DOI: https://doi.org/10.53350/pjmhs2023171254

**ORIGINAL ARTICLE**

# Validation of Modified Mallampati Test with Addition of Thyromental Distance and Sternomental Distance to Predict Difficult Endotracheal Intubation in Adults Presenting in Surgical Emergency

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## ABSTRACT

**Objective:** To validate modified mallampati test with addition of thyromental distance and sternomental distance in prediction of difficult endotracheal intubation in adults presenting in surgical emergency.

**Study Deign:** Prospective, single-blinded observational study

**Place and duration:** Department of Anesthesia and intensive care Nishtar Hospital, Multan from August 2021 to January 2022 in one year duration.

**Methodology:** A total of 120 patients were included in the study. Difficult intubation was predicted by measuring modified mallampati test following thyromental distance and sternomental distance. Validation of mallampati test and combining predictors was assessed by measuring sensitivity, specificity, positive & negative predictive value. Contingency table 2x2was designed.

**Results:** The sensitivity and specificity of this procedure was 62.5% and 80.0%, respectively. Validity of combining all parameters to predict the difficult in endotracheal intubation was shown in table IV. The sensitivity and specificity of this procedure was 25.0% and 27.0%, respectively.

**Practical Implication:** Endotracheal intubation is a common pre-operative complication having potential to lead poor post operative results. This study will help the anesthesiologists to overcome the problem of intubation and reduce the incidence of post operative complications in routine practice.

**Conclusion:** Specificity of modified mallampati is too high, validity of combine parameters modified mallampati, sternomental distance and thyromental distance is very high when compared with mallampati test alone. All three parameters MMT, SMD and TMD can be used collectively for assessment of difficult airway in adult patients planned for surgery under general anesthesia.

**Keywords:** Validity, anaesthesia, modified Mallampati test, endotracheal intubation, thyromental distance, sternomental distance

## INTRODUCTION

Failed intubation and wrong prediction of difficult intubation are two main anaesthesia related causes of morbidity and mortality. Difficult intubation have incidence rate of 3.2%[1] including difficult intubation, difficult mask ventilation or laryngoscopy and failed intubation. Proper evaluation and prediction of difficult intubation with Modified Mallampati Test (MMT) can reduce the risk of failed intubation[2].

Efficacy of MMT can be increased by adding some other measuring parameters of preoperative airway like inter incisor gap, thyromental orsternomental distance and cervical mobility.[3]. National Audit Project observed that assessment failure of difficult intubation may cause poor outcomes and post operative recovery and complications like sore throat[4]. Previously no method is useful for prediction of difficult intubation with high rate of sensitivity and specificity[5].

Some complications are also associated with difficult airway like trauma to airway delayed airway, emergency surgical airway, admission to ICU, brain injury and mortality that can enhance hospital cost. Difficult intubation is that when more than 3 attempts taken or bougie is used to manage intubation[6].

Numerous airway assessment methods are in practice like Wilson risk score, head and neck movement, mouth opening or inter-incisor gap, thyromental distance, horizontal length of mandible, sternomental distance and mallampati test but sensitivities ranges upto 33%[7]. Few studies are available on combination of these methods to assess the predictive values like upper lip bite and thyromental distance[8-10]. This study aims to evaluate validation of MMT by adding SMD and TMD in prediction of difficult intubation or laryngoscopy in surgical patients.

## METHODOLOGY

Study was conducted at department of Anesthesia and intensive care Nishtar Hospital, Multan from August 2021 to January 2022 in one year duration. The study was conducted after approval from ethical review committee of hospital.

**Population:** All the adults' patients requiring general anesthesia with endotracheal tube insertion were enrolled in the study, after taking informed consent.

**Sample Size:** was calculated by using online calculator Openepi.com using formula, Sample size n = [DEFF*Np(1-p)]/ [(d$^2$/Z$^2_{1-\alpha/2}$*(N-1)+p*(1-p)] using statisticsP1 (Sensitivity of MMT in previous study): 28.3%, P2 (Sensitivity of MMT in previous study): 85.5%, Confidence level 95% , Power of study 80%, Calculated sample size is 120 patients. Sampling technique: Non probability consecutive sampling technique was used.

Inclusion criteria: All the patients requiring general anesthesia with endotracheal intubation, age 15 to 60 years of age and both gender were included in the study. Exclusion criteria: Patients with BMI >26kg/m2, swelling, scars, contractures in front of the neck pregnant women were excluded. After nothing per oral (NPO) for 8 hours an investigator who was unaware of study data wasdetermined the difficulty level of intubation before intubation and at the time of intubation. Glycopyrrolate at the dose of 4 µg/kg and 20 µg/kg midazolam wasgiven 15 minutes before surgery intravenously.

**Data Collection**: Before induction of anesthesia oxygen ventilation was given for five minutes. Anesthesia was induced with slow propofol injection at the dose 2 mg per kg and fentanyl injection 2 ug per kg intravenously. Succinylcholine was given intravenously at the dose of 1.5 mg per kg. After neuromuscular relaxation endotracheal tube was inserted. Head was extended on a pack of 10 cm and neck flexion to mark modified Jackson position before

start of laryngoscopy. After laryngoscopy larynx was pointed. Demographic data and specific data regarding the dependent and independent variables were collected on the already formed Performa.

Instrument: Thyromental distance(TMD) was measured by measuring distance between the thyroid notch and symphysismenti is measured. Sitting position is preferred with full head extension mouth closure. Difficult intubation was predicted if TMD < 6.5 cm.Sternomental distance (SMD) was measured by a straight line between bony point of symphysis-menti and above border of manubrium sterni. SMD < 12.5 centimeter considered as predictor of difficult intubation.

Classification of modified mallampati was a simple scoring system that correlates the size of tongue and mouth opening to give space available for intubation. In case of visible soft palate, uvula and pillars class was labeled as "I". Soft palate and uvula visibility was labeled as class "II". Soft palate and base of uvula visibility was labeled as class "III" and only hard palate visibility was labeled as "IV". Among this classification class III and IV was labeled as difficult intubation.

**Reliability and Validity:** True positives: defined as those patients in whom MMT or MMT+TMD+SMD for difficult intubation is found positive and Cormack and Lehane laryngoscopic grading also found positive.True negatives: defined as those patients in whom MMT or MMT+TMD+SMD for difficult intubation is found negative and Cormack and Lehane laryngoscopic grading also negative.

**False positives:** defined as those patients in whom MMT or MMT+TMD+SMD for difficult intubation is found positive and Cormack and Lehane laryngoscopic grading negative.False negatives: defined as those patients in whom MMT or MMT+TMD+SMD for difficult intubation is found negative and Cormack and Lehane laryngoscopic grading also positive.

**Positive Predictive Value:** TP/TP+FP, Negative predictive value: TN/TN+FN, Sensitivity: TP/TP+FN, Specificity: TN/FP+TN. Diagnostic Accuracywas measured by using formulaTrue positive cases + True Negative cases / Total number of patients in study.

**Data Analysis**: SPSS version 23 (statistical package for social sciences) was used for data entrance and analysis. Qualitative data like age, gender were presented as frequency and percentage and quantitative data was presented as mean and standard deviation. 2x2 contingency table was drawn to measure PPV, NPV, sensitivity, specificity and diagnostic accuracy. A p value of ≤ 0.05 was considered as significant.

## RESULTS

Overall, 120 patients were included in our study. The average age and weight of the patients was 33.58±7.11 years and 60.55±2.52 kg, respectively. There were 77 (64.2%) males and 43 (35.8) females. Only 8 (6.7%) patients had ASA I. Further, majority of the patients 38 (31.7%) were undergone general surgical procedure (Table. I).

Table-1: Demographic and gonial angle in lateral cephalogram and OPG

| Characteristic | Mean±S.D | N (%) |
|---|---|---|
| Age (years) | 33.58±7.11 | |
| Gender | | |
| Male | | 77 (64.2) |
| Female | | 43 (35.8) |
| Weight (kg) | 60.55±2.52 | |
| ASA status | | |
| I | | 8 (6.7) |
| II | | 112 (93.3) |
| Type of surgery | | |
| Laparoscopic | | 31 (25.8) |
| Orthopaedic | | 13 (10.8) |
| Ear nose & throat | | 21 (17.5) |
| Urological | | 17 (14.2) |
| General surgery | | 38 (31.7) |

The average age of difficulty in endotracheal intubationpatients was greater than not difficult in endotracheal intubation patients as 36.81±8.09years and 33.68±2.41years, respectively, (p<0.001). The average weight of difficulty in endotracheal intubationpatients was greater than not difficult in endotracheal intubation patients as 62.52±2.45years and 57.95±2.56years, respectively, (p<0.001) (Table. II).

The validity of modified Mallampati test to predict the difficulty of intubation was shown in table. III. The sensitivity and specificity of this procedure was 62.5% and 80.0%, respectively. (Table. III). Validity of combining all parameters to predict the difficultin endotracheal intubationwas shown in table IV. The sensitivity and specificity of this procedure was 25.0% and 27.0%, respectively (Table. IV).

Table-2: Comparison age, weight and ASA status with difficulty in endotracheal intubation

| | Difficulty in endotracheal intubation | | p-value |
|---|---|---|---|
| | Yes | No | |
| Age (years) | 32.81±8.09 | 33.68±2.41 | >0.001 |
| Weight (kg) | 56.52±2.45 | 62.95±2.56 | <0.001 |
| ASA status | | | |
| I | 3 (37.5) | 6 (5.4) | <0.001 |
| II | 5 (62.5) | 106 (94.6) | |

Table-3:Validity of modified Mallampati test method to predict difficulty in endotracheal intubation

| Modified Mallampati test | Difficulty in endotracheal intubation | | p-value |
|---|---|---|---|
| | Yes | No | |
| I & II | 5 (62.5) | 103 (91.9) | <0.001 |
| III & IV | 3 (62.5) | 9 (8.1) | |

Table-4: Validity of combining all parameters in predicting difficult endotracheal intubation

| All predictors together | Difficulty in endotracheal intubation | | p-value |
|---|---|---|---|
| | Yes | No | |
| I | 2 (25.0) | 109 (97.3) | <0.001 |
| II & III | 6 (75.0) | 3 (2.7) | |

## DISCUSSION

In our study average age and weight of the patients was 33.58±7.11 years and 60.55±2.52 kg, respectively. There were 77 (64.2%) males and 43 (35.8) females,sensitivity and specificity of mallampati test in predicting difficulty in endotracheal intubation were 62.5% and 80.0% respectively and sensitivity and specificity of combining all factor was 25.0% and 27.0% respectively. A study was conducted by Patel B et al[11] in 2014, there were 71 male and 64 female with mean age of 29.7 ± 1.4 years and reported that validity of combine MMT, SMT and TMD is very high as compare to MMT alone in predicting difficulty of endotracheal intubation.

In our study 8 (6.7%) patients had ASA I. Further, majority of the patients 38 (31.7%) were undergone general surgical procedure.A study was conducted by Ittichaikulthol et al[12] on Thai population, majority of patients were having ASA II 52.7% and common procedures were relevant to general surgery, combination of, SMT, TMD (<6.5) and MMT are better predictor of difficult laryngoscopy. Findings of this study are comparable to our study. Another Chinese study was conducted by Magalhãeset al[13]on pregnant women and compared with non pregnant women. At the end of study it was concluded that combination of predictors have better results regarding the sensitivity and specificity in difficult intubation.Lundstrøm et al[14] conducted a study on Irish population and compare modified mallampati and combination of MMT with thyromental and sterno mental distance and concluded that validity of mallampati increased upto100% by adding other predictors. In another study by Seoet al[15] reported contrast results that combination of thyromental distance with MMT has no significant improved predictability for difficult intubation and more suggestive studies were recommended.

In few previous studies MMT, SMD and TMD measurements were taken in sitting position[11]. Singhalet al[16] conducted a study on this topic and concluded that MMT in sitting position is not valid as in supine position. Usually intubation performed in supine position that's why measurements in supine position can predict status of

difficulty better in supine position. We used TMD distance ≤6.5 and SMD≤12.5 for prediction of difficult intubation. In a study Neyrincket al[17] used TMD ≤ 5 cm and Khan et al[18] used SMD value 13 cm for difficult intubation but reported similar results and efficacy of adding SMD and TMD in MMT.

In our study mean weight of patients was 60.55±2.52 kg and mean age was 33.58±7.11 years, but there was no association was observed between weight of patients and difficult intubation. Similar results were observed by Sheffet al[19] in his study that increased BMI is not a predictor of difficult intubation. Similarly Orozco-Díazet al[20] concluded that there was no association between age of patients and difficult intubation.

## CONCLUSION

Our results reveal that specificity of modified mallampati is too high, validity of combine parameters modified mallampati, sternomental distance and thyromental distance is very high when compared with mallampati test alone. All three parameters MMT, SMD and TMD can be used collectively for assessment of difficult airway in adult patients planned for surgery under general anesthesia.

## REFERENCES


1. Rao KVN, Dhatchinamoorthi D, Nandhakumar A, Selvarajan N, Akula HR, Thiruvenkatarajan V. Validity of thyromental height test as a predictor of difficult laryngoscopy: A prospective evaluation comparing modified Mallampati score, interincisor gap, thyromental distance, neck circumference, and neck extension. Indian J Anaesth. 2018;62(8):603-608. doi: 10.4103/ija.IJA_162_18.
2. Mallhi AI, Abbas N, Naqvi SMN, Murtaza G, Rafique M, Alam SS. A comparison of Mallampati classification, thyromental distance and a combination of both to predict difficult intubation. Anaesth Pain & Intensive Care. 2018;22(4):468-473. https://applications.emro.who.int/imemrf/Anaesth_Pain_Intensive_Care/Anaesth_Pain_Intensive_Care_2018_22_4_468_473.pdf
3. Panjiar P, Kochhar A, Bhat KM, Bhat MA. Comparison of thyromental height test with ratio of height to thyromental distance, thyromental distance, and modified Mallampati test in predicting difficult laryngoscopy: A prospective study. J AnaesthesiolClinPharmacol. 2019;35(3):390-395. doi: 10.4103/joacp.JOACP_276_18.
4. Tribuddharat S, Sathitkarnmanee T, Sangsungnern P. A Composite Thyromental-Modified Mallampati- Sternomental Score Predicts Difficult Laryngoscopy Better Than Individual Airway Examinations. J Med Assoc Thai. 2020;103:148-54. http://www.jmatonline.com/index.php/jmat/article/view/10658#
5. Shobha D, Adiga M, Rani DD, Kannan S, Nethra SS. Comparison of Upper Lip Bite Test and Ratio of Height to Thyromental Distance with Other Airway Assessment Tests for Predicting Difficult Endotracheal Intubation. Anesth Essays Res. 2018;12(1):124-129.doi: 10.4103/aer.AER_195_17.
6. Shah PJ, Dubey KP, Yadav JP. Predictive value of upper lip bite test and ratio of height to thyromental distance compared to other multivariate airway assessment tests for difficult laryngoscopy in apparently normal patients. J AnaesthesiolClinPharmacol. 2013;29:191-5.doi: 10.4103/0970-9185.111700.
7. Kaniyil S, Anandan K, Thomas S. Ratio of height to thyromental distance as a predictor of difficult laryngoscopy: A prospective observational study. J AnaesthesiolClinPharmacol. 2018; 34:485-9.doi: 10.4103/joacp.JOACP_283_17.
8. Harjai M, Bhaskar P, Saxena S. Is RHTMD a new predictor for assessment of difficult intubation in nonobese patients? J Evolution Med. Dent. Sci. 2018; 7(38):4957-4960.DOI:10.14260/jemds/2018/930
9. Mostafa M, Saeed M, Hasanin A, Badawy S, Khaled D. Accuracy of thyromental height test for predicting difficult intubation in elderly. Journal of anesthesia. 2020;34(2):217-23.doi: 10.1007/s00540-019-02721-6.
10. Basaranoglu G, Columb M, Lyons G. Failure to predict difficult tracheal intubation for emergency caesarean section. Eur J Anaesth. 2010 Nov 1;27(11):947-9. DOI: 1097/EJA.0b013e32833e2656
11. Patel B, Khandekar R, Diwan R, Shah A. Validation of modified Mallampati test with addition of thyromental distance and sternomental distance to predict difficult endotracheal intubation in adults. Indian J Anaesth. 2014;58:171-5.doi: 10.4103/0019-5049.130821.
12. Ittichaikulthol W, Chanpradub S, Amnoundetchakorn S, Arayajarernwong N, Wongkum W. Modified Mallampati test and thyromental distance as a predictor of difficult laryngoscopy in Thai patients. J Med Assoc Thai. 2010;93:84-9.PMID: 20196416.
13. Magalhães E, Oliveira Marques F, Sousa Govêia C, AraújoLadeira LC, Lagares J. Use of simple clinical predictors on preoperative diagnosis of difficult endotracheal intubation in obese patients. Rev Bras Anestesiol. 2013;63:262-6. doi: 10.1016/S0034-7094(13)70228-9.
14. Lundstrøm LH. Detection of risk factors for difficult tracheal intubation. Dan Med J. 2012;59:B4431.PMID: 22459727.
15. Seo SH, Lee JG, Yu SB, Kim DS, Ryu SJ, Kim KH. Predictors of difficult intubation defined by the intubation difficulty scale (IDS): Predictive value of 7 airway assessment factors. Korean J Anesthesiol. 2012;63:491-7. https://pesquisa.bvsalud.org/portal/resource/pt/wpr-197381
16. Singhal V, Sharma M, Prabhakar H, Ali Z, Singh GP. Effect of posture on mouth opening and modified Mallampati classification for airway assessment. J Anesth. 2009;23:463-5.doi: 10.1007/s00540-009-0761-4.
17. Neyrinck A. Management of the anticipated and unanticipated difficult airway in anesthesia outside the operating room. CurrOpinAnaesthesiol. 2013;26:481-8.doi: 10.1097/ACO.0b013e328362cc69.
18. Khan ZH, Mohammadi M, Rasouli MR, Farrokhnia F, Khan RH. The diagnostic value of the upper lip bite test combined with sternomental distance, thyromental distance, and interincisor distance for prediction of easy laryngoscopy and intubation: A prospective study. AnesthAnalg. 2009;109:822-4.doi: 10.1213/ane.0b013e3181af7f0d.
19. SheffSR, May MC, Carlisle SE, Kallies KJ, Mathiason MA, Kothari SN. Predictors of a difficult intubation in the bariatric patient: Does preoperative body mass index matter? SurgObesRelat Dis. 2013;9:344-9.doi: 10.1016/j.soard.2012.02.004.
20. Orozco-Díaz E, Alvarez-Ríos JJ, Arceo-Díaz JL, Ornelas-Aguirre JM. Predictive factors of difficult airway with known assessment scales. Cir Cir. 2010;78:393-9.PMID: 21219809.