



Identifying the more suitable nostril for nasotracheal intubation using radiographs

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Background: One nostril must be selected for nasotracheal intubation. In some cases, structural anomalies within the nasal cavity hinder the insertion of the tube or complications, such as epistaxis, develop. This study examined the possibility of using radiography to select the nostril that would induce fewer complications.

Methods: Four hundred and five patients who underwent nasotracheal intubation under general anesthesia were studied. A 7.0-mm internal diameter nasal right angle endotracheal (RAE) tube and 6.5-mm internal diameter nasal RAE tube were inserted into men and women, respectively. Complications were considered to have developed in cases in which insertion of the tube into the nasal cavity failed or epistaxis occurred. The tube was inserted into the other nostril for insertion failures and hemostasis was performed in cases of epistaxis. The degree of nasal septal deviation was determined from posteroanterior skull radiographs or panoramic radiographs; the incidence of complications was compared depending on the direction of the septal deviation and the intubated nostril.

Results: The radiographs of 390 patients were readable; 94 had nasal septum deviation. The incidence of complications for cases without nasal septum deviation was 16.9%, that for cases in which the tube was inserted into the nostril on the opposite side of the deviation was 18.5%, and that for cases in which the tube was inserted into the nostril with the deviation was 35.0%, showing a high incidence of complications when intubation is performed through the nostril with septum deviation (chi-square test, $P < 0.05$).

Conclusions: Although there were no differences in the incidence rates of complications between intubation through the left nostril and that through the right nostril, radiological findings indicated that incidence of complications significantly increased when the tube was inserted into the nostril with the septum deviation.

Keywords: Nasal septum; Nasotracheal intubation; Panoramic radiography

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INTRODUCTION

During oral and maxillofacial surgery and dental treatment, the airway is commonly maintained via nasotracheal intubation. One nostril must be selected for nasotracheal intubation, and generally, if there is no obstruction in breathing with one nostril blocked, neither nostril is contraindicated. However, in many cases,

patients who are in need of oral and maxillofacial surgery have anatomical anomalies within the nasal cavity that result in deformities of several structures within the cavity, which render airway management difficult [1,2]. Such structural anomalies may hinder the passage of the tube through the nasal cavity, requiring the intubation to be re-attempted on the other nostril, and may also induce various complications, including epistaxis.

Hence, predicting and selecting the nostril that would

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be easier for nasotracheal intubation and less associated with complications, such as epistaxis, would be conducive to a safer airway management. Furthermore, in some cases, a particular nostril must be selected due to the location of the lesion in surgery; thus, it would be beneficial for the patient if the risks and incidences of complications associated with the selection of nostril were examined.

Although nostril selection has been largely neglected by the literature, some reports have suggested a higher incidence of complications when intubation is performed through the left nostril [2,3]. Smith et al. [4] reported that using a nasal endoscope could be useful for nostril selection. Panoramic radiographs or skull radiographs, which show the anatomical structures within the nasal cavity, are usually taken for patients undergoing nasotracheal intubation. This study was performed because there has been no previous report of prediction of the most appropriate nostril using radiographs.

In this study, we first examined whether there were nostril-specific differences in the incidence of complications for nasotracheal intubation. Then, we conducted a post hoc analysis of the patients' panoramic or postero-anterior skull radiographs, which are generally taken for patients who undergo oral and maxillofacial surgery, to determine the severity of nasal septal deviation. We then compared the results with the incidence of complications after the nasotracheal intubation to examine whether the presence of septal deviation influences the development of complications. We expect the findings of this study to provide important information that can assist in nostril selection for nasotracheal intubation and contribute to safer patient management.

METHODS

1. Study subjects

This study was approved by the Institutional review board (IRB) of the Seoul National University (SNU) Dental Hospital (IRB No. CRI05010). Of patients who

underwent surgery at the SNU Dental Hospital, those who had either ASA physical status I or II, and were in need of nasotracheal intubation and provided written informed consent to the surgery and anesthesia were enrolled. Patients who showed nasal obstruction in either nostril in the operating room or who were required to be intubated through a particular nostril due to the operation site or on request from the surgeon were excluded from the study. Patients aged 15 or younger, in whom different sizes of tubes are usually used, were also excluded from the study. Only patients who had undergone panoramic or posteroanterior skull radiography for preoperative diagnosis were included in the study, resulting in a total of 405 patients in the final analysis.

2. Methods

1.1. Measurement of the nostril-specific incidence of complications during nasotracheal intubation

We did not use a particular table of random digits to assign patients to either the left or right nasotracheal intubation group; instead, we simply allocated patients based on the last digit of their hospital registration numbers, where patients with odd numbers were assigned to the left nostril group and those with even numbers were assigned to the right nostril group. This method was used for random allocation of patients because the registration numbers at the SNU Dental Hospital are created using parity bit and an alignment of the numbers in accordance with the order of admission.

The nasotracheal tube was made of PVC material, and a 6.5-mm internal diameter tube and 7.0-mm internal diameter right angle endotracheal (RAE) tube was used in women and men, respectively.

Anesthesia was induced using the general anesthetics and muscle blockers generally used in dental anesthesia at the SNU Dental Hospital. Vasoconstrictor was not sprayed in the nasal cavity prior to intubation as it could have introduced bias. Instead, we soaked the tube in hot water (about 40°C) to soften it and applied jelly for intubation. If for some reason the insertion of the tube

was obstructed, we inserted the tube into the other nostril, and if intubation through the other nostril still failed, we changed the tube to a smaller size. After inserting the tube into the nasal cavity, we used a laryngoscope to check for bleeding within the oral cavity. If there was heavy bleeding, hemostasis was performed with a gauze after nasotracheal intubation.

Changes of nostril due to obstruction on one side during intubation and the presence of bleeding were recorded as incidences of complications.

1.2. Radiograph analysis

For a double-blind test, three dental anesthesiologists who were not involved in the nasotracheal intubation analyzed the patients' posteroanterior skull radiographs or panoramic radiographs. After nasotracheal intubation was performed, each of the three dental anesthesiologists analyzed the radiographs to determine whether the nasal septum had 1. no deviation, 2. deviation to the right, or

3. deviation to the left. The majority of the three decisions were selected as the final decision, and when interpretation of the posteroanterior skull radiograph and panoramic radiographs differed, a decision with regard to deviation was made based on the posteroanterior skull radiograph, which has a higher resolution.

1.2.1. Nasal septum deviation determination criteria for posteroanterior skull radiographs

On posteroanterior skull radiographs, nasal septum deviation was determined by connecting a vertical line from the base of the nasal septum to the top of the nasal septum to examine the curvature of the nasal septum with reference to this line. The patient was determined to have nasal septum deviation if the nasal septum was bowed by more than 2 mm from this line; in such cases, the deviation was clear to the naked eye and the distances between the inferior concha and septum were shortened (Fig. 1).

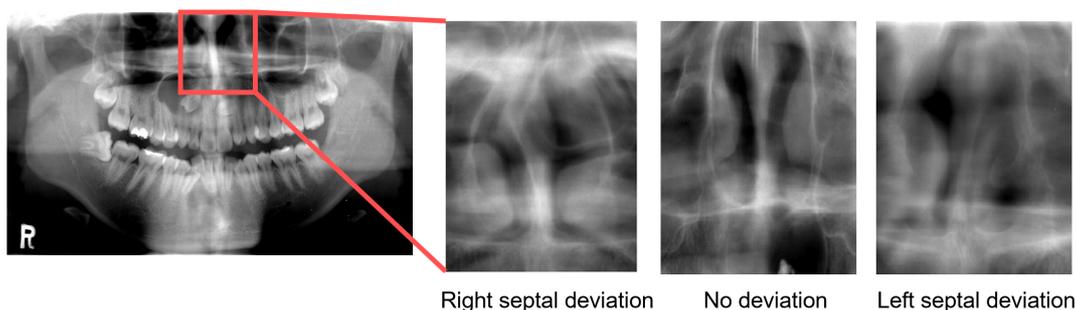


Fig. 1. Panoramic radiographs.

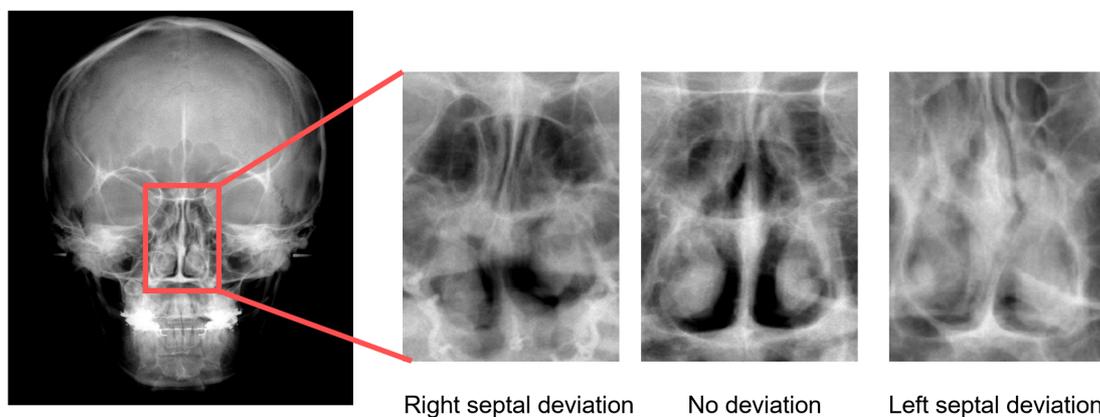


Fig. 2. Posteroanterior skull radiographs.

1.2.2. Nasal septum deviation determination criteria for panoramic radiographs

On panoramic radiographs, septal deviation was determined based on whether the nasal septum was skewed to one side with reference to the hard palate. In addition, the patient was determined to have septal deviation if the distances between the inferior concha and the left and right septum were markedly different (Fig. 2).

1.3. Statistical considerations

1.3.1. Measurement of the nostril-specific incidence of complications during nasotracheal intubation

A chi-square test was performed to examine whether there are significant differences in the incidence of complications between nasotracheal intubation through the left and right nostril. A P-value of less than 0.05 was considered significant.

1.3.2. Radiograph analysis

After determining the presence of nasal septum deviation from posteroanterior skull radiograph or panoramic radiograph, the patients were classified into three groups: intubation on the deviated side, intubation on the opposite side, and intubation with no deviation. The incidence of complications was determined for all three groups and was analyzed via a chi-square test. A P-value of less than 0.05 was deemed significant. All

statistical analyses were performed using the SPSS 22.0 (SPSS Inc. Chicago, IL, USA).

RESULTS

1. Measurement of the nostril-specific incidence of complications during nasotracheal intubation

From 405 subjects, 204 patients underwent nasotracheal intubation through the right nostril while 201 patients underwent that through the left nostril. The gender ratio and demographic features of the subjects are shown in Table 1. The incidence of complications, including the incidence of epistaxis and change of nostrils due to insertion difficulty, is shown in Table 2. The chi-square test showed that there was no significant difference between left and right nostril intubation and the incidence of complications ($P > 0.05$). The incidence of complications in the right nostril was 18.1% while that in the left nostril was 20.4%, with an overall incidence of 19.3%.

2. Analyses of posteroanterior skull radiographs and panoramic radiographs

From 405 subjects, 262 had posteroanterior skull radiographs while 398 had panoramic radiographs. Fifteen of these radiographs were not readable, and 115

Table 1. Patient characteristics according to nostril side used

	Right nostril	Left nostril
Patients(number)	204	201
Age (years)	30.1 ± 13.3	30.5 ± 14.2
Sex (M:F)	108:96	99:102
Weight(kg)	62.0 ± 12.5	62.6 ± 12.6
Height(cm)	166.9 ± 8.4	166.0 ± 11.1
Skull radiograph	125	131
Panoramic radiograph	200	197

Table 2. Incidence of intubation complications according to nostril side used

Complications	Right nostril	Left nostril	Total
No complication	167	160	327
Complications	37	41	78
(Epistaxis)	(26)	(32)	(58)
(Insertion failure)	(15)	(16)	(31)
Incidence	18.1%	20.4%	19.2%

Table 3. Nasal septum deviation decisions from posteroanterior skull radiographs and panoramic radiographs

Septum Deviation	Selected nostril		Total
	Right	Left	
No deviation	139	136	275
Left deviation	30	22	52
Right deviation	29	34	63
Not defined	6	9	15
Total	204	201	405

Table 4. Incidence of complications between the nostril side used and septal deviation

Complications	Nostril side used and septal deviation			Total
	No Deviation	The nostril opposite of septal deviation	The nostril with the septal deviation	
No	230	52	34	316
Yes	45	12	17	74
Incidence	16.3%	18.7%	33.3%*	18.9%

*P < 0.05.

patients were found to present with nasal septum deviation (Table 3).

The incidence of complications among patients without septal deviation was 16.3%. The incidence of complications when the tube was inserted into the opposite side of the deviated septum was 18.7%, and that when the tube was inserted ipsilaterally was 33.3%. The chi-square test verified that the incidence of complications was significantly higher among patients who underwent intubation through the nostril that presented septal deviation ($P < 0.05$) (Table 4).

DISCUSSION

Generally, orotracheal intubation is performed to control the airway during general anesthesia, but nasotracheal intubation is crucial for oral and maxillofacial surgery as well as dental procedures because the oral area is the operation site. However, passing the tube through the nasal cavity, a structurally complex and relatively narrow space, before reaching the trachea during nasotracheal intubation, induces complications such as epistaxis, turbinate fracture, nasal septal fracture, and sinusitis, as well as nasal obstruction or stenosis, rendering intubation difficult [5,6]. The most common complication is epistaxis. It makes airway

management difficult during intubation as it clouds the visual field and may cause airway obstruction when the blood flows into the airway [7].

Many studies have been conducted to identify methods to reduce complications associated with nasotracheal intubation. Using a PVC tube as opposed to the usual rubber tube [8], softening the tube by soaking it in hot water [9], applying surgical jelly [5], spraying vasoconstrictors such as epinephrine in the nasal cavity [10], or using tubes with smaller radii [5] were reported to be useful for reducing epistaxis. Furthermore, the red-rubber catheter technique [11], using an esophageal stethoscope [12], or using a nasogastric tube [13] have been reported to reduce epistaxis, but there are no certain methods that prevent epistaxis heretofore; thus, various conditions must be considered to choose the most effective method for reducing complications.

In addition, it is also important to select the nostril that is predicted to be less associated with complications. According to existing literature, intubation through the left nostril may increase the incidence of complications [14], and nasotracheal intubation through the right nostril may be more beneficial due to the Murphy eye and sharp linings on the right side of the tube [11]. However, many reports have noted that there are generally no differences in using either nostril [5,15]. One report has suggested that selecting the nostril with the high flow rate during

expiration with one nostril blocked may be clinically useful [16]. Nostril selection is complex due to the site of operation and the position of the surgeon during surgery, but many reports have reported that intubation through the left nostril is more useful for orthognathic surgery [17].

A physical examination must precede nostril selection. Currently, the most widely used examination method to prevent complications is to block one nostril and breathe through the other nostril to identify nasal obstruction. In addition, a thorough history taking to identify and avoid the nostril with polyps or sinusitis may also be useful in preventing complications. There may be several causes of epistaxis, and intubation should proceed with caution when the patient has a systemic hemorrhagic disease [18]. These physical examinations and history taking are helpful for reducing complications, but many anesthesiologists tend to neglect physical exams prior to nasotracheal intubation due to a lack of supporting literature. In particular, the findings, as in the present study, that suggest that incidence of complications is largely similar for both nostrils may further promote such tendencies, but these findings may also be useful for selecting nostrils requested by the surgeon for patients with no particular intranasal disease. Furthermore, the fact that this study showed radiographs to be a useful tool to prevent complications is expected to contribute to nostril selection and encourage dental anesthesiologists to refer to panoramic or posteroanterior skull radiographs to verify the presence of intranasal diseases.

In conclusion, this study found no significant difference in the incidence of complications depending on the selection of the nostril for nasotracheal intubation (20.4% and 18.1% for left and right nostril, respectively). However, the incidence of complications significantly increased when the tube was inserted into the nostril found to have septal deviation through posteroanterior skull radiograph and/or panoramic radiograph analyses. Hence, this study concludes that analyzing panoramic or posteroanterior skull radiographs to determine the severity of nasal septal deviation prior to nasotracheal

intubation to select the nostril with less septal deviation would be helpful for reducing the incidence of complications, such as epistaxis or intubation difficulty.

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