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# COMPARISON OF RAMPED POSITION VERSUS SNIFFING POSITION ON GLOTTIC VISUALIZATION AND ITS RELATION TO PREDICTORS OF DIFFICULT AIRWAY IN NON-OBESE PATIENTS

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**ABSTRACT** **Background and Aims:** Proper head and neck positioning is vital for optimizing glottic visualization during direct laryngoscopy and ensuring successful intubation. While the sniffing position (SP) is considered the gold standard, the ramp position (RP) has been proposed as a superior alternative, particularly in obese patients. This prospective comparative study evaluates and compares the effectiveness of the Ramp position versus Sniffing Position in improving the laryngoscopic view and ease of endotracheal intubation in adult patients undergoing elective surgery. **Materials and Methods:** This study included 80 adult patients, aged 18–60 years, with American Society of Anesthesiologists (ASA) physical status I and II scheduled for elective surgery under general anesthesia. Patients were randomized into two groups: Group R and Group S . Direct laryngoscopy was performed initially in the assigned position, and Modified Cormack-Lehane Grade (CLG) was recorded. Subsequently, the position was switched and CLG was reassessed. Additional data collected included use of airway adjuncts, need for ancillary maneuvers, and complications. Associations between CLG and factors such as BMI, Mallampati score, thyromental distance, and neck circumference were also analyzed. **Results:** Ramp position provided superior laryngoscopic views compared to sniffing position in both obese (BMI ≥25; p=0.034) and non-obese patients (BMI <25; p=0.003). Statistically significant improvement was observed in RAMP position and improvements were consistent in obese, and across Mallampati classes (MMC ≥3: p=0.034; MMC <3: p=0.005) and TMD groups (<6.5 cm: p=0.049; ≥6.5 cm: p=0.026). There was also reduced need for ancillary maneuvers in ramp position, No significant correlation was found between neck circumference and CLG. Complications were minor and equally distributed in both groups. Complication rates were similar (15% RP vs 20% SP; p=0.6), with hypertension most common (12.5% both groups). **Conclusion:** The ramp position improves glottic visualization and facilitates easier intubation, even in non-obese patients. This supports the broader use of ramp positioning as a routine strategy in airway management to improve patient outcomes.

**KEYWORDS :** Ramp Position, Sniffing Position, Endotracheal Intubation, Cormack-Lehane Grade, Airway Management

## INTRODUCTION

Endotracheal intubation is an essential skill that every anesthesiologist should master. Appropriate positioning of head and neck is required for successful endotracheal intubation, which require the alignment of the airway axes; the oral, pharyngeal and laryngeal axes. According to The Difficult Airway Society, classic supine "sniffing" position is the recommended position for all patients undergoing direct laryngoscopy with Macintosh laryngoscope. "Ramped" position is recommended for obese patients because it improves the view of larynx during direct laryngoscopy.[1] Sniffing position is provided by flexion at lower cervical joint and extension at the atlanto- occipital joint with 35° neck flexion and 15° head extension[2]. In obese individuals due to their distended abdomen which pushes thorax upward and outward, there is failure in good laryngeal visualization in sniffing position even if the Mallampatti class, thyromental distance, neck circumference and cervical extension suggest less difficulty[3]. Ramp position can be achieved by elevation at the shoulder level so that the head and shoulders of the patient are raised above the lower body and the ear and sternal notch comes in the same plane horizontally[4].This aligns the oral,pharyngeal and laryngeal axes and promotes good laryngeal visualization. Direct laryngoscopy is thus a dynamic procedure requiring adjustments as per patients' anatomy of head and neck.

Only a few studies comparing these two positions in non-obese patients are available. Hence, we decided to conduct a comparative study to determine if the ramping position improved laryngoscopy grade when compared to the sniffing position for non-obese patients undergoing endotracheal intubation. We also wanted to evaluate the association between Modified Cormack Lehane grading (CLG), and the commonly used predictors of difficult intubation such as Thyromental distance, Neck circumference and Mallampatti Score, in obese and non-obese individuals and to observe any complications encountered during intubation.

## MATERIALS AND METHODS

The study was conducted after obtaining approval from the institutional ethics committee (Approval number: JSS/MC/PG/2046/16/2023-24) and registering in the Clinical Trial Registry of India (CTRI number CTRI/2024/04/065544). After obtaining written informed consent, patients belonging to ASA physical class I-II in the age group of 18-60 years of either sex undergoing elective surgery under general anesthesia requiring endotracheal intubation were selected for the study. Since we wanted to validate the efficacy of ramp position in the obese patients and study the effect of this position in non-obese population, we did not have any cut-off criteria for BMI but only ensured randomization. Patients with unstable cervical spine and spine abnormalities, those requiring rapid sequence intubation or awake fiberoptic intubation or nasal intubation, and having gross facial deformities or orofacial injuries were excluded from the study.

The patient's BMI, Mallampati Score, Thyromental distance and Neck circumference were noted during the pre-anesthetic evaluation. They were divided into two groups, Group S and Group R. Randomization was achieved using shuffled opaque sealed envelope technique by an anesthesiologist who did not participate further in the study.

On the day of the surgery, standard ASA monitors were attached. Patient was preoxygenated with 100% oxygen for three minutes, premedicated with Injection Midazolam0.01mg/kg and Injection Fentanyl 2µg/kg. Patient was induced with Injection Propofol 2mg/kg and Injection Vecuronium 0.1mg/kg. In Group S, laryngoscopy was done in "sniffing position" first and Modified Cormack Lehane grade was noted. The table position was then altered to achieve "ramp position". A protractor was used to elevate the table to $50^0 \pm 6^0$ angle, with $0^0$ in alignment with the table in neutral position[5]. ( FIGURE 1). The head piece of the table was then flattened to bring the external auditory meatus (EAM) and sternal notch in a horizontal line (FIGURE 2). This was confirmed by using the Scale-Ampoule method where a transparent ampoule was plastered to a long metallic scale and held horizontally between EAM and sternal notch and adjusted such that the bubble in the ampoule came to lie in the centre (FIGURE3)[11]. Modified Cormack Lehane grading was noted in this position again. In GroupR, laryngoscopy was done in ramp position first and in sniffing position later. The endotracheal tube of appropriate size was inserted and the ease of tube insertion was assessed, by noting the need for any external maneuvers like backward, upward and rightward pressure

(BURP) by the assistant or use of adjunct devices like stylet or bougie. The position of the ET tube was confirmed with 5 point auscultation and capnography.

In case the intubation was difficult in either of the positions, a switch was made to the other position. If direct laryngoscopy and intubation was still difficult after change of position, call for help and difficult airway algorithm was initiated assuming an unanticipated difficult airway scenario.

Calculation of sample size was based on the prevalence in previous studies that compared the laryngoscopic view of patients undergoing elective surgery under General anesthesia in supine position and ramp position. Considering the proportion in group "sniffing" and group "ramp" of 0.567(56.7%) and 0.344(34.4%) from the parent article, the calculated risk difference came up to 0.233. With 5% α error and 80% power, the sample size was 77 for each arm which was rounded to 80.

**Data Analysis**

Statistical methods: The collected data was analyzed using the Statistical Package for the Social Sciences (SPSS version 28) and R software. For continuous variables, descriptive statistics such as mean and standard deviation were calculated, while frequency and percentage were measured for categorical variables.

The mean difference between groups was determined using Independent sample T test for continuous variables. Mann – Whitney U test was applied to find the difference between two discrete variables. Chi square test was used find the difference in proportions between two independent groups. The level of significance was set at 0.05, with a 95% confidence level and 5% α error.

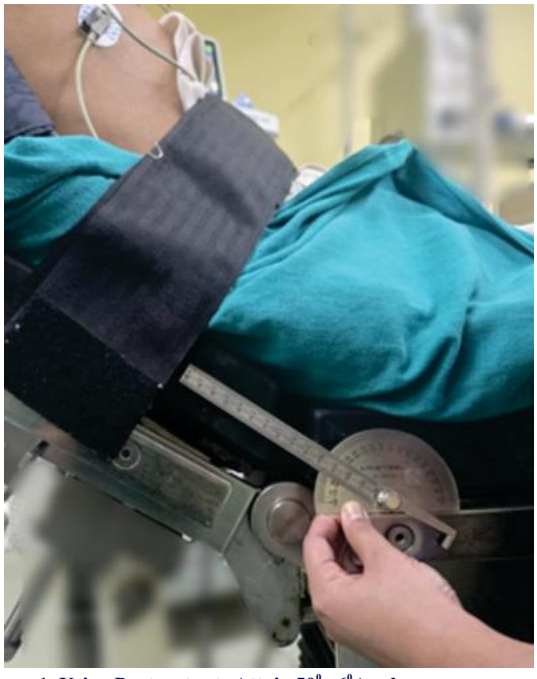

**Figure 1: Using Protractor to Attain $50^0 \pm 6^0$ Angle**

**Figure 2: The Final RAMP Position of the Table**

**Figure 3: Scale –ampoule Assembly**

**RESULTS**

In this study involving eighty patients, both the ramp and sniffing groups were comparable in terms of demographic features such as age, gender, BMI, ASA status, and distribution of predictors of difficult airway (thyromental distance, neck circumference, and Mallampati class)Statistically significant difference was not seen in the baseline parameters.(TABLE 1)

Cormack-Lehane (CL) Grading is the primary outcome measure in our study. Higher proportion of patients in the sniffing group exhibited restricted laryngoscopic views (Grade III) than those in the ramp group (32.5% vs. 7.5%; p=0.01). There was a significant improvement in laryngoscopic view in the ramped position over the sniffing position (p=0.003). Grade III views were fewer in the Ramp group (7.5%) than in the Sniffing group (32.5%). (p = 0.01). (TABLE 2)

The ramp position consistently offered better laryngoscopic views compared to the sniffing position for all BMI categories.(BMI ≥25 p=0.034; BMI <25p=0.003). Improved CL grades were observed in patients across all the Mallampati classes (MMC) [MMC ≥3p=0.034 and MMC<3 p=0.005]. Similarly ramp position improved CL grades with respect to the Thyromental distance [TMD<6.5 cm(p=0.049), and TMD ≥6.5 cm (p=0.026)] Neck circumference did not show a significant association with the laryngoscopic view in either position, although clinically better views were noted in the ramped group.(TABLE 3)

The need for external laryngeal manipulation was less in ramp position compared to the sniffing position, hence the ease of intubation was better in ramp position. Complication rates were similar between groups, (p = 0.6) with hypertension being the most common (12.5% in both groups), followed by hypotension (2.5% in Group Ramp vs. 7.5% in Group Sniffing).

**Table 1: Comparison of Study Groups in Terms of Demographic Characteristics, Use of External Laryngeal Manipulation and Complications**

| Characteristic / Parameter | Group Ramp (n=40) | Group Sniffing (n=40) | p-value | Statistical Test |
|---|---|---|---|---|
| Age (years), Mean ± SD | 39 ± 13 | 39 ± 12 | 0.90 | Independent t-test |
| Gender | | | 0.25 | Chi-square |
| – Female | 24 (60.0%) | 29 (72.5%) | | |

| | | | | |
|---|---|---|---|---|
| – Male | 16 (40.0%) | 11 (27.5%) | | |
| ASA Physical Status | | | 1.00 | Fisher's Exact |
| – I | 21 (52.5%) | 21 (52.5%) | | |
| – II | 19 (47.5%) | 19 (47.5%) | | |
| BMI (kg/m²) | | | 0.62 | Chi-square |
| – <18.5 (Underweight) | 2 (5.0%) | 3 (7.5%) | | |
| – 18.5–22.99 (Normal) | 12 (30.0%) | 12 (30.0%) | | |
| – 23–24.99 (Overweight) | 11 (27.5%) | 7 (17.5%) | | |
| – ≥25 (Obese) | 15 (37.5%) | 18 (45.0%) | | |
| External Laryngeal Manipulation (ELM) | | | 0.31 | Chi-square |
| – No | 23 (57.5%) | 19 (47.5%) | | |
| – Yes | 17 (42.5%) | 21 (52.5%) | | |
| Overall Complications | | | 0.55 | Fisher's Exact |
| – No | 34 (85.0%) | 32 (80.0%) | | |
| – Yes | 6 (15.0%) | 8 (20.0%) | | |
| Complication Types | | | 0.48* | Fisher's Exact (by type) |
| – Hypertension | 5 (12.5%) | 5 (12.5%) | 1.00 | Fisher's Exact |
| – Hypotension | 1 (2.5%) | 3 (7.5%) | 0.30 | Fisher's Exact |

**Table 2: Cross Tabulation of Cormack Lehane Grading in Sniffing Position (CL-S) and Ramp Position(CL-R)**

| CL-S \ CL-R | I | IIA | IIB | III | Total |
|---|---|---|---|---|---|
| I | 2 | 3 | 2 | 0 | 7 |
| IIA | 2 | 8 | 9 | 0 | 19 |
| IIB | 5 | 12 | 16 | 2 | 35 |
| III | 1 | 6 | 9 | 3 | 19 |
| Total | 10 | 29 | 36 | 5 | 80 |

**Table 3: Change in Cormack Lehane Grade in Ramp Position for Various Parameters**

| Parameter | Sub-group | n | Improve-ment Rate | Worsening Rate | Odds Ratio (95% CI) | McNemar-Bowker Test (p-value) |
|---|---|---|---|---|---|---|
| BMI | ≥25 kg/m² (Obese) | 33 | 48.5% | 12.1% | 3.42 (1.21–9.68) | $\chi^2$=8.91, p=0.034 |
| | <25 kg/m² (Non-obese) | 92 | 42.9% | 9.5% | 4.33 (1.25–15.03) | $\chi^2$=18.64, p=0.003 |
| Mallampati Class (MMC) | ≥3 (Difficult) | 16 | 56.3% | 18.8% | 5.00 (1.45–17.28) | $\chi^2$=6.12, p=0.034 |
| | <3 (Normal) | 34 | 44.1% | 8.8% | 5.00 (1.45–17.28) | $\chi^2$=18.64, p=0.005 |
| Thyromental Distance (TMD) | <6.5 cm (Short) | 52 | 38.5% | 11.5% | 3.33 (1.30–8.54) | $\chi^2$=12.63, p=0.049 |
| | ≥6.5 cm (Long) | 28 | 46.4% | 10.7% | 4.33 (1.25–15.03) | $\chi^2$=14.32, p=0.026 |
| Neck Circum-ference (NC) | >40 cm | 58 | 44.8% | 10.3% | 4.33 (1.25–15.03) | $\chi^2$=5.23, p=0.065 |
| | ≤40 cm | 22 | 36.4% | 13.6% | 2.00 (0.72–5.52) | $\chi^2$=2.38, p=0.123 |

## DISCUSSION

Endotracheal intubation is a vital skill for anesthesiologists. An essential factor contributing to the success of laryngoscopy and intubation is appropriate patient positioning.

The Difficult Airway Society recommends the traditional sniffing position (SP) for all patients undergoing direct laryngoscopy using a Macintosh laryngoscope.[1] This position was first recommended by Ivan Magill in 1936.[15] The beneficial effect of this position is explained by the three axes alignment theory (TAAT), proposed by Bannister and Macbeth. SP aligns oral, laryngeal and pharyngeal axes bringing the direct line of vision on the glottis.[16] Horton et al. defined the angle of plane of face extension with horizontal plane as $15^0$ and angle of neck flexion as $35^0$ to achieve this SP.[17]

Head elevation to bring the external auditory meatus (EAM) and the sternal notch in horizontal alignment is considered as a marker for appropriate positioning for obese patients as it has been shown to provide better visualization of the larynx during laryngoscopy. Hence Ramped position is advised for obese patients,[5,18] however it is not routinely used for non-obese patients.

From our study we wanted to see if the ramp position offers any extra benefit in non-obese patients in terms of glottic view, ease of intubation and complications. Hence, we correlated Cormack Lehane grading with the parameters predictive of difficult airway like Thyromental distance, Mallampati class and neck circumference. Conventionally Ramp position is achieved by stacking linen, with specialized pillows (Ex: Oxford Head Elevating Laryngoscopy Pillow, Hasanin pillow) or commercially available ramp devices (Troop Elevation Pillow). But this entails extra personnel, linen, expense, and time. During emergencies, precious time will be lost in assembling the ramp, thereby delaying intubation. In our study, we have used remote operated tables which were raised to $50° \pm 5°$, with the remote to achieve ramp position and EAM- sternal notch alignment was achieved by flattening the head piece of the table. Accuracy was ensured by using a unique, and simple technique of the scale ampoule assembly.

Cormack-Lehane (CL) Grading is the primary outcome measure in our study. We considered CL grades I, IIA, IIB as better grades and grades III and IV as worse grades of glottic visualization, The ramped position was associated with a statistically significant enhancement in glottic visualization compared to the sniffing position. These results are consistent with the findings of Nayak et al. and Collins et al. Collins et al reported superior glottic visualization with the Head-Elevated Laryngoscopy Position (HELP), achieved by stacking pillows and blankets below the patients' thorax[5] to align the sternal notch with the external auditory meatus. Nayak et al. previously compared the sniffing and head-elevated positions using Cormack-Lehane grading (CLG) and the Intubation Difficulty Scale (IDS). Their findings indicated better laryngeal visualization and improved IDS scores in the head-elevated group[14]

Lebowitz et al. also concluded that head and shoulder elevation significantly enhance laryngoscopic view, aligning with our findings[10]. Dhar et al. compared fixed-height and custom-height pillows, noting the challenges of achieving proper ramping without standardized equipment[13]. In our study we have tried to overcome this problem by standardizing the angulation and positioning by using the scale-ampoule assembly

A study conducted by Levitan et al in 2003 on 7 human cadavers tried to find the effect of laryngoscopy by progressively elevating head and flexing neck [Head-Elevated Laryngoscopy Position (HELP)]. The laryngoscopy angle was assessed using an angle finder where the mean mid-position laryngoscopy angle was taken as $49°\pm6°$.[7] Based on this finding, we have used $50° \pm 5°$, as the reference angle to achieve ramp position with the help of a protractor. The alignment of the external auditory meatus (EAM) and sternal notch was confirmed with the Scale Ampoule Method as used in the study by Sinha et al, where a transparent ampoule (attached to a long metallic scale) was held horizontally between the EAM and sternal notch. The table's elevation and head-end adjustments were fine-tuned until the air bubble inside the ampoule was centered, ensuring precise positioning[11]. With this method there was easy transition from the sniffing to the ramp position without relying on stacked blankets or costly specialized pillows, offering a practical, and cost-effective alternative for improving laryngoscopic view and intubation success.

Additionally, in our study, the need for external laryngeal manipulation was less frequent in the ramp group (42.5%) than the sniffing group (52.5%). This difference was clinically significant although not statistically significant (p=0.3). This indicates that the ramp position offers a more optimal glottic view, reducing the need for auxiliary intubation maneuvers and improving overall intubation success.

Both groups showed comparable rates of adverse events such as hypertension and hypotension, confirming that the ramped position is as safe as the sniffing position for airway management. The most

frequent complication observed was hypertension, noted equally in both groups (12.5%).

Further analysis on the entire study population based on BMI, showed that the ramped position offered statistically significant improvements in glottic visualization in both obese (BMI ≥25 kg/m²) and non-obese (BMI <25 kg/m²) patients (p=0.034 and p=0.003, respectively). These findings agree with those from Dhar et al[13]. and Lebowitz et al[10], who found that even non-obese individuals benefited from head and shoulder elevation during laryngoscopy. Our study also revealed that in the ramp position the CL grade improved not just for the higher Modified Mallampati Class (MMC ≥3), but also in MMC <3 patients. Similarly with respect to Thyromental distance, the ramp position consistently improved CL grades in patients with TMD ≥6.5cm (p=0.026) besides providing favorable view in TMD <6.5cm (p=0.049). Although neck circumference (NC) >40 cm is considered a predictor for difficult airway, our study did not find a statistically significant association between NC and poor laryngoscopic views in either position (p=0.857 in sniffing and p=0.545 in ramped). This contrasts slightly with previous findings by Brodsky et al[6]. and Gonzalez et al., where NC was identified as a strong predictor. Small sample size likely underpowered this analysis and did not give a statistically significant value. From this we can incur that irrespective of the MMC and TMD, ramp position offers an added advantage of better glottic visualization.

Given the significant enhancement in laryngoscopic view, reduced need for ancillary maneuvers, and consistent benefits across different airway profiles, our findings support the ramped position as a superior alternative to the conventional sniffing position for elective airway management. Existing literature suggests the beneficial use of ramp position for laryngoscopy and intubation in obese patients. Our study adds to this existing literature that ramp position is beneficial even in non-obese patients and in those with no predictors of difficult intubation. Hence even if airway management is started in classic sniffing position and an unanticipated difficult airway scenario is encountered, we can quickly shift to ramp position by altering the table position without the need of extra man power, costly gadgets or too much time. We can thus safely concentrate on securing the airway with minimal yet effective changes in the setup. There is also an additional benefit that the patient can be positioned to supine position after achieving intubation without further wastage of time or need for extra manpower. In case of the use of pillow or sheets, there is a need for extra personnel to lift the anaesthetized patient and remove these props to position the patient supine. This consumes extra time and carries the risk of inadvertent injury to the anaesthetized patient during re-positioning. All these can be avoided with our technique.

The main limitations of our study are that it is a single centre study, has a small sample size, and the time taken for achieving the ramp position was not measured. This study was carried out in elective cases, its usefulness in emergencies and unanticipated difficult airway scenarios requires further evaluation

## CONCLUSION

This study demonstrates that the ramped position, achieved through precise adjustment of an operating table, offers better laryngoscopic view compared to the traditional sniffing position, not only in obese patients but also in non obese individuals and in those with no difficult airway predictors.The ramped position significantly improves the Cormack Lehane grades, reduces the need for external laryngeal manipulation and use of adjunct airway devices thus improving the ease of intubation. It eliminates the need for extra manpower, extra linen, or costly devices, and provides a time efficient, economically favorable, and standardized approach for patient positioning. Anesthesiologists can consider adopting ramp positioning as a strategy for elective intubations, and switching to this position in case of an unanticipated difficult airway scenario.

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**Conflicts of Interest**
There are no conflicts of interest

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