A Comparative Study Between Modified Mallampati Classification, Thyromental Distance and Neck Circumference for Predicting Difficulty During Endotracheal Intubation

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***Abstract*—Unanticipated difficult endotracheal intubation can lead to significant perioperative complications, making accurate preoperative airway evaluation essential. This study compares the effectiveness of Modified Mallampati Classification (MMC), Thyromental Distance (TMD), and Neck Circumference (NC) as predictors of difficult endotracheal intubation. Patients scheduled for elective surgical procedures under general anesthesia from Saveetha Medical College Hospital, Chennai, Tamil Nadu, India underwent preoperative assessment using these three airway parameters. The ease of intubation was subsequently evaluated during direct laryngoscopy and tracheal intubation. The predictive performance of each assessment tool was analyzed and compared using appropriate statistical measures. By identifying the parameter with the highest predictive accuracy, this study aims to improve the detection of potentially difficult airways, support anesthesiologists in planning airway management strategies, and contribute to safer anesthetic practice and improved patient outcomes.**

***Index Terms*—Endotracheal intubation, Modified Mallampati Classification, Thyromental Distance, Neck circumference, Laryngoscopy.**

I. INTRODUCTION

Securing the airway through endotracheal intubation is a fundamental and often life-saving procedure in anesthesia and emergency medicine. However, unanticipated difficult intubation

remains a significant clinical challenge, with potential consequences ranging from prolonged hypoxia to failed airway management and even mortality. Studies estimate the incidence of difficult intubation in the general surgical population to be between 1.5% and 8%, with higher rates observed in certain subgroups, such as obese patients or those with anatomical anomalies. Accurate preoperative prediction of a difficult airway allows clinicians to plan appropriate airway strategies, reduce preoperative complications and improve patient safety. Consequently, the development and validation of reliable, simple and cost-effective bedside tests for airway assessment are crucial in routine anesthetic practice.

(a) MODIFIED MALLAMPATI CLASSIFICATION:
MMC assesses the visibility of oropharyngeal structures with the patient in a seated position, head in neutral alignment, mouth opened maximally, and tongue protrude without phonation. The degree of visibility of the posterior pharyngeal structures is then classified into four grades:

Class I: Soft palate, fauces, uvula and tonsillar pillars visible.
Class II: Soft palate, fauces and uvula visible.
Class III: Soft palate and base of uvula visible.
Class IV: Only the hard palate visible.
Higher Mallampati grades (III & IV) have been associated with increased difficulty in laryngoscopy and intubation. The simplicity and non-invasiveness of the test make it a convenient preoperative screening tool. While MMC alone offers moderate sensitivity and specificity, it is best used as part of multifactorial airway assessment strategy, in combination with other predictors like Thyromental distance, Neck circumference and jaw mobility.

(b) THYROMENTAL DISTANCE:
Thyromental distance is defined as the straight-line distance measured from the thyroid notch (Adam's apple) to the bony point of the mentum (chin) with the neck fully extended. It reflects the mandibular space available for tongue displacement during laryngoscopy and indirectly assesses the alignment of the oral, pharyngeal and laryngeal axes. TMD is typically measured in centimeters using a rigid ruler or measuring tape. A TMD of less than 6.5 cm – 7.0 cm is generally considered indicative of a potentially difficult airway. Shorter distances may suggest reduced mandibular space or restricted neck-mobility, both of which can hinder optimal visualization of the glottis during laryngoscopy.

(c) NECK CIRCUMFERENCE:
It refers to the measurement of the distance around the neck, typically taken just below the larynx, perpendicular to the long axis of the neck. It is usually measured in centimeters (cm) using a flexible measuring tape while the patient stands upright with their head in a neutral position. It is an emerging anthropometric measured used to assess body fat distribution and predict metabolic

and cardiovascular health risks. Unlike traditional metrics such as BMI and waist circumference, neck circumference is relatively easy to measure.

II. REVIEW OF LITERATURE

- Kim, J. H., Kim, H., Jang, J. S., Hwang, S. M., Lim, S. Y., Lee, J. J., & Kwon, Y. S. (2021). Development and validation of a difficult laryngoscopy prediction model using machine learning of neck circumference and thyromental height. *BMC Anesthesiology, 21*(125), 1–9
- Bhat, M. G., Bangera, A., Bhat, S. G. K., & Shivakumar, K. G. (2022). Relevance of ratio of neck circumference to thyromental distance in predicting difficult intubation. *International Journal of Health Sciences, 6*(S6), 4515–4524.
- Pradeep, S., Kundu, S. B., & Nivetha, C. (2023). Evaluation of neck-circumference-thyromental-distance ratio as a predictor of difficult intubation: A prospective observational study. *Indian Journal of Anaesthesia, 67*(5), 445–451.
- Shamim, A., Swami, S., Konnur, S., & Patil, K. N. (2024). The importance of evaluation of neck circumference to thyromental distance ratio as a predictor of difficult intubation. *Archives of Anesthesiology and Critical Care, 10*(2), 113–117.
- Udaya, R. K., Khan, S., Pathak, L., & Chhetri, P. (2024). Anticipation of difficult airway by neck circumference to thyromental distance ratio. *Journal of Universal College of Medical Sciences, 12*(1), 9–14.
- Yuan, J., Ye, H., Tan, X., Zhang, H., & Sun, J. (2024). Determinants of difficult laryngoscopy based on upper airway indicators: A prospective observational study. *BMC Anesthesiology, 24*(157), 1–11.

These findings collectively reinforce the importance of Modified Mallampati classification, thyromental distance and neck circumference in difficult airway assessment for predicting difficult laryngoscopy and intubation.

III. AIM AND OBJECTIVES

- To compare the effectiveness of Modified Mallampati Classification (MMC), Thyromental Distance (TMD) and Neck Circumference (NC) as predictors of difficult endotracheal intubation in adult patients undergoing elective surgical procedures under general anesthesia.
- To identify cases of difficult intubation based on intraoperative findings, particularly using the Comark-Lehane grading system.
- To determine whether a combination of these parameters improves the overall prediction of difficult airway compared to individual predictors alone.

IV. MATERIALS AND METHODS

- Study Design: prospective observational study

- Sample Size: 100 patients scheduled for elective surgical procedures under general anesthesia
- Duration: January 2025 – June 2025
- Setting: Department of Anesthesiology, Saveetha Medical College Hospital, Chennai.
- Inclusion Criteria: Adult patients (aged 18-50 years) undergoing elective surgical procedures under general anesthesia requiring endotracheal intubation and American Society of Anesthesiology (ASA) physical status I & II.
- Exclusion Criteria: Patients with facial or Neck deformities, Limited neck mobility, edentulous patients and those with known difficult airway.
- Data Collection: Patient demographics, each patient was assessed preoperatively using Modified Mallampati classification, thyromental distance, neck circumference and recorded.

V. RESULTS

- A total of 100 patients were included in the study to evaluate the predictive value of Modified Mallampati Classification (MMC), Thyromental distance (TMD) and Neck Circumference (NC) in assessing the difficulty of endotracheal intubation.
- Difficult intubation was observed in 29 patients (29%).
- No difficulty was reported in 71 patients (71%).

(TABLE 1- MMC DISTRIBUTION)

MMC	COUNT
I	14
II	41
III	24
IV	21

(TABLE 2- TMD DISTRIBUTION)

TMD	COUNT
5	3
6	31
7	51
8	15

(TABLE 3- NC)

GROUP	COUNT	MEAN NC (cm)
DIFFICULT INTUBATION	29	37.93
NO DIFFICULTY	71	37.58

VI. DISCUSSION

This study was conducted to evaluate the predictive accuracy of three common preoperative airway assessment methods – Modified Mallampati Classification (MMC), Thyromental distance (TMD) and Neck Circumference (NC) – in identifying patients at risk of difficult intubation. Statistical analyses using Chi-square and t-tests revealed that none of the three parameters were significantly associated with difficult intubation. For MMC, the Chi-square test yielded a P-value of 0.3516, indicating no statistically significant relationship between the Mallampati class and the incidence of difficult intubation. Although class III and IV are traditionally considered markers for potential difficulty, in this study population, they did not show strong predictive accuracy. When assessing diagnostic performance, MMC demonstrated a sensitivity of 48.3 %, specificity of 56.3%, positive predictive value (PPV) of 31.1% and negative predictive value (NPV) of 72.7%. These values suggest that while MMC has modest utility in ruling out difficult airways (as reflected by the relative higher NPV), its ability to correctly identify patients with difficult intubation is limited.
Thyromental distance is another widely used parameter, also failed to show a statistically significant association (P-value =0.6009) with difficult intubation. Using a common clinical cutoff of less than or equal to 6.5 cm to define a positive test, TMD had a sensitivity of 37.9%, specificity of 70.6%, PPV of 35.5% and NPV of 72.7%. These results indicate that TMD, although more specific than MMC, lacks sufficient sensitivity to serve as a standalone predictive tool. Regarding Neck Circumference, the t-test analysis showed p-value of 0.6154, with no significant difference in mean NC between patients with and without difficult intubation. Due to the lack of categorization in NC values sensitivity and specificity could not be calculated for this parameter in the current analysis.

VII. CONCLUSION

Although MMC and TMD showed moderate specificity and negative predictive value, their sensitivity and positive predictive value were low, limiting their standalone utility. Neck circumference, while considered promising in prior studies, also failed to show statistical significance in this study. Overall, the study reinforces the importance of a multifactorial approach to airway assessment. Relying solely on MMC, TMD, or NC may not be adequate for accurately predicting difficult airways. Instead, integrating multiple assessment methods along with clinical judgment is essential to enhance patient safety and airway management outcomes.

REFERENCES

[1] Rather TA, Gupta H, Rana S, et al. A comparative study of Modified Mallampati classification, thyromental distance and sternomental distance for predicting difficult laryngoscopy. Journal of Medical Science and Clinical Research. 2016;4(11):13797-13802.

[2] Kumar, R., Khan, S., Pathak, L., & Chhetri, P. (2024). Comparative evaluation of airway indices for prediction of difficult intubation in obese and non-obese patients. *Journal of Universal College of Medical Sciences, 12*(1), 9–14.

[3] Demir Senoglu, G., & Kara Timucin, E. (2025). Evaluation of anthropometric and ultrasonographic measurements with different machine learning methods in predicting difficult intubation: A prospective observational study. *BMC Anesthesiology, 25*, 496.

[4] Thirunavukkarasu, B., Jaswal, S., Walia, H. S., & Batra, Y. K. (2025). Comparison of neck circumference at the hyoid and thyroid levels, neck circumference-to-thyromental distance ratio, and hyomental distance ratio in predicting difficult laryngeal visualization in obese and non-obese populations. *Cureus, 17*(2), e78879.

[5] Uma, G., Padmapriya, P., Manoj, M. M., & Raajaram, M. U. (2025). Neck circumference to thyromental distance ratio and neck circumference to thyromental height ratio as a predictor of difficult intubation: A hospital-based cross-sectional study. *Archives of Anesthesiology and Critical Care, 7*(2), 26–34.

[6] Rastogi, A., Singh, A. K., Srivastava, D., Kannaujia, A. K., Singh, T. K., & Mishra, P. (2025). Evaluation of ultrasound measured tongue thickness, tongue thickness–thyromental distance ratio, and skin-to-epiglottis distance in predicting unanticipated difficult laryngoscopy. *Journal of Anaesthesiology Clinical Pharmacology, 41*(1), 151–157.

[7] Veer, S. D., & Khillari, B. (2025). Neck circumference to thyromental distance ratio as a predictor of difficult intubation in obese patients: A prospective observational study. *Journal of Population Therapeutics and Clinical Pharmacology, 32*(1), 1068–1072.

[8] Adzim, T. F., Winata, A., & Irina, R. S. (2025). Comparison of neck circumference to thyromental distance as a predictor of difficulty visualizing the larynx in elective surgery patients at Haji Adam Malik General Hospital. *Jurnal Anestesiologi Indonesia, 17*(3), 219–228.

[9] Khan, Z. H., Mohammadi, M., Rasouli, M. R., Farrokhnia, F., & Kermani-Alghoraishi, M. (2009). Predictive value of Mallampati test, thyromental distance, and sternomental distance in difficult laryngoscopy and intubation. *Indian Journal of Anaesthesia, 53*(4), 429–437.

[10] Roe, N. A., & Ranganathan, P. (2012). The role of neck circumference in prediction of difficult intubation in obese patients. *Indian Journal of Anaesthesia, 56*(4), 343–348.