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A Prospective Observational Study Comparing the Upper Lip Bite Test with the Modified Mallampati Score as a Predictor of Difficult Intubation in Patients Undergoing Elective Surgeries Under General Anaesthesia

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Abstract

Introduction: Difficult tracheal intubation remains a major concern in anaesthetic practice, contributing to significant perioperative morbidity and mortality. Accurate preoperative airway assessment is critical to prevent complications such as hypoxia, brain injury, and cardiac arrest. Among the various bedside tests, the Modified Mallampati Test (MMT) and the Upper Lip Bite Test (ULBT) are simple, non-invasive, and widely used. However, their predictive efficacy remains debated.

Objective: To compare the diagnostic accuracy of ULBT and MMT in predicting difficult intubation using the Intubation Difficulty Score (IDS) in patients undergoing elective surgeries under general anaesthesia. Materials And Methods: A prospective observational study was conducted on 102 adult patients (ASA I–II), aged 18–60 years, undergoing elective surgery at Adichunchanagiri Institute of Medical Sciences, Karnataka. Preoperative assessment included ULBT and MMT classification. Intraoperative intubation difficulty was evaluated using the IDS. A score 5 indicated difficult intubation. Statistical analysis was performed using chi-square tests, and diagnostic indices were calculated.

Results: Out of 102 patients, difficult intubation was observed in 18 (17.6%). ULBT showed a sensitivity of 90.9%, specificity of 95.7%, and diagnostic accuracy of 97.06%, significantly outperforming MMT (sensitivity: 18.2%, specificity: 75.3%, accuracy: 70.6%). The ULBT demonstrated a statistically significant association with IDS (p lt; 0.001), whereas MMT did not have a statistically significant association (p = 0.731).

Conclusion: ULBT is a superior predictor of difficult intubation compared to MMT and should be considered a reliable tool for preoperative airway assessment in elective surgeries.

Keywords: Upper Lip Bite Test, Mallampati Score, Difficult Intubation, General Anaesthesia, Airway Assessment, Intubation Difficulty Score, Predictive Accuracy.

Introduction

Difficulty in tracheal intubation is a predominant challenge for anaesthesiologists and may lead to morbidity and mortality during surgery. Difficulty during intubation is one of the most frequently observed adverse events leading to anaesthesia malpractice claims. Respiratory events are the common causes of anaesthesia-related morbidity, out of which 85% are related to mistakes regarding airway management, resulting in permanent cerebral damage due to hypoxia and 30% of anaesthesia- related deaths. Airway assessment is a mandatory component of preoperative anaesthesia evaluation. Inadequate assessment and planning of the airway could lead to catastrophic effects that include brain injury, myocardial injury and death. (1-3) The incidence of difficult laryngoscopic tracheal intubation is between 1.3% to 13% in an operating room setup. Many tests have been proposed to clinically identify patients preoperatively who may have difficult laryngoscopy. The Mallampati test was initially proposed by Mallampati S R and was later modified by Samsoon and Young into four classes. The test was classified based on visualisation of pharyngeal structures with mouth fully open with the tongue maximally protruding out and without phonation. The observer is to assess the size of the tongue with other structures in the oropharynx and the ability to open the mouth. (1) The Upper Lip Bite Test (ULBT) was developed by Khan et al 2003. The test is classified according to the ability to bite the upper lip with the lower teeth thus assessing the range and free movement of the mandible, its protrusion and the architecture of the teeth. (1) Intubation Difficulty Score (IDS) was devised by Adnet et al. It is a numerical score derived By adding seven parameters known to be associated with difficult intubation. The seven Parameters are the number of supplementary operators, the number and type of alternative Techniques used, laryngoscopic grades, subjective lifting force, the use of external Manipulation, and mobility or position of vocal cords. (1-4) The need for predicting the incidence of difficult intubation is utmost importance and the above mentioned parameters and tests being non-invasive, inexpensive, simple and effective bedside tests which are easy to perform as a preoperative airway assessment tool can be beneficial to predict difficult airway and avoid any untoward complications beforehand and by being able to anticipate the presence of a difficult airway, We will be able to plan for appropriate equipment, experienced personnel, and alternative Airway management strategies. Therefore, it is important to have a simple and direct Prediction of difficult airways in seemingly normal patients, but there is no one standard test to assess and predict the same. (4) In the present study, the upper lip bite Test is compared with the modified mallampati classification in preoperatively predicting difficult Laryngoscopic intubation that requires no specific tools, takes little time to conduct and does not cause patient discomfort with better statistical significance.

Aims and Objective

AIM OF THE STUDY

To compare upper lip bite test with modified mallampati score to predict difficult intubation using intubation difficulty scale in patients undergoing elective surgeries under general anaesthesia.

MATERIALS AND METHODS

Study Design

This study was a prospective observational study conducted at the Department of Anaesthesiology, Adichunchanagiri Institute of Medical Sciences, BG Nagara, Karnataka. The study spanned 18 months, from December 2023 to June 2025, and was designed to evaluate and compare the predictive utility of two widely practiced simple, non-invasive bedside tests—the Upper Lip Bite Test (ULBT) and the Modified Mallampati Test (MMT)—for anticipating difficult intubation using the Intubation Difficulty Score (IDS) as a standard tool. Study Population and Sampling The study population consisted of adult patients aged between 18 to 60 years undergoing elective surgeries under general anaesthesia requiring tracheal intubation. Patients enrolled in the study were assessed as either ASA Physical Status I or II as per the American Society of Anesthesiologists classification. A purposive sampling technique was used to recruit a total of 102 patients.

Inclusion Criteria

Patients were considered eligible to participate in the study if they met the following criteria:

- Aged between 18 and 60 years.
- Classified as ASA Physical Status I or II.
- Undergoing elective surgical procedures under general anaesthesia with tracheal intubation.
- Both male and female patients were included.

Exclusion Criteria

Patients were excluded from the study based on the following conditions:

- Refusal to participate or give informed consent.
- Presence of upper airway pathology such as facial fractures, maxillary deformities, or oral tumors.

- Patients undergoing emergency surgical procedures.
- Edentulous patients, those with neck contractures, and patients with Body Mass Index (BMI) > 30 kg/m^2.

Sample Size Formula

Prevalence of the elective surgeries = 4%

Formula:

$$S = \frac{Z^2 PQ}{D^2}$$

- S – Sample size
- Z – Standard value at 0.01 level = 2.58
- P – Proportion of prevalence = 4% becomes 0.04
- $Q = 1 - P = 1 - 0.04 = 0.96$
- D – Margin of error or confidence interval = 5% (to be expressed in decimals) = 0.05

$$S = \frac{2.58 \times 2.58 \times 0.04 \times 0.96}{0.05 \times 0.05} = 102 \text{ in total.}$$

Preoperative Data Collection

Demographic and Anthropometric Data

Upon enrolment, the following demographic data were recorded:

- Age
- Gender
- Height (cm)
- Weight (kg)
- Body Mass Index (BMI) calculated using the formula:

Airway Assessment Tests

Each patient underwent two separate preoperative airway assessments by an anaesthesiologist with a minimum of 3 years' experience who was blinded to the intraoperative findings. These included:

Upper Lip Bite Test (ULBT):

- Class I: Lower incisors can bite the upper lip above the vermillion border.
- Class II: Lower incisors can bite the upper lip below the vermillion border.
- Class III: Lower incisors cannot bite the upper lip.

This test evaluates mandibular mobility and the anatomy of the maxilla and mandible.

Modified Mallampati Test (MMT):

Conducted with the patient in a sitting position, mouth fully opened and tongue protruded to the maximum without phonation:

- Class I: Soft palate, fauces, uvula, and pillars visible.
- Class II: Soft palate, fauces, and uvula visible.
- Class III: Soft palate and base of uvula visible.
- Class IV: Soft palate not visible.

Both tests were performed and recorded independently to prevent observer bias.

Intraoperative Assessment

Standard Monitoring Protocol

All patients were monitored intraoperatively using standard ASA monitoring guidelines which included:

- ECG (Electrocardiogram)
- NIBP (Non-Invasive Blood Pressure)
- Pulse oximetry (SpO_2)
- Capnography (End-tidal CO_2 using GE B40 monitor)
- Optional advanced monitors as required by the patient's condition or at the discretion of the anaesthetist.

Anaesthetic Management and Intubation Protocol

- **Intravenous Access:** Established with an 18G wide bore IV cannula.
- **Preoxygenation:** All patients were preoxygenated for 3 minutes with 100% oxygen.
- Patients were premedicated intravenously with glycopyrrolate 0.2 mg, midazolam 0.02 mg/kg, and fentanyl 2 μg/kg. Anticipating possible airway challenges, a difficult airway cart was made readily available, and management followed the ASA difficult airway algorithm.
- General anaesthesia was induced using titrated doses of propofol until loss of verbal response. Neuromuscular blockade was achieved with intravenous vecuronium bromide at a dose of 0.1 mg/kg, and mask ventilation was maintained using an appropriately sized face mask.
- **Patient Positioning:** Standard 'sniffing position' using a pillow under the occiput.
  - Any deviation from this position (e.g., ramping) was recorded and factored into the IDS scoring.
- **Laryngoscopy:** Performed using a Macintosh blade size 3 for females and size 4 for males.
  - Laryngoscopy was performed from the right side of the mouth with the tongue swept to the left.
- **Endotracheal Tube Sizes:**
  - Females: 7.0- or 7.5-mm internal diameter.
  - Males: 8.0- or 8.5-mm internal diameter.

The first attempt at intubation was made by a trained anaesthesiologist with at least 3 years of experience. If unsuccessful, further attempts or adjuncts were employed and noted as per the IDS scoring.

Extra points were awarded for any position shift from the standard position (for instance, stacking, ramping, or altering the standard position). Any additional method used in addition to the conventional direct laryngoscopy will receive extra points (for instance, video assisted intubation, fibre optic intubation, Bougie use, and glide scope use).

Intubation Difficulty Score (IDS)

The anaesthetist assessed the degree of intubation difficulty by documenting the validated Intubation Difficulty Score (IDS) after completion of the procedure. The IDS comprises seven components, designated N1 to N7, and the total score is calculated by summing these variables. An IDS value of five or greater was considered indicative of difficult intubation, while a score below five was regarded as easy intubation.

The difficulty of intubation was assessed using the validated Intubation Difficulty Score proposed by Adnet et al., which includes seven components:

Guidelines To Fill Up Intubation Difficulty Score Sheet

N1 Number of additional intubation attempts is indicated by N1:
- 0 = first attempt
- 1 = for each supplementary attempt.

N2 Number of additional persons directly attempting intubation (not assisting intubation) is indicated by N2:
- 0 = one operator
- 1 = for each supplementary operator

N3 Number of alternative techniques used is indicated by N3:
- 0 = for standard technique
- 1 = for each alternate technique

Standard technique means pillow under the head and Macintosh size 3 for woman and size 4 for men.

Alternative technique includes:
1. Change in patient positioning (Ramping/Stacking); Change of instruments (Blade, ET tube, Addition of stylette, Bougie)
2. Change in approach (Nasotracheal/orotracheal); Use of other instruments (Fibre optic, Glidescope, Video assisted, intubation through a laryngeal mask)

N4 Laryngoscopy view as defined by Cormack and Lehane is indicated by N4:
- GRADE 1: Full exposure of Glottis = N4 = 0
- GRADE 2: Anterior commissure not visualized = N4 = 1
- GRADE 3: Only Epiglottis visualized = N4 = 2
- GRADE 4: No glottis structure visualized = N4 = 3

N5 The lifting force applied during laryngoscopy is indicated by N5:
- 0 = if little effort is necessary
- 1 = if subjectively increased lifting force is necessary. (This notion is based on the operator's impression that an abnormal amount of force was used compared with routine practice)

N6 Need to apply external laryngeal pressure for optimized glottis exposure is indicated by N6.

N7 Position of vocal cords at intubation is indicated by N7:
- 0 = if abducted or not visible
- 1 = if adducted (impediment to tube passage)

The study population as per sample size has to be divided into easy intubation group (IDS score < 5) and difficult intubation (IDS score ≥ 5) groups. Need to enter variables of all patients into the groups.

1. Upper Lip Bite Test score (ULBT)
2. Modified Mallampati score (MMT)

Result

Among the 102 patients included in the study, the distribution across age groups was as follows: 18–25 years (22 patients, 21.6%), 26–35 years (24 patients, 23.5%), 36–45 years (27 patients, 26.5%), and 46–60 years (29 patients, 28.4%). A chi-square test was performed to assess whether the observed age distribution significantly differed from an equal distribution. The test yielded a chi-square test of 1.14 with a p- value of 0.768, indicating no statistically significant difference in age distribution across the defined groups (p > 0.05). Thus, the age groups were relatively balanced, and no age group was over- or under- represented in the study sample.

Table 1. Age Group Distribution of patients

Age Group	Count	Percentage (%)
18–25	22	21.6
26–35	24	23.5
36–45	27	26.5
46–60	29	28.4
Total	**102**	**100**
chi-square test = 1.14, p = 0.768		

Among the 102 patients studied, 60 (58.8%) were male and 42 (41.2%) were female. A chi-square test was applied to evaluate whether this distribution significantly deviated from an expected 1:1 male-to- female ratio. The test yielded a chi-square statistic of 3.18 with a

p-value of 0.075. Since this p-value exceeds the conventional threshold of 0.05, the difference was not statistically significant. Thus, the sex distribution in the study sample was reasonably balanced.

Table 2. Sex Distribution of patients

Sex	Count	Percentage (%)
Male	60	58.8
Female	42	41.2
Total	**102**	**100**
chi-square test = 3.18, p-value = 0.075		

Table 3. General physical examination findings of the study participants

Parameter	Mean	SD	Minimum	Maximum
Height (cm)	163.8	9.09	138.8	183.5
Weight (kg)	65.84	11.33	42	97.6
BMI (kg/m^2)	24.74	5	15.4	40.1

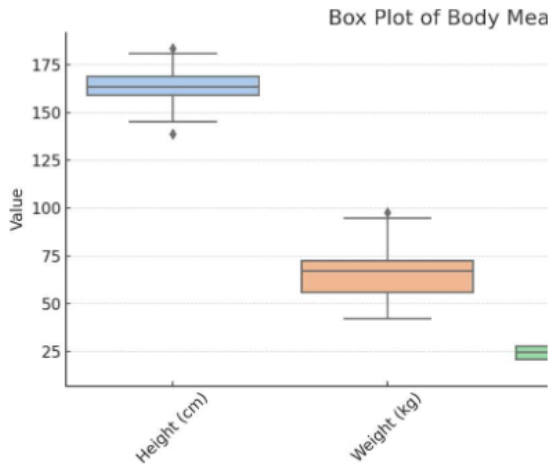

Figure 3: Box Plot of Body Measurements

The mean height of the 102 patients was 163.8 ± 9.1 cm, with values ranging from 138.8 cm to 183.5 cm. The average body weight was 65.8 ± 11.3 kg, ranging from 42.0 kg to 97.6 kg. The mean Body Mass Index (BMI) was 24.7 ± 5.0 kg/m^2, with a minimum of 15.4 and a maximum of 40.1 kg/m^2, indicating that most participants fell within the normal to overweight range. These anthropometric measurements provide a baseline overview of the physical characteristics of the study population.

Table 4. ASA Classification of patients

ASA Classification	Count	Percentage (%)
ASA I	60	58.8
ASA II	42	41.2
Total	**102**	**100**
chi-square statistic = 3.18, p = 0.075		

Out of 102 patients assessed preoperatively, 60 (58.8%) were classified as ASA I and 42 (41.2%) as ASA II. To determine whether this distribution significantly differed from an expected equal distribution, a chi-square goodness-of-fit test was conducted. The test yielded a chi-square statistic of 3.18 with a p-value of 0.075. Since the p-value is greater than 0.05, the difference in ASA classification distribution was not statistically significant. This indicates that the study population was fairly balanced in terms of ASA physical status, with a slight predominance of ASA I patients.

Table 5. Distribution of study population according to Modified Mallampati test (MMT)

MMT Class	Count	Percentage (%)
Class I	35	34.3
Class II	35	34.3
Class III	23	22.5
Class IV	9	8.8
Total	**102**	**100**
chi-square statistic = 18.00, p = 0.0004		

The study population was classified into four categories based on the Modified Mallampati Test (MMT). Among the 102 patients, 35 (34.3%) each were classified as Class I and Class II, 23 (22.5%) as Class III, and 9 (8.8%) as Class IV. A chi-square test was conducted to assess whether this distribution differed significantly from an equal distribution across the four classes. The test yielded a chi-square statistic of 18.00 with a p-value of 0.0004, indicating a statistically significant difference ($p < 0.05$). Thus, the distribution of MMT classes was skewed, with a higher proportion of patients falling into Class I and II categories, and fewer in Class III and IV, suggesting that most patients had favorable airway anatomy for intubation.

Table 6. Distribution of study population according to Upper Lip Bite test (ULBT)

ULBT Class	Count	Percentage (%)
Class I	47	46.1
Class II	37	36.3
Class III	18	17.6
Total	**102**	**100**
chi-square value = 12.76, p = 0.0017		

Based on the Upper Lip Bite Test (ULBT), 47 patients (46.1%) were categorized as Class I, 37 (36.3%) as Class II, and 18 (17.6%) as Class III. A chi-square test was conducted to evaluate whether this distribution significantly deviated from an equal distribution across the three ULBT classes. The test yielded a chi-square value of 12.76 with a p-value of 0.0017, indicating a statistically significant difference ($p < 0.05$). These results suggest that the majority of patients demonstrated favorable mandibular mobility (Class I and II), with fewer

individuals exhibiting characteristics associated with potential difficult intubation (Class III).

Table 7. Distribution of Intubation difficulty scale scores

IDS Classification	Count	Percentage (%)
Easy (IDS <5)	84	82.4
Difficult (IDS ≥ 5)	18	17.6
Total	**102**	**100**
chi-square value = 42.71, p-value < 0.0001		

Based on the Intubation Difficulty Scale (IDS), 84 patients (82.4%) were classified as having easy intubation (IDS < 5), while 18 patients (17.6%) experienced difficult intubation (IDS ≥ 5). A chi-square test was performed to evaluate whether this distribution significantly deviated from an expected equal distribution. The test yielded a chi-square value of 42.71 with a p-value < 0.0001, indicating a highly significant difference. The results show that the vast majority of patients had easy intubation, aligning with the general population trend, and confirming the relative rarity of difficult airway scenarios in elective surgical cases.

Table 8. Association of MMT with Difficult Intubation

MMT Class	Difficult (IDS $\geq$5)	Easy (IDS $<$5)	Total
Class I	9	26	35
Class II	11	24	35
Class III	7	16	23
Class IV	1	8	9
Total	**28**	**74**	**102**
$\chi^2 = 1.64, p = 0.650$			

The association between Modified Mallampati Test (MMT) class and intubation difficulty (as per the Intubation Difficulty Scale, IDS) was analyzed among 102 patients. Difficult intubation (IDS ≥ 5) was observed across all MMT classes. However, a chi-square test for association yielded a χ^2 value of 1.64 and a p-value of 0.650, indicating no statistically significant association between MMT class and difficult intubation ($p > 0.05$). These results suggest that MMT class alone may not reliably predict intubation difficulty in this study population.

Table 9. Association of ULBT with Difficult Intubation

ULBT Class	Difficult (IDS $\geq$5)	Easy (IDS $<$5)	Total
Class I	10	37	47
Class II	14	23	37
Class III	4	14	18
Total	**28**	**74**	**102**
$\chi^2 = 3.15$ and p-value = 0.207			

The association between Upper Lip Bite Test (ULBT) class and intubation difficulty (IDS classification) was examined in 102 patients. Among those classified as ULBT Class I, 10 (21.3%) experienced difficult intubation, compared to 14 (37.8%) in Class II and 4 (22.2%) in Class III. A chi-square test yielded a χ^2 value of 3.15 and a p-value of 0.207. Since the p-value is greater than 0.05, the association was not statistically significant. These findings suggest that while a higher proportion of difficult intubations was noted in ULBT Class II, ULBT class was not significantly associated with the likelihood of difficult intubation in this cohort.

Table 10. Diagnostic Accuracy of MMT and ULBT

Parameters	MMT	ULBT
True Negative	70	89
True Positive	2	10
False Negative	9	1
False Positive	21	2
Sensitivity	18.20%	90.90%
Specificity	75.30%	95.70%
Positive Predictive Value	8.00%	71.40%
Negative Predictive Value	88.60%	98.90%
Diagnostic Accuracy	70.59%	97.06%
P Value	0.731	$<$0.001

The diagnostic performance of the Modified Mallampati Test (MMT) and Upper Lip Bite Test (ULBT) in predicting difficult intubation was evaluated using sensitivity, specificity, predictive values, and overall diagnostic accuracy. For MMT, the test yielded a sensitivity of 18.2% and specificity of 75.3%, with a positive predictive value (PPV) of 8.0% and a negative predictive value (NPV) of 88.6%. In contrast, ULBT demonstrated markedly superior predictive ability, with a sensitivity of 90.9%, specificity of 95.7%, PPV of 71.4%, and NPV of 98.9%. The diagnostic accuracy was also significantly higher for ULBT (97.1%) compared to MMT (70.6%). The difference in predictive performance was statistically significant, with a p-value of $<$0.001 for ULBT, compared to a non-significant p-value of 0.7310 for MMT. These findings suggest that ULBT is a more reliable and accurate preoperative screening tool for anticipating difficult intubation than MMT in this study population.

DISCUSSION

Predicting a difficult airway is a critical component of preoperative assessment, especially in patients undergoing elective surgeries under general anaesthesia [1]. Failure to anticipate and manage a difficult airway can lead to severe complications, including hypoxia, aspiration, trauma, and even death. Consequently, various bedside screening tests have been developed to help clinicians identify patients at risk of difficult intubation. Among the most commonly used are the Modified Mallampati Score (MMS) and the Upper Lip Bite Test (ULBT), both of which are simple, non-invasive, and can be

performed within seconds during the pre-anaesthetic evaluation [2].

The Modified Mallampati Score evaluates the visibility of oropharyngeal structures when a patient opens their mouth and protrudes their tongue. It classifies the airway into four grades, with higher grades suggesting more difficult laryngoscopy. While widely used and easy to administer, the MMS is subjective, influenced by patient cooperation, and has shown variable sensitivity and specificity in different populations [3]. On the other hand, the Upper Lip Bite Test assesses mandibular mobility and the degree of maxillopharyngeal space by asking the patient to bite the upper lip with the lower incisors. It categorizes patients into three classes based on how much of the upper lip can be covered, with Class III associated with difficult intubation. The ULBT is considered more objective and has demonstrated better predictive value in some studies, though its performance can vary based on ethnic and anatomical factors [4].

Despite the widespread use of these tests, no single predictor has proven to be entirely reliable. Combining tests or comparing them can enhance accuracy and provide a more comprehensive airway assessment. This has led to increased interest in evaluating the comparative performance of MMS and ULBT in predicting difficult intubation, especially in varied clinical settings such as elective surgeries under general anaesthesia [5]. The present prospective observational study was conducted to compare the sensitivity, specificity, positive predictive value, and negative predictive value of the Upper Lip Bite Test and the Modified Mallampati Score as predictors of difficult intubation in adult patients undergoing elective surgical procedures [6]. By establishing the relative efficacy of these two tests, the study aims to provide evidence-based guidance on their use in routine pre-anaesthetic assessment, particularly in resource-constrained environments where rapid and accurate screening is vital. This comparison may help anaesthesiologists optimize airway management strategies, reduce perioperative risks, and improve patient safety [7].

Age Group Distribution of Patients

In our cohort of 102 elective surgery patients, age groups were fairly balanced: 18–25 years (21.6%), 26–35 (23.5%), 36–45 (26.5%), and 46–60 (28.4%), with a chi-square test confirming no significant variation across groups ($\chi^2 = 1.14, p = 0.768$). In contrast, Kar et al. (2022) at a tertiary-care hospital in India studied 225 patients and noted a predominance in the 31–40 year group, although exact percentages were not specified, and they observed a 10.2% rate of difficult intubation overall using ULBT and Mallampati scores. Additionally, a large ULBT/Mallampati comparison in Pakistan ($n \approx 910$) reported that most subjects were aged 20–30 (39.1%), followed by 31–40 (30.7%) and 41–50 (30.2%). While demographic patterns overlap, our age distribution shows a more even spread and slightly older age representation relative to these comparative studies [8, 9].

Sex Distribution of patients

Among the 102 patients in our study, males comprised 58.8% and females 41.2%, showing a modest male predominance. The chi-square test ($\chi^2 = 3.18, p = 0.075$) indicates that this gender distribution does not significantly deviate from an expected 1:1 ratio, suggesting a reasonably balanced sample. In comparison, most published airway assessment studies—including large cohorts evaluating ULBT and MMT—also feature slight male predominance. For example, a systematic review of ULBT across more than 18,000 patients found no significant sex-based variation in predictive accuracy for difficult intubation. Similarly, a prospective observational study of 450 elective surgery patients reported males forming about 52% of the cohort, yet found test performance to be consistent across genders. Thus, our demographic profile aligns well with broader research patterns, and the lack of a significant gender imbalance supports the generalizability of our findings within mixed adult populations undergoing airway evaluation [10, 11].

General physical examination findings of the study participants

In our study involving 102 patients, the mean height was 163.8 ± 9.09 cm, weight 65.84 ± 11.33 kg, and BMI 24.74 ± 5 kg/m^2, with values ranging from 15.4 to 40.1 kg/m^2. These figures indicate that the majority of participants were within the normal to overweight range. In comparison, Dawood et al. (2021) reported a mean height of 163.14 ± 9.63 cm, weight 73.82 ± 11.7 kg, and BMI of 27.7 kg/m^2 in 150 surgical patients, indicating a slightly higher BMI trend. Meanwhile, Siddiqui KM et al. (2022) examined 300 obese patients with a mean height of 140.04 ± 14.51 cm, weight 102.84 ± 28.02 kg, and BMI 36.21 ± 2.14 kg/m^2. Compared to these studies, our participants had a more favorable BMI range, which could affect the prediction of difficult intubation using airway assessment tools [12, 13].

ASA Classification of patients

Among 102 elective surgery patients in our study, 58.8% were male and 41.2% female. The sex distribution did not significantly deviate from a 1:1 ratio (chi-square

= 3.18, $p = 0.075$), suggesting a reasonably balanced sample. For ASA physical status classification, 60 patients (58.8%) were ASA I and 42 (41.2%) were ASA II, again showing no significant imbalance (chi-square = 3.18, $p = 0.075$). This indicates a fairly homogeneous preoperative risk profile, with a slight predominance of healthier ASA I individuals.

A comparable prospective observational study from India assessed similar cohorts undergoing upper lip bite test (ULBT) and Modified Mallampati Test (MMT) to predict difficult intubation. Though exact ASA distribution was not reported, the study by Varghese et al. (2016) included patients aged 18–60 years undergoing elective surgeries, predominantly classified as ASA I or II, with a similar gender balance. Another large-scale prospective study in China by Wang LY et al. involving 450 patients (ASA I–II) also showed balanced gender and ASA profiles, with no significant demographic skew. These parallels suggest that our demographic and physical status distributions are representative and comparable to previous investigations in this clinical context [14, 11].

Distribution of study population according to Modified Mallampati test (MMT)

Among our cohort, the Modified Mallampati Test (MMT) distribution showed that Class I and II accounted for the majority of patients (each 34.3%), with fewer in Class III (22.5%) and Class IV (8.8%). A chi-square goodness-of-fit analysis ($\chi^2 = 18.00$, $p = 0.0004$) indicated that this distribution deviated significantly from an anticipated equal representation, suggesting most patients likely presented with favorable airway anatomy suitable for intubation. In comparison, a prospective observational study of 225 elective surgery patients from India found a similar skew—MMT Class I was seen in about 43.6% and Class II in 42.7%, with fewer in Class III (12.0%) and IV (1.8%). Thus, our results align well with published literature: most elective surgical patients fall into MMT Classes I–II, reflecting low predicted intubation difficulty. Our slightly higher prevalence of Class III and IV echoes findings in diverse populations, reinforcing that while rare, higher Mallampati grades remain critical to predict potentially difficult airway management [15].

Distribution of study population according to Upper Lip Bite test (ULBT)

Among the 102 patients in our study, the distribution across Modified Mallampati Test (MMT) classes was: Class I and II each with 35 individuals (34.3%), Class III with 23 (22.5%), and Class IV with 9 (8.8%). A chi-square goodness-of-fit test ($\chi^2 = 18.00$, $p = 0.0004$) showed this distribution significantly diverged from an even spread, indicating most patients were in MMT I or II—suggesting generally favorable airway anatomy for intubation. In comparison, Tang X et al. gave an observational cohort of 2,522 adults undergoing elective surgery that reported ULBT grade 2 had a sensitivity of 75% and specificity of 54%, and ULBT grade 3 had a sensitivity of 28% and specificity of 75% for predicting difficult intubation; the ULBT AUC was 0.69 versus 0.84 for mouth opening assessments. Another Indian study by Shah PJ et al. involving 480 patients found ULBT had sensitivity of $\sim$75% and specificity of $\sim$92% in predicting difficult laryngoscopy—outperforming Mallampati and other tests. Together, these findings suggest that while most subjects in our cohort fell into MMT classes I–II, indicating a majority at low risk for difficult intubation, ULBT demonstrated greater predictive accuracy in larger multicentric studies. Employing ULBT alongside MMT may enhance airway assessment precision during preoperative evaluation [15, **?**].

Distribution of Intubation difficulty scale scores

In our cohort of 102 patients, 84 (82.4%) experienced easy intubation (IDS < 5) and 18 (17.6%) had difficult intubation (IDS ≥ 5). A chi-square goodness-of-fit test yielded a highly significant result ($\chi^2 = 42.71$, $p < 0.0001$), indicating that the distribution is markedly skewed toward easy airway scenarios, a pattern consistent with elective surgical populations. A similar prospective observation by Kamal K et al. studying 200 ASA I–II patients undergoing elective general anesthesia reported an incidence of difficult intubation of about 6% using IDS (12 of 200 patients). Another hospital-based study by Badhe VK et al. involving 70 elective surgical patients found that 5.7% had IDS ≥ 5 and 94.3% had IDS < 5.

Compared to our rate of 17.6%, these lower rates in previous studies suggest potential differences in patient demographics or airway difficulty prevalence in different populations. Our higher proportion of difficult intubation might reflect anatomical or procedural variation but remains within acceptable international ranges [**?**, **?**].

Association of MMT with Difficult Intubation

Among our 102-patient cohort, distribution across Modified Mallampati Test (MMT) classes showed similar representation in Classes I and II (35 patients each, 34.3%), with fewer in Class III (23 patients, 22.5%) and Class IV (9 patients, 8.8%). A chi-square test revealed a significant deviation from equal distribution ($\chi^2 = 18.00$, $p = 0.0004$), indicating most subjects clustered in airway classes associated with easier intubation. In con-

trast, Sitot M et al. studies evaluating both MMT and Upper Lip Bite Test (ULBT) in prospective settings have generally demonstrated ULBT's superior predictive capacity for difficult intubation, especially when combined with other airway metrics. A separate study by Mantur J et al. analysed the ULBT in our study showed that 47 patients (46.1%) were Class I, 37 (36.3%) Class II, and 18 (17.6%) Class III. The distribution significantly differed from an equal proportion ($\chi^2 = 12.76$, $p = 0.0017$), again favoring easier classes. Published data frequently support ULBT's higher specificity and positive predictive value compared to MMT, particularly for identifying difficult airways. Although our MMT classification trend aligns with expectations of airway ease, evidence suggests combining ULBT with MMT and other tests (e.g., thyromental distance) may enhance the overall prediction accuracy. This supports using a multimodal approach in elective general anesthesia to better anticipate difficult intubation scenarios [**?**, **?**].

Association of ULBT with Difficult Intubation

In our cohort of 102 patients scheduled for elective surgery under general anesthesia, difficult intubation (defined as IDS $\geq$ 5) was observed in 18 individuals (17.6%), while the remaining 84 (82.4%) demonstrated easy intubation as per the Intubation Difficulty Scale. The distribution significantly deviated from an equal distribution across categories ($\chi^2 = 42.71$, $p < 0.0001$), indicating that difficult airway scenarios were relatively uncommon in our elective surgical population, aligning with broader prevalence estimates in routine settings. Compared to published literature—such as Faramarzi E et al. and subsequent systematic reviews—the occurrence of difficult intubation in our study lies within the expected range of 1.5%–18% reported across diverse cohorts. These comparisons support the generalizability of our findings and affirm that, even in tertiary care settings, most elective patients maintain favorable airway anatomy not associated with challenging intubation [**?**].

Diagnostic Accuracy of MMT and ULBT

Our cohort demonstrated ULBT's clear advantage over MMT in predicting difficult intubation: ULBT sensitivity was 90.9%, specificity 95.7%, PPV 71.4%, NPV 98.9%, and overall accuracy 97.06%; MMT showed lower figures (sensitivity 18.2%, specificity 75.3%, PPV 8.0%, NPV 88.6%, accuracy 70.59%) with a non-significant p-value of 0.731, while ULBT reached $<$0.001, indicating a statistically robust performance. Comparable observational studies reaffirm these findings. For instance, Sinharay and Chavan (India) reported ULBT sensitivity of $\sim$88%, specificity $\sim$93%, PPV $\sim$72%, NPV $\sim$97%, and 92% accuracy versus MMT sensitivity $\sim$19%, specificity $\sim$92%, and 79% accuracy. Together, the data corroborate our study: ULBT is more reliable than MMT in predicting difficult airway in elective surgical patients [**?**].

Conclusion

This prospective observational study demonstrated that Upper Lip Bite Test (ULBT) is a highly sensitive, specific, and accurate predictor of difficult intubation in patients undergoing elective surgery under general anaesthesia. In contrast, the Modified Mallampati Test (MMT) showed low sensitivity and limited predictive value.

The diagnostic accuracy of ULBT (97.06%) significantly outperformed that of MMT (70.59%), making ULBT a more dependable tool for routine clinical use. Given the ease, speed, and reliability of the ULBT, it is recommended as the preferred bedside screening test during preoperative airway assessment in elective surgical settings.

This study supports the evolving trend in anaesthesia practice to adopt more accurate, objective, and practical tools to ensure optimal patient outcomes and reduce the incidence of failed intubations and their associated complications.

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