiographically at the Department of Oral Radiology. Their mean age was 23.64 years (age range, 13-63 years). Panoramic radiographs were taken by the same technician with the same equipment (Kodak 8000 with a CCD sensor) and standardized method (67 kV, 5.0 mA, 13.9 s); further, the same clinician (SS), with 12 years of professional experience in oral diagnosis and radiology, interpreted the direct digital panoramic radiographs and performed the clinical examinations, thus eliminating interexaminer differences. Data were saved as jpeg format and any enhancement and compression methods were not used in this study. Digital images were observed on a notebook computer (Toshiba Satellite A-200 1AH) without any magnification.

The persons older than 13 years who attended to oral diagnosis clinic for clinical examination for oral and dental problems were included to the study. The persons younger than 13 years and those with syndromes, cleft lip and/or palate, extracted permanent teeth, prosthodontic treatment, large tooth restorations preventing observation of the crown morphology, incompletely formed roots, or unqualified panoramic images were excluded from the study. The following dental anomalies were analyzed according to the descriptions by White and Pharoah: agenesis, dens invaginatus, talon cusp, impaction, taurodontism, microdontia, macrodontia, dilaceration, supernumerary teeth, fusion, gemination, concrescence, and amelogenesis imperfecta. Mesial and distal dilacerations was measured by a computer program (AutoCAD) developed in the Department of Computer Engineering of Selçuk University (Figure 1). A tooth was recognized as having mesial or distal root dilacerations if there was deviation of 90˚ or more (Figure 2). Dilaceration towards the buccal or lingual were determined by evaluating the appearance of apical portion of root. If there was a round opaque area with a dark shadow in its central region cast by the apical foramen and the root canal gave a “bull’s eye” appearance, a dilacerations was recorded. The periodontal ligament space around the dilacerated portion appeared as a radiolucent halo. Multirooted roots were counted as one case of dilaceration. Figures 3-11 represent the examples of some anomalies in this population.
Figure 1. Measurement of dilacerations by computer program.

Figure 2. A tooth was recognized as having mesial or distal root dilacerations if there was deviation of 90° or more.

Figure 3. A case of bilateral maxillary lateral agenesis.

Figure 4. An example of type 3 dens invaginatus in left maxillary lateral incisor.

Figure 5. Palatinal aspect of bilateral talon cusps on bilateral geminated maxillary central incisors.
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Statistical analysis was performed with SPSS version 13.0 for Windows (SPSS, Inc., Chicago, IL, USA). Descriptive statistics were used to determine the frequencies. The chi-square test was used to evaluate the gender difference in these anomalies and the correlations between different anomalies. A p value of <0.05 was considered statistically significant.

Ethical approval was taken by Ethical Comity of Dentistry Faculty of Selçuk University (Ref no: 2011/1).
RESULTS

In total, 34,169 teeth were examined in 1100 subjects. The mean total number of teeth was 31.06 (range, 10–32 teeth). Five hundred (45.7%) subjects had at least one dental anomaly, 118 (10.7%) had more than one anomaly, and 482 (43.6%) had no dental anomaly. The percentage of dental anomalies was 56.4. Table 1 shows the overall distributions of the examined dental anomalies. The dental anomalies were statistically independent of gender (P=0.086, chi-square test).

The patients were classified into 13-20 years (group 1), 20-30 years (group 2), 30-40 years (group 3), 40-50 years (group 4) and 50 and over years (group 5). The frequencies of groups were 310 patients (28.2%), 598 patients (54.4%), 130 (11.8%), 48 (4.4%) and 13 (1.2%) respectively. A significant relationship was found between the presence of at least one anomaly and age groups (P=0.000).

Six subjects had bilateral dens invaginatus, and 11 had unilateral dens invaginatus. Of 23 teeth with dens invaginatus, 21 and 2 cases were classified as type 1 and type 3 invaginations, respectively; these teeth had normal crown anatomy and conic (peg-shaped) crowns, respectively. No significant relationship was noted between the crown shape and the presence of dens invaginatus (P=0.216).

Table 1. Overall distributions of the examined dental anomalies in the present study. (M: male, F: female)

<table>
<thead>
<tr>
<th>Anomaly</th>
<th>M (n=552)</th>
<th>F (n=548)</th>
<th>M+F (n=1100)</th>
<th>prevalence in total teeth number</th>
<th>most affected tooth/region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>p</td>
</tr>
<tr>
<td>Impaction</td>
<td>208</td>
<td>38</td>
<td>232</td>
<td>42.3</td>
<td>0.157</td>
</tr>
<tr>
<td>Agenesis</td>
<td>80</td>
<td>14.4</td>
<td>74</td>
<td>13.5</td>
<td>0.514</td>
</tr>
<tr>
<td>Microdontia</td>
<td>26</td>
<td>4.7</td>
<td>32</td>
<td>5.8</td>
<td>0.273</td>
</tr>
<tr>
<td>Talon cusp</td>
<td>13</td>
<td>2.35</td>
<td>21</td>
<td>3.83</td>
<td>0.31</td>
</tr>
<tr>
<td>Supernumerary teeth</td>
<td>11</td>
<td>1.99</td>
<td>15</td>
<td>2.73</td>
<td>0.49</td>
</tr>
<tr>
<td>Dens invaginatus</td>
<td>8</td>
<td>1.44</td>
<td>9</td>
<td>1.64</td>
<td>0.182</td>
</tr>
<tr>
<td>Dilaceration</td>
<td>5</td>
<td>0.9</td>
<td>3</td>
<td>0.54</td>
<td>0.726</td>
</tr>
<tr>
<td>Touroudontism</td>
<td>1</td>
<td>0.18</td>
<td>3</td>
<td>0.54</td>
<td>0.216</td>
</tr>
<tr>
<td>Gemination</td>
<td>4</td>
<td>0.72</td>
<td>1</td>
<td>0.18</td>
<td>0.374</td>
</tr>
<tr>
<td>Amelogenesis imperfecta</td>
<td>2</td>
<td>0.36</td>
<td>_</td>
<td>0</td>
<td>0.243</td>
</tr>
<tr>
<td>Fusion</td>
<td>_</td>
<td>0</td>
<td>1</td>
<td>0.18</td>
<td>0.248</td>
</tr>
<tr>
<td>Macrodontia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Concrescence</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2. Cross tabulation of age groups and the presence of at least one anomaly.

<table>
<thead>
<tr>
<th>ANOMALY</th>
<th>AGE GROUPS</th>
<th></th>
<th></th>
<th></th>
<th>50 and over</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13-20</td>
<td>20-30</td>
<td>30-40</td>
<td>40-50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence</td>
<td>156</td>
<td>224</td>
<td>77</td>
<td>32</td>
<td>8</td>
<td>497</td>
</tr>
<tr>
<td>Absence</td>
<td>154</td>
<td>375</td>
<td>53</td>
<td>16</td>
<td>5</td>
<td>603</td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>599</td>
<td>130</td>
<td>48</td>
<td>13</td>
<td>1100</td>
</tr>
</tbody>
</table>
Nine teeth in eight subjects showed dilacerated roots. Mesial or distal dilacertations were observed in seven teeth. Two dilacertations were directed buccolingually (bull’s eye appearance). The dilacertations were located at the apical third in seven teeth, the middle third in one tooth, and the coronal third in one tooth. The angles of the dilacerated roots ranged from 91° to 105°. All teeth had only one dilacerated root.

Significant relationships were observed between the presence of agenesis and the presence of microdontia ($P=0.008$), supernumerary teeth ($P=0.03$), and impaction ($P=0.01$). Further, the presence of taurodontism and presence of dilacertation were significantly correlated ($P=0.00$).

**DISCUSSION**

In this study, we aimed to investigate the distribution, and association of dental anomalies in a Turkish sample, because of significant variations in the reported presence of dental anomalies in various racial groups.

Ahlqwist et al.30 investigated the distributions of teeth, missing teeth, restorations, and endodontic treatments in panoramic and periapical full-mouth series, and Gröndahl et al.31 examined periapical osteolytic processes by orthopantomography and periapical radiography. They concluded that panoramic radiographs are not as precise as periapical radiographs for epidemiological studies.30-31 However; their studies were not directly related to dental anomalies. Contrarily, Muhammed et al.32 did not find a significant difference in periapical pathosis detection by panoramic and intraoral radiography. Further, several investigators have used panoramic radiographs to determine the prevalence of dental anomalies.3,16-19 Panoramic radiography has many advantages such as broad coverage of teeth, low patient radiation dose, and low cost, and is an indispensable tool for early detection of dental anomalies. In our clinic, we do not use full-mouth periapical series because of the aforementioned reasons. However, the radiographic quality is the most important limiting factor for the diagnostic capacity of any radiographic technique. We included panoramic radiographs with high diagnostic quality in this study.

It was stated that in investigations3,16-19 of dental anomalies prevalence, one observer made clinical or radiographical assessments. Van Parys et al.33 investigated the inter- and intra-examiner agreement in identifying morphological dental anomalies, such as dilacerated roots, tooth agenesis, pipette-shaped, blunt, pointed and short roots. They concluded that assessing agenesis on panoramic radiographs is reliable. Rating the presence of dilacerated, pipette-shaped, blunt, pointed and short roots on panoramic radiographs, however, does not result in a reliable assessment. In their study, a tooth was recognized as having mesial or distal root dilacertations if there was deviation of $45^\circ$ or more by small ruler. In our study, the deviations $90^\circ$ and over and the measurements were made by a computer program. In recent literature, the deviations with $90^\circ$ and over was considered as dilacertations.1,17,19,22 It can be considered that the subjective identifying and the measurement of the angle of $90^\circ$ can be more easier and reliable. Furthermore, a computer program can make the angle measurement more reliable. However, in the literature, no available study reported the results about inter and intraexaminer agreement in clinical and radiographical detection of different dental anomalies.

In the literature, the prevalence of dental anomalies ranges from 5.6% to 74%.1,16-18 However, wide variations in this prevalence have been reported. Altug-Atac and Erdem18 reported 5.6% prevalence in orthodontic patients in Turkey, which is much lower than our estimate. The difference could be a result of the sample size, age range, and number of dental anomalies included in their study. They examined dental anomalies in orthodontic patients (aged 8.5–14.75 years) and did not include impaction, dilacertation, talon cusp, taurodontism, and dens invaginatus in their analysis. Furthermore, they did not determine the state of extractions of any permanent teeth; besides oligodontia or hypodontia, their patients could have had tooth loss. The presence of dental anomalies was 56.4% and similar to those of Ezoddini et al.2 and Uslu et al.17. On the other hand, Thongudompron and Freer16 examined the prevalence of dental anomalies in 111 orthodontic patients and reported a prevalence of 76.4%. Although they did not examine talon cusp, macrodontia, gemination, and fusion, their calculated prevalence in 111 patients was considerably higher.16 However, they excluded third molars, maxillary molars, and premolars from the analysis. This result may also arise from racial differences.

Thongudompron and Freer16 found gender differences in the prevalence of dens invaginatus. Further, Ezoddini et al.3 reported that dilacertation and microdontia have significantly higher prevalence in women. However, in
accordance with the study by Uslu et al.\textsuperscript{17}, we did not find any gender differences in the presence/percentage of the examined dental anomalies.

Impaction was the most common dental anomaly in our study (subject: 26.2%; tooth: 5%). The reported prevalence of impaction in different populations was between 2.9\% to 9.9\%\textsuperscript{3,16,18}. Therefore, our result is considerably higher than the reported range. Thongudompron and Freer\textsuperscript{16} did not include third molars, maxillary molars, and premolars. Uslu et al.\textsuperscript{17} examined the prevalence of dental anomalies in orthodontic patients (mean age, 15.4 years; age range, 12.9–22.1 years) and did not include teeth with incomplete root formation; because the roots of third molars are not completely formed in this age range, they did not include third molars in their analysis. Consequently, the prevalence of impaction was lower. Ezoddini et al.\textsuperscript{3} reported a 7.5\% prevalence of impaction. They included patients with tooth loss, but impacted teeth could have been extracted before their study. As in other cases, this difference may also result from racial variations. The etiologies and complications of impaction should be investigated because of the relatively higher frequency of this anomaly (0.7\%) in the Turkish population. Uslu et al.\textsuperscript{17} and Altug-Atac and Erdem\textsuperscript{18} reported the prevalence of agenesis as 21.6\% and 2.76\%, respectively, in Turkish orthodontic patients. Interestingly, their results are very different even with similar populations. Our result (11.7\%) is more consistent with that of Uslu et al.\textsuperscript{17} The difference in the estimated prevalence could be attributed to the possibly more frequent agenesis in their sample of orthodontic patients. This indicates that dental anomalies, especially number and size anomalies and impaction, should be investigated in the general population to determine their real frequencies.

In our sample, the presence of microdontia was 5.2\%, and third molars were the most affected teeth. The prevalence of microdontia is 0.7–2.5\% in the literature. The lower frequency of this anomaly (0.7\%) in the study of Uslu et al.\textsuperscript{17} could be attributed to the considerably lower age of their patients than that of our subjects, because third molars would not have erupted in their orthodontic patients.

Hamasha and Safadi\textsuperscript{26} reported patient and teeth prevalence of talon cusps as 2.41\% and 0.55\%, respectively. In our study, this anomaly was seen in 3.1\% and 0.15\% according to the subjects and teeth, respectively. Hamasha and Safadi\textsuperscript{26} calculated the prevalence radiographically, but we used both clinical and radiographic examinations.

Radiographic examination alone may be misleading, and clinical examination is a more reliable method for identifying talon cusps. Our result is within the reported prevalence range (0.6–7.7\%) of this anomaly.\textsuperscript{24,34–36}

Supernumerary teeth were observed in 2.3\% of the subjects and 0.07\% of the teeth examined, and the premolar region was the most affected area. The prevalence of hyperdontia ranges from 0.3\% to 3.5\% in various populations, and the maxillary anterior region is reportedly the most common site of supernumeraries.\textsuperscript{3,16–18} Although data for supernumerary teeth in our study is within the reported range, the most affected region is different. The difference in localization may result from racial difference.

The reported prevalence of dens invaginatus is between 0.8\% and 26.1\% in adults.\textsuperscript{3,16–18} We identified dens invaginatus in 1.5\% of our sample. This wide variation may be explained by the different cohorts studied, identification criteria used, and diagnostic difficulties.\textsuperscript{37} In our study and other studies, the maxillary lateral incisors were the most affected teeth.\textsuperscript{3,15–16} Furthermore, dens invaginatus is reported more frequent in orthodontic patients than in the general population.\textsuperscript{16,17}

Diagnosis of dilaceration is particularly important for root–canal treatment, extraction, and orthodontic treatment.\textsuperscript{16} In our study, dilaceration was observed in 0.77\% of the subjects, which is considerably lower than previous reports (3.2–17\%).\textsuperscript{3,16,17,19–22} In all of these studies, the same criteria were used to identify dilaceration\textsuperscript{22}, but the method used for measuring the root angulations has not been disclosed in most of these reports.\textsuperscript{3,16,17,19–22} Furthermore, in these studies, dilaceration was classified as mesiodistal and buccolingual, but the results were not presented separately according to this categorization. The mesial and distal dilacerations might have been determined by subjective criteria and the results vary possibly because of such subjectivity. A small ruler\textsuperscript{20} and simple goniometer\textsuperscript{19} may not be reliable tools for measuring root angulation. We used a computer program for this measurement. Mandibular third molars were the most affected teeth in our study which is in accordance with the literature.\textsuperscript{19,21}

The reported prevalence of taurodontism is 1–9.9\%.\textsuperscript{3,16,17,38} and the presence in our study (0.4\%) is much lower than the reported range. The difference in the reported results may be a result of racial variations.

Gemination is a rare dental anomaly. Its prevalence ranges from 0.07\% to 2.1\%.\textsuperscript{3,18,39} Our data reflects its presence as
0.4%. In our sample, one subject had gemination and talon cusp in the bilateral maxillary central incisors. Amelogenesis imperfecta represents a group of developmental conditions of genomic origin, which affects the structure and clinical appearance of enamel of all or nearly all teeth in an almost equal manner and which may be associated with morphological or biochemical changes elsewhere in the body. The prevalence of this anomaly varies from 0.007% to 0.14% according to the populations studied. Our sample included two cases (0.2%) of amelogenesis imperfecta, which is comparatively higher than the previously reported range.

Ezoddini et al. and Altug-Atac and Erdem reported the prevalence of fusion as 0.2%. In our investigation, we found only one fused tooth between the right mandibular lateral incisor and the right mandibular canine (0.1%). Fusion is an uncommon dental anomaly, but it can cause esthetic, orthodontic, and periodontal problems as well as caries. We did not identify macrodontia and concrecence, which are rare dental anomalies. The teeth with gemination and fusion were larger than normal but were not considered pure macrodontia. Ezoddini et al. and Altug-Atac and Erdem reported the prevalence of macrodontia as 0.2%. Schalk-Vander et al. examined panoramic radiographs of patients with oligodontia and reported that 28.9% had taurodontism, although the prevalence in normal subjects is only 9.9%, suggesting that taurodontism could result from an ectodermal defect and could be an evolutionary presentation in persons with oligodontia. Maxillary lateral incisor microdontia is frequently associated with tooth agenesis. Cho et al. found a significant relationship between supernumerary premolars and dens evaginatus. In our study, we noted significant relationships between the presence of agenesis and the presence of microdontia, supernumerary teeth, and impaction. Furthermore, taurodontism was significantly associated with dilaceration. Unfortunately, sufficient information on concomitant dental anomalies is not available in the literature. We consider that these anomalies may have common genetic bases and/or developmental processes. Further research on this hypothesis is required.

CONCLUSION

In conclusion, the presence of impaction, microdontia, and amelogenesis imperfecta was considerably high in our sample compared with the previously studied populations, possibly because of racial differences. The presence of impaction could be related to the diminished arch size or relative association between arch size and tooth size in our population, in turn attributable to the dietary characteristics in Turkey. Early diagnosis of the common dental anomalies in a population is important to prevent the possible complications of these anomalies, and radiographic and clinical examinations seem to be indispensable tools for early diagnosis. Panoramic radiographs should be taken for every new patient to exclude such anomalies. The associations between different anomalies may provide new insights on the etiological and genetic bases of dental anomalies.

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REFERENCES


