Developmental defects in the primary dentition of low birth-weight infants: adverse effects of laryngoscopy and prolonged endotracheal intubation

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David I. Tudehope, MBBS, FRACP  Michael O’Callaghan, MBBS, FRACP

Abstract

Trauma caused by laryngoscopy and orotracheal intubation affects mainly the maxillary anterior teeth. Examination of the primary dentition of 63 low birth-weight, prematurely born children showed that developmental defects of these teeth occurred in 85.0% of 40 intubated children compared to only 21.7% of nonintubated children, a fourfold difference. Trauma caused by laryngoscopy affects mainly the left maxillary anterior teeth; in the intubated group of children with defects of maxillary anterior teeth, 66.1% of the affected teeth were on the left compared with 33.9% on the right, a twofold difference. Traumatic injury caused by laryngoscopy and endotracheal intubation at the critical period of amelogenesis may contribute to defects in the dentition of low birth-weight infants whose dental development already is compromised by derangements of calcium metabolism and other systemic factors.

Patients and Methods

The patients in this study were children aged two years and older who were attending the Growth and Development Clinic of the Mater Children’s Hospital, South Brisbane. This clinic was established in 1978 to provide a multidisciplinary longitudinal followup of all surviving infants of low birth weights managed at the Mater Mothers’ Hospital.13-16

A total of 63 children with low birth weights were available for study. They were all prematurely born, with birth weights of between 605 g and 1,500 g, and a mean birth weight of 1,154 g.

There were 37 males and 26 females. Forty received endotracheal intubation and mechanical ventilation in the neonatal period, while 23 did not. At the time of dental examination, the ages of the children ranged from two years, two months to five years, five months, with a mean of three years, eight months. All these children were single births except for a set of twins and three sets of triplets (two sets of which had two surviving members each). Only two children from the third set of triplets were included in the study because the third child had a cleft lip and palate — teeth in the region of orofacial clefts often are defective.

The dental examinations were performed under ideal conditions at the University of Queensland Dental School. The teeth were dried and a mirror and probe used to detect caries, opacities, and enamel hypoplasia. The diagnosis of opacity was restricted to teeth with white or yellow brown areas that did not have hypoplastic enamel, i.e., pitting, ridging, or other disturbances of surface contour. If a tooth showed both opacity and hypoplasia, a diagnosis of hypoplasia was made. All tooth surfaces were examined and the severity and extent of each dental defect recorded in a comprehensive chart. Intraoral photographs were taken in some children. Postnatal medical and dental histories were obtained from the parents. Maternal and neonatal medical histories were
Table 1. Distribution of Defective Teeth in 40 Intubated and 23 Nonintubated Low Birth-Weight Children

<table>
<thead>
<tr>
<th>Tooth</th>
<th>Hypoplasia</th>
<th>Opacity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>E D C B A</td>
<td>A B C D E</td>
<td></td>
</tr>
<tr>
<td>Intubated Group</td>
<td>0 0 3 3 4</td>
<td>15 10 3 2 1</td>
<td>41</td>
</tr>
<tr>
<td>Nonintubated Group</td>
<td>2 4 3 3 1</td>
<td>2 4 3 3 1</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>5 3 6 6 7</td>
<td>17 14 6 5 2</td>
<td>71</td>
</tr>
</tbody>
</table>

Results

Effect of Endotracheal Intubation

Table 1 shows the distribution of defective teeth in the 40 intubated and 23 nonintubated children. To investigate the effects of endotracheal intubation, it is necessary to consider only the dental defects present in the maxillary incisors and canines as neither the laryngoscope nor orotracheal tube would extend beyond the region of the maxillary canines.

Thirty-four (85%) of the 40 intubated infants had defects of the maxillary anterior teeth (Table 2). These 34 affected children had a total of 56 defective maxillary anterior teeth. Only 5 (21.7%) of the 23 nonintubated children had defective maxillary anterior teeth (Table 2). These 5 children had a total of 19 defective maxillary anterior teeth. The difference in the children affected in the two groups (85% versus 21.7%) was statistically significant ($X^2 = 24.46, p < 0.001$). In contrast, no statistical difference was found in the mandibular anterior teeth between the intubated and nonintubated groups ($X^2 = 0.18, p < 0.1$), suggesting that the maxillary anterior teeth were being affected selectively during the intubation process.

Although the intubated group was comparable in gestational age to the nonintubated group ($t = 1.17, p < 0.1$), their mean birth weight was 181 g less ($t = 2.53, p < 0.05$), which indicates that both general and local factors may be operative in causing defective amelogenesis in the intubated group (Table 2). However, low birth weight does not seem to predispose to an increase in prevalence of dental defects in the whole group of 63 children. As can be observed in Table 3, there is no statistical difference in the prevalence of defective dentition between children with birth weight less than 1,000 g, and those of 1,000 g and more ($X^2 = 0.91, p < 0.1$).

Effect of Laryngoscopy

In order to determine whether the endotracheal tube per se is responsible for the selective distribution of dental defects in our study population, the data were analyzed by two separate procedures.

Table 4 shows the relationship between the length of intubation and the prevalence of dental defects. Dental defects occurred in 66.7% of the group receiving intubation for less than 1 day (usually for less than two hours), compared to 74.2% in the group intubated for 2 to 64 days ($X^2 = 0.28, p < 0.1$). These results suggest that laryngoscopy, rather than the endotracheal tube itself, may be the more important cause of the selective distribution of dental defects in our sample.

Further support of this conclusion is provided by

Table 2. Group Characteristics of Intubated and Nonintubated Children

<table>
<thead>
<tr>
<th>Intubated Group (40 Children)</th>
<th>Nonintubated Group (23 Children)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children with defective maxillary anterior teeth (%)</td>
<td>34(85%)</td>
<td>5(21.7%)</td>
</tr>
<tr>
<td>Number of children with defective mandibular anterior teeth (%)</td>
<td>10(25.0%)</td>
<td>5(21.7%)</td>
</tr>
<tr>
<td>Gestational age in weeks (mean ± S.D.)</td>
<td>29.0 ± 2.7</td>
<td>30.3 ± 1.9</td>
</tr>
<tr>
<td>Birth-weight in grams (mean ± S.D.)</td>
<td>1,088.3 ± 257.9</td>
<td>1,269.1 ± 194.3</td>
</tr>
</tbody>
</table>
Table 3. Relationship of Birth Weight to Prevalence of Dental Defects

<table>
<thead>
<tr>
<th>Birth Weights</th>
<th>Number of Children</th>
<th>Number of Children With Defective Teeth*</th>
</tr>
</thead>
<tbody>
<tr>
<td>605-999 g</td>
<td>16</td>
<td>14 (87.5%)</td>
</tr>
<tr>
<td>1,000-1,500 g</td>
<td>47</td>
<td>37 (78.7%)</td>
</tr>
</tbody>
</table>

*χ² = 0.91, p<0.1

The present study indicates that the adverse influences of systemic factors on amelogenesis may be compounded by traumatic factors, the most obvious being laryngoscopy and orotracheal intubation. This reasoning is supported by the observation that in the intubated group of children, the distribution of the defective dentition is localized selectively to the region of the maxillary anterior teeth, notably the left central and lateral incisors. This distribution can be explained better by the traumatic effects of laryngoscopy, rather than by orotracheal intubation for the following reasons. First, the orotracheal tube is taped routinely to the midline, and with regular turning of the infant, it should be displaced evenly on both sides of the midline, rather than predominantly on the left. Second, the prevalence of dental defects did not correlate with the duration of orotracheal intubation. Third, it previously has been reported that traumatic damage to erupted maxillary anterior teeth can be inflicted by laryngoscope leverage.

In the neonate, the process of laryngoscopy involves insertion of the laryngoscope blade into the right side of the mouth, but the blade has to be brought across just to the left of the midline in order to create enough room for the insertion of the orotracheal tube. The instrument is so constructed that it is always held with the left hand, while the right hand is occupied with insertion of the orotracheal tube along the groove on the right side of the laryngoscope blade. Ideally, no force should be applied to the maxillary alveolar ridge during the process of laryngoscopy. However, in very small infants, especially those of low birth weight, the mandible is so hypoplastic that it does not provide a sufficient fulcrum for lifting the anterior oropharynx and tongue in order to expose the laryngeal opening. Thus, an inadvertent leverage

**Discussion**

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Table 4. Relationship of Length of Intubation to Prevalence of Dental Defects

<table>
<thead>
<tr>
<th>Length of Intubation</th>
<th>Number of Children</th>
<th>Defective maxillary anterior teeth (%)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 day*</td>
<td>9</td>
<td>6 (66.7%)</td>
</tr>
<tr>
<td>2 days and greater**</td>
<td>31</td>
<td>23 (74.2%)</td>
</tr>
</tbody>
</table>

* Length of intubation usually less than two hours.
** Length of intubation from 2 days to as long as 64 days.
† χ² = 0.28, p<0.1.

Figure 1. Defective maxillary left central incisor teeth in intubated children.
force sometimes is exerted on the maxillary anterior alveolar ridge, on the left side adjacent to the midline. The importance of the orotracheal tube cannot be discounted completely as another possible local cause of dental defects. Boice et al. reported a nonsurviving low birth-weight infant who showed a notable concavity of the anterior left maxillary ridge clearly outlining the placement of the orotracheal tube. Sections taken through the notched alveolar ridge showed severe disruption of the developing enamel organ. Other workers have observed development of an indentation on the anterior ridge of mechanically ventilated infants due to continual trauma from orotracheal tubes.

Conclusions

The selective distribution of dental defects in intubated infants to the left maxillary anterior teeth indicates that traumatic injuries produced by laryngoscopy and orotracheal intubation may compound further the already high predisposition of low birth-weight infants to developmental defects in their primary dentitions.

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Quotable quote: esthetics and society

The ability to alter appearance has affected how we respond esthetically to differences. An example of this situation is the case of relative maxillary protrusion, the Class II malocclusion. A child who may have been acceptably "buck-toothed" in the 1950s and who may have been a candidate for orthodontic braces in the 1950s and 1960s, now often has a dentofacial deformity, the treatment for which is maxillofacial surgery. The expansion of medical attention toward this nonlife-threatening condition serves to increase its unacceptability as normal. As a result, a minor variant of normal becomes a deformity.

When something is correctable, our willingness to accept it untouched is reduced. The more esthetic variation can be controlled, the less likely we are to tolerate difference. Those who choose not to avail themselves of surgical correction experience peer and community pressures. New forms of treatment also may serve to reawaken concerns in people who had accepted their appearance and were adapted to their social roles.