The unerupted impacted maxillary canine - a post-surgical review

Introduction
The unerupted impacted maxillary canine tooth is a complex problem of multifactorial aetiology. The maxillary canine has the longest path of eruption of any permanent tooth and, aside from the third molars, is the tooth most likely to become impacted.1 The tooth may be impacted in a buccal position and this is often associated with an arch-length discrepancy.2 However, a palatal displacement may be the result of genetic factors3 or the presence of peg-shaped, short-rooted or absent lateral incisor teeth.4 The frequency of impaction varies from 0.8-2.8%.1 In general, patients presenting with this type of problem are treated by surgical exposure of the unerupted impacted canine followed by orthodontic alignment of the tooth.

The Public Health Orthodontic Service in Ireland provides orthodontic treatment and care for patients with certain dental anomalies. Until July 2007 the criteria used were those known as the Department of Health Guidelines 1985.6 In July 2007 the criteria for eligibility changed and the administrative structure of orthodontics within the public health system also changed. It was therefore decided to review the records of patients referred for surgical exposure of the unerupted impacted canine tooth attending the public orthodontic service in the counties of Cork and Kerry during the study period increased from 580,365 in 2002 to 621,130 in 2006.7

The aims of the study were:
1. To determine what trends were evident regarding the number and site of the unerupted impacted maxillary canine.
2. To examine the eruption status of these teeth following surgical exposure.
3. To determine the incidence of agenesis or peg-shaped lateral incisors in patients referred for surgical exposure of an unerupted impacted maxillary canine tooth.

Materials and methods
The letters of referral for all patients referred from the public health orthodontic service in the counties of Cork and Kerry for ancillary treatment from January 2000 until July 2007 were examined. From this we developed a list of 936 patients referred for surgical exposure of an unerupted maxillary canine tooth.

1. The name, address, date of birth, sex and date of referral for surgical exposure of the tooth.
2. Pre-orthodontic study models.
3. Pre-surgical radiographs, OPG and lateral cephalometric.
4. Pre-orthodontic photographs.
The site of the impacted tooth was determined from pre-surgical radiographs and pre-orthodontic photographs and study models. At times the comments of the oral surgeon were available in the orthodontic records. Agenesis of the lateral incisors or the presence of peg-shaped lateral incisors was determined from pre-surgical radiographs and pre-orthodontic photographs and study models. Complete records were not available in all cases; however, if a decision could definitively be made then these cases were included in the study.

Unfortunately, between 2000 and 2007 the Health Service entered into private arrangements with a number of private orthodontists and with the local University Dental School & Hospital regarding the provision of treatment for groups of selected patients. As a result, the records of 180 patients were no longer available for examination. Subsequent review of patient records indicated that 70 patients either refused surgery following initial referral, failed to attend for the surgical appointment or failed to attend for orthodontic assessment following surgical exposure of the tooth, and in a small number of cases the tooth erupted prior to surgical exposure. This amounted to 70 patients being excluded from the study and we were left with 685 patients with full orthodontic records to be included in the study. The palatally placed canines were exposed by open exposure and allowed to erupt spontaneously. The buccally placed canines were exposed by apically repositioned flaps.

**Results**

*Figure 1* indicates the number and sex of patients referred for surgical exposure of the maxillary canine tooth. Of the 685 patients included in the study, 447 (65%) were female and 238 (35%) were male. In *Figure 2* we see the age of patients at referral for surgery. Of the 685 patients, 443 or 65% of the total number of patients in the study were between 10 and 14 years of age. A total of 212 patients were between the ages of 15 and 18 years of age. Finally, 30 patients or 4% of the total were over 18 years of age at the time of referral for surgery.

The number and site of the impacted teeth is displayed in *Figure 3*. A total of 179 patients had both maxillary canine teeth referred for surgical exposure. In all, 864 teeth were referred for exposure and 657 of these, or 76% of the total number of teeth exposed, were palatally placed. A total of 207, or 24% of the teeth, were labially placed. It is evident from the diagram that there is very little difference between the number of teeth on the right hand side (447) and on the left hand side (417), despite 506 patients having only one tooth exposed.
The technique of open exposure was the surgical treatment of the patients referred, a peg-shaped lateral incisor tooth was examined in Table 2. In 635 cases, or 93% of the total number of patients referred, there was no evidence of congenital absence or peg-shaped malformation of the lateral incisor tooth. However, in 15 cases, or 2% of the patients referred, there was congenital absence or agenesis of the lateral incisor. In 34 cases, or 5% of the patients referred, a peg-shaped lateral incisor tooth was present.

**Table 1: The eruption status following surgical exposure of the maxillary canine.**

<table>
<thead>
<tr>
<th>Status</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth erupted uneventfully</td>
<td>829</td>
<td>96%</td>
</tr>
<tr>
<td>Tooth erupted following re-exposure</td>
<td>17</td>
<td>2%</td>
</tr>
<tr>
<td>Tooth remaining unerupted</td>
<td>18</td>
<td>2%</td>
</tr>
<tr>
<td>Total</td>
<td>864</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Table 2: The agenesis and peg-shaped malformation of lateral incisor teeth associated with unerupted maxillary canine teeth.**

<table>
<thead>
<tr>
<th>Status</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No effect</td>
<td>636</td>
<td>93%</td>
</tr>
<tr>
<td>Agenesis</td>
<td>15</td>
<td>2%</td>
</tr>
<tr>
<td>Peg-shaped</td>
<td>34</td>
<td>5%</td>
</tr>
<tr>
<td>Total</td>
<td>685</td>
<td>100%</td>
</tr>
</tbody>
</table>

Discussion

The timeframe from referral to surgical treatment also varied during the treatment period. The technique of open exposure was considered for 17 teeth and these teeth subsequently erupted. However, in 18 teeth re-exposure was not considered and these teeth subsequently failed to erupt, and the majority of cases were referred for surgical removal of the unerupted canine tooth.

Aggenesis and peg-shaped malformation of lateral incisor teeth associated with the unerupted impacted maxillary canine tooth is generally considered to be due to an inadequate arch space. In this study, the impacted maxillary canine was more prevalent in female patients than in male patients, at slightly less than 2:1. Dachi and Howell (1961) found that it was slightly greater than 2:1, and more common in girls than boys. Jarjoura et al (2002) also indicated that it was more common in women than men. Numerous articles have referred to the early detection and management of this condition; however, this is not necessarily the case within a public health system, where treatment can only be offered if the tooth is surgically exposed. Therefore, work such as that done by Erickson and Kurol, where deciduous canines were extracted, or indeed where first premolars were extracted to facilitate eruption of the unerupted canine, were not included in this study. Early diagnosis and intervention can lead to significant improvement of 78% of cases, according to Erickson and Kurol. However, within the Irish system, if the tooth erupted, but in an unacceptable position, treatment might not be offered for this tooth; therefore, case selection had to be quite strict as to who would benefit from early intervention. It is possible that given the option patients may opt for this type of intervention, with a possibility of avoiding surgery, and opt to receive treatment privately outside the public health system.

The issue of interceptive management within a public health setting in Ireland is different to that of private practice. If an interceptive approach regarding extraction of deciduous canines leads to eruption of the canine tooth, even if the canine tooth erupts into an unacceptable position, then that patient can be refused further treatment for alignment of the tooth within the Irish public health system. However, if the tooth is surgically exposed then, irrespective of where the tooth erupts, that patient is entitled to receive orthodontic alignment of the tooth. The policy within the Orthodontic Unit for Cork and Kerry is to provide a situation to enable the patient to receive the most time to adequately plan within the context of the public service and the personnel available for orthodontic alignment of the tooth.
comprehensive treatment available, i.e., if an interceptive approach would allow the tooth to erupt into an acceptable aesthetic and functional position then this approach was carried out. On the other hand, if it was felt that an interceptive approach would simply allow a tooth to erupt and the tooth would erupt into an unacceptable position, then the patient was referred for surgical exposure. Therefore, the decision to refer patients for surgical exposure was a clinical decision in an effort to provide the best possible opportunity for a successful outcome from the patient's point of view, working within the restrictions of a public health orthodontic system.

The age profile of patients in this study is important: the majority of patients were between 10 and 14 years of age at the time of referral for surgery. However, this did not mean that they received surgery when they were within this age band. During the period of the study, four oral surgeons were involved in the surgical exposure of the teeth. At one stage, due to the death of one surgeon and illness of another, there was a long timeframe – often over 18 months – from the time of referral to the time that the patient actually received surgery. The routine school examination in some areas of Cork and Kerry was delayed and, combined with the lack of radiographic facilities, these resulted in delays in patient referral. In many cases the unerupted impacted canine was only discovered during the orthodontic assessment. Therefore, the age profile for patients in this study is significantly higher than in other studies.13,15

In this study the majority of the canine teeth were in the palatal position with a palatal–labial ratio of 3:1. This is quite low in comparison with previous studies,14 which found a palatal–canine ratio of 85-15%. Interestingly, there was little difference between the number of teeth impacted on the right hand side and the number of teeth impacted on the left hand side. Sometimes articles refer to teeth erupting in the line of the arch; however, this distinction was not made in this study and the positioning of the tooth was classified according to the direction of the surgical exposure if the unerupted impacted tooth was close to the line of the arch.

The eruption status of the canine teeth was one of the main reasons for conducting this study. In all cases the palatally placed teeth were exposed using open exposure and the labially placed teeth were exposed using an apically repositioned flap. Therefore, in all cases the open eruption method was used.19 Patients who had the closed eruption method, i.e., a bonded attachment placed at operation and the palatal flaps sutured back intact, were not included in the study.

In this study, 829 canines or 96% of the total number of teeth referred for surgical exposure, erupted uneventfully. In 35 cases or 4% the teeth did not erupt. It was decided to re-expose the unerupted teeth in these cases and, following re-exposure, 17 cases or 2% subsequently erupted. In all, 18 canine teeth out of 864 teeth remained unerupted following surgical exposure and these teeth were subsequently extracted. Therefore, surgical exposure using the open eruption technique allowed 98% of the canine teeth to erupt into the mouth. Of the 18 teeth that ankylosed and failed to erupt, seven were in a labial position and 11 were in the palatal position. Eight patients were in the 10-14 age group, five in the 13-18 and five in the greater than 18 age group. Therefore, a preliminary analysis indicates that age was not a definitive factor in ankylosis of these teeth. Perhaps a more detailed investigation on the exact position relative to the mid line and to the occlusal plane of these teeth may be of benefit in determining why these teeth failed to erupt.

Becker (1981)15 reports an exceptionally high incidence of palatal displacement of maxillary cusps in the presence of anomalous lateral incisors. In this study, I confined myself to the upper lateral incisors being either classified as absent or peg-shaped. I did not measure the size of the lateral incisors and perhaps this could be looked into in a further study. Becker found that in patients with unerupted impacted maxillary canine teeth, congenital absence was found in 5.5% and peg-shaped lateral incisors were found in 17.2% of cases. Mossy et al (1994)17 found weak support for the association between palatal canines and the absence of lateral incisors, and a weak association between palatal displaced canines and lateral incisors of smaller than average crown width. Similarly, Peck et al (1996)18 found similar results; however, Brenchly and Oliver (1997),19 in their results, did not find that peg-shaped or small lateral incisors were associated with palatal displacement of the adjacent canine. In this study, we found that 15 out of 864 canines had a congenital absent lateral incisor associated with it; this was 1.7% of teeth. In 34 cases there was a peg-shaped lateral incisor present. This was 3.9% of impacted canine teeth. Therefore, in this study, the association of congenital absence or agenesis of lateral incisors, and indeed the presence of peg-shaped lateral incisors associated with unerupted impacted maxillary canine teeth is extremely low. I did not examine root resorption associated with the lateral incisors because the radiographic techniques used over the study period would not be sensitive enough to accurately determine the presence or absence, or even extent, of root resorption. The periodontal response of the canine teeth following surgical exposure and subsequent orthodontic alignment will be the subject of a future article.

Summary
The orthodontic records of 685 patients referred for surgical exposure of an unerupted impacted maxillary canine tooth were examined. The condition was more common among females than males, slightly less than 2:1. The impacted teeth had a palatal-labial ratio of 3:1. All of the teeth were exposed using the open surgical technique and in 98% of cases the tooth erupted and was orthodontically aligned. In 2% of cases ankylosis occurred and the teeth were subsequently extracted. The presence of peg-shaped lateral incisors associated with the impacted maxillary canine tooth was 3.4% of the total number of impacted teeth and congenital absence was found in 1.7% of impacted teeth.
References