

Correlation of Direct Laryngeal Visualisation with Thyromental Height Test in Unanticipated Difficult Airway Patients

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ABSTRACT

Background

Unanticipated difficult airway is a major concern for an anaesthesiologist during anaesthesia and ICU practice. Several markers are proposed to predict potentially difficult tracheal intubation, but with limited success. We studied usefulness of Thyromental height test (TMHT) as a clinical predictor of difficult visualisation of vocal cords.

Materials And Methods

Following approval by the Institutional ethics committee (EC-219) and CTRI registration (CTRI/2022/10/046337), written informed consent was taken. The study was conducted on 270 patients aged 18 – 60 years belonging to ASA-PS I and II over a period of 6 months. Study was conducted at a tertiary medical college and hospital.

Preoperatively all patients airway was evaluated using Modified Mallampati test(MMT), Thyromental distance(TMD), and Sternomental distance(SMD) in addition to TMHT. During direct laryngoscopy, Cormack &Lehane grading was recorded. We calculated the ROC AUC, sensitivity and specificity for visualisation of vocal cords with regard to TMHT, and also MMT, TMD, and SMD.

Results

The incidence of unanticipated difficult laryngoscopy was 11.85%. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of TMHT were 75%, 89.50%, 48.98%, and 96.38%, respectively. The sensitivity, specificity, PPV and NPV of MMT are 81.25%, 79.41%, 34.67%, 96.19% respectively. The sensitivity, specificity, PPV and NPV of TMD are 62.50%, 82.35%, 32.26%, 94.23%. The sensitivity, specificity, PPV and NPV of SMD are 65.63%, 69.75%, 22.58%, 93.79%.

Conclusion

TMHT can be a good indicator of difficult visualisation of cords in adult patients due to better predictive values than most previously reported bedside tests. Due to higher specificity, THMT is useful in accurately identifying non-difficult laryngoscopy cases.

Keywords: Thyromental Height Test, Difficult Laryngeal Visualisation, Airway assessment

INTRODUCTION

Securing the airway and providing adequate oxygenation and ventilation is crucial in patients undergoing surgery under General Anaesthesia. Unanticipated difficult airway is a major concern for an anesthesiologist. The need to predict potentially difficult tracheal intubation with an accurate marker, even before laryngoscopy, has received more importance but with limited success^[1]. Difficulties in visualization of the vocal cords during laryngoscopy and intubation, usually graded as Cormack & Lehane grade III and IV, are not uncommon, with a reported incidence ranging from 1 to 20%^[2].

Failure in managing the airway may result in significant morbidity and mortality. It is reported that of all the anesthetic deaths, 30%–40%, are attributed to inability to manage difficult airway. Therefore, preoperative assessment of patients airway to predict difficult laryngoscopy and intubation accurately is very crucial^[3]. Therefore, several risk scores for difficult intubation have been proposed, but sensitivity is mostly limited and consequently, useful clinical guidance often fails.^[4]

Several preoperative clinical airway assessment tests, such as modified Mallampati test (MMT), thyromental distance (TMD), sternomental distance (SMD), and ratio of height to thyromental distance (RHTMD) have been used singly or in various combinations for predicting difficult airway. However, no single test or combination of tests has been validated as the best predictor of difficult airway.

There is a need for a test, which is (a) quick and easy to perform; (b) is highly sensitive (so that majority of difficult cases can be identified); and (c) highly specific (so that false positive rate will be low when the test is used routinely). Any test devised should be easy to perform and interpret at the bedside. Etezadiet *al* validated the use of Thyromental height test (TMHT) and showed that the new airway predictor thyromental height test (TMHT) had a better predictive value than MMT, TMD, and SMD^[3]. In our study, we propose to study the value of Thyromental height test in predicting difficult laryngoscopic view as assessed by Cormack lehane grading. We also propose to observe the correlation of the mallampati grading, thyromental distance, sternomental distance in predicting the difficult laryngoscopy view as assessed by Cormack –Lehane grading during intubation.

The TMHT is an easy-to-do and non-invasive test. The test is based on the height between the anterior border of the mentum and the thyroid cartilage, while the patient lies supine with the mouth closed. The aim of this study is to determine clinical performance and usefulness of the TMHT as a predictor of difficult intubation. Thus we plan to test the hypothesis that, decreased TMHT is associated with higher incidence of difficult laryngeal visualisation.

MATERIALS AND METHODS

Following approval by the Institutional ethics committee(Reference number: EC-219) and registration with CTRI(CTRI/2022/10/046337), written informed consent was obtained from all patients for participation. Study was conducted at operation theater complex, in a tertiary care medical college and hospital. This study was designed as a prospective, double blinded, observational study.

270 patients of either sex, aged between 18 – 60 years belonging to with American Society of Anesthesiologist's Physical Status (ASA-PS) I and II undergoing elective surgeries under general anaesthesia with endotracheal intubation posted for elective surgeries were enrolled in the study. Patients who refused to give consent, those with Maxillofacial and neck deformity, trauma or surgery, BMI >35 kg/m², Pregnant patients, Long standing diabetes mellitus were excluded from the study. The study was conducted from October 2022 – March 2023.

A detailed pre-anaesthetic evaluation of patients and clinical assessment of the airway parameters were done. The following predictive test measurements were obtained and recorded:

1. Modified Mallampati Classification: Mallampati classification with patient in the sitting position, mouth maximally opened, and tongue protruded, while the observer looking from the patient's eye level inspected the pharyngeal structures with a pen torch, without the patient phonating. The oropharyngeal view was graded as Class I where soft palate, fauces, uvula, pillars visible; Class II where soft palate, fauces, uvula visible; Class III where soft palate, base of uvula visible; and Class IV where soft palate not visible at all. Class III and IV were classified as difficult intubation.

2. Thyromental distance (TMD) was measured as straight distance between the thyroid notch and the lower border of mental prominence, with the head fully extended and the mouth closed, using a rigid ruler. A measurement of ≤ 6.5 cm was considered to be a predictor of difficult intubation.

3. Sternomental distance (SMD): It is the distance in centimeters as straight distance between the superior border of the manubrium sterni and the bony point of the mentum, with the head in full extension and the mouth closed using a rigid ruler. An SMD ≤ 13.5 cm was considered predictive of difficult laryngoscopy.

4. Thyromental height test(TMHT): The height between the anterior border of the thyroid cartilage (on the thyroid notch just between the two thyroid laminae) and the anterior border of the mentum (on the mental protuberance of the mandible) was measured, with the 'Difficult Intubation' was defined as the placement of the endotracheal tube by using conventional laryngoscopy that required > 2 attempts^[5] lasted > 10 min, or required alternate methods.

The 'time taken for intubation' was defined as the time point from initiation of the first direct laryngoscopy attempt to confirmation of successful endotracheal intubation by continuous waveform capnography.

patient lying supine using a pillow with her/his mouth closed. This height was measured with a digital depth gauge (INSIZE® Electronic Depth Gage, INSIZE). TMHT of less than 50mm is taken as cut off value for difficult visualization of cords.

Difficulties in visualization of the vocal cords during laryngoscopy and intubation, usually graded as Cormack & Lehane grade III and IV and classified as "difficult"

The study subjects were advised regarding the fasting guidelines. Premedication in the form of tab. pantoprazole 40mg was given the day before and on the day of surgery. On the day of surgery, after confirming the duration of preoperative fasting, in the preoperative room, all enrolled patients underwent a duly explained bedside thyromental height test(TMHT)

Grade I: Full view of the glottis.

Grade IIa: Partial view of the glottis is visible.

Grade IIb: Arytenoids or posterior part of the vocal cords only just visible.

Grade III: Only epiglottis is visible.

Grade IV: No glottis structures visible.

Thereafter, the patients were shifted to the operation theatre and standard monitors were applied. After adequate pre-oxygenation, general anesthesia was induced with inj.propofol 2 mg/kg IV, inj.midazolam 0.05 mg/kg IV, inj. fentanyl 2mcg/kg IV, and inj.succinylcholine 2 mg/kg IV. After 30-60 seconds of mask ventilation, a single experienced investigator (≥ 5 years of experience) performed the laryngoscopy using Macintosh blade of appropriate size 3 or 4 in the sniffing position. The glottic view obtained on first attempt of direct laryngoscopy without any external laryngeal maneuvers was graded according to the Cormack-Lehane classification.

All laryngoscopies was performed by a single experienced anaesthesiologist who will not be involved in preoperative airway examination.

(To facilitate laryngeal view, external laryngeal manipulation was allowed, and intubation was attempted). In case of failed attempts at intubation, standard protocols were followed as per unanticipated Difficult intubation guidelines. The investigator who performed the Thyromental height test was blinded to the preoperative airway assessment data and intubation procedure.

RESULTS

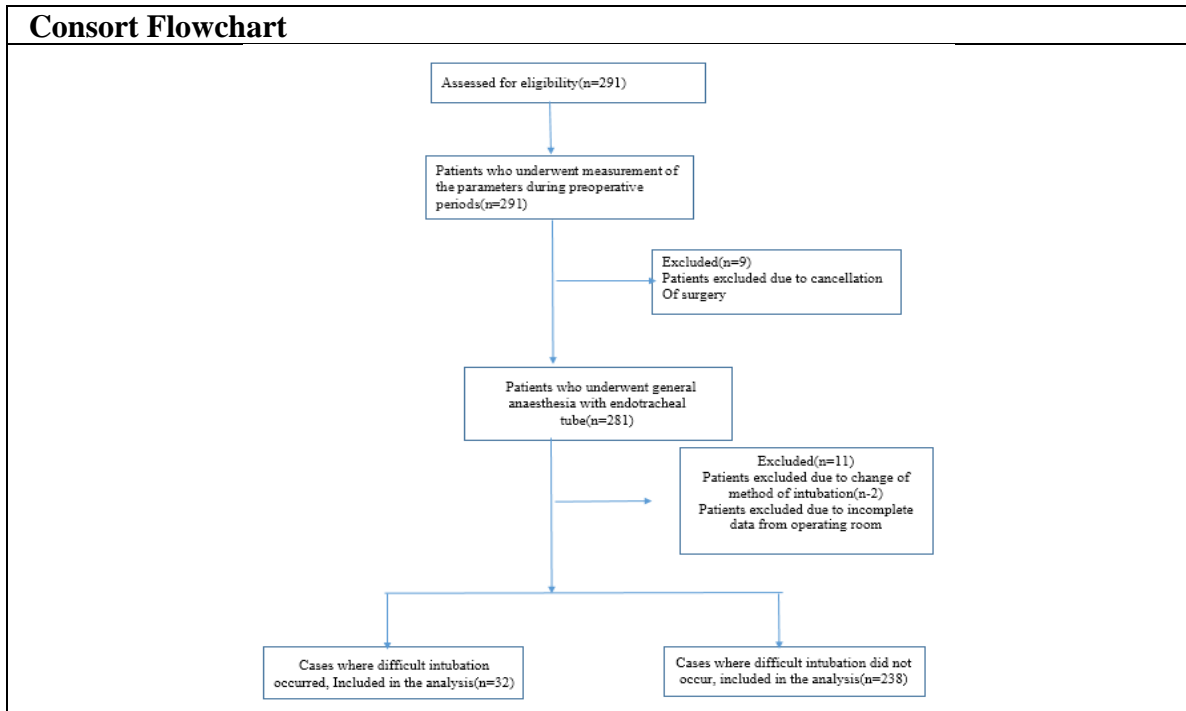
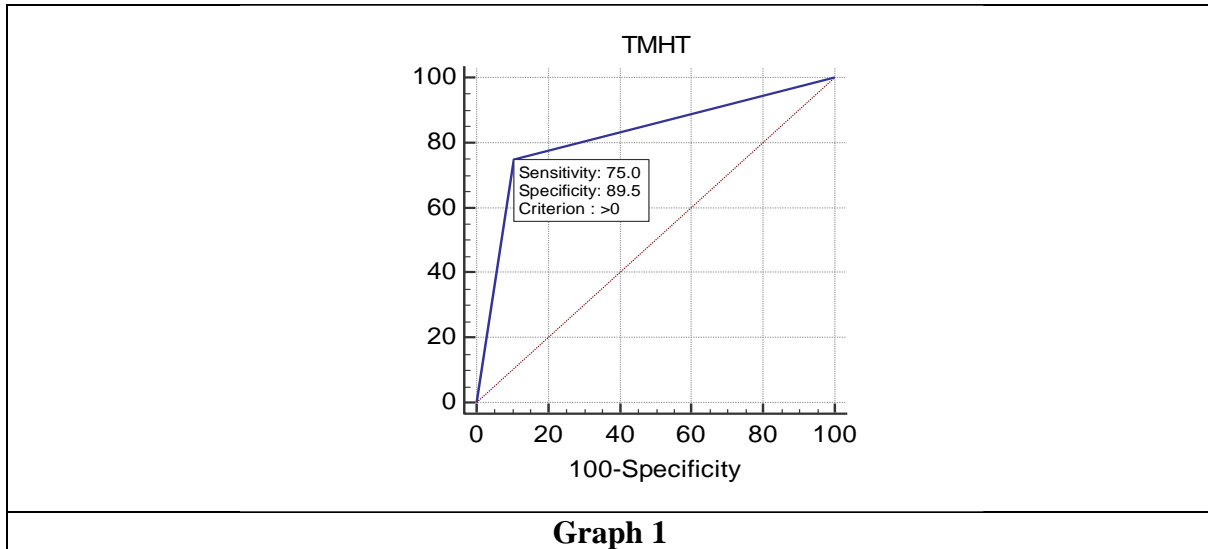


Table 1: Correlation TMHT findings with CL grade

Correlation of TMHT findings with CL grade		CL grade		Total
		Difficult	Easy	
THMT	Difficult	24	25	49
	Easy	8	213	221
	Total	32	238	270

Table 2: TMHTvs CL grade

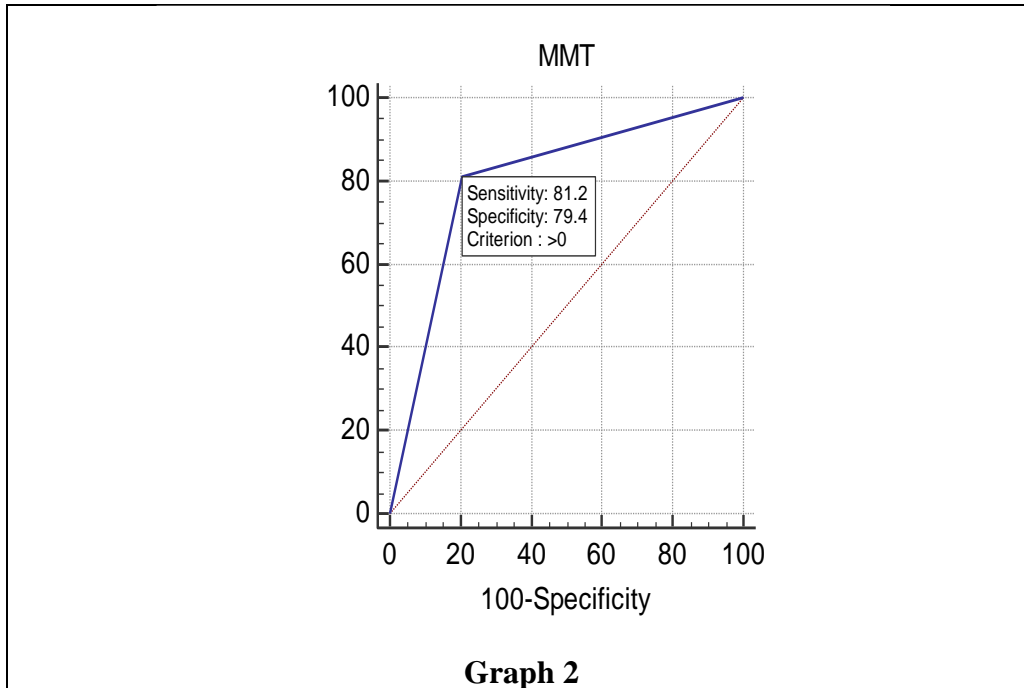
Sensitivity	75.00%
Specificity	89.50%
PPV	48.98%
NPV	96.38%



In our study, out of 270 patients, 49 patients TMHT was observed to be less than 50mm, and in 221 patients, it was observed to be more than 50mm. Sensitivity was 75%, specificity was found to be 89.50%, negative predictive value was 96.38%, and positive predictive value was only 48.98%. An increase in TMHT by 1...mm decreased the risk of difficult intubation by 7% ² Similar to our study.

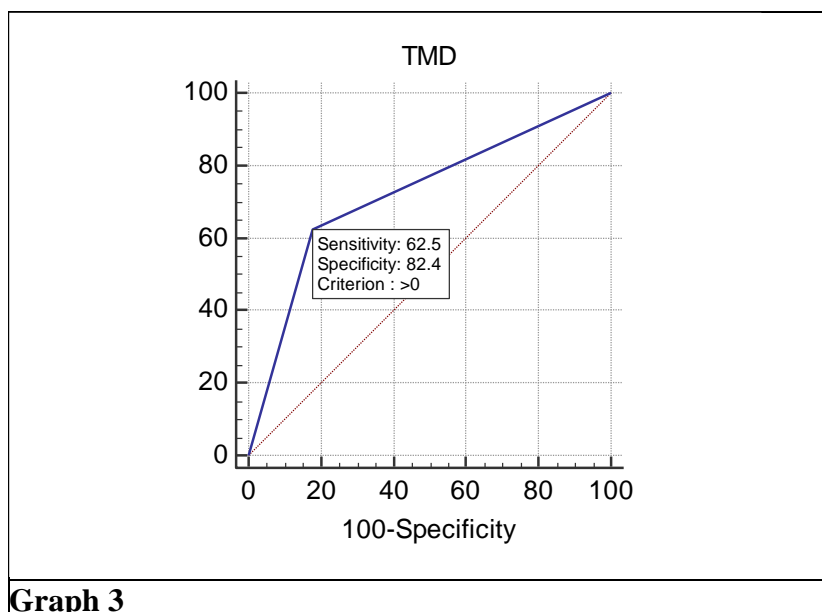
Table 3: Correlation MMT findings with CL grade				
Correlation of MMT findings with CL grade		CL grade		
		Difficult	Easy	Total
MMT	Difficult	26	49	75
	Easy	6	189	195
	Total	32	238	270

Table 4: MMT vs. CL grade	
Sensitivity	81.25%
Specificity	79.41%
PPV	34.67%
NPV	96.19%



In our study, out of 270 patients, 195 patients MMT class was observed to be I and II, and in patients, 75 it was observed to be III and IV. Sensitivity was 81.25%, specificity was found to be 79.41%, negative predictive value was 96%, but positive predictive value was only 34.67%.

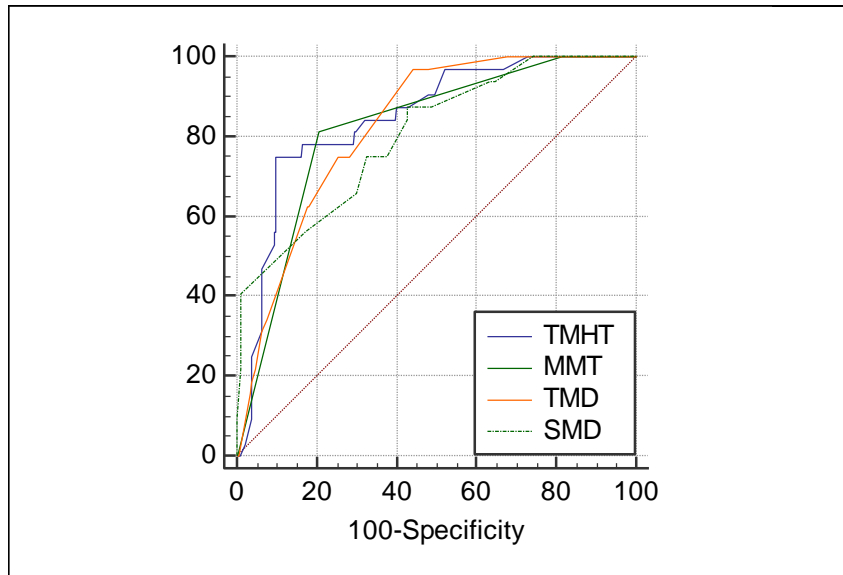
Table 5: Correlation TMD findings with CL grade				
Correlation TMD findings with CL grade		CL grade		Total
		Difficult	Easy	
TMD	Difficult	20	42	62
	Easy	12	196	208
	Total	32	238	270



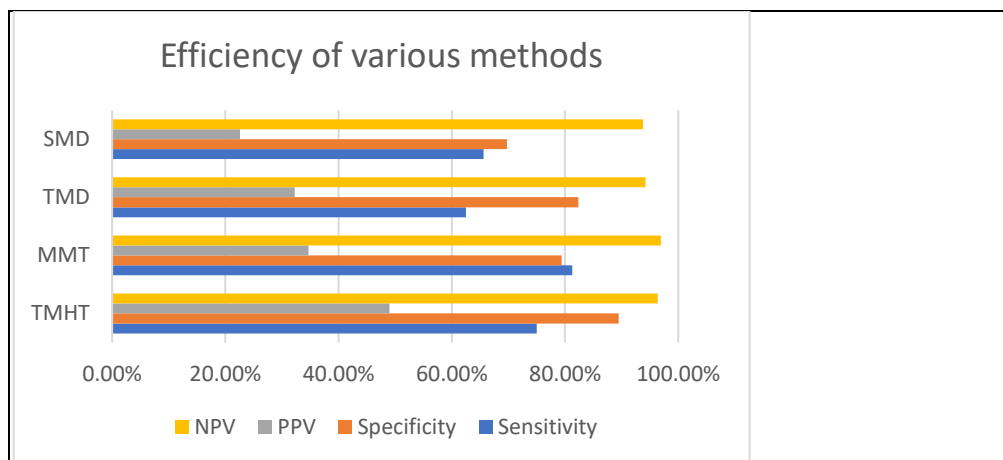
In our study, out of 270 patients, 62 patients TMD class was observed to less than 6.5 cm, and in patients, 208 it was observed to more than 6.5 cm. In our study of TMD, we found sensitivity of 62.50%, specificity of 82.35%, positive predictive value of 32.26%, and negative predictive value of 94.23%.

Correlation of SMD findings with CL grade		CL grade		Total
		Difficult	Easy	
SMD	Difficult	21	72	93
	Easy	11	166	177
	Total	32	238	270

In our study, out of 270 patients, 93 patients TMD class was observed to less than 13.5 cm, and in patients, 177 it was observed to more than 13.5 cm. In our study, SMD specificity was found to be 65.63%, sensitivity was 65.63%, positive predictive value was 22.58%, and negative predictive value was 93.79%



Graph 4



Graph 5

Table 7: Correlation of Cormack lehane with other airway predictors

		CL grade		P value
		Difficult	Easy	
TMHT	Difficult (49)	24 (49%)	25 (51%)	<0.001
	Easy (221)	8 (3.6%)	213 (96.4%)	
MMT	Difficult (75)	26 (34.7%)	49 (65.3%)	<0.001
	Easy (195)	6 (3.1%)	189 (96.9%)	
TMD	Difficult (62)	20 (32.3%)	42 (67.7%)	<0.001
	Easy (208)	12 (5.8%)	196 (94.2%)	
SMD	Difficult (93)	21 (22.6%)	72 (77.4%)	<0.001
	Easy (177)	11 (6.2%)	166 (93.8%)	

	SENSITIVITY	SPECIFICITY	PPV	NPV
THMT	75.00%	89.50%	48.98%	96.38%
MMT	81.25%	79.41%	34.67%	96.19%
TMD	62.50%	82.35%	32.26%	94.23%
SMD	65.63%	69.75%	22.58%	93.79%

DISCUSSION

Prediction of difficult laryngeal visualization and intubation is of high clinical interests and several anatomical landmarks and multifactorial indexes have been developed in the past. Multifactorial indexes are more reliable than single measures, and no anatomical landmark alone has been reported to have acceptable accuracy for prediction of difficult intubation so far. Identifying a single easy-to-do and repeatable predictor of difficult intubation is still lacking.

The TMHT is an already long known technique, but recently gained popularity again.

In our study, the prediction of difficult laryngoscopy was done by MMT, TMD, SMD, and thyromental height test^[6,7] during preoperative assessment and correlating it to CL laryngoscopy grading at intubation. MMT Class III and IV, TMD ≤6.5 cm, SMD ≤13.5 cm, and CL Grade III and IV were considered as predictors of difficult intubation. Among these, CL grading was considered as gold standard, other tests were compared with this.

TMHT is a simple and easily applicable objective measure of difficult laryngoscopy and intubation. Unlike TMD and SMD, that need to be measured in head extension position, TMHT is measured in the neutral head position. Therefore, TMHT is independent of cervical spine mobility, dentition, and patient’s cooperation^[4]. Thyromental height test provides the best test characteristics for predicting a difficult airway^[6]. A depth gauge is required for accurate measurement of TM HT.

The thyromental height could be a surrogate for the degree of mandibular protrusion, the submandibular space, and anterior position of the larynx.^[8] TMHT was proposed by Etezadi et al^[7] and found to be a more accurate predictor of difficult laryngoscopy than the modified Mallampati test, TMD and SMD. They found that the optimal sensitivity and specificity values for TMHT ranged between 47.46 to 51.02...mm. They chose a cut-off value of 50 mm to facilitate clinical application. Using the 50-mm cut-off point for TMHT, Selvi et al^[9] reported a high sensitivity (91.89%) and high NPV (98.63%) with low specificity (52.2%) and low PPV values (14.7%)

CONCLUSION

Thyromental height test arises as a good predictor of difficult laryngoscopy in adult patients presenting better predictive values than most previously reported bedside tests. TMHT had a satisfying predictive potential for direct laryngoscopic visualization with stability, comprehensiveness and independence. THMT also showed a higher specificity, which is the ability to accurately identify non-difficult laryngoscopy cases.

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