ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

# Comparison of ease of endotracheal intubation with fixed height pillow versus pillow height attained by alignment of external auditory meatus to sternal notch

**Priyanka Bansal[1], Pulkita Kataria[2], Kirti Kshetrapal[3], Hemant Kamal[4], Renu Bala[5], Geeta Ahlawat[6]**

*[1]Associate Professor, [2]Junior Resident, [3,5]Professor, [6]Senior Professor, Department of Anaesthesia, [4]Senior Professor, Department of Urology, PGIMS, Rohtak, Haryana, India*

Submission: 07-11-2024 Revision: 15-11-2024 Publication: 01-12-2024

## ABSTRACT

**Background:** Endotracheal intubation is considered to be the "Gold Standard" for airway management during the administration of general anesthesia and in critical care setting because of its advantages, which allows delivery of anesthetic gases and oxygen through positive pressure ventilation without inflation of stomach, permits access to tracheobronchial tree for pulmonary hence minimizing the risk of gastric content aspiration, and improves surgical access to head and neck. The major determinants of easy tracheal intubation are optimal laryngoscopy and a good visualization of the glottis. **Aims and Objectives:** The aims and objectives of the study are to seek the optimal pillow height that gives the best direct laryngoscopic view and can be recommended as the starting head position before direct laryngoscopy in adults. **Materials and Methods:** The present study was conducted in a prospective randomized comparative manner in the Department of Anaesthesiology and Critical Care, Pt. B.D. Sharma University of Health Sciences, Rohtak after obtaining approval from the institutional ethical committee (approval number: No. BREC/Th/20/Anaesth.../034). Patients included were scheduled for elective surgery under general anesthesia requiring endotracheal intubation. The inclusion criteria were patients aged 18–50 years of either sex of ASA I and II. **Results:** A total of 50 subjects, 25 in each group, were included in the final analysis. Following observations and results were drawn from the present prospective and randomized study using appropriate statistical tests. The various observations were out of 50 patients in the study population, and the mean age in years of patients in Group 1 was 38.48±11.77 years and 39.36±11.64 years in Group 2. **Conclusion:** To conclude, alignment of external auditory meatus to sternal notch offers better conditions for endotracheal intubation than conventionally used sniffing position when assessed in terms of Cormack–Lehane grading and time taken for laryngoscopy and intubation.

**Key words:** Endotracheal intubation; Laryngoscopy; Positive pressure ventilation; Mallampatti grade

**Access this article online**

**Website:**

http://nepjol.info/index.php/AJMS

**DOI:** 10.3126/ajms.v15i12.71314

**E-ISSN:** 2091-0576

**P-ISSN:** 2467-9100



## INTRODUCTION

Endotracheal intubation is considered to be the "Gold Standard" for airway management during the administration of general anesthesia and in critical care setting because of its advantages, which allows delivery of anesthetic gases and oxygen through positive pressure ventilation without inflation of stomach, permits access to tracheobronchial tree for pulmonary hence minimizing the risk of gastric content aspiration, and improves surgical access to head and neck.[1]

The major determinants of easy tracheal intubation are optimal laryngoscopy and a good visualization of the glottis.[2] There is discrepancy between the incidence of

**Address for Correspondence:**
Dr. Kirti Kshetrapal, Professor, Department of anaesthesia, PGIMS, Rohtak, Haryana, India. **Mobile:** +91-9215650615.
**E-mail:** kamalkirti47@gmail.com

difficult laryngoscopy which ranges from 5% to 18% and the rate of failed laryngoscopy which ranges from $<0.4\%$ in the emergency department to $<0.05\%$ in the operating room.[3] In most instances, difficult laryngoscopy correlates with poor laryngeal exposure.[4]

The sniffing position has been commonly advocated as the standard head position for direct laryngoscopy. The position is achieved by flexion of the neck on the chest and extension of the head on the atlanto-occipital joint, which is achieved by head elevation using a pillow or a headrest. In this position, the cervical spine below C5 is straight and there is increasing flexion from C4 to C2 with the head fully extended. Neck flexion between C2 and C4 is achieved by elevation of the head. This dictum was questioned by Tripathi et al., who reassessed the value of sniffing position in their series of clinical investigation.[5]

Conventionally, the sniffing position is achieved by placing a fixed height pillow (FHP) of 7–10 cm height under the occiput. Shah et al., suggested a 35° neck flexion and 15° face plane extension for adequate sniffing to be achieved.[6] However, it has been suggested recently that the alignment of oral, pharyngeal, and laryngeal axis is better achieved by aligning external auditory meatus to the sternal notch. Few authors have used different pillow heights to improve the laryngeal view; however, there is no conclusive evidence as to what pillow height leads to the alignment of AM-S line. The purpose of our study was to seek the optimal pillow height that gives the best direct laryngoscopic view and can be recommended as the starting head position before direct laryngoscopy in adults.

### Aims and objectives

The aims and objectives of the study are to seek the optimal pillow height that gives the best direct laryngoscopic view and can be recommended as the starting head position before direct laryngoscopy in adults.

## MATERIALS AND METHODS

### Study design

The present study was conducted in a prospective randomized comparative manner in the Department of Anaesthesiology and Critical Care, Pt. B.D. Sharma University of Health Sciences, Rohtak, after obtaining approval from the institutional ethical committee (approval number: No. BREC/Th/20/Anaesth./034), patients's consent, and CTRI registration number: CTRI/2022/07/043757 [registered on July 06, 2022].

### Study subjects

Patients included were scheduled for elective surgery under general anesthesia requiring endotracheal intubation. The inclusion criteria were patients aged 18–50 years of either sex of ASA I and II.

The exclusion criteria were patients with upper airway pathology, height $<140$ cm, thyromental distance (TMD) $<5.5$ cm, neck mass, cervical spine pathology, edentulous/loose or missing teeth/bucked teeth, pregnancy, intra-oral mass/tumor temporomandibular joint ankylosis, facial and tongue anomalies, mouth opening $<3$ cm, history of obstructive sleep apnea, body mass index (BMI) $\geq 35$ kg/m$^2$, and Mallampati Grade IV (MPG).

Shah et al.,[6] reported mean pressure bag height of 4.86 cm among the groups. Our estimated sample size was based on Cormack and Lehane grade among groups. For the sample size calculation, we defined mean difference of 0.6 with 0.75 standard deviation. We calculated the sample size with 95% confidence level, 80% power, and alpha level of 0.05 N=50, n=25 in each group.

### Preparation of patient

All the patients were subjected to detailed history, complete physical as well as systemic examination before surgery. Patient's age, weight, and height were recorded to calculate BMI. Routine investigations such as hemoglobin, bleeding time, clotting time, and urine examination were done. Other investigations such as blood urea, blood sugar, renal function tests, serum electrolytes, chest X-ray, electrocardiograph, and rest all relevant investigations as per patient requirement were done. The purpose and protocol of the study was explained to patients and informed written consent was obtained.

Upon arrival for pre-anesthetic checkup, the study population meeting inclusion criteria was randomly selected and the airway of these patients was assessed using the following:

- Modified MPG was done with patient in sitting position with the head in neutral position. The patient was asked to open the mouth and protrude the tongue without phonation which was then graded accordingly (grade 0- ability to see any part of the epiglottis upon mouth opening and tongue protrusion; grade 1- hard palate, soft palate, uvula, faucial pillars visible; grade 2- hard palate, soft palate, uvula visible; grade 3- hard palate, soft palate, base of uvula visible; and grade 4- only hard palate visible).[7]
- Neck circumference (NC) was measured in centimeters at the level of thyroid cartilage, using a measuring tape.
- Inter-incisor gap (IIG) was measured as the inter-incisor distance with maximum mouth opening using vernier calipers.
- TMD was measured as the straight distance from the tip of thyroid cartilage to the tip inside the mentum with the neck fully extended and mouth closed, using a measuring tape.

- Sternomental distance (SMD) was measured as the straight distance from the upper border of the manubrium to the tip of the mentum with neck fully extended and mouth closed, using a measuring tape.
- Atlanto-occipital extension (AOE) was assessed by asking the patient to touch his chin with manubrium sterni, followed by asking the patient to look at the ceiling without raising eyebrow, measured using goniometer.

### Randomization and group allocation

Patients were randomly allocated into one of the following groups:

- Group I (n=25): Endotracheal intubation was done using Macintosh laryngoscope with a FHP of 7 cm placed under the head of the patient
- Group II (n=25): Endotracheal intubation was done using Macintosh laryngoscope where in the head was elevated till the external auditory meatus to sternal notch alignment was achieved.

Randomization was done using computer-generated list of random numbers.

### Anaesthesia technique

In the operating room, routine monitoring was done including non-invasive blood pressure, electrocardiography, and pulse oximetry ($SpO_2$). Intravenous line was secured using 18 G cannula. Vital signs were recorded before and after the drug administration.

In the pre-operative period, 2 pillows were kept ready, i.e., one FHP of height 7 cm and a variable height pillow (VHP). The VHP was made with a thin cushioned wooden board at the top and bottom with jack mechanism fitted inside and a handle to adjust the height; the height of this pillow was adjusted for each patient so that horizontal alignment of external auditory meatus and sternal notch in each patient was achieved.

Pre-oxygenation was done with 100% oxygen for 3 min; all patients received intravenous fentanyl (2 mcg/kg). Injection propofol 2–2.5 mg/kg was given for induction of anesthesia. Ventilation was assessed with bag mask ventilation using Han's scale. Injection atracurium bromide 0.5 mg/kg was given to facilitate the placement of endotracheal tube. Patients were ventilated with 1 MAC sevoflurane in 50% $N_2O$ and 50% $O_2$.

Group I (n=25) – In this group, initially, the VHP was placed under the patient's head and the patient was ventilated in this position following induction of anesthesia. Mask ventilation was assessed using Han's scale, then laryngoscopy was done using appropriate size Macintosh laryngoscope blade and patient's laryngeal view was assessed by modified Cormack and Lehane grading. Then, the height of the pillow was adjusted to a fixed height of 7 cm. Laryngoscopy was done using appropriate size Macintosh laryngoscope blade and patient's laryngeal view was assessed by modified Cormack and Lehane grading. Endotracheal intubation was done using appropriate-sized ETT and intubation difficulty score (IDS) was assessed.

Group II (n=25) – In this group, initially, a FHP of height 7 cm was kept under the patient's head and patient was ventilated in this position following induction of anesthesia. Mask ventilation was assessed using Han's scale, then laryngoscopy was done using appropriate size Macintosh laryngoscope blade and patient's laryngeal view was assessed by modified Cormack and Lehane grading. Then, the height of the pillow was adjusted to the variable height and the patient was ventilated in this position. Laryngoscopy was done using appropriate size Macintosh laryngoscope blade and patient's laryngeal view was assessed by modified Cormack and Lehane grading. Now, endotracheal intubation was done using appropriate-sized ETT and IDS will be assessed.

Modified Cormack and Lehane grading was noted both with and without optimal external laryngeal manipulation (OELM). Mask ventilation was resumed while changing the patient's position to maintain adequate oxygenation. If we were unable to perform endotracheal intubation after 3 attempts, an alternate method to secure the airway was used. Difficult intubation cart was also kept ready. Further anesthetic technique was carried out as per case and surgical requirement.

### Observation

Following observations were recorded:

1. Pre-operative measurements: BMI, ASA grade, MPG, NC, TMD, SMD, AOE, IIG.
2. Difficult mask ventilation was assessed by Han's scale. Han's scale grading was as follows:[15]
   Grade 1-Ventilated by mask, 2-Ventilated by mask with oral/nasal airway with or without muscle relaxants, 3-Difficult ventilation (inadequate, unstable, or requiring two providers) with or without muscle relaxants, 4-Unable to mask ventilate with or without relaxants.
3. Laryngoscopic view was assessed by Cook's modification of Cormack and Lehane grading. Grade 1-Glottic opening is clearly visualized. The posterior commissure and the entire length of both vocal cords can be seen, 2A The glottis opening is partly visualized. The posterior commissure and parts of both vocal cords can be seen, 2B The posterior commissure is visualized, but no portion of vocal cords are visualized, 3A Only the epiglottis is visualized,

which is liftable using an introducer or bougie, 3B Only the epiglottis is visualized but is not liftable with either an introducer or bougie, and 4-Only the root of the tongue is visualized

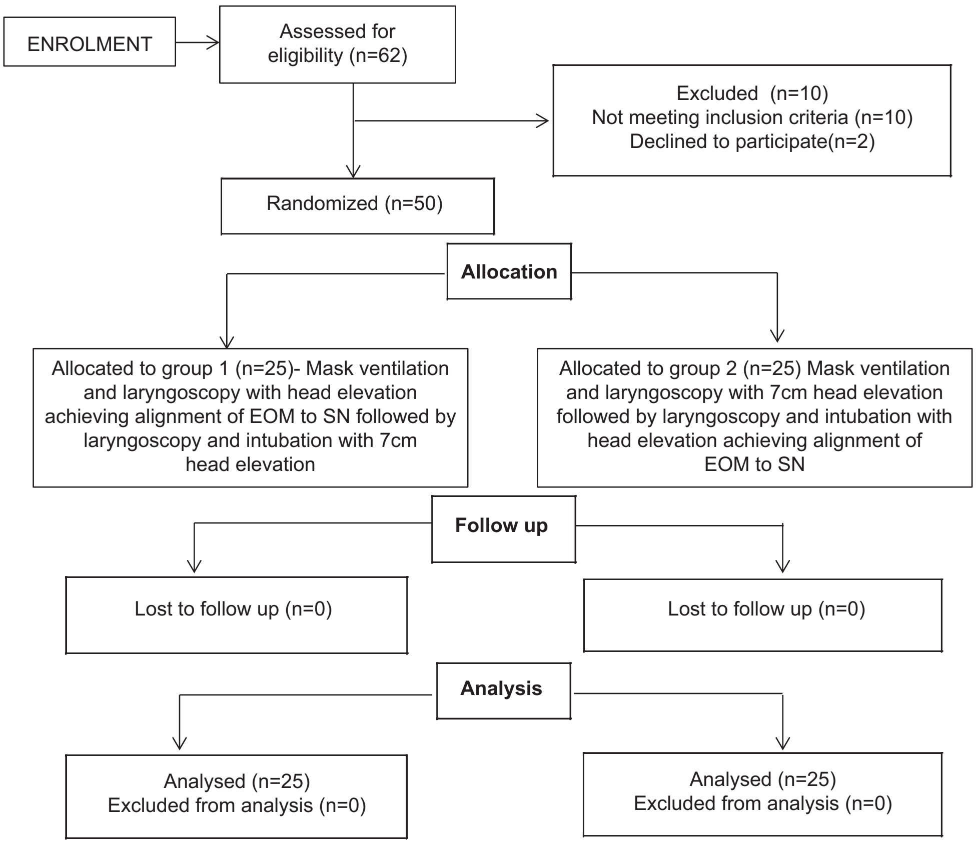
4. Endotracheal intubation difficulty was assessed by IDS developed by Adnet et al., on the basis of seven variables associated with difficult intubation (Table 1). The seven variables and associated parameters were as follows:

The IDS score was sum of N1 to N7.

An IDS score of <5 indicated no or slight difficult intubation and an IDS score of ≥5 was labeled as difficult intubation.[7]

5. Time taken for laryngoscopy (T1): time taken from introduction of laryngoscope to obtaining a best laryngeal view
6. Time taken for intubation (T2): time taken from obtaining a best laryngeal view to successful placement of endotracheal tube
7. Total time taken for laryngoscopy and intubation: time taken from the introduction of laryngoscope to the placement of endotracheal tube (T1+T2)
8. Number of patients requiring stylet to aid in intubation were also noted.

## CONSORT FLOW DIAGRAM




## OBSERVATION AND RESULTS

The data were compiled and checked for normal distribution of data. It was normally distributed and the quantitative variables in both groups were expressed as mean±SD or median (IQR) and compared using unpaired t-test. The qualitative variables were expressed as frequencies/percentages and compared using Chi-square/Fisher's exact test. A P<0.05 was considered statistically significant. "R" programming and/or Statistical Package for the Social Sciences (SPSS) version 20 were used for statistical analysis.

A total of 25 subjects were included in the final analysis. The following observations and results were drawn from the present prospective and randomized study using appropriate statistical tests. The various observations were that out of 50 patients in the study population, the mean age in years of patients has been mentioned in Table 2. The mean value of height, weight, and BMI in both the groups has been mentioned (Table 2).

When compared statistically using Student t-test, both groups were comparable with respect to age, height, weight, and BMI (P=0.0.776, P=0.767, P=0.219, respectively).

All airway measurements were comparable between the two groups when compared using Wilcoxon-Mann-

Whitney U Test (P>0.05) except for the TMD (P=0.03) with the mean TMD being highest in Group 1 (Table 2).

Distribution of patients in both the groups according to MPG was statistically insignificant ($\chi^2$=1.523, P>0.05) (Table 3).

There was no statistical significant difference between the two groups in terms of baseline heart rate, systolic blood pressure, diastolic blood pressure, and $SPO_2$ (P=0.620, 0.778, 0.493, 0.112, respectively).

**Table 1: Intubation difficulty score**

| | |
|---|---|
| N1 | Number of additional intubation attempts |
| N2 | Number of additional persons directly attempting (not assisting) intubation |
| N3 | Number of alternative intubation techniques used, e.g., changing from oral to blind nasotracheal intubation or from a curved to straight blade of laryngoscope during intubation |
| N4 | Glottis exposure as defined by Cormack and Lehane grading, which is as follows: Grade 1, N4=0: entire vocal cords visible<br>Grade 2, N4=1: posterior part of laryngeal aperture visible<br>Grade 3, N4=2: only epiglottis visible<br>Grade 4, N4=3: no glottis structure visible |
| N5 | Lifting force applied during laryngoscopy.<br>N5=0: inconsiderable lifting force applied<br>N5=1: considerable lifting force applied |
| N6 | Need to apply external laryngeal pressure to improve glottis exposure.<br>N6=0: no external pressure applied<br>N6=1: considerable external pressure applied<br>Applying Sellick's Maneuver does not alter the score. |
| N7 | Position of the vocal cords at intubation.<br>N7=0: abducted or not visible<br>N7=1:adducted |

Among the study population, in 25 patients of Group 1, 24 (96%) patients were Han's scale grade 1 and 1 (4%) patient was Han's scale grade 2, and in 25 patients of Group 2, 24 (96%) patients were Han's scale grade 1 and 1 (4%) patient was Han's scale grade 2. Han's scale grades 3 and 4 were not encountered in any group. Mask ventilation assessed by Han's scale was statistically non-significant in between the two groups (P>0.05).

There was no significant difference between the groups in terms of Height of Pillow in VHP (cm) (W=267.500, P=0.384). The mean (SD) of Height of Pillow in VHP (cm) in all 50 patients was 5.32±0.74 and the median (IQR) was 5.10 (4.9–5.7).

The overall change in CL Grade (Without OLEM) was statistically significant (Stuart–Maxwell test: $\chi^2$=14.537, P=0.013) (Table 4).

The overall change in CL Grade (With OLEM) was statistically significant (Stuart–Maxwell test: $\chi^2$=13.536, P=0.019) (Table 5).

The comparison of mean value of IDS was statistically non-significant with a P=0.926.

The change in time taken for laryngoscopy in FHP versus VHP was statistically significant (Wilcoxon test: V=823.0, P≤0.001) (Table 6).

There was a significant difference between the 2 groups in terms of time taken for laryngoscopy and intubation

**Table 2: Airway measurements in between groups**

| Patient group | Statistical test | Parameters | | | | |
|---|---|---|---|---|---|---|
| | | Neck circumference (cm) | Interincisor distance (cm) | Thyromental distance (cm) | Sternomental distance (cm) | AOE (degrees) |
| Group 1 (n=25) | Mean±SD | 33.66±2.45 | 4.46±0.31 | 7.55±1.05 | 13.32±1.17 | 35.08±0.64 |
| | Median (IQR) | 33 (32–36) | 4.5 (4.2–4.6) | 7 (6.8–9) | 13 (12.5–14) | 35 (35–35) |
| | Min-Max | 30–38 | 4–5.2 | 6.2–9.5 | 12–16.5 | 34–36 |
| Group 2 (n=25) | Mean±SD | 33.74±1.83 | 4.33±0.36 | 6.82±0.53 | 12.62±1.48 | 35.12±0.67 |
| | Median (IQR) | 34 (32–35) | 4.3 (4.2–4.5) | 7 (5–7) | 13 (12.5–13.5) | 35 (35–36) |
| | Min-Max | 30–37.5 | 3.5–5 | 6–8 | 9.2–14.4 | 34–36 |
| Test | Wilcoxon-Mann–Whitney U test | w=301.0 | w=380.0 | w=422.5 | w=358.0 | w=302.0 |
| P-value | | 0.829 | 0.188 | 0.03 | 0.378 | 0.826 |

**Table 3: Distribution of patients in both groups according to Modified Mallampatti grading**

| MPG | Group (%) | | | Fisher's Exact Test | |
|---|---|---|---|---|---|
| | 1 | 2 | Total | $\chi^2$ | P-value |
| Grade 1 | 7 (28.0) | 9 (36.0) | 16 (32.0) | 1.523 | 0.551 |
| Grade 2 | 18 (72.0) | 15 (60.0) | 33 (66.0) | | |
| Grade 3 | 0 (0.0) | 1 (4.0) | 1 (2.0) | | |
| Total | 25 (100.0) | 25 (100.0) | 50 (100.0) | | |

Chi-square (Fisher's exact) test

(s) (W=463.500, P=0.003), with the median time taken for laryngoscopy and intubation (s) being highest in the Group 1.

## DISCUSSION

Endotracheal intubation is considered to be the gold standard for airway management during administration of general anesthesia and in critical care setting. There is discrepancy between the incidence of difficult laryngoscopy which ranges from 5% to 18% and the rate of failed laryngoscopy which ranges from <0.4% in the emergency department to <0.05% in the operating room.[4] In most instances, difficult laryngoscopy correlates with poor laryngeal exposure.[5,6] The correct positioning of the patient appears to be the main determining factor for obtaining good glottis visualization.

Our demographic profile is in congruence with the studies done by the following authors. Dhar et al.,[8] conducted a study on 134 patients to compare the use of a FHP versus a customized pillow (CP) height for head elevation in terms of glottic visualization and time required for tracheal intubation.

**Table 4: Change in CL grade (Without OLEM) with pillow height (n=50)**

| VHP | FHP | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2a | 2b | 3a | 3b | 4 | |
| 1 | 8 | 7 | 3 | 0 | 0 | 0 | 18 |
| 2a | 3 | 10 | 7 | 1 | 0 | 0 | 21 |
| 2b | 1 | 0 | 4 | 5 | 0 | 1 | 11 |
| 3a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3b | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 12 | 17 | 14 | 6 | 0 | 1 | 50 |

Stuart–Maxwell test, VHP: Variable height pillow, FHP: Fixed height pillow

**Table 5: Change in CL grade (With OLEM) with pillow height (n=50)**

| VHP | FHP | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 1 | 2a | 2b | 3a | 3b | 4 | |
| 1 | 16 | 10 | 1 | 0 | 0 | 0 | 27 |
| 2a | 3 | 11 | 6 | 2 | 1 | 0 | 23 |
| 2b | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3b | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 19 | 21 | 7 | 2 | 1 | 0 | 50 |

Stuart–Maxwell test, VHP: Variable height pillow, FHP: Fixed height pillow

Our demographic profile is also similar to the study done by Bhattarai et al., who conducted a study on 400 patients to compare the relative efficacy of sniffing position and simple head extension for visualization of glottis during direct laryngoscopy.[9]

In our study, it was observed that, 7 patients in Group 1 and 9 patients in Group 2 had a MPG grade I. There were 18 patients in Group 1 and 15 patients in Group 2 with MPG grade II. One patient in Group 2 had MPG grade III. In Group 1, no patient had MPG grade more than II.

Few authors whose studies were similar to ours have compared the two groups in terms of external airway parameters similar to our study. In the study conducted by Dhar et al., pre-operative airway assessment was done in both the groups. The parameters assessed were mouth opening (cm), TMD (cm), and MMP grade. Mouth opening and TMD were similar in both the groups. The prevalence of MMP Grade 1 was higher in the FP group as compared to CP group.[8]

Pachisia et al., studied the comparative evaluation of laryngeal view and intubating conditions in two laryngoscopy positions attained by conventional 7 cm head raise and that attained by horizontal alignment of external auditory meatus – sternal notch line – using an inflatable pillow.[10]

Mask ventilation assessed in the present study was statistically non-significant in between the two groups (P>0.05). It was observed that all the patients of Group 1 and Group 2 were adequately ventilated with no patient having a grade of more than 2. Our study results are similar to study done by Shah et al., who conducted a prospective randomized study on 100 patients to compare the glottis views with FHP versus adjustable pillow height by pressure infusion bag for successful intubation.[6] Inadequate ventilation was not encountered in any patient of the two groups similar to as observed in our study.

We designed a VHP achieved which was made with a thin cushioned wooden board at the top and bottom with

**Table 6: Assessment of change in time taken for laryngoscopy (s) in VHP versus FHP (n=50)**

| Position | Time Taken for Laryngoscopy (s) | | | V | P-value |
|---|---|---|---|---|---|
| | Mean (SD) | Median (IQR) | Range | | |
| FHP | 12.16±3.59 | 12.00 (10–14) | 6.00–20.00 | 823.0 | <0.001 |
| VHP | 10.30±2.18 | 10.00 (9–12) | 4.00–16.00 | | |

Paired Wilcoxon test, VHP: Variable height pillow, FHP: Fixed height pillow jack mechanism fitted inside and a handle to adjust the height. The minimum and maximum heights that could be achieved using this pillow were 4 cm and 9.5 cm, respectively. The difference observed between the two groups was statistically non-significant (P=0.384). The mean height when external auditory meatus was aligned to sternal notch was 5.32±0.74. Hence, if this position is to be considered as the actual sniffing position, the head elevation required is less than the height conventionally recommended for sniffing position that is 7–10 cm.[11]

Similarly, in study conducted by Pachisia et al.,[10] the mean head rise required to achieve AM-S line alignment observed was 4.920±1.460 cm. In a similar study conducted by Shah et al.,[6] a deflatable pressure infusion bag was put under the nape of neck and occiput in one of the two groups. Although they did not align the external auditory meatus to sternal notch, similar to our study, they achieved the best laryngeal view at a lower height than conventionally recommended for the sniffing position.[6,10]

In our study, visualization of the glottis as assessed using Cook's modification of Cormack and Lehane grading during laryngoscopy with a FHP of 7 cm versus the VHP placed under the patient's head. The assessment was made with and without OELM. The CLG (without OELM) when a FHP was placed under the patient's head, restricted visualization of glottis (CL grade 2b and 3a) was noted in 20 patients and difficult visualization (CL grade 3b) was noted in 1 patient whereas with VHP restricted visualization was observed in 11 patients and difficult visualization of glottis was not encountered in any of the patients.

Our observations of OELM were in concordance with a study conducted by Sinha et al., in which best laryngoscopic view was observed with the 4.5 cm pillow compared to other pillows and without a pillow (P<0.01). The mean POGO score was significantly greater and CL grade significantly lower in case of 4.5 cm pillow height as compared to other pillow heights.[11,12]

Our observations were also similar to study done by Pachisia et al. They observed that CL-grade-I was obtained in significantly larger number of patients with AM-S alignment position than with 7 cm head raise (P=0.004) and CL-grade-III was obtained in significantly lesser number of patients with AM-S alignment (P=0.002). The results were analogous to the observations of our study.[10,13]

In our study, we compared the IDS variables between both intubating positions using Fischer's exact and Chi-squared test. No significant difference was observed with respect to seven variables of IDS between the two groups. Our results are in accordance with few authors.[14,15]

Our results were also not in accordance to the study conducted by Pachisia et al., in which it was observed that the mean IDS with AM-S alignment was significantly less than with 7 cm head raise, which is not similar to as observed in our study.[10]

In our study, we did a comparative evaluation of time taken for laryngoscopy (T1) with FHP of 7 cm and the VHP achieving the alignment of external auditory meatus to sternal notch under the patient's head.

Considering the wide literature review, the quest for the optimal head position for laryngoscopy is still on. In an attempt to find the best head position to perform laryngoscopy and intubation, multiple head positions, which include placing the head in simple head extension, achieving alignment of external auditory meatus to sternal notch and elevated sniffing position, have been proposed. However, none of the studies have conclusively recommended a single best position and even after multiple studies, a substantial evidence does not exist to formulate guidelines and recommendations for the initial head position required for tracheal intubation. Moreover, changing head position at the time of difficult laryngeal visualization can be cumbersome and time consuming. This demands the availability of an adjustable height pillow that should be used in routine anesthesia practice so that the pillow height can be customized for each patient from as low as simple head extension to elevated sniffing height, especially in a difficult airway situation. In our study, we made a CP which allowed us to change the patient's head position simply by rotating the handle attached to the jack mechanism.

### Limitations of the study

The limitation of our pillow was that it is height ranged between 4.0 cm and 9.50 cm thereby limiting its usage beyond these limits. Furthermore, the fact that it was a single-center study with a relatively small sample size. An important limitation of this study was failure to blind observers due to obvious differences in head position, therefore, inter-observer and even intra-observer variation in the assessment of glottis visualization is expected.

## CONCLUSION

To conclude, alignment of external auditory meatus to sternal notch offers better conditions for endotracheal intubation than conventionally used sniffing position when assessed in terms of Cormack–Lehane grading and time taken for laryngoscopy and intubation. We advocate the manufacturing and use of a CP in routine anesthesia practice.

## ACKNOWLEDGMENT

Sincere love and gratitude for my patients.

## REFERENCES

1. Thomas EB and Moss S. Tracheal intubation. Anesth Intensive Care Med. 2014;15:5-7.
2. Akhtar M, Ali Z, Hassan N, Mehdi S, Wani GM and Mir AH. A randomized study comparing the sniffing position with simple head extension for glottis visualization and difficulty in intubation during direct laryngoscopy. Anesth Essays Res. 2017;11(3):762-766.
   https://doi.org/10.4103/0259-1162.204206
3. Levitan RM, Mechem CC, Ochroch EA, Shofer FS and Hollander JE. Headelevated laryngoscopy position: Improving laryngeal exposure during laryngoscopy by increasing head elevation. Ann Emerg Med. 2003;41(3):322-330.
   https://doi.org/10.1067/mem.2003.87
4. Adnet F, Baillard C, Borron SW, Denantes C, Lefebvre L, Galinski M, et al. Randomized study comparing the-sniffing position with simple head extension for laryngoscopic view in elective surgery patients. Anesthesiology. 2001;95(4):836-841.
   https://doi.org/10.1097/00000542-200110000-00009
5. Tripathi M and Pandey M. Short thyromental distance: A predictor of difficult intubation or an indicator for small blade selection? Anesthesiology. 2006;104(6):1131-1136.
   https://doi.org/10.1097/00000542-200606000-00006
6. Shah K, Thakkar J and Vaidya D. Comparison of glottis views with fixed-height pillow versus adjustable-pillow height by pressure infusion bag for successful intubation. Bali J Anesthesiol. 2020;4(2):35-38.
   https://doi.org/10.4103/BJOA.BJOA_1_20
7. Adnet F, Borron SW, Racine SX, Clemessy JL, Fournier JL, Plaisance P, et al. The intubation difficulty scale (IDS): Proposal and evaluation of a new score characterizing the complexity of endotracheal intubation. Anesthesiology. 1997;87(6):1290-1297.
   https://doi.org/10.1097/00000542-199712000-00005
8. Dhar M, Karim HR, Rajaram N, Prakash A, Sahoo SK and Narayan A. A randomised comparative study on customised versus fixed sized pillow for tracheal intubation in the sniffing position by Macintosh laryngoscopy. Indian J Anaesth. 2018;62(5):344-349.
   https://doi.org/10.4103/ija.IJA_672_17
9. Bhattarai B, Shrestha SK and Kandel S. Comparison of sniffing position and simple head extension for visualization of glottis during direct laryngoscopy. Kathmandu Univ Med J (KUMJ). 2011;9(33):58-63.
   https://doi.org/10.3126/kumj.v9i1.6265
10. Pachisia AV, Sharma KR, Dali JS, Arya M, Pangasa N and Kumar R. Comparative evaluation of laryngeal view and intubating conditions in two laryngoscopy positions-attained by conventional 7 cm head raise and that attained by horizontal alignment of external auditory meatus-sternal notch line-using an inflatable pillow-A prospective randomised cross-over trial. J Anaesthesiol Clin Pharmacol. 2019;35(3):312.
    https://doi.org/10.4103/joacp.JOACP_35_19
11. Sinha S, Layek A, Bhattacharjee S and Hazra A. The effect of different pillow heights on direct laryngoscopic views: A prospective randomised controlled study. Egypt J Anaesth. 2013;29(4):279-283.
    https://doi.org/10.1016/j.egja.2013.04.007
12. Ahmed-Nusrath A, Tong JL and Smith JE. Pathways through the nose for nasal intubation: A comparison of three endotracheal tubes. Br J Anaesth. 2008;100(2):269-274.
    https://doi.org/10.1093/bja/aem350
13. Henderson J. Airway management. In: Miller RD, editor. Miller's Anesthesia. 7th ed. Philadelphia, PA: Churchill Livingstone; 2010. p. 1573.
14. Coleman L, Gold J and Zawkowski M. Functional anatomy of the airway. In: Hagberg CA, Artime C and Aziz M, editors. Hagberg and Benumof's Airway Management. 2nd ed. Philadelphia, PA: Elsevier; 2018. p. 2-18.
15. Larson MD. History of anesthetic practice. In Miller RD, editor. Miller's Anesthesia. 6th ed., Vol. 1. Philadelphia, PA: Churchill Livingstone; 2005. p. 3-52.

**Authors' Contributions:**
**PB, PK-** Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation, and submission of article; **KK, HK, RB**- Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; **PB, GA**- Design of study, statistical analysis, and interpretation; **PK, HK**- Review manuscript; **HK, KK-** Review manuscript; **RB, KK**- Literature survey and preparation of figures; **PB, RB, KK-** Coordination and manuscript revision.

**Work attributed to:**
Pt. BD Sharma PGIMS, Rohtak, Haryana, India.

**Orcid ID:**
Dr. Priyanka Bansal - https://orcid.org/0000-0002-5900-401X
Dr. Pulkita Kataria - https://orcid.org/0000-0003-1723-5297
Dr. Kirti Kshetrapal - https://orcid.org/0000-0002-1860-3163
Dr. Hemant Kamal - https://orcid.org/0000-0002-1533-4231
Dr. Renu Bala - https://orcid.org/0000-0002-7064-7868
Dr. Geeta Ahlawat - https://orcid.org/0000-0002-4986-2002

**Source of Support:** Nil, **Conflicts of Interest:** None declared.