



Comparison of the Glottic Views in a Head Elevated Laryngoscopy Position with the Patient in Supine or 25° Backup: An Observer-Blinded Randomised Clinical Trial

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Abstract

Background: Simple manoeuvres such as head elevated laryngoscopy position (HELP) can facilitate a better glottic view. We conducted this prospective randomised clinical trial to compare the glottic view in a HELP with the same patient in supine and 25° backup positions.

Methods: A total of 180 patients aged between 18 and 65 years who planned for elective surgery under general anaesthesia with endotracheal intubation using Macintosh laryngoscope were included. Any patient with anticipated airway difficulty, emergency surgeries, or rapid sequence induction was excluded. All patients were randomised into two groups (group B = 90 and group S = 90). In group S, the glottic view was assessed whilst the patients were in the 25° backup HELP position (first position). Then, the patients were repositioned and intubated in the supine HELP (second position) position after reassessing the glottic view. In group B, the glottic view was assessed whilst the patients were in the supine HELP position (first position). Then, the patients were repositioned and intubated in the 25° backup HELP position (second position) after reassessing the glottic view. Percentage of glottis opening score (POGO), Cormack Lehane (CL) grade, laryngoscopy time, intubation time, attempts for intubation, anaesthesiologists comfort, use of ancillary devices/manoeuvres, and ease of intubation were recorded.

Results: The mean POGO score was significantly more in 25° backup than supine position (n = 180; 25° backup HELP: 64.78±26.83% vs supine HELP: 46.96±27.71%, P-value <.0001). The CL grade was significantly higher in the supine HELP position than the 25° backup HELP position (n = 180, P-value <.0001). The mean laryngoscopy time was comparable between two positions (n = 180, supine with HELP: 9.38±3.80 seconds, 25° backup with HELP: 9.47±3.80 seconds; P-value: .608). The mean intubation time was significantly shorter (P = .001) in group B (7.7±2.2 seconds) than group S (9.2±3.6 seconds).

Conclusions: This study has shown that the 25° backup HELP position provides improved glottic view in comparison with the supine HELP position.

Keywords: Glottic view, head elevated laryngoscopy position, Cormack Lehane grade, POGO score

Introduction

The direct laryngoscopy (DL) is a most common intubation technique. To achieve optimal head position during DL, the horizontal supine sniffing position has been traditionally preferred by most of the anaesthesiologists.¹⁻⁴ However, in conjunction with the alignment of the relevant anatomical structures, the intubating anaesthesiologist's line of sight must fall easily and comfortably on the glottic aperture. In head elevated laryngoscopy position (HELP), the patient is positioned such that the line from the sternal notch to external auditory meatus is at the same horizontal level. This has been found to improve the glottic view significantly and preoxygenation in obese patients when compared to the horizontal sniffing position.^{5,6} The HELP position has also been found to improve the percentage of glottic opening (POGO) scores significantly compared to the supine position.^{7,8}

Recently, the impact of the 25° backup position on intubating conditions was analysed in a few studies.^{1,9} This position has shown to provide better intubation conditions during DL. A backup position achieved by flexion of the



Figure 1. Group B: supine HELP position (1), protractor (2), and 25° backup HELP position (3).

torso at the hips may improve the line of sight for the anaesthesiologist. In this position, less force is required to elevate and move the tongue and other tissues out of the line of sight. This position avoids stooping by the anaesthesiologist to acquire a view of the larynx.¹ The 25° backup position also reduced the need for laryngeal manipulation and the time taken for intubation.⁹ The previous studies either did not apply for HELP or were conducted on mannequins/two different sets of patients. Thus, we designed this study to compare the glottic view in a HELP with supine or 25° backup position.

Methods

Subject selection

This study was conducted at Mahatma Gandhi Medical College and Research Institute, Pondicherry, from May 2018 to May 2019. This study was approved by the Mahatma Gandhi Medical College and Research Institute (PG/12/2017/111) and was registered at “Clinical Trial Registry-India” (identifier: CTRI/2018/04/013542). After obtaining a written informed consent, a total of 180 patients of either sex aged between 18 and 60 years, belonging to ASA (American Society of Anaesthesiologists) 1 and 2 and undergoing elective surgeries under general anaesthesia with endotracheal intubation using Macintosh laryngoscopes were

included in this study by the consecutive sampling method. Any patients with an anticipated difficult airway and those undergoing emergency surgeries, requiring rapid sequence induction were excluded from the study. All patients were randomised and allocated to one of the two groups, i.e., group B or group S using computer-generated randomisation. In group S, the patients were placed initially in the 25° backup HELP position (first position), and the glottic view was assessed. Then, the patients were repositioned and intubated in the supine HELP position (second position) after reassessing the glottic view. In group B, the patients were initially placed in the supine HELP position (first position), and the glottic view was assessed. Then, the patients were repositioned and intubated in the 25° backup HELP position (second position) after reassessing the glottic view.

Protocol

All patients fasted and received premedication as per the institutional protocol. On the surgery day, in the operating room, all patients were connected with routine monitors, including pulse oximetry, noninvasive blood pressure, and electrocardiography. After securing intravenous access, all patients received midazolam 1 mg and fentanyl 2 µg kg⁻¹. Initially, all the patients were placed in a HELP such that the line from the sternal notch to external auditory meatus was horizontal. The patients were preoxygenated for 5 minutes. The choice for intravenous induction agent and inhalational agents was based on the attending anaesthesiologist's choice. The adequacy of mask ventilation was assessed before administering muscle relaxant. Any patient, in which anaesthesiologist was unable to maintain adequate ventilation with the mask without assistance, was excluded from the study. After confirmation of bag and mask ventilations, the injection vecuronium 0.1 mg kg⁻¹ was administered intravenously. The DL was done using a Macintosh blade (size 3 or 4) after the suppression of all the twitches on a train of four on the monitor.

Main Points

- The glottis view was better in the 25° backup HELP position than the supine HELP position.
- The 25° backup HELP position led to better alignment of laryngoscopy line with performer's line of vision.
- The intubation in the 25° backup HELP position was easier (on Likert scale) with a lower incidence of anaesthesiologist's stooping and lesser use of external laryngeal manoeuvre and/or Bougie.



Figure 2. Group S: 25° backup HELP position (1), protractor (2), and supine HELP position (3).

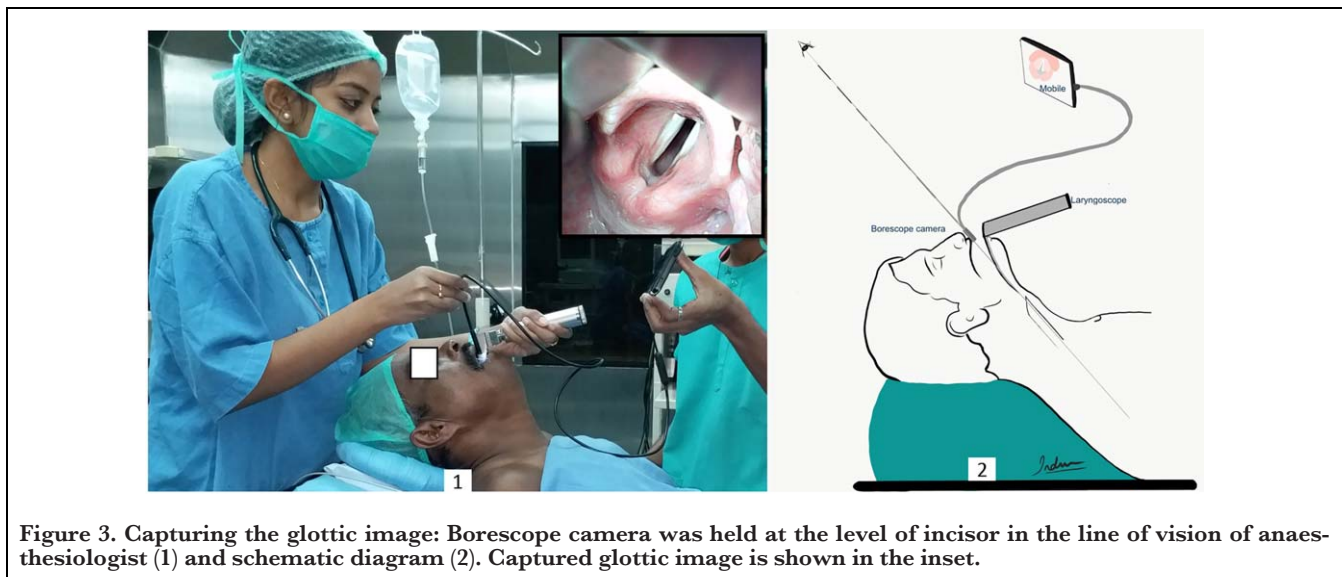


Figure 3. Capturing the glottic image: Borescope camera was held at the level of incisor in the line of vision of anaesthesiologist (1) and schematic diagram (2). Captured glottic image is shown in the inset.

In group B (Figure 1(1)), the first laryngoscopy (best attempt without external laryngeal manoeuvre) was done in the supine HELP position (first position). The glottis view (CL grade) was noted by the anaesthesiologist, and image was captured by placing the borescope camera in the line of sight at the level of superior incisors (Figure 3). After the first laryngoscopy, vocal cords were sprayed with 10% lignocaine. The mask ventilation was continued whilst changing position to 25° backup (second position) (Figure 1(3)). The 25° backup position was achieved using a protractor (Figure 1(2)). The position change was done within 10 seconds. In the 25° backup HELP position, second laryngoscopy (best attempt without external laryngeal manoeuvre) was done. The glottis view (CL grade) was noted by the anaesthesiologist, and image was captured as mentioned before. The endotracheal intubation was done in the second position.

In group S (Figure 2), after induction, patients' position was changed to 25° backup HELP position (first position) using a protractor. The first laryngoscopy (best attempt without external laryngeal manoeuvre) was done in the 25° backup position (first position). The glottis view (CL grade) was noted by the anaesthesiologist, and image was captured by placing the borescope camera in line of sight at the level of superior incisors (Figure 3). After the first laryngoscopy, the vocal cords were sprayed with 10% lignocaine, and the mask ventilation continued during changing position to the supine HELP position (second position). The position was changed within 10 seconds. In the supine HELP position, second laryngoscopy (best attempt without external laryngeal manoeuvre) was done. The glottis view (CL grade) was noted by the anaesthesiologist, and image was captured as mentioned before. The endotracheal intubation was done in the second position.

During laryngoscopy in either position, the anaesthesiologist's xiphoid process was at the level of the patient's forehead using the step stool if needed. The anaesthesiologist with experience of more than 3 years had performed the laryngoscopy and took the images of glottic view in both positions using borescope camera with the assistance of an observer and performed endotracheal intubation.

The laryngoscopy time (time from the removal of the mask to obtain the best glottic view) and intubation time (time from the introduction of the endotracheal tube into oral cavity and appearance of capnography waveform) were recorded using stopwatch by the nearby assistant. The number of attempts taken to pass an endotracheal tube through glottis was considered as intubation attempt. Anaesthesiologist's stooping (yes/no) during intubation was noted by an observer. If the anaesthesiologist was unable to intubate in three best attempts using external laryngeal manoeuvre and bougie, those patients were excluded from the study. Further airway management was left on attending senior consultant. Hemodynamic parameters (heart rate, mean arterial pressure (MAP), and oxygen saturation) were recorded before induction and every 2 minutes till 10 minutes after induction. The ease of endotracheal tube insertion was assessed on five-point Likert-type scale: 1-very difficult, 2-difficult, 3-neutral, 4-easy, and 5-very easy. The collected glottis images were graded (POGO score) by three independent anaesthesiologists, who were blinded to the position change and study group. POGO score of 100% includes visualisation of the entire glottis opening from the anterior commissure of the vocal cords to the inter arytenoid notch. POGO score of 0% corresponds with no visualisation of laryngeal structures. The average POGO score was documented.

Any airway-related complications like desaturation, bleeding, etc. were noted.

Statistical analysis

The PS Power and Sample Size Calculation Software (version 3.0, January 2009, licensed under Creative Commons Attribution-Non-commercial-NoDerivs 3.0 United States license) was used to calculate the sample size using the "Mean POGO score" as the primary outcome variable. Based on a previous study done by Lee et al.,¹ the mean POGO score in supine was 42%. We hypothesised that the POGO score would increase by 30% in the 25° backup position. We calculated the minimum sample size to be 77 in each group with the power of study of 80%. Considering drop out, we recruited 90 patients in each group.

SPSS for Window 16.0 (SPSS Inc, Chicago) was used for statistical analysis. Parametric data (age, body mass index (BMI), percentage of glottis opening, laryngoscopy time, and intubation time) were expressed as mean±standard deviation,

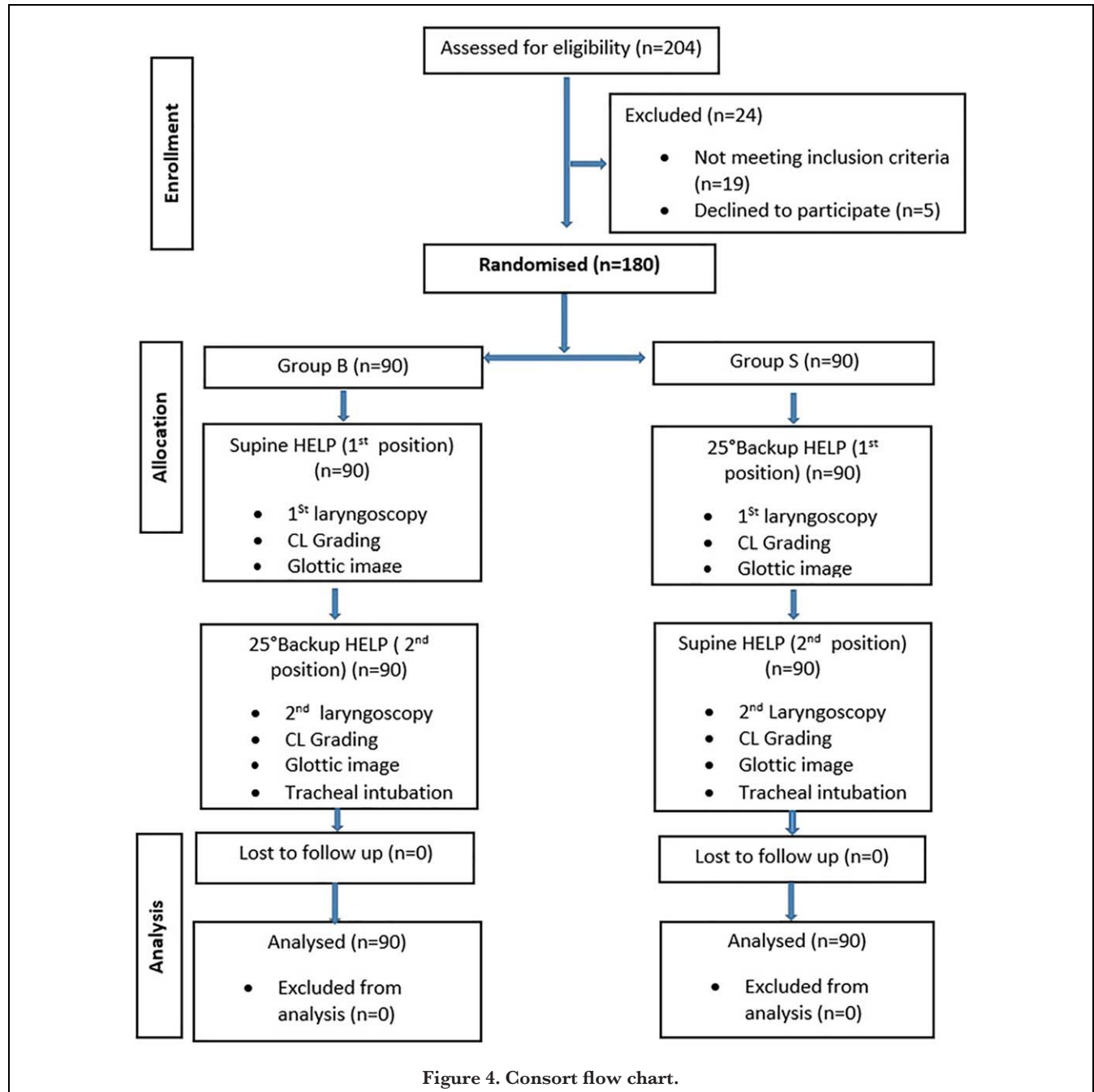
whilst nonparametric data (sex distribution, ASA status, Cormack Lehane (CL) grade, intubation attempts, ancillary device used, anaesthesiologist's position, and ease of intubation) were expressed as number (percentage). The data analysis was done using the Student's t-test for continuous variables (normally distributed) and Mann-Whitney U test (not normally distributed) and Chi-square test or Fisher's exact test as appropriate for categorical variables. The POGO score, CL grade, and laryngoscopy time were compared between the two positions irrespective of group allocation. All comparisons were two-tailed. $P < .05$ was considered significant.

Results

A total of 204 patients were screened for eligibility by the consecutive sampling method. After excluding 24 patients who were not satisfying inclusion criteria, 180 eligible patients were recruited for the study (Figure 4, consort chart). None of the patients were excluded after randomisation. The patients matched demographic data between the two groups (Table 1). The mean POGO score was significantly more in the 25° backup HELP than supine HELP position (n = 180; 25° backup HELP: 64.8±26.8%; 95% CI (61.5-68.1) vs supine HELP: 47.0±27.7%, 95% CI (42.9-51), $P < .0001$). The CL grade was significantly lower in the 25° backup HELP position than supine HELP position (n = 180; $P < .0001$). The mean laryngoscopy time was comparable between the two positions (n = 180; supine HELP: 9.4±3.8 seconds vs 25° backup HELP: 9.5±3.8 seconds; P : .608). The mean intubation time was significantly more in group B than in group S (group B: 7.7±2.2 seconds vs group S: 9.2±3.6 seconds, P : .001). There was no incidence of intubation failure in either group. There was no difference in the number of intubation attempts in either group (P : .246). Ease of endotracheal tube insertion was significantly easier in group B than in group S ($P < .0001$). Incidence of anaesthesiologist's stooping and use of external laryngeal manoeuvre and/or Bougie during intubation were significantly lesser in group B than group S (P : .002 and .014, respectively). There was no incidence of bradycardia in either group. A total of 10 patients in group B and eight patients in group S showed a transient episode of tachycardia during the first laryngoscopy. In group S, patients showed transient fall in MAP at second and fourth minute after induction. There was no incidence of severe hypotension (>20% fall) in either group during the change in position. None of the patients had airway-related complications like trauma, desaturation, etc.

Discussion

In this study, we found that the 25° backup HELP position significantly improved glottic view during DL than the supine HELP position. Improved glottic view in the 25°



	Group S, n = 90	Group B, n = 90
Age (years), mean (SD)	36.11 (10.94)	36.63 (12.34)
ASA (1/2), n	77/13	70/20
Gender (female/male), n	51/39	44/46
BMI	24.36 (3.60)	23.98 (3.76)

backup HELP is due to the alignment of the performer’s line of vision with the laryngeal inlet. In our study, we considered both the POGO score and CL grade for assessing glottic view. Though the POGO scoring system is more accurate and reliable than CL grade, we decided to keep both scoring systems since POGO score is not applicable for CL grades 3 and 4.^{8,10} To ensure blinding, the captured glottic images were graded by three anaesthesiologists independently, and the average value was considered.

Our study was consistent with the results observed by Lee et al.¹ and Levitan et al.⁵ Lee et al.⁵ compared glottic view in 25° backup vs supine. They found that there was an improvement in the POGO score from 42.4% in supine to 66.8% in 25° backup. However, they did not apply HELP position in their study. They used 0° bronchoscope at various depth for capturing the glottic image. The relative position of the performer with table height was not fixed, unlike our study. Similarly, Levitan et al.⁵ assessed glottic opening during laryngoscopy on seven fresh human cadavers and showed significant improvement in POGO scores from 31% in the head flat to 87% with maximal head elevation position. They used straight blade, i.e., Henderson laryngoscope blade.³ The previous simulation-based nonblinded studies also found that an upright intubating position at 45° was associated with improved POGO views compared to the supine position, though there was no statistically significant difference in intubation success rates.^{11,12}

Contradictory to our study's finding, Reddy et al.⁹ found that the 25° backup does not improve glottis view than the supine position. These results could be because POGO score assessment was based on memory and HELP position was not applied. A recent meta-analysis reported that ramped position did not have an advantage over the sniffing position for intubation with the number of attempts and CL grading and intubation time.¹³

USB Borescope was used for capturing glottic image in our study as it is cheaper and an easily available inexpensive airway gadget.¹⁴⁻¹⁶ As the laryngoscopy line must pass through the inferior edge of the upper incisors and the centre of the vocal cords, the USB Borescope camera was kept at the lower edge of upper incisor in line of vision of the performer.¹⁷

In our study, laryngoscopy time was comparable between two positions. This can be attributed to the fact that laryngoscopy was performed by the same anaesthesiologist in both positions. Though intubation time was statistically more in group S than group B, a difference of 2 seconds is unlikely to have any clinical significance. Reddy et al.⁹ showed a difference of 4 seconds between the two positions. In their study, both trainees and senior consultants performed intubation faster in the backup position, and the difference, although not significant, was greater for the senior consultants. Pinchak et al.¹⁸ also showed that the intubation time was 7 seconds more in a supine position when compared to the 25° backup position. This result could be since their study was done in mannequins where HELP was not applied.

Easier endotracheal intubation (assessed on Likert scale), lower incidence of anaesthesiologist's stooping and lesser use of external laryngeal manoeuvre and/or Bougie during intubation in group B could be due to better alignment of laryngoscopy line with performer's line of vision and change in the direction of the force along with the laryngoscope handle

in the 25° backup position.¹⁷ Walker et al.¹⁹ whilst discussing the reason for anaesthesiologist's stooping during intubation inferred that intubation position depends on their years of experience and habit. Transient fall in the blood pressure after induction in group S could be due to additive effect of induction drugs and change in position from supine to backup, leading to falling in preload. The fall in blood pressure in the backup position can be mitigated using a modification of backup along with leg up.

Though the 25° backup HELP position is uncustomary, the performers in our study were able to insert laryngoscope in all patients without difficulty, similar to the previous studies.^{1,9,12,20} The laryngoscopists in our study felt that the force required during DL in 25° backup HELP was less, though it was not quantified and assessed. A retrospective study showed a decrease incidence of airway-related complications during emergency tracheal intubation in 30-degree head-up position in comparison to the supine position.²¹

Though it was difficult to blind the performer regarding patient's group allocation, POGO score was assessed by three independent anaesthesiologists who were unaware of allocation. Thus, we ensured blinding of the primary outcome. POGO scoring was not memory-based as we used a borescope to capture the glottis image. We eliminated the airway-related confounding factor as we compared POGO score and CL grade according to positions (n = 180) irrespective of group allocation. Our study had a few limitations. First, we used only one blade design, i.e., Macintosh blade. Second, we excluded patients with an expected difficult airway. Thus, the results of our study cannot be extrapolated to patients with a difficult airway. Further studies are needed to explore the intubating condition at various degrees of backup with modifications, e.g., 15° backup with HELP, backup with leg up position, etc.

We concluded that the 25° backup HELP position improved the glottic view significantly in comparison to the supine HELP position and had a lower incidence of anaesthesiologist's stooping and lesser use of external laryngeal manoeuvre and/or Bougie with comparable laryngoscopy time and intubation attempts.

Ethics Committee Approval: Ethical committee approval was received from the Institutional Research and Human Ethics Committee of the Mahatma Gandhi Medical College and Research Institute (PG/12/2017/111).

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - H.K.V.R.; Design - H.K.V.R., K.N.; Supervision - H.K.V.R.; Data Collection and/or Processing - J.N., I.M.; Analysis and/or Interpretation - I.M.; Literature Search - J.N., I.M.; Writing Manuscript - J.N., I.M., K.N.; Critical Review - H.K.V.R., K.N.

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