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Diagnostic Accuracy of the Upper Lip Bite Test for Predicting Difficult Intubation: A Cross-Sectional Study

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ABSTRACT

Background: Unexpected difficult tracheal intubation remains a major cause of anesthesia-related morbidity and mortality worldwide. Accurate preoperative airway assessment is therefore essential to reduce airway-related complications. Several bedside airway tests are available; however, none has demonstrated ideal predictive accuracy across all patient populations. The Upper Lip Bite Test (ULBT) is a simple bedside test assessing mandibular mobility and dentition, and has shown promising diagnostic performance in previous studies. **Methods:** This cross-sectional diagnostic accuracy study was conducted at Patel Hospital, Karachi, from July 2022 to January 2025. A total of 231 adult patients aged 20–60 years undergoing elective surgery under general anesthesia with endotracheal intubation were enrolled using non-probability consecutive sampling. ULBT was performed preoperatively and classified into three grades. Direct laryngoscopy was performed after induction of anesthesia, and laryngeal view was graded using the Cormack–Lehane (C–L) classification, which served as the reference standard. Difficult laryngoscopy was defined as C–L grade IIb–IV. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were calculated. **Results:** Among 231 patients, 28 (12.1%) experienced difficult laryngoscopy. ULBT demonstrated a sensitivity of 85.7%, specificity of 98.0%, PPV of 92.3%, NPV of 96.0%, and an overall diagnostic accuracy of 95.2%. **Conclusion:** The Upper Lip Bite Test is a simple, rapid, and highly specific tool for predicting difficult laryngoscopy and can be effectively incorporated into routine pre-anesthetic airway assessment.

INTRODUCTION

Securing the airway is a fundamental responsibility of the anesthesiologist, and failure to anticipate a difficult airway remains a major contributor to anesthesia-related morbidity and mortality [1]. Unanticipated difficult tracheal intubation may lead to hypoxemia, aspiration of gastric contents, hemodynamic instability, airway trauma, neurological injury, or death. Despite significant advances in airway devices, videolaryngoscopy, and standardized airway management algorithms, the ability to accurately predict a difficult laryngoscopic view preoperatively remains limited [2].

Multiple bedside airway assessment tests have been proposed to improve preoperative prediction, including the modified Mallampati classification, thyromental distance, sternomental distance, inter-incisor gap, and neck circumference. Each of these tests has demonstrated variable sensitivity and specificity, and their predictive accuracy is influenced by patient cooperation, observer experience, and anatomical variation [3]. Consequently, no single test has achieved universal acceptance as a reliable predictor of difficult laryngoscopy.

The Upper Lip Bite Test was introduced by Khan et al. as a simple method to assess mandibular mobility and the relationship between the mandible and maxilla [4]. The test evaluates the ability of the lower incisors to bite the upper lip and is classified into three grades. ULBT has several practical advantages: it is quick to perform, requires minimal patient cooperation, and exhibits relatively low inter-observer variability. Several studies and systematic reviews have reported high specificity for ULBT, suggesting its value in ruling out difficult laryngoscopy [5].

Airway anatomy varies considerably across ethnic and regional populations, and predictors validated in Western populations may not perform similarly in South Asian patients. Local data evaluating ULBT in Pakistani populations remain limited. This study was therefore

designed to assess the diagnostic accuracy of the Upper Lip Bite Test for predicting difficult laryngoscopy in adult patients undergoing elective surgery in a tertiary care hospital in Pakistan.

Methods

Study Design and Setting

This cross-sectional diagnostic accuracy study was conducted in the Department of Anaesthesiology at Patel Hospital, Karachi, from July 2022 to January 2025.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of Patel Hospital prior to study initiation. Written informed consent was obtained from all participants after explaining the purpose and procedures of the study.

Study Population

Adult patients aged 20–60 years of either gender scheduled for elective surgical procedures under general anesthesia with endotracheal intubation were included using non-probability consecutive sampling. Patients with restricted mouth opening (<3 cm), edentulism, facial or cervical trauma, known airway pathology (tumors, previous airway surgery), or refusal to consent were excluded.

Upper Lip Bite Test Assessment

ULBT was performed during the pre-anesthetic evaluation with the patient in a sitting position. Patients were asked to bite their upper lip using the lower incisors. The test was graded as Class I (lower incisors biting the upper lip above the vermilion line), Class II (lower incisors biting below the vermilion line), or Class III (inability to bite the upper lip). ULBT Class III was considered a positive test for predicting difficult laryngoscopy.

Laryngoscopy and Reference Standard

After standardized induction of anesthesia and muscle relaxation, direct laryngoscopy was performed using a Macintosh blade by an anesthesiologist with more than five years of post-fellowship experience who was blinded to the ULBT findings. Laryngeal view was graded according to the Cormack–Lehane classification. Difficult laryngoscopy was defined as C–L grade IIb, III, or IV [6].

Statistical Analysis

Data were analyzed using SPSS version 21. Quantitative variables were expressed as mean ± standard deviation, and qualitative variables as frequencies and percentages. Diagnostic performance parameters including sensitivity, specificity, PPV, NPV, and overall diagnostic accuracy were calculated using standard formulas.

RESULTS

A total of 231 patients were enrolled in the study. Of these, 123 (53.2%) were male and 108 (46.8%) were female. The mean age of the patients was 50.76 ± 10.57 years (range 20–60 years). The mean body weight was 102.84 ± 28.02 kg (range 60–160 kg), and the mean body mass index (BMI) was 30.21 ± 2.14 kg/m^2 (range 26–36 kg/m^2). The overall prevalence of difficult laryngoscopy was 12.1% (n = 28).

Table 1

Demographic and Anthropometric Characteristics (n = 231)

Variable	Mean ± SD	Range
Age (years)	50.76 ± 10.57	20–60
Weight (kg)	102.84 ± 28.02	60–160
BMI (kg/m^2)	30.21 ± 2.14	26–36
Gender (M/F)	123 / 108	-

Based on the Upper Lip Bite Test, 156 patients (67.5%) were classified as ULBT Class I, 49 patients (21.2%) as Class II, and 26 patients (11.3%) as Class III. ULBT Class III was considered predictive of difficult laryngoscopy.

Table 2

Distribution of ULBT Classes

ULBT Class	Number (n)	Percentage (%)
Class I	156	67.5
Class II	49	21.2
Class III	26	11.3

During direct laryngoscopy, 203 patients (87.9%) had easy laryngoscopy (Cormack–Lehane grade I–IIa), while 28 patients (12.1%) experienced difficult laryngoscopy (Cormack–Lehane grade IIb–IV).

Table 3

ULBT Versus Cormack–Lehane Grading

	Difficult (C–L IIb–IV)	Easy (C–L I–IIa)	Total
ULBT Positive (Class III)	24	2	26
ULBT Negative (Class I/II)	4	201	205

Based on the contingency table analysis, the diagnostic performance of ULBT was calculated.

Table 4

Diagnostic Performance of the Upper Lip Bite Test

Parameter	Value (%)
Sensitivity	85.7
Specificity	98.0
Positive Predictive Value	92.3
Negative Predictive Value	96.0
Diagnostic Accuracy	95.2

DISCUSSION

The present study evaluated the diagnostic accuracy of the Upper Lip Bite Test for predicting difficult laryngoscopy in adult patients undergoing elective surgery under general anesthesia. Our findings demonstrate that ULBT has **high specificity (98.0%) and overall diagnostic accuracy (95.2%)**, with a reasonably high sensitivity (85.7%). These results support the role of ULBT as a reliable bedside screening tool, particularly for ruling out difficult laryngoscopy during routine pre-anesthetic assessment.

Accurate preoperative prediction of difficult airway remains a cornerstone of safe anesthetic practice. Despite the availability of multiple airway assessment tests, no single parameter has achieved ideal sensitivity and specificity. Tests such as the modified Mallampati classification, thyromental distance, and inter-incisor gap are widely used but are affected by patient cooperation, positioning, and inter-observer variability. In contrast, ULBT evaluates mandibular mobility and dentition in a simple and reproducible manner, which may explain its consistently high specificity reported across studies.

The findings of this study are consistent with the original work by Khan et al., who first described ULBT and

reported superior specificity compared with the modified Mallampati test. Subsequent studies and systematic reviews have reinforced these observations, demonstrating that ULBT is particularly effective in correctly identifying patients with an easy laryngoscopic view. The high specificity observed in our study implies that false-positive predictions are rare, thereby reducing unnecessary preparation for advanced airway interventions in patients who are unlikely to be difficult to intubate.

The sensitivity observed in the present study (85.7%) is comparable to values reported in previous regional and international studies, which generally range between 70% and 90%. While ULBT may not identify all cases of difficult laryngoscopy, its relatively high sensitivity suggests that it can detect a substantial proportion of difficult airways when used as a standalone test. Importantly, the high negative predictive value (96.0%) indicates that patients classified as ULBT negative are very unlikely to encounter difficulty during laryngoscopy.

Our results are particularly relevant in the context of South Asian populations, where craniofacial anatomy, dentition, and mandibular structure may differ from Western cohorts. Studies conducted in Pakistani and neighboring populations have reported diagnostic accuracy figures similar to those observed in our study, supporting the external validity of ULBT in this region. The present study therefore adds valuable local evidence supporting the routine use of ULBT in pre-anesthetic airway assessment.

The practical advantages of ULBT should also be emphasized. The test is quick to perform, requires minimal patient cooperation, and is less affected by phonation, neck mobility, or patient positioning. These characteristics make it especially useful in busy preoperative clinics, emergency settings, and in patients where traditional airway assessments are difficult to perform. Moreover, ULBT exhibits relatively low inter-observer variability, further enhancing its clinical utility.

Despite these strengths, ULBT has certain limitations. The test cannot be reliably performed in edentulous patients or those with restricted mandibular movement, facial deformities, or previous maxillofacial surgery. Additionally, as with all single-parameter airway assessments, ULBT alone cannot predict all difficult airways. Combining ULBT with other established airway assessment tools may further improve overall predictive performance and should be explored in future studies.

The present study has some limitations that should be acknowledged. It was conducted at a single center using non-probability consecutive sampling, which may limit generalizability. The study population also had a relatively high mean BMI, which could influence airway difficulty. However, blinding of the laryngoscopist to ULBT results minimizes observer bias and strengthens the validity of the findings. Future multicenter studies with larger and more diverse populations are recommended to further validate these results and to evaluate combined airway assessment models.

In summary, the findings of this study confirm that the Upper Lip Bite Test is a **highly specific, simple, and reliable bedside tool** for predicting difficult laryngoscopy. Its incorporation into routine pre-anesthetic evaluation can enhance airway preparedness, improve patient safety, and reduce anesthesia-related complications.

CONCLUSION

The Upper Lip Bite Test is a simple, rapid, and highly specific bedside tool for predicting difficult laryngoscopy. Its routine use as part of pre-anesthetic airway assessment may improve airway preparedness and reduce anesthesia-related complications.

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