Minor Dental Injuries (Cracks) due to Oral and Nasal Endotracheal Intubation and Related Factors in Tehran Taleghani Hospital

Massoud Yaghmaei, Massoud Ejlali, Mastaneh Dahi, Mahshid Ghassemi, Hassan Mohajerani, Fereydoun Pourdanesh, Parisa Kaerdouni, Neda Kaerdouni

Abstract

Objective: Oral and dental injuries commonly occur during oral and nasal intubation and comprise one third of lawsuits against anesthesiologists. This study sought to assess dental traumas (especially minor injuries like cracks) due to oral and nasal intubation and related risk factors.

Methods: This observational prospective study was conducted on 60 patients (30 patients in the oral and 30 in the nasal intubation groups) during 2010-2011 in Taleghani Hospital in Tehran. Patients were examined using a disposable sterile clinical examination kit, a periodontal probe and a light curing unit.

Results: Maxillary central incisors had the highest incidence of new cracks (60% and 63.3% in the oral and nasal intubation groups, respectively). Gender, BMI, ASA class, Angle’s classification, and experience of the operator who inserted the tube had no significant association with higher frequency of cracks in the two groups. Incidence of visible dental injuries following nasal and oral intubation was 1.7% and 10%, respectively.

Conclusion: Invisible dental injuries due to intubation are highly prevalent. These injuries are mostly disregarded by the anesthesiologists since they are not visible and do not cause any complication or problem during anesthesia. Enhancing the knowledge of anesthesiologists about dental anatomy, physiology and pathology and use of teeth-guard are necessary measures to prevent such injuries.

Key words: Dental injuries, Anesthesia, Intubation

Introduction:

Endotracheal intubation is a widely used medical procedure that has numerous advantages. However, it is associated with the risk of tooth injury (1). Oral and dental injuries are still among the most common complications of endotracheal intubation for general anesthesia (2-6) and comprise one-third of lawsuits against anesthesiologists (7, 8).

Major dental injuries are noticed by anesthesiologists but invisible minor ones like tooth cracks have not been evaluated and although major dental injuries due to intubation have been widely discussed in anesthetic literature, studies regarding minor dental injuries are scarce.

In the available literature, injuries like fracture, luxation, evulsion and their incidence rates have
been thoroughly discussed; but, tooth cracks have yet to be comprehensively studied. Such invisible injuries have a direct effect on patient’s esthetics and comfort and may impose a treatment and related high costs. Crack propagation may directly change the prognosis of the respective tooth. Thus, any potential crack has to be evaluated before any dental treatment. These cracks may be harmless like the superficial enamel cracks or may be as visible as a fractured cusp. Cracks may extend to the root canal system and cause pulp involvement or may even longitudinally bisect the whole tooth. Cracks may be oblique and propagate cervically. In such cases, the coronal section may be removed and the remaining tooth structure may or may not be repairable. Each of the mentioned conditions may be accompanied by mild, moderate or severe symptoms or can be completely asymptomatic. Due to the high prevalence of tooth fractures and cracks and their direct effect on tooth prognosis, the present study extensively reviews this condition (9).

In the available literature, dental traumas due to nasal intubation have not been discussed. Minor dental injuries like cracks have not been studied either. In a study by Yaghmaei et al, (10) in 2006 the incidence of major dental injuries was reported as 21.42%. By inclusion of cracks as invisible dental injuries, incidence of dental traumas will reach more than 50%. Although the anesthesiologists’ work is through oral cavity, they usually do not have adequate knowledge about teeth, gingival tissue or intraoral prostheses. Thus, enhancing the knowledge of anesthesiologists about the risk of potential minor tooth injuries like enamel cracks is an important task.

Increasing the knowledge of anesthesiologists and dentists about dental injuries due to intubation and proper prevention measures can reduce the incidence of perianesthetic tooth injuries. This study was conducted during 2010-2011 in Taleghani Hospital in Tehran and evaluated tooth injuries due to oral and nasal endotracheal intubation (especially minor injuries like cracks) and related risk factors.

**Methods:**

This prospective observational (cohort) study was conducted on 60 patients presenting to Taleghani Hospital in Tehran who were candidates for general anesthesia. During the study period, patients who based on the surgeon’s opinion and based on the type of surgery were candidates for nasal intubation were selected and matched in terms of age and sex with those who were candidates for oral intubation.

Patients who met the inclusion criteria entered the study. The inclusion criteria were patient’s consent, need for emergency surgery and age over 16 yrs. The exclusion criteria were having no teeth at the under study site, presence of any visible pathology, presence of crown or fixed partial prosthesis (bridge) at the site and use of oral airway. Dental and oral examinations were carried out in the maxilla from canine to canine in order to evaluate visible and invisible dental injuries. Since each patient was hospitalized 24 hours prior to surgery, preoperative examination was done one day prior to surgery. Patients were mainly selected from the maxillofacial, ENT and orthopedic wards. Patients were examined using a sterile disposable examination kit, a periodontal probe and diagnostic head of the SDI light curing unit (Figure 1). This device has several replaceable heads and a powerful LED (light emitting diode). By using its diagnostic head, clinical problems that are not detectable with conventional methods can be found. Use of this device is a non-invasive technique for assessment of patients’ clinical problems. Diagnostic head of this device emits white light with 400-750 nm wave length that passes through the intact tooth structure. Teeth with
calculus or caries cannot adequately pass light. Thus, this device is also helpful for detection of primary caries. Also, it is ideal for revealing tooth cracks (Figure 2).

Figure 1- Light curing unit with its diagnostic head (SDI, Australia)

Figure 2- Detection of tooth cracks using light curing unit

This device is cordless and was covered with disposable covers for each patient. By placing its head behind the tooth, it was able to reveal the cracks, tooth-colored restorations and caries even the primary ones. In each patient, presence of cracks in the 6 anterior maxillary teeth was evaluated using the light curing unit and larger defects like caries or restorations were detected by the use of an explorer. Using a periodontal probe, depth of periodontal pockets was measured at the deepest points in mesiobuccal, midbuccal, distobuccal and palatal sites. Mobility and luxation of the 6 anterior maxillary teeth were also evaluated using dental mirror handle and dental tweezers. The following variables were recorded in the data sheet: patient’s age, sex, height, weight, type of surgical procedure, patient’s physical condition and ASA classification, intermaxillary relationship, general dental status before and after intubation, visible soft tissue traumas pre- and post-intubation and their location, periodontal problems, luxation grade, pocket depth, number and status of enamel cracks, shape and direction of cracks in terms of being horizontal, vertical or oblique before and after intubation, Mallampati score (classification), Cormack-Lehane classification, experience of the operator who inserted the endotracheal tube, type of intubation and in cases of nasal intubation using the right or left nostril. Mallampati score is determined based on the visibility of laryngeal structures at the maximum mouth opening with the tongue sticking out in a seated position without phonation. Cormack-Lehane classification is used for the grading of the best laryngoscopic view possible during laryngoscopy and at the end of intubation. These two variables were used to assess the difficulty of intubation. These variables were re-evaluated after intubation. Post-intubation examination was done by another dentist in order for the experiment to be blind. Since all the operators were right handed and Macintosh curved blade laryngoscope was used in all patients, these two variables were excluded from the data sheet.

Data were analyzed using SPSS version 17 software. In order to evaluate the effect of different variables on the number of cracks, logistic regression analysis or nonparametric Mann Whitney U test were used. At first, the study was thoroughly explained to each patient and after obtaining a written informed consent the examination was started. After examination, dental treatments were carried out in the dental
Results:

Of 60 understudy patients, 30 were in the oral and 30 in the nasal intubation groups. Table 1 presents the information regarding the descriptive statistical indices of patients. Incidence of visible dental traumas following nasal and oral intubation was 1.7% and 10%, respectively.

Table 1- Distribution of descriptive statistical indices in the two groups of oral and nasal intubation

<table>
<thead>
<tr>
<th>Group</th>
<th>Oral intubation</th>
<th>Nasal intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>29.6 (±49.1)</td>
<td>29.8 (±2.53)</td>
</tr>
<tr>
<td>BMI</td>
<td>24.90 (±0.82)</td>
<td>26.12 (±1.20)</td>
</tr>
<tr>
<td>Acceptable dental status</td>
<td>14 (%46.7)</td>
<td>12 (40%)</td>
</tr>
<tr>
<td>ASA</td>
<td>Class I 28 (93.3%)</td>
<td>27 (90%)</td>
</tr>
<tr>
<td></td>
<td>Class II 2 (6.7%)</td>
<td>2 (7.6%)</td>
</tr>
<tr>
<td></td>
<td>Class III 0</td>
<td>1 (3.3%)</td>
</tr>
<tr>
<td>Intermaxillary relationship</td>
<td>Class I 29 (96.7%)</td>
<td>20 (66.7%)</td>
</tr>
<tr>
<td>(Angle’s classification)</td>
<td>Class II 0</td>
<td>7 (23.3%)</td>
</tr>
<tr>
<td></td>
<td>Class III 1 (3.3%)</td>
<td>3 (10%)</td>
</tr>
</tbody>
</table>

Results in the oral intubation group: Of 30 patients in this group, in 27 (90%) number of vertical cracks increased by a minimum of one and in 3 (10%) cases no change occurred in the number of vertical cracks. In 2 cases (6.6%), number of horizontal cracks increased (in one case one crack and in the other one 3 new cracks). Incidence of new tooth cracks following intubation was found to be 90%.

In order to determine the effect of intubation on the number of new cracks and considering the fact that some teeth already had cracks before the intubation, number of newly developed cracks was calculated by subtracting the number of pre-intubation cracks from the number of post-intubation cracks. Number of vertical cracks developed following oral intubation is demonstrated in Table 2.

No significant association was found between vertical cracks and age (using Spearman’s correlation coefficient and P=0.864), sex (using non-parametric Mann Whitney U test and P=0.118) or BMI (using Spearman’s correlation coefficient and P=0.713).

Logistic regression analysis was used to assess the effect of Mallampati score and Cormack-Lehane classification on the number of newly developed cracks. Mallampati score (P=0.411) or Cormack-Lehane classification (P=0.647) had no statistically significant effect on the number of cracks. Considering the fact that most intubations were done by anesthesiology residents, in order to evaluate the effect of gender of operator and his/her work experience on the number of developed cracks, only data regarding anesthesiology residents were used. Gender of residents (P=0.366) or their work experience (P=0.097) had no significant effect on the number of developed cracks.

Percentage of new cracks in each tooth alone was also calculated. Increase in number of cracks was 60% in teeth # 11 and 21, 20% in tooth # 22, 10% in teeth # 12 and 13 and 6.7% in tooth # 23. Maxillary central incisors had the highest incidence of new cracks following intubation (60%).

The coefficient was 0.236 for the correlation between the number of newly developed cracks and caries in the respective teeth, 0.298 for the correlation between the number of newly
developed cracks and restorations in the affected teeth and -0.298 for the correlation between the number of developed cracks and periodontal problems. However, none of these were correlations statistically meaningful.

Results in the nasal intubation group: Of 30 patients in this group, number of vertical cracks increased in 28 cases (73.3%) while in 8 cases (26.7%) no change was observed in the number of vertical cracks. Number of horizontal cracks increased in only one case. Number of vertical cracks following nasal intubation is demonstrated in Table 2. A positive association was found between age and number of cracks (with Spearman’s correlation coefficient=0.372 and P=0.05). No significant association was detected between gender and number of cracks using Mann Whitney U test. Spearman’s correlation coefficient also failed to find a significant correlation between BMI and number of cracks (P=0.923). Patients’ physical status or ASA classification had no significant impact on increasing the number of vertical cracks using non-parametric Mann Whitney U test (P=0.744). Kruskal Wallis test failed to find an association between Angle’s classification and increased number of cracks (P=0.396).

Table 2- Distribution of number of cracks developed following intubation in the two groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Oral intubation</th>
<th>Nasal intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of created cracks</td>
<td>0 (10%)</td>
<td>8 (26.7%)</td>
</tr>
<tr>
<td></td>
<td>1 (36.7%)</td>
<td>5 (16.7%)</td>
</tr>
<tr>
<td></td>
<td>2 (10%)</td>
<td>8 (26.7%)</td>
</tr>
<tr>
<td></td>
<td>3 (16.7%)</td>
<td>2 (6.7%)</td>
</tr>
<tr>
<td></td>
<td>4 (3.3%)</td>
<td>5 (16.7%)</td>
</tr>
<tr>
<td></td>
<td>5 (6.7%)</td>
<td>1 (3.3%)</td>
</tr>
<tr>
<td></td>
<td>6 (6.7%)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>7 (6.7%)</td>
<td>1 (3.3%)</td>
</tr>
<tr>
<td></td>
<td>12 (3.3%)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Nasal intubation through the right or left nostril (P=0.974), Mallampati score (P=457) and Cormack classification (P=0.929) had no statistically significant effect on the number of cracks. In order to assess the effect of operator (anesthesiology resident, anesthesiology technician or anesthesiologist) on number of newly developed cracks, logistic regression analysis was used and no statistically significant effect was found in this respect (P=0.467). Gender (P=0.117) or work experience (P=0.129) of anesthesiology residents had no significant impact on the number of newly developed cracks.

Percentage of new cracks in each tooth alone was also evaluated. Increase in number of cracks was 63.3% in tooth # 21, 40% in tooth # 11, 30% in tooth # 22, 13.3% in tooth # 12 and 3.3% in teeth # 23 and 13. Maxillary left central incisor had the highest incidence of newly developed cracks (63.3% following intubation). The coefficient was -0.034 for the correlation between the number of newly developed cracks and caries in the respective teeth, 0.273 for the correlation between the number of newly developed cracks and restorations in the respective teeth and -0.265 for the correlation between the number of newly developed cracks and periodontal problems. Although a correlation was found between the number of developed cracks and restorations and periodontal problems in the respective teeth,
these associations were not statistically significant.

Discussion:

Risk assessment for perianesthetic dental injuries can be done through preoperative evaluation of teeth and individual anatomical variations at the head and neck area that can interfere with the endotracheal intubation and informing the patient about them. During laryngoscopy, when obtaining an acceptable view of the gloat is difficult, sometimes the maxillary anterior incisors of the patient are used as a rest for the laryngoscope blade. Thus, maxillary incisors especially the maxillary left central incisors show the highest damage (11-14).

In the literature review, we could not find any text relevant to minor dental injuries following intubation like cracks and no data is available regarding their prevalence. In an unpublished study on the visible and invisible dental injuries (including dental cracks) done in 2006 in Taleghani Hospital, incidence of dental cracks following intubation was reported as high as 50% (10). In the present study conducted in Taleghani Hospital in Tehran during 2010-2011, incidence of tooth cracks was 90% following oral and 73.3% following nasal intubation. It seems that difference in incidence of cracks in the present study and the previous one is due to the use of a different device in the present study for detection of cracks. In the current study, SDI light curing unit with the diagnostic head designed specifically for this purpose was used for detection of cracks.

Based on the obtained study results, number of newly developed vertical cracks was smaller in subjects who already had cracks before intubation compared to those with smaller number or no pre-operative cracks. However, this difference was not statistically significant. This issue may be due to the increased flexibility of the tooth crown due to the present cracks. In both groups, maxillary central incisors (teeth #11 and 23) have the most vulnerable location during laryngoscopy and receive the greatest damage. On the other hand, these teeth play the most important role in patients’ esthetics (1).

Although as expected, a correlation existed between the presence of restoration and periodontal problem in teeth and development of new cracks, this correlation were not statistically significant. The correlation between the number of vertical cracks and the restoration in respective teeth was not statistically significant; however, there is a possibility that in restored teeth due to the reduced crown material the force/volume ratio increases resulting in increased risk of cracks. The association between the increased number of vertical cracks and periodontal problems was not statistically significant; however, there is a possibility that periodontal problems cause increased mobility of the teeth resulting in lower number of cracks. Although the reverse correlation between the number of newly developed vertical cracks following intubation and caries in the respective teeth was not significant, caries may increase the flexibility of teeth and subsequent risk of tooth fracture but at the same time reducing the risk of cracks. In a study by Newland et al, (14) in 2007, the most important risk factors for dental traumas included endotracheal intubation, inadequate dental status and difficulty of laryngoscopy and intubation. Maxillary incisors showed the highest damage (62%) and patients in the age range of 50-70 yrs. suffered the highest rate of injuries. In comparison to their study, although our study results demonstrated associations between restorations and periodontal problems with development of cracks, Mallampati score and Cormack classification that were used as indices for assessment of intubation difficulty had no
significant effect on the number of newly developed cracks.
In a study by Chen et al, (15) in 1990 inadequate dental status, presence of dental prostheses, loss of deciduous teeth, inadequate intermaxillary relationship and anterior crowding were the most important risk factors for tooth injuries due to intubation. However, the mentioned study evaluated the visible dental traumas and did not mention tooth cracks. Experience of anesthesiology residents had no statistically significant effect on the number of developed cracks. This finding is in accord with the results of Nakahashi et al, (16) in 2003 who found that expertise of anesthesiology residents had no influence on the risk of dental injuries. In a study by Gaiser and Castro (17) in 1998 incidence of dental trauma due to intubation caused by anesthesiology residents was reported as 0.1% and had no association with their expertise. Several studies have evaluated visible dental traumas. The reason for higher attention of anesthesiologists to visible injuries is because of the lawsuits in this regard as well as risk of aspiration. In an unpublished study by Yaghmaei et al, (10) in 2006, incidence of visible dental injuries was reported as 21.4%. This rate was 1.7% following nasal and 10% following oral intubation. In Chen et al, study (15) in 1990 incidence of dental injuries was found to be 12.1%. Lockhart et al, (12) in 1986 reported the mean incidence of dental injuries to be 1:1000 in 1,135,212 population in one year. Nakahashi et al, (16) in 2003 reevaluated the medical files of patients who had undergone general anesthesia and reported the incidence of dental injuries to be 2.1%. In a retrospective study by Ueda et al, (18) in 2010 conducted on 30,845 patients that had undergone general anesthesia, 110 patients (0.36%) suffered perianesthetic dental injuries. In a prospective study in 2001, Fung et al, (19) found variable degrees of oral traumas in 6.9% of cases. Difference in incidence of major dental injuries in the present study and others may be attributed to the fact that the available studies are retrospective and have had a large sample size. On the other hand, in the present study, the operators were aware of the conduction of this study and thus, they might have paid more attention when inserting the tube. However, it should be noted that in previous studies dental injuries were reported following oral intubation while in the present study we evaluated dental injuries following oral and nasal intubations.

**Conclusion:**

In summary, this study revealed that invisible dental injuries are usually left unnoticed by anesthesiologists because first of all, they are not visible and second of all they do not cause a complication or problem during anesthesia. In general, incidence of dental injuries following nasal intubation was 73.3%. This rate was 90% following oral intubation. Thus, enhancing the knowledge of anesthesiologists regarding dental anatomy, physiology and pathology is of utmost importance.

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