INCIDENCE OF IMPACTED TEETH AND TRANSMIGRATED CANINES--A RADIOGRAPHIC STUDY IN TURKISH DENTAL PATIENTS

Koray Halıcıoğlu, DDS, PhD
Assistant Professor, Department of Orthodontics, Faculty of Dentistry, Abant İzzet Baysal University, Bolu, Turkey

Bayram Çörekçi, DDS, PhD
Assistant Professor, Department of Orthodontics, Faculty of Dentistry, Abant İzzet Baysal University, Bolu, Turkey

Celal Irgin, DDS, PhD
Assistant Professor, Department of Orthodontics, Faculty of Dentistry, Abant İzzet Baysal University, Bolu, Turkey

ABSTRACT

Background and Aim: The aim of the present study was to determine the incidence of transmigrated maxillary and mandibular canine teeth and also of the other impacted teeth, apart from third molars, in a Turkish dental patients subpopulation.

Materials and Methods: This was a retrospective study of 2900 panoramic radiographs (PRs) taken from patients who were referred to the Faculty of Dentistry, Abant İzzet Baysal University, Turkey, between December 2010 and July 2011, and who were examined to identify cases of transmigrated canines and impacted teeth. Demographic data of all patients were also recorded. The effect of sex and sidedness on the recorded abnormality was evaluated using a t-test.

Results: A total of 137 (4.72%) patients presented with at least one impacted tooth. None of them had impacted mandibular incisors and maxillary molars. Impacted maxillary canines were the most prevalent dental anomaly (3.27%), followed by mandibular canines (0.55%) and mandibular premolars (0.37%). In patients whose impacted teeth were detected, sex showed statistical significance (p = 0.005), whereas sidedness did not show statistical significance on the recorded abnormality. Furthermore, the incidence of transmigrated upper and lower canine teeth was found to be 0.13% and 0.06%, respectively.

Conclusions: The most frequently impacted tooth was the upper canine followed by the lower canine, lower premolars, upper premolars, and the rest. The incidence of transmigrated maxillary canine teeth was greater than that of the mandibular canine teeth. With the increased use of panoramic radiographs, it is unavoidable that the diagnosis of such anomalies will increase.

Key words: Incidence, Impacted Teeth, Panoramic Radiographs, Transmigrated Canine
INTRODUCTION

The eruption of permanent teeth presents a complex series of events, via eruptive movements of the tooth germ taking place at a predetermined time and route, enabling the tooth to find its antagonist at a predetermined occlusal plane. A tooth that is unerupted more than 1 year after the normal age for eruption is defined as "retained." Failure of a tooth to reveal into the maxillary and mandibular dental arch, usually because of either space deficiency or the existence of an entity clogging its path of eruption, results in "impaction." An impacted tooth generally remains within the same side of the dental arch. However, its movement from its normal position to the contralateral hemiarch, crossing the midline, is known as "dental transmigration." This is a rare phenomenon and an unusual developmental anomaly of an unknown reason.

All permanent teeth might be impacted; however, maxillary and mandibular third molars, maxillary canines, maxillary and mandibular premolars, and maxillary central incisors are the teeth most frequently involved. On the other hand, transmigration involves almost exclusively maxillary and mandibular canines.

As a tooth that is impacted or transmigrated should be treated with rigorous care, especially in terms of orthodontic treatment planning, the diagnosis should be made both clinically and radiographically. To confirm the clinical findings of an impacted and transmigrated tooth radiographically, two-dimensional radiographic imaging is known to be the most common modality, and is used clinically as the primary diagnostic radiograph for the localization. Panoramic radiographs (PRs) is a standard diagnostic tool in orthodontics for the preoperative diagnosis of routine cases. Although surveys related to the incidence of impacted teeth and canine transmigration are observed in different populations, this incidence may have variability in the different subpopulations of the same population. The aim of the present study was to determine the incidence of impacted teeth excluding third molars and transmigrated canine teeth in Turkish dental patients using PRs, basing on the relevant published literature.

MATERIALS AND METHODS

A retrospective study was performed using PRs of 2900 patients (1598 females and 1302 males) ranging in age from 15 to 74 years (mean age: 36.4±2.21 years) referred to the Faculty of Dentistry, Abant İzzet Baysal University, Bolu, Turkey, between 2010 December and 2011 July. Approval from the ethics committee was not required for this retrospective study.

All radiographs were taken by the same radiology technician on digital panoramic systems (Vatech Pax-Uni3D digital panoramic system; Yongin, Republic of Korea). All radiographs were assessed by three experienced orthodontist. Selection criteria of the samples consisting of patients that were not diagnosed with any syndrome or illness involved odontogenesis and dental eruption. Observations were made regarding the patient’s sex and age, side and number of the impacted mandibular and maxillary teeth except third molars as well as retained or exfoliated deciduous canines, any associated pathology, patient's sex and age, and side and number of transmigrated canines on PRs.

If the patient was older than 15 years and the tooth was not exposed in the oral cavity, the tooth was evaluated as impacted (Figures 1 A, B, C and D). However, the mandibular tooth was considered transmigrated if the eruption path had been altered, and the tooth had drifted to the opposite side of the arch with at least half of the crown length crossing the midline (Figures 2 A and B). Besides, in the maxillary tooth, a migration of across the mid-palatal suture, regardless of the distance, was accepted as a transmigration (Figures 3 A and B).

Statistical evaluation

As the diagnosis of transmigrated and impacted teeth is an objective assessment and as these teeth are clearly visible on PRs, a study of a method for detecting errors was not considered a requirement. All assessments were made by the common agreement of the authors. Therefore, in inter-rater and intra-rater agreements for the classification, the Kappa statistics for categorical variables was not used. The incidence of all impacted teeth, except the third molars, was calculated as a percentage. The effect of gender and sidedness (left or right side) on the recorded abnormality was evaluated using a t-test.

RESULTS

Distribution of all impacted teeth and canine transmigration in terms of sex, number, and location are shown in Tables 1, 2, and 3, respectively. The incidence of total impaction and total transmigration was 4.72% (137 subjects) and 0.20% (6 subjects), respectively.

A total of 137 (4.72%) patients were presented with at least one impacted tooth. There were more cases of impacted
Figure 1 A, B, C and D. Impacted teeth observed on panoramic radiographs.

Figure 2A. Bilateral transmigrated mandibular canines observed on panoramic radiograph.

Figure 2B. Unilateral transmigrated mandibular canine observed on panoramic radiograph.

Figure 3 A and B. Transmigrated maxillary canines observed on panoramic radiographs.
maxillary teeth (n=109) than impacted mandibular teeth (n=50), and maxillary canines were the most commonly encountered (3.27%), followed by mandibular canines (0.55%), maxillary premolars (0.24%), maxillary central teeth (0.20%), and maxillary lateral and mandibular molar teeth (0.03% each). None of them had impacted mandibular incisors and maxillary molars. Besides, impacted mandibular molar was observed in only one patient. In addition, the male to female ratio of the study group was 1:1.22 (1302:1598), and this ratio for patients with impacted teeth was 1:1.77 (50:109); this difference was statistically significant (p=0.005). Additionally, regarding all impacted teeth, the frequency of cases in the right side (79 teeth) was almost the same as that in the left side (80 teeth), but this was not statistically significant (Table 1).

Among the 2900 patients, 6 patients had 7 transmigrated canines. The incidence of transmigrated upper and lower canine teeth was found to be 0.13% and 0.06%, respectively. The left side is usually affected more often than the right side in the upper jaws. A patient with transmigrant maxillary canine had pathologies that probably include cysts, and another patient had mandibular bilateral transmigrant canines. There were no statistically significant sex and side differences regarding the transmigration of teeth (p=0.70). However, maxillary canine transmigration was found significantly more frequent than mandibular canine transmigration (Tables 2 and 3).

**DISCUSSION**

Rebellato and Schabel informed that PR, occlusal, periapical, and submentovertex projections can be used to determine the three-dimensional location of the impacted teeth. However, computed tomography (CT) is the gold standard for localization of impacted teeth, although radiation exposure could be an issue. CTs may be obtained only in specific cases such as implant surgery, tumors, or cysts, whereas PRs may be utilized for a routine dental examination. In the present study, the records of 2900 patients were examined retrospectively. Therefore, PRs were used to localize the impacted teeth and transmigrated canines, together with other dental reasons because of associated costs and ethical considerations. We observed that PRs were often used by the investigator(s) who performed all the previous incidence studies (Tables 4 and 5).
contrast, Stanley et al. observed more cases of impacted teeth in the mandible region. We think that the reason for this is that these studies have been performed on different populations and/or including the third molar.

In the present study, in descending order, the 159 impacted teeth were as follows: maxillary canines, mandibular canines, mandibular premolars, maxillary premolars, maxillary incisors, and mandibular molar. None of the patients had impacted mandibular incisors and maxillary molars. This pattern of impacted tooth types observed was similar to the previous reports. Although the investigated subjects may not represent the whole Turkish population, there was little variation in the prevalence and distribution of impacted teeth, and the results were in agreement with the different studies. Unlike the present study order, Aktan et al. found that the most frequently impacted tooth was the upper canine followed by the lower canine, lower second premolar, and upper second premolar in other Turkish subpopulations.

Regarding the location of the impacted teeth, they were classified according to which side they were located. Incidence investigation related to dental anomaly has generally been comprised of either impacted teeth or canine transmigration. In this study, the incidence of impacted and transmigrated canines was investigated together with the incidence of the other impacted teeth. Similar to previous studies on the prevalence of impacted teeth, in the present study, the third molars were not evaluated and taken into account. The prevalence of impacted teeth in this study population was 4.72%, a relatively lower figure compared with those of the other studies involving third molars. Besides, some incidence studies were performed on orthodontic patient subpopulation in the dental literature (Tables 4 and 5). We think that impacted teeth incidence in orthodontic patient subpopulation may be more than that of the whole society.

In our study, there were more cases of total maxillary impacted teeth than total mandibular impacted teeth. Our findings are in line with those of Brown et al. and Shah et al. who have reported that impacted teeth are usually observed in the maxilla than in the mandible region. By contrast, Stanley et al. observed more cases of impacted teeth in the mandible region. We think that the reason for this is that these studies have been performed on different populations and/or including the third molar.

In the present study, in descending order, the 159 impacted teeth were as follows: maxillary canines, mandibular canines, mandibular premolars, maxillary premolars, maxillary incisors, and mandibular molar. None of the patients had impacted mandibular incisors and maxillary molars. This pattern of impacted tooth types observed was similar to the previous studies. Although the investigated subjects may not represent the whole Turkish population, there was little variation in the prevalence and distribution of impacted teeth, and the results were in agreement with the different studies. Unlike the present study order, Aktan et al. found that the most frequently impacted tooth was the upper canine followed by the lower canine, lower second premolar, and upper second premolar in other Turkish subpopulations.

Regarding the location of the impacted teeth, they were classified according to which side they were located.
There was 0.075% to 0.48% incidence of canine transmigration found in the dental literature (Table 5). Aydin et al.\(^\text{12}\) reported that 14 maxillary and mandibular transmigrated canines were found in 4500 patients, and Javid\(^\text{4}\) found merely 1 mandibular transmigrated canine in 1000 people. Maxillary canine transmigration has been previously reported in the literature in only a few studies\(^\text{7,9,35,36}\), and this issue was first reported by Aydin and Yılmaz\(^\text{36}\) in 2003. In this study, among the 2900 patients, 6 patients had 7 transmigrated maxillary and mandibular canines (Figures 2AB and 3AB). The incidence of transmigrated upper and lower canine teeth was found to be 0.13% and 0.06%, respectively. The findings in the present study are in agreement with the previous surveys that showed that this incidence of transmigrated canines is a rare phenomenon (Table 5).

Maxillary canine impaction is approximately 20 times more common than mandibular canine impaction.\(^\text{37}\) Ryan et al.\(^\text{38}\) Regarding all impacted teeth, the frequency of cases in the right side (79 teeth) was almost the same as that in the left side (80 teeth); that’s why no statistical differences were observed. In addition, a lot of researchers\(^\text{3,27,33}\) reported that the left canine was more often to be impacted than the right canine. In the current study, there were more impacted maxillary right canines (61 teeth) than impacted maxillary left canines (50 teeth), which is in line with the study by Aktan et al.\(^\text{9}\) on other Turkish orthodontic subpopulation. Besides, female patients tend to have cases of tooth impaction more frequently than male patients.\(^\text{9,27,33}\) In the present study, the female predilection was more dominant (\(p= 0.005\)). Barely, Aydin et al.\(^\text{12}\) found that male patients tend to have this condition more frequently than female patients. This difference could be explained by the fact that more female patients than male patients seek dental treatment, although there still remains no consensus on the domination of sex.\(^\text{34}\)

### Table 4. Prevalence of total impacted teeth and canines reported in the dental literature.

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>N</th>
<th>Diagnosis</th>
<th>Total Teeth Impaction</th>
<th>Impacted Maxillary Canines</th>
<th>Impacted Mandibular Canines</th>
<th>Total Canines Impaction</th>
<th>Subpopulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aktan et al(^\text{9})</td>
<td>5000</td>
<td>Panoromic, Lateral, Occlusal, Periapical</td>
<td>2.94%</td>
<td>1.74%</td>
<td>0.46%</td>
<td>2.2%</td>
<td>Turkish</td>
</tr>
<tr>
<td>Uslu et al(^\text{15})</td>
<td>900</td>
<td>Panoromic</td>
<td>2.9%(^\ast)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Turkish</td>
</tr>
<tr>
<td>Kazanci et al(^\text{14})</td>
<td>3165</td>
<td>Panoromic</td>
<td>4.55%(^\ast)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Turkish</td>
</tr>
<tr>
<td>Lee et al(^\text{19})</td>
<td>3133</td>
<td>Panoromic</td>
<td>3.09%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Korean</td>
</tr>
<tr>
<td>Thongudomporn and Freer(^\text{16})</td>
<td>111</td>
<td>Panoromic</td>
<td>9.9%(^\ast)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Australian</td>
</tr>
<tr>
<td>Fardi et al(^\text{17})</td>
<td>1239</td>
<td>Panoromic</td>
<td>13.7%(^\ast)</td>
<td>-</td>
<td>-</td>
<td>8.8%</td>
<td>Greek</td>
</tr>
<tr>
<td>Abu Alhajia et al(^\text{18})</td>
<td>1003</td>
<td>Oral examination</td>
<td>1.8%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Jordanian</td>
</tr>
<tr>
<td>Chu et al(^\text{9})</td>
<td>7486</td>
<td>Panoromic</td>
<td>28.3%(^\ast)</td>
<td>-</td>
<td>-</td>
<td>0.8%</td>
<td>China</td>
</tr>
<tr>
<td>Ahlqwist and Grondahl(^\text{10})</td>
<td>1418</td>
<td>Panoromic</td>
<td>8.3%(^\ast)</td>
<td>-</td>
<td>-</td>
<td>0.01%</td>
<td>Swedish, Women</td>
</tr>
<tr>
<td>Aitasalo et al(^\text{21})</td>
<td>4063</td>
<td>Panoromic</td>
<td>14.1%(^\ast)</td>
<td>0.036%</td>
<td>0.004%</td>
<td>0.04%</td>
<td>Finn</td>
</tr>
<tr>
<td>Alattar et al(^\text{22})</td>
<td>6780</td>
<td>Panoromic</td>
<td>22.3%(^\ast)</td>
<td>-</td>
<td>-</td>
<td>0.01%</td>
<td>US</td>
</tr>
<tr>
<td>Eliasson et al(^\text{23})</td>
<td>2128</td>
<td>Panoromic</td>
<td>30.3%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Swedish</td>
</tr>
<tr>
<td>Shah et al(^\text{10})</td>
<td>7886</td>
<td>Panoromic</td>
<td>6.9%</td>
<td>0.007%</td>
<td>0.001%</td>
<td>0.008%</td>
<td>Canadian</td>
</tr>
<tr>
<td>Kramer and Williams(^\text{24})</td>
<td>3745</td>
<td>Panoromic</td>
<td>18.3%(^\ast)</td>
<td>-</td>
<td>-</td>
<td>0.012%</td>
<td>US</td>
</tr>
<tr>
<td>Dachi and Howell(^\text{11})</td>
<td>1685</td>
<td>Panoromic</td>
<td>16.7%(^\ast)</td>
<td>0.016%</td>
<td>0.007%</td>
<td>0.024%</td>
<td>US</td>
</tr>
<tr>
<td>Brown et al(^\text{25})</td>
<td>1895</td>
<td>Panoromic</td>
<td>30.8%</td>
<td>0.079</td>
<td>0.023</td>
<td>0.105%</td>
<td>African</td>
</tr>
</tbody>
</table>

\(^\ast\)This study includes third molars.

* This study was performed on orthodontic patient population.

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Table 5. Prevalence of total impacted and/or transmigrated canines reported in the dental literature.

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>N</th>
<th>Diagnosis</th>
<th>Impacted Maxillary Canine</th>
<th>Impacted Mandibular Canine</th>
<th>Total Canine Impaction</th>
<th>Transmigrated Maxillary Canine</th>
<th>Transmigrated Mandibular Canine</th>
<th>Total Canine Transmigration</th>
<th>Subpopulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aktan et al⁹</td>
<td>5000</td>
<td>Panoromic, Lateral, Occlusal, Periapical</td>
<td>1.74%</td>
<td>0.46%</td>
<td>2.2%</td>
<td>0.34%</td>
<td>0.14%</td>
<td>0.48%</td>
<td>Turkish</td>
</tr>
<tr>
<td>Aras et al⁷</td>
<td>6000</td>
<td>Panoromic</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.02%</td>
<td>-</td>
<td>-</td>
<td>Turkish</td>
</tr>
<tr>
<td>Büyükurt et al⁶</td>
<td>4500</td>
<td>Panoromic</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Turkish</td>
</tr>
<tr>
<td>Çeliköğüş et al¹³</td>
<td>2215+</td>
<td>Panoromic</td>
<td>-</td>
<td>-</td>
<td>5.1%</td>
<td>-</td>
<td>-</td>
<td>0.3%</td>
<td>Turkish</td>
</tr>
<tr>
<td>Kara et al¹⁰</td>
<td>12000</td>
<td>Panoromic</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.2%</td>
<td>Turkish</td>
</tr>
<tr>
<td>Gündüz and Çelenk¹¹</td>
<td>112873</td>
<td>Panoromic</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.075%</td>
<td>Turkish</td>
</tr>
<tr>
<td>Yavuz et al¹⁵</td>
<td>5022</td>
<td>Panoromic</td>
<td>-</td>
<td>1.29%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.3%</td>
<td>Turkish</td>
</tr>
<tr>
<td>Aydın et al¹²</td>
<td>4500</td>
<td>Panoromic</td>
<td>-</td>
<td>-</td>
<td>3.58%</td>
<td>-</td>
<td>-</td>
<td>0.17%</td>
<td>Turkish</td>
</tr>
<tr>
<td>Mupparapu²⁷</td>
<td>2150</td>
<td>Panoromic</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>American</td>
</tr>
<tr>
<td>Mazinis et al²⁸</td>
<td>3856</td>
<td>Panoromic</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Greek</td>
</tr>
</tbody>
</table>

*This study was performed on orthodontic patient population*

Despite the existence of a number of factors suggesting more studies should be conducted on transmigration, the etiology and absolute mechanism are still unclear. Peck indicated that canine transmigration is congenital. In addition, possible etiological factors of transmigration are as follows: retention or premature loss of deciduous teeth, crowding, spacing, supernumerary teeth, and an excessive crown length of the permanent canine. Furthermore, Joshi believed that there is a barrier, the maxillary midpalatal suture, which prevents a palatally impacted incisor from crossing the opposite side of the arch. Joshi also postulated that transmigrated mandibular canines occur more commonly than maxillary ones. Similarly, Aktan et al. informed that transmigrated mandibular canines occur more commonly than maxillary ones. Similarly, Aktan et al. informed that transmigrated mandibular canines occur more commonly than mandibular ones. Bilateral transmigration was a relatively rare occurrence. Blinded transmigration has been reported as unilateral in many studies up to now. However, all transmigrated maxillary canines are among the more common events, and in the present study, bilateral transmigration was found in the same population. Nevertheless, Mupparapu found incidences of transmigrated maxillary canines in 0.004% of the American subpopulation. One possible reason for this difference is that the incidence of transmigrated maxillary canines may appear to be variable in different subpopulations. Considering this, no bilateral maxillary transmigrated canines were found in the present study.

The mandibular canines have been reported to transmigrate mesially, bypassing the incisors and crossing the midline to the canine of the opposite side, both unilaterally and bilaterally. However, all transmigrated maxillary canines and bilateral mandibular transmigrated canines are among the more common events, and in the present study, bilateral transmigration was found in the same population. Nevertheless, Mupparapu found incidences of transmigrated maxillary canines in 0.004% of the American subpopulation. One possible reason for this difference is that the incidence of transmigrated maxillary canines may appear to be variable in different subpopulations. Considering this, no bilateral maxillary transmigrated canines were found in the present study.
Impacted teeth and transmigrated canines

transmigration process or that the pathology occurred after the migration of the canine.
Joshi et al.34 reported that almost all the transmigrant mandibular canines were impacted, that is to say, nonerupted. Aydin et al.12 reported that only one transmigrant maxillary canine was partially erupted. In this study, there were no erupted transmigrant maxillary and mandibular canines. If transmigrant canines are nonerupted, treatment options include surgical removal, transplantation, and forced eruption13,40, or long-term follow-up may be an alternative option, if nonsymptomatic. Forced eruption is the best option for this. For successful orthodontic treatment, a transmigrated canine should be detected in the early age; if not, eruption and alignment will be more complicated. In the present study, 4 of the 6 subjects with transmigrated canine underwent surgery for the extraction of the transmigrated canines either because they did not accept orthodontic treatment or orthodontic treatment was not applicable. Moreover, two patients had a follow-up observation.

CONCLUSIONS

• The data received show that the incidence of tooth impaction is a common dental anomaly in the Turkish subpopulation of dental patients. Approximately 4.72% of the samples presented with at least one impacted tooth. No incidence of mandibular incisor and maxillary molar impaction was found. The most frequently impacted tooth was the upper canine followed by the lower canine, lower premolars, and upper premolars and the rest.
• The incidence of transmigrated canines was found to be 0.20%. The incidence of transmigrated maxillary canine teeth was greater than the mandibular canine teeth. Transmigration observed 0.05% of all impacted canines.
• With the increased use of panoramic radiographs, it is unavoidable that the diagnosis of such anomalies will increase.

REFERENCES


