Prevalence and distribution of dental anomalies in orthodontic patients

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Aim: To study the prevalence and distribution of dental anomalies in a sample of orthodontic patients. Methods: The dental casts, intraoral photographs, and lateral panoramic and cephalometric radiographs of 509 Egyptian orthodontic patients were studied. Patients were examined for dental anomalies in number, size, shape, position, and structure. The prevalence of each dental anomaly was calculated and compared between sexes. Results: Of the total study sample, 32.6% of the patients had at least one dental anomaly other than agenesis of third molars; 32.1% of females and 33.5% of males had at least one dental anomaly other than agenesis of third molars. The most commonly detected dental anomalies were impaction (12.8%) and ectopic eruption (10.8%). The total prevalence of hypodontia (excluding third molars) and hyperdontia was 2.4% and 2.8%, respectively, with similar distributions in females and males. Gemination and accessory roots were reported in this study; each of these anomalies was detected in 0.2% of patients. Conclusion: In addition to genetic and racial factors, environmental factors could have more important influence on the prevalence of dental anomalies in every population. Impaction, ectopic eruption, hyperdontia, hypodontia, and microdontia were the most common dental anomalies, while fusion and dentinogenesis imperfecta were absent. Orthodontics (CHIC) 2012;13:52–59

Key words: dental anomalies, distribution, orthodontic patients, prevalence

Dental anomalies in number, dimension, morphology, position, or structure are of importance for both patients and orthodontists. Besides affecting esthetics, they could also be the cause of malocclusions. Their presence must be considered in treatment planning. Meticulous examination is required to diagnose and manage cases with dental anomalies.

The etiology of dental anomalies can be genetic or environmental. Genetic causes have been discussed in the literature.²–⁶ Dental anomalies, such as tooth agenesis, are frequently associated with other anomalies such as microdontia, delayed dental development, and some discrete tooth ectopia, perhaps because a certain genetic mutation causes a series of different phenotypic expressions.⁷ Although defects in certain genes are considered the main causes, etiologic events in the pre- and postnatal periods have also been blamed for dental anomalies.⁸,⁹ Influences on teeth may begin before or after birth, and primary and permanent teeth can both be affected.¹⁰
Different studies show different percentages of dental anomalies; racial differences were stressed as a possible main explanation of this variation. In spite of this variation, a common point between the different studies was the unavoidable frequency of developmental dental anomalies in every community.

The objective of this study was to survey the prevalence and distribution of dental anomalies in a sample of Egyptian orthodontic patients.

METHODS

This study was designed as a retrospective study. The study included examination of records of orthodontic patients who attended the orthodontic clinic between 2007 and 2010 and met the inclusion criteria. A total of 509 Egyptian orthodontic patients were examined. Of these patients, 312 were females and 197 were males. The sample size was determined using Epi Info 2000 Statcalc Division for WHO (World Health Organization) for sample-size and power calculation. The age of the patients ranged from 14 to 21 years. Patients with syndromes as ectodermal dysplasia or Down syndrome, as well as those with cleft lips and palates, were excluded from the study. Patients who had undergone previous orthodontic treatment were also excluded.

Examination of each case included evaluation of pretreatment study casts, panoramic and periapical radiographs, intraoral photographs, and anamnestic data. The records were examined by two investigators.

The dental anomalies included (1) anomalies in number (agenesis and extra teeth, including supernumerary, supplementary, and mesiodens); (2) anomalies in shape and size (fusion, gemination, peg-shaped lateral incisors, microdontia, macrodontia, dilacerations, and accessory roots); (3) anomalies in position (ectopic eruption, including transposition, improper angulation, and impaction); and (4) anomalies in structure (amelogenesis imperfecta and dentinogenesis imperfecta).

Impaction was diagnosed when the tooth was not expected to erupt completely into its normal functional position; impaction of the third molars was not included. On the other hand, ectopic eruption included teeth abnormally mesially or distally inclined, regardless of whether resorption of adjacent tooth roots was caused. Canines erupted in labioversion are included in the ectopic eruption group. A tooth was listed under the microdontia category when it was disproportionately small compared with its antimere. Dilaceration was diagnosed when an angulation or bend in the linear relationship between the tooth crown and root or in the root was observed in the radiographs. Deciding whether gemination or fusion was involved was determined after counting teeth and examining periapical radiographs. Gemination showed a normal count of the teeth in the dental arch, and the geminated tooth showed a common pulp chamber.

In addition to genetic and racial factors, environmental factors could have more important influence on the prevalence of dental anomalies in every population.
RESULTS

The general prevalence and distribution of the dental anomalies among the orthodontic patients is shown in Table 1. Other than agenesis of third molars, 32.6% of the patients had at least one dental anomaly. Of the female patients, 32.1% had at least one dental anomaly, and of the males, 33.5% had at least one dental anomaly.

Agenesis of at least one third molar was detected in 15.3% of patients; the prevalence among females was 15.7% and 14.7% among males. Prevalence of maxillary third molar agenesis, mandibular third molar agenesis, and agenesis of all four third molars was 8.4%, 5.1%, and 1.8%, respectively.

The prevalence and distribution of impacted teeth is shown in Table 2. Impaction of teeth was detected in 12.8% of patients. Of these, mandibular second premolars constituted 49.2%, maxillary canines constituted 26.2%, and maxillary incisors constituted 13.8%. The prevalence and distribution of ectopically erupted teeth is shown in Table 3. Ectopic eruption of teeth was detected in 10.8% of patients; 53.6% were maxillary canines in labioversion—of these, 66.7% were in females and 33.4% were in males.

The total prevalence of hypodontia, excluding third molars, was 2.4%. The distribution was similar in females and males. The prevalence and distribution of third molar agenesis is shown in Table 4.

Dental anomalies in number, dimension, morphology, position, or structure are of importance for both patients and orthodontists. . . . Meticulous examination is required to diagnose and manage cases with dental anomalies.
The prevalence of microdontia in this study was 2.0% (see Table 1); 75.0% of the affected teeth were peg-shaped maxillary lateral incisors—55.6% on the left side and 44.4% on the right side.

Gemination and accessory roots were reported in this study; each of these anomalies was detected in 0.2% of examined patients (see Table 1).

**DISCUSSION**

The sample selection for this study was influenced by more than one factor. Patients included in the study were those who attended the orthodontic clinic between 2007 and 2010. This limited time frame considered the evolutionary perspective of the developmental absence of one or more teeth—it is claimed that there is a progressive tendency in the reduction of tooth number.15,16 Another factor that affected the sample selection was the age of the included patients. Because agenesis of third molars was considered in this study, the age was set to be between 14 and 21. The age of 14 was considered a critical age for determination of third molar agenesis.3 It is worth mentioning here that young patients who undergo the first phase of orthodontic treatment constitute a large portion of the patients in the orthodontic clinic. As a result, the number of patients eligible for inclusion was reduced.

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**Table 2** Prevalence and distribution of impacted teeth

<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th>Males</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second premolars</td>
<td>27</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>First premolars</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Canines</td>
<td>10</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Incisors</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

**Table 3** Prevalence and distribution of ectopically erupted teeth

<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th>Males</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labioversion</td>
<td>22</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Abnormal angulation</td>
<td>8</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>Transposition</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Table 4** Prevalence and distribution of third molar agenesis

<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th>Males</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxillary</td>
<td>24</td>
<td>19</td>
<td>43</td>
</tr>
<tr>
<td>Mandibular</td>
<td>17</td>
<td>9</td>
<td>26</td>
</tr>
<tr>
<td>All third molars</td>
<td>8</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>
Prevalence and distribution of dental anomalies

In 32.6% of the patients included in this study, at least one dental anomaly (other than agenesis of third molars) was detected. The prevalence and distribution of dental anomalies in the orthodontic patients of every population, as indicated in other studies, showed a wide variation. A study by Thongudompon and Freer found the prevalence to be 74.77% in Japanese orthodontic patients, while a study by Altug-Atac and Erdem showed that 5.46% of the Turkish population had at least one dental anomaly. At least one dental anomaly was found in 40.3% of Turkish orthodontic patients and in 31.3% of an Indian population. Several factors could contribute to these variations, including racial differences, sample-size criteria, diagnostic criteria, and sampling methods.

Because previous studies did not show a consistent pattern for the distribution of dental anomalies among females and males as each population showed its characteristic pattern of distribution, distribution according to sex, for the dental anomalies as a whole and for each one separately, was included in this study—32.1% of female patients and 33.5% of male patients had at least one dental anomaly.

In the current study, tooth impaction was the most common dental anomaly other than agenesis of third molars and was found in 12.8% of patients. The results of this study showed mandibular second premolars were the most commonly impacted tooth, followed by the maxillary canines. Impacted mandibular second premolars constituted 49.2%. Of these patients, 28.1% had bilateral impaction, 37.5% had right impaction, and 34.4% had left impaction. On the other hand, impacted maxillary canines constituted 26.2%; impactions were almost equally distributed between bilateral impactions, impaction of right canines, and impaction of left canines. Other studies showed maxillary canines to be the most commonly impacted tooth, followed by mandibular second premolars. Canines erupted in labioversion in 60.0% of patients with ectopically erupted teeth; of these patients, 33.3% had both maxillary canines in labioversion, 24.2% had only the maxillary right canine, while 27.3% had only the maxillary left canine and 15.2% had the mandibular canine in labioversion. In two cases, the primary canines were retained—all remaining cases showed insufficient space. Dental history suggested early extraction of primary teeth in young children with no interceptive measure taking place leading to arch length-tooth size discrepancy as a possible contributing factor to tooth impaction or ectopic eruption. In three patients, seven maxillary incisors were impacted due to the presence of supernumerary teeth. In the remaining cases, the most probable cause, as mentioned earlier, was early extraction of the predecessor. Changes in the overlying keratinized tissue occur in long-standing edentulous areas, causing the thick fibrous tissue to hinder eruption of the successor. However, the angulation of the impacted permanent incisor is another suggested cause for delayed eruption.

Molar ectopic eruption was detected in two males; both were mandibular left second molars. In both cases, the third molars were present.

Three complete transposition cases were identified in this study; complete transposition means that both crown and root have changed places in the dental arch. All three cases were of maxillary canine–lateral incisor transposition, but no other specific features were identified. Two of the cases were on the left side and one on the right side. In two cases, the maxillary third molars were present—they were absent in the third case. These three patients constituted 0.59% of the studied sample (orthodontic patients). Tooth transposition was detected in 0.27% of the Turkish population, and 60.0% of the observed cases were maxillary canine/lateral incisor. It is important to stress here that whether the dental anomalies were studied in the whole population, orthodontic patients, or orthodontic patients with specific complaints could influence the results.
The total prevalence of hypodontia, excluding third molars, was 2.4%; the prevalence among females and males was 2.3% and 2.5%, respectively. Previous studies showed variations in their results: Altug-Atac and Erdem \(^1\) found hypodontia to be the most common dental anomaly—it was detected in 21.6% of Turkish orthodontic patients. In Japanese orthodontic patients, \(^2\) the prevalence of hypodontia was 8.5% (9.3% for females and 7.5% for males). Nordgarden et al\(^2\) found hypodontia among 5.1% of females and 4.0% of the males. The results of this study showed, as other studies did, \(^2\) that agenesis of maxillary lateral incisors was the most common followed by agenesis of mandibular second premolars. However, in some studies, \(^2\) mandibular second premolars were found to be the most commonly missing tooth.

Of the total sample of the current study, 84.7% had all third molars present and 15.3% had agenesis of at least one third molar. There seemed to be no sex predilection, but agenesis of maxillary molars was higher than mandibular molars in a ratio of 1.5:1.0, which was in agreement with the study of Kazanci et al\(^2\), although their study found 23.8% agenesis of third molars. Celikoglu et al\(^2\) found third molar agenesis of 17.3% with no statistically significant sex differences.

Supernumerary teeth were detected in 2.8% of the patients (3.0% in males and 2.6% in females). The supernumerary teeth were equally distributed between supplemental and mesiodens; 75.0% were in the anterior region, and 25.0% were premolars. In a Swiss population, prevalence of supernumerary teeth was 1.5%, and the prevalence was higher among boys than girls—86.0% were in the maxillary anterior teeth. \(^2\) In an Iranian orthodontic population, the prevalence of supernumerary teeth was 0.74%. \(^2\)

The prevalence of microdontia had been reported to increase over time. This was attributed to the rate of evolution, \(^1\) and the prevalence in this study was 2.0%. In agreement with other studies, \(^1,10\) maxillary lateral incisors were the most commonly affected tooth. Peg-shaped maxillary lateral incisors constituted 75.0% of the affected teeth, with more prevalence on the left side than the right. An interesting observation was that the two female patients who showed microdontia also had macrodontia of the neighboring tooth (in other words, microdontia of the maxillary lateral incisor and macrodontia of the central incisor and microdontia of the mandibular left first premolar and macrodontia of the second premolar). This could be attributed to a genetic factor, as suggested by other studies. \(^2\)

Three maxillary left incisors in two males showed dilacerations; this is 0.4% of the entire sample. Guttal et al\(^1\) found dilacerations in 22.5% of the Indian population. Dilaceration is commonly explained as a consequence of trauma, \(^9,10,28\) and this could be true in this study, since where males are generally more engaged in sports and athletics. Other studies supported the idea that dilaceration might be a true developmental anomaly unrelated to trauma. \(^2\)

Gemination and accessory roots are dental anomalies that were each detected in 0.2% of examined patients. Only one boy had gemination in the maxillary central incisors. In the Indian population, gemination constituted 0.28%, \(^1\) while in Turkish orthodontic patients, it constituted 0.07%. \(^1\)

Accessory roots were detected in one mandibular first molar. In an Indian population, accessory roots were detected in the mandibular premolars and first molars, constituting 2.0% of the population. \(^1\) There are no reports on the effects of accessory roots on tooth movement during orthodontic treatment.

The only structural anomaly detected in the current study was amelogenesis imperfecta. The primary clinical problems of amelogenesis imperfecta are tooth sensitivity, loss of occlusal vertical dimension, dysfunction, and esthetics. \(^3\) In this study, the chief complaint of the patients who showed amelogenesis imperfecta was malocclusion not related to this dental anomaly. However,
the patient or parents always asked if there was anything that could be done to deal with the abnormality.

Evidence-based dental practice demands integrating systematic assessments of clinically relevant scientific evidence with clinical expertise and the patient’s treatment needs and preferences. In this context, orthodontists must consider detection of dental anomalies during orthodontic examination that must be considered subsequently during treatment planning. The current study showed that at least three of every 10 Egyptian orthodontic patients had at least one dental anomaly. The results showed an influential effect of environmental factors on the prevalence of dental anomalies, making impaction and ectopic eruption the most common dental anomalies. Early diagnosis of dental anomalies would help apply timely interceptive measures. Timely extraction of predecessors could solve the problem of ectopic eruption. According to Ericson and Kurol, normal eruption of ectopically displaced permanent maxillary canines could be achieved by early extraction of primary maxillary canines. Early detection of transposition would help informed decision making about proper management and timely intervention. Diagnosis of those anomalies that appear earlier may indicate a potential risk for tooth and eruption disturbances.

CONCLUSION

The following can be concluded from the results of this study:

- Environmental factors could have more influence on the prevalence of dental anomalies than genetic and racial factors in every population.
- Impaction, ectopic eruption, hyperdontia, hypodontia, and microdontia were the most common dental anomalies.
- Gemination and secondary roots were the least detected dental anomalies, while fusion and dentinogenesis imperfecta were not detected at all.

REFERENCES