

## Randomized Study Comparing the “Sniffing Position” with Simple Head Extension for Laryngoscopic View in Elective Surgery Patients

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**Background:** The “sniffing position” is recommended for optimization of glottic visualization under direct laryngoscopy. However, no study to date has confirmed its superiority over simple head extension. In a prospective, randomized study, the authors compared the sniffing position with simple head extension in orotracheal intubation.

**Methods:** The study included 456 consecutive patients. The sniffing position was obtained by placement of a 7-cm cushion under the head of the patient. The extension position was obtained by simple head extension. The anesthetic procedure included two laryngoscopies without paralysis: the first was used for topical glottic anesthesia. During the second direct laryngoscopy, intubation of the trachea was performed. The head position was randomized as follows: group A was in the sniffing position during the first laryngoscopy and the extension position during the second; group B was in the extension position during the first laryngoscopy and the sniffing position during the second. Glottic exposure was assessed by the Cormack scale.

**Results:** The sniffing position improved glottic exposure (decreased the Cormack grade) in 18% of patients and worsened it (increased the Cormack grade) in 11% of patients, in comparison with simple extension. The Cormack grade distribution was not significantly modified between the two groups. Multivariate analysis showed that reduced neck mobility and obesity were independently related to improvement in laryngoscopic view with application of the sniffing position.

**Conclusions:** Routine use of the sniffing position appears to provide no significant advantage over simple head extension for tracheal intubation in this setting. The sniffing position appears to be advantageous in obese and head extension–limited patients.

DIFFICULT laryngoscopy (as defined by poor glottic visualization) is synonymous with difficult intubation dur-

ing surgery in the vast majority of patients.<sup>1</sup> Correct positioning of the patient appears to be the main determining factor for obtaining a good glottic visualization under direct laryngoscopy. The “sniffing position” has been commonly advocated as the standard head position for direct laryngoscopy. In this position, the neck must be flexed on the chest, typically by elevating the head with a cushion under the occiput and extending the head on the atlanto-occipital joint.<sup>2,3</sup> However, the anatomic explanation of the advantage of the sniffing position has been called into question.<sup>4–6</sup> There is no scientific validation of the efficacy of the sniffing position; in particular, there has been no prospective evaluation of this maneuver. In brief, the sniffing position, although considered the standard of care, needs scientific evaluation. The current study evaluates, in a prospective randomized method with a cross-over design, the potential superiority of the sniffing position compared with simple head extension for glottic visualization during direct laryngoscopy in routine general surgery.

### Methods

After approval by the Human Subjects Committee of the Robert Ballanger Hospital (Aulnay, France) and written informed consent were obtained, all adult patients (older than age 18 yr) scheduled for orthopedic, abdominal, and vascular surgery with general anesthesia in our university hospital were selected for inclusion in this study.

#### Randomization

Randomization was performed by placing index cards with the letter A or B into 600 sealed envelopes (more than the number of study patients), which were then placed in random order. At the time of a patient’s enrollment, the next available envelope was placed with the patient’s chart. At the time of intubation, the envelope was opened and the sequence was thus determined.

#### Preoperative Assessment

Preoperative airway assessment was performed by an attending anesthesiologist. Seven attending anesthesiologists participated in the recruitment and induction of patients. The following criteria were recorded: (1) mouth opening, as the interincisor gap measured in centimeters, with the mouth fully opened (a value less

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than 35 mm was considered predictive of intubation difficulty); (2) thyromental distance was measured along a straight line from the thyroid notch to the lower border of the mandibular mentum with the head in full extension (a value less than 65 mm was considered associated with difficult intubation)<sup>7</sup>; (3) modified Mallampati classification (class I = soft palate, fauces, uvula, and pillars seen; class II = soft palate, fauces, and uvula seen; class III = soft palate and base of uvula seen; and class IV = soft palate not visible<sup>8,9</sup>), performed without phonation; (4) body mass index (BMI), calculated as the weight in kilograms, divided by the square of the height in meters (obesity was defined as a BMI greater than 30 kg/m<sup>2</sup>); and (5) the amplitude of neck and head movement, measured as described by Wilson *et al.*<sup>10</sup> In brief, this technique requires that the patient fully extend the head and neck. A pencil is placed on the forehead in alignment with the vertical axis and the patient is asked to fully flex while the anesthesiologist gauges the change in angle in reference to a fixed point. The angle is then classified according to two levels: less than 80° and 80° or more. Pathologic conditions associated with difficulties in laryngoscopy, such as malformation of the face, cervical spondylosis, tumors of the airway, long-standing diabetes, sleep apnea syndrome, limitation of mandibular anterior-posterior movement, and loose teeth (upper incisors), were also recorded.

#### *Induction of Anesthesia*

Each patient was routinely monitored during the entire procedure by electrocardiography, pulse oximetry measurement of oxygen saturation, and measurement of end-tidal carbon dioxide tension.

Hydroxyzine (100 mg) was given orally as premedication 2 h before surgery. Before induction, standard monitoring for anesthesia was initiated. The standard induction included midazolam 0.03 mg/kg, sufentanyl 0.25 µg/kg, and propofol 2.5 mg/kg. The patients were ventilated with 100% oxygen by mask for 40 s. The initial two laryngoscopies (L1 and L2) were performed in all cases with use of a Macintosh number 3 laryngoscope blade for the sake of consistency of technique. If the operator encountered difficulty with the Macintosh blade, the intubating technique (after L2) could be altered as necessary. Topical anesthesia was performed with use of 5% lidocaine spray during L1. After 40 s, L2 was performed and orotracheal intubation was achieved. This induction process (other than choice of blade) is standardized in our department for scheduled surgery.

Before induction all patients were randomized into one of two groups. Group A included the patients placed in sniffing position during L1 by insertion of a cushion (height, 7 cm) under the head, which was removed before L2. Then, L2 was performed with the patient in simple head extension without a cushion. In group B, the patient was placed in simple head extension without

a cushion during L1 and in the sniffing position with a cushion during L2.

Glottic visualization during L1 and L2 was assessed by utilization of the modified Cormack and Lehane classification, without external laryngeal manipulation.<sup>11</sup> External laryngeal pressure was permitted after evaluation in order to facilitate topical anesthesia during L1 or for insertion of the endotracheal tube during L2. This classification involves four grades of glottic visualization: grade 1 corresponds to complete visualization of the vocal cords, grade 2 to visualization of the inferior portion of the glottis, grade 3 to visualization of only the epiglottis, and grade 4 to a nonvisualized epiglottis.<sup>9,11</sup> The drawing of each grade was given to each operator. A summarized protocol is represented in figure 1. Difficult laryngoscopy was defined as Cormack grade 3 or 4. Intubation difficulty was assessed by the Intubation Difficulty Scale (IDS).<sup>12</sup> This scale is based on the determination of seven parameters, recorded by an independent observer after each intubation: N<sub>1</sub>, the number of supplementary intubation attempts; N<sub>2</sub>, the number of supplementary operators; N<sub>3</sub>, the number of alternative intubation techniques used; N<sub>4</sub>, glottic exposure as defined by the Cormack and Lehane grade 1 (grade 1, N<sub>4</sub> = 0; grade 2, N<sub>4</sub> = 1; grade 3, N<sub>4</sub> = 2; grade 4, N<sub>4</sub> = 3); N<sub>5</sub>, the lifting force applied during laryngoscopy (N<sub>5</sub> = 0 if little effort was necessary, N<sub>5</sub> = 1 if subjectively increased lifting force was used); N<sub>6</sub>, the necessity of applied external laryngeal pressure for improved glottic exposure (N<sub>6</sub> = 0 if no external pressure was applied and N<sub>6</sub> = 1 if external laryngeal pressure was necessary); and N<sub>7</sub>, position of the vocal cords at intubation (N<sub>7</sub> = 0 if the vocal cords were in abduction; N<sub>7</sub> = 1 if the cords were adducted, blocking the tube passage; N<sub>7</sub> = 0 if the cords were not visualized). The IDS score is the sum of N<sub>1</sub> through N<sub>7</sub>. A score of 0 represents an ideal intubation: one performed by the first operator on the first attempt, with use of the first technique and with full visualization of the glottis and little effort. An IDS score between 1 and 5 represents slight difficulty, and an IDS score greater than 5 represents moderate to major difficulty. If intubation is impossible, the IDS score is the value attained before abandonment of intubation attempts.

#### *Statistical Analysis*

We used nonparametric tests (Mann-Whitney U test, Kruskal-Wallis analysis of variance) for comparisons of non-Gaussian distributions. The chi-square and Fisher exact tests were used for comparison of qualitative variables. Assuming a percentage of difficult laryngoscopy (Cormack grade 3 or 4) of around 10%, we calculated the appropriate sample size with use of  $\alpha = 0.05$  and  $\beta = 0.10$  with the Casagrande and Pike formula.<sup>13</sup> With the assumption that use of the sniffing position might reduce the incidence of difficult laryngoscopy to approximately

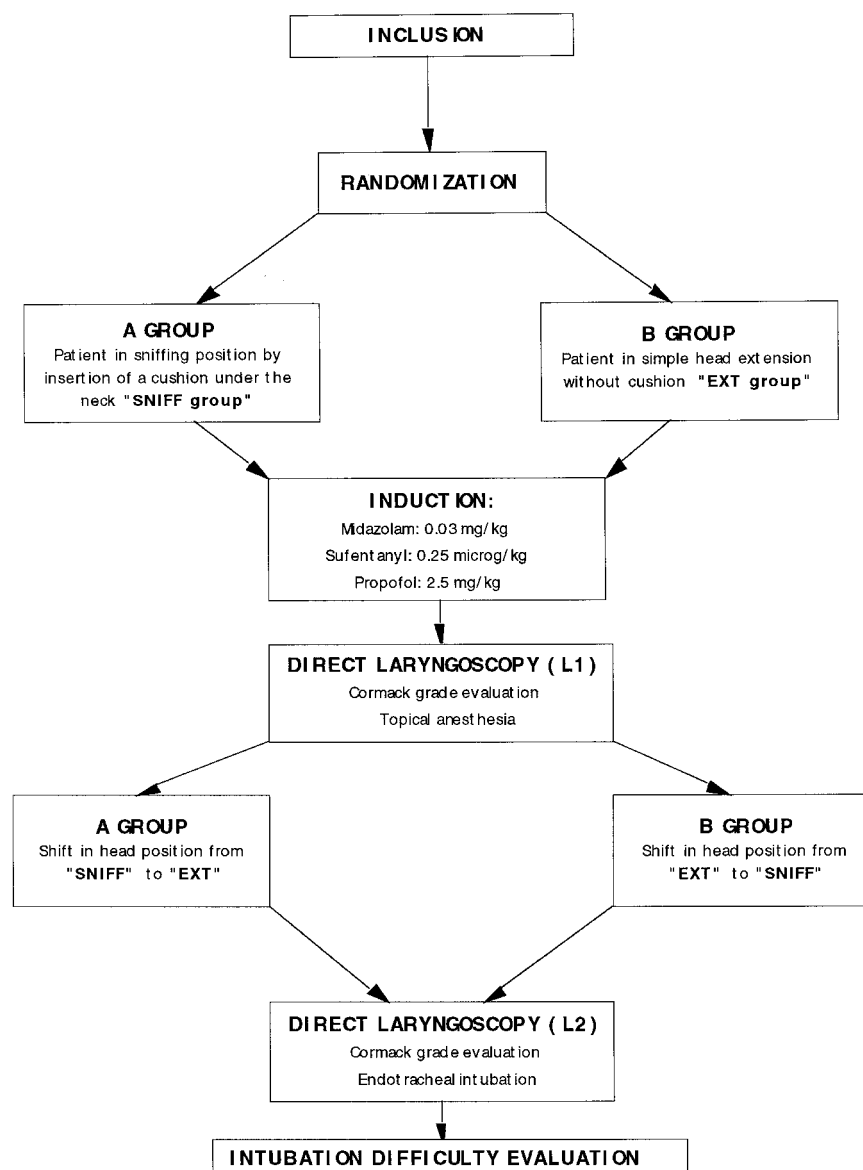


Fig. 1. The study protocol, involving use of the sniffing position (SNIFF) versus simple head extension (EXT).

the same degree as laryngeal manipulation, a minimum of 222 patients for each group should be included.<sup>14,15</sup> Multiple logistic regression was used for analysis of the improvement (or worsening) of glottic visualization by the sniffing position maneuver (binary outcome, yes or no).

All statistics were performed with use of software (Stat-View<sup>®</sup> version 5.0; Abacus Concepts, SAS Institute, Berkeley, CA).  $P < 0.05$  was considered statistically significant.

## Results

### Demographic Data

Four hundred fifty-six patients were consecutively enrolled in this study. Sixty-three additional eligible patients refused to give informed consent for the study and were excluded. Seventy-seven (17%) of the 456 enrolled patients were scheduled for abdominal surgery, 302

(66%) for orthopedic surgery, and 77 (17%) for thoracic surgery. Two hundred twenty-five patients (49.4%) were included in the A group and 231 (50.6%) in the B group. The mean age ( $\pm$ SD) was  $49 \pm 16$  yr. The A and B groups were comparable with respect to age, sex, BMI, and presence or absence of predictive factors of intubation difficulty (table 1). The American Society of Anesthesiologists physical status of 93% of patients was I-II.

### Laryngoscopic Difficulty

Laryngoscopies were possible for all patients, and no patient who consented to participate was excluded. The distribution of Cormack grades between L1 and L2 did not differ significantly for the 456 patients. The incidence of difficult laryngoscopy was 11.4% in the sniffing position group and 10.7% in the simple extension position group ( $P = \text{NS}$ ). The distribution of Cormack grades was not different between the two groups (table 2). The

**Table 1. Baseline Characteristics of Patients from Groups A and B**

Characteristics	Group A (n = 225)	Group B (n = 231)
Age (yr, mean ± SD)	49 ± 15	50 ± 16
Sex ratio (M/F)	114/98	130/86
ASA class III–IV (%)	7	6
BMI (kg/m <sup>2</sup> , mean ± SD)	26 ± 5	26 ± 5
Predictors of intubation difficulty (%)		
Mouth opening < 35 mm	0	0
Thyromental distance < 65 mm	2	3
Mallampati class III–IV	12	10
Neck movement < 80°	8	6
BMI > 30 kg/m <sup>2</sup>	17	18
Tooth missing	8	8
Sleep apnea syndrome	0	1
Other anatomic factors	1	1
Presence of at least one factor	39	38

ASA = American Society of Anesthesiologists; BMI = body mass index.

use of the sniffing position improved glottic visualization (*i.e.*, the Cormack grade decreased) in 84 patients (18%) and worsened it in 51 (11%), in comparison with simple extension. Among the 84 patients for whom the sniffing position improved the laryngeal view, the Cormack grade improved from 4 to 3 in 2 patients, from 3 to 2 in 16 patients, and from 2 to 1 in 66 patients.

**Intubation Difficulty**

No intubation was impossible in this series. The median (25th–75th percentiles) IDS value was 1 (0–2). Intubation without difficulty (IDS score = 0) represented 52% (239) of the 456 intubations. The percentage of intubations with an IDS score greater than 5 (moderate to major difficulty) was 2.6%. In the sniffing position group, the median (25th–75th percentile) IDS score was 0 (0–2), and in the extension position group it was 1 (0–1) (*P* = NS). Comparison of the IDS score distribution between the two groups demonstrated no statistically significant differences (fig. 2).

**Table 2. Distribution of Cormack and Lehane Grades between the Sniffing Position Group and Extension Groups**

Cormack and Lehane Grade	Sniffing Position Group (n = 456)	Extension Group (n = 456)	<i>P</i>
1	269 (59%)	238 (52%)	NS
2	135 (30%)	169 (37%)	
3	49 (11%)	45 (10%)	
4	3 (1%)	4 (1%)	

NS = not significant.

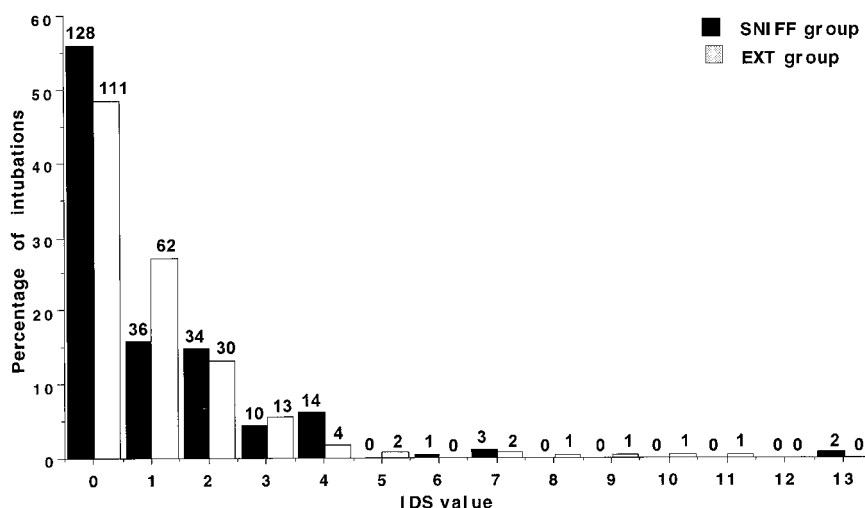
**Predictive Factors Associated with the Improvement of Glottic Visualization by the Sniffing Position Maneuver**

For the 84 patients for whom the sniffing position showed an improvement of laryngoscopic view, correlation with predictive factors of intubation difficulty was determined. Univariate analysis revealed improvement in the quality of the laryngoscopic view by application of the sniffing position for obese patients (BMI, greater than 30 kg/m<sup>2</sup>), reduction of neck movement to less than 80°, or presence of a least one known factor of difficult intubation (table 3). Multivariate analysis showed that limitation of head extension and a BMI greater than 30 kg/m<sup>2</sup> were independently related to good laryngoscopic view when the patient was placed in the sniffing position, with odds ratios (95% confidence interval) of 2.8 (1.2–6.8) and 2.4 (1.1–5.2), respectively. For the 51 patients in whom the sniffing position worsened the laryngoscopic view, similar analyses revealed no significant association with predictive factors of difficult intubation.

**Discussion**

This study shows that the sniffing position does not significantly affect the laryngoscopic view, in comparison with simple extension, during direct laryngoscopy when it is systematically used with the Macintosh blade.

**Fig. 2. Intubation Difficulty Scale (IDS) score distribution among patients in the sniffing position (SNIFF) group versus the simple head extension (EXT) group during the second laryngoscopy. The assigned IDS values are shown on the horizontal axis, whereas the number of patients with each score is represented in the vertical bars. The absolute numbers of patients are shown above each bar.**





**Table 3. Factors Associated with Improvement in Glottic Visualization Obtained by the Sniffing Position**

Characteristics	Sniffing Position with Improved Laryngoscopic View (n = 84) (%)	All Others (n = 372) (%)	P
Mouth opening < 35 mm	0	0	NS
Thyromental distance < 65 mm	1	3	NS
Mallampati class III-IV	14	10	NS
Neck movement < 80°	14	6	< 0.01
BMI > 30 kg/m <sup>2</sup>	29	16	< 0.01
Others anatomic factors	0	1	NS
Presence of at least one factor	47	33	< 0.05

NS = not significant; BMI = body mass index.

We chose to standardize the blade used for consistency, but we recognize that the findings might be different under other conditions (the use of other blades, for example). The sniffing position for tracheal intubation is usually obtained by (1) flexing the neck on the chest by elevating the head with blankets or pillows under the occiput and (2) extending the head on the neck (atlanto-occipital extension) by tilting the head backward with the hand of the operator.<sup>3</sup> This position is widely recommended, although there has been no rigorous scientific evaluation of its efficacy. This study is the first, to our knowledge, to attempt to validate the benefit of systematic use of the sniffing position by insertion of a cushion (or blankets) under the neck of the patient before anesthesia. Systematic application of the sniffing position is, in our experience, operator-dependent. In other words, operators often choose to use or not use the sniffing position on the basis of clinical impressions rather than protocol. We found no appreciable benefit in its systematic use in comparison with simple head extension. In contrast, the presence of obesity or limitation of head extension appears to be a significant independent predictor of improvement of glottic visualization when the sniffing position is used.

The fact that we found no significant advantage of the sniffing position over simple head extension (with the exception of obese patients and those with limited extension) is less an indictment of the sniffing position than reinforcement of the importance of head extension in all patients. The principal difference between the sniffing position and simple head extension resides in inducing neck flexion on the thorax. In fact, in the nonobese patient with normal extension, the simple maneuver of head extension against a flat surface will inevitably somewhat flex the neck, as demonstrated in an experimental study with use of magnetic resonance imaging (MRI).<sup>5</sup> On the other hand, obese patients almost certainly have an increased distance between the axis of the cervical spine and the table surface (because of the greater body fat on the back and shoulders). This implies that simple extension may not inevitably lead to

neck flexion on the thorax and that addition of a cushion (to compensate for body fat) may provide anatomic support for neck flexion. For patients with limited cervical extension, the most practical means of achieving neck-on-thorax flexion is to add a cushion.

This study has several limitations. First, it was unblinded; however, we chose not to perform a blinded study because of the technical difficulties that blinding would impose. Perhaps in a limited series of patients, the use of a fiberoptic camera to obtain an operator's view of glottic exposure might be useful. Furthermore, the choice of a Macintosh blade was imposed on the operators for sake of consistency. We recognize that use of a different blade might alter the results.

As noted by Hochman *et al.*<sup>16</sup> in an historical and experimental article, review of the literature reveals that direct exposure of the larynx has developed primarily as an art and a craft, without sophisticated investigations based on anatomic principles. The anatomic explanation advocated by Bannister *et al.*<sup>5</sup> is in disagreement with findings in recent MRI studies. Our findings also suggest that we must re-examine the ideal head and neck position for direct laryngoscopy in a patient whose airway is difficult to expose. Hochman *et al.*<sup>16</sup> evaluated, in a prospective investigation in 20 patients, three neck-head positions for laryngoscopic view. These were extension-extension (occiput was placed below the horizontal plane), flexion-extension (sniffing position), and flexion-flexion (chin to the chest). In this study, glottic exposure improved gradually with progression from extension-extension to flexion-extension and finally to flexion-flexion.<sup>16</sup> However, the authors did not evaluate simple head extension, with the occiput resting on the operating table. Furthermore, with the sniffing position, elevation of the head from the horizontal line was manually performed; thus, this parameter was not constant.

Clearly, during direct laryngoscopy, the main determinant of good glottic visualization is aligning the line of vision of the operator (the line from superior incisors to the posterior portion of the cricoid cartilage) with the laryngeal axis.<sup>11</sup> Thus, the angle between these two axes must be minimized. We have found in an experimental study with use of MRI that there was no significant difference in this angle between simple head extension and the sniffing position, but this angle decreased during the passage from neutral to head extension or to the sniffing position.<sup>5</sup> This study, however, was limited by the fact that it involved nonanesthetized volunteers and the laryngoscope blade was not used. Our clinical study, in contrast, was performed under scheduled anesthesia conditions without modification of our routine anesthetic procedures.

Our results suggest that there is no significant difference between the sniffing position and head extension with regard to the incidence of difficult laryngoscopy. We have compared the patients in whom direct laryn-

gосcopy was improved by the sniffing position and all other patients. Multivariate analysis identified only obesity and reduction of neck extension as anatomic factors with which the sniffing position offers an advantage.

One final note is that this clinical study reaffirms the findings of our previous MRI study involving healthy volunteers, suggesting that MRI may play a useful role in the investigation of factors involved in difficult laryngoscopy and intubation.

In conclusion, in a series of 456 patients undergoing general anesthesia, systematic application of the sniffing position offered no appreciable advantage over simple head extension for improvement of glottic visualization with use of direct laryngoscopy and a Macintosh blade. The sniffing position appears to be advantageous for obese and head extension-limited patients.

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