COMPARISON OF MODIFIED MALLAMPATI TEST AND UPPER LIP BITE TEST FOR PREDICTION OF DIFFICULT ENDOTRACHEALINTUBATION: A CROSS-SECTIONAL COMPARATIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Anticipation of difficult airway provides ample opportunity to prepare and manage the situation effectively and safely, limiting the adverse outcomes. However, the available multitude of predictive tools to predict difficult intubation lack accuracy. Hence, we compared the modified Mallampati test (MMT), a commonly used test, the and upper lip bite test (ULBT) to know its ability to predictdifficult intubation. **Aim**: To compare MMT with ULBT in predicting difficulty in endotracheal intubation **Objectives:** To determine and compare the accuracy of the MMT and ULBT.**Materials & Method:** After institutional ethical committee approval, 240 ASA I and II patients ofeither sex, aged more than 18 years undergoing elective surgery under generalendotracheal anaesthesia, were enrolled. Airway assessment included MMT andULBT. MMT class III and IV and ULBT class III were considered difficultintubation. An anaesthesiologist, who was not involved in performing pre-operative MMT and ULBT, assessed the laryngoscopic view at intubation, usingCormack and Lehane classification. Grade III and IV were considered difficultintubation. Statistical analysis was done using Chi square test. Parameters like sensitivity, specificity, accuracy, positive predictive value and negative predictivevalues of ULBT and MMT were calculated and compared. P value of < 0.05 wasconsidered significant. **Results**: ULBT was more sensitive (56.2 vs 37.5%) and specific (98.7 vs 96.9%) than MMT. Positive predictive value, Negative predictive value and accuracy were better for ULBT than MMT (75 vs 46.2 %; 96.9 vs 95.6 % and 95.83 vs 92.92% respectively).**Conclusion**: ULBT can be used as a better test than MMT for the prediction of difficult endotracheal intubation.
Key-words: Modified Mallampati Test, Upper lip bite test, Difficult endotracheal intubation

INTRODUCTION

The fundamental responsibility of an anaesthesiologist is to maintain adequate respiratory gas exchange.[1] Therefore, the airway should be managed in such a way that it always remains patent.[2] Unanticipated difficult laryngoscopic tracheal intubation is considered as one of the main challenging tasks for anaesthesiologists. The incidence of difficult laryngoscopy or endotracheal intubation is varied from 1.5% to 13% in patients undergoing surgery.[3] Inability to intubate and failure of exchange of the gases, even

for a few moment, it could result in dangerous outcomes like brain injury or morbidity/ mortality.[4]

Various tests like Mallampati technique, Thyromental distance etc have been to anticipate difficult

airway prior to the surgery. However, these tests are not completely reliable.[5,6] The Upper lip bite test (ULBT) which assesses the mandible subluxation and existence of buck tooth at same time in only one test, is claimed to be reliable and have less interobserver variability.[7] Anticipation of difficult airway provides ample opportunity to prepare and manage the situation effectively and safely. Hence, it becomes crucial to identify patients with difficult airway during preanesthetic check-up.

MATERIALS & METHODOLOGY

A cross sectional comparative observational study was conducted in the Department of Anaesthesiology and Critical Care in Justice K. S. Hegde Charitable Hospital affiliated to K. S. Hegde Medical Academy under Nitte (Deemed to be University) from Jan 2020 – June 2021

Sample size: Based on the study conducted by Balakrishnan et al, the specificity of ULBT is represented as 96.5%. Using the following specificity formula,

	MMT	ULBT
Alpha error	5%	5%
Sp = Specificity	0.965	0.8182
1 – Specificity	0.035	0.1818
d = difference, minimum expected difference between MMT and ULBT	0.05	0.05
Prev = Prevalence	0.047	0.047

$$N = \frac{Z^2 Sp(1 - Sp)}{d^2 \times (1 - Prev)}$$

	MMT	ULBT
1 – prevalence	0.953	0.953
Sample as per specificity	54.46	239.85
Sample as per specificity	55	240

Considering the specificity of both tests, sample size of 240 was taken.

After approval from the Institutional Ethics Committee (INST.EC/EC/145/2019- 20), the patients satisfying inclusion criteria and consenting to be included in the study were enrolled. All patients were subjected to pre-anaesthetic check-up and airway assessment by the same investigator to avoid inter-observer variability. Airway was assessed in sitting position, with examiners and participants eyes at same level. MMT was done by asking the patient to open their mouth maximally and to protrude the tongue without phonation. Test was done with the aid of a torchlight. NPO duration was according to the institutional protocol. Standard monitors were attached after

shifting the patient to OT and baseline vitals were checked. IV line was secured. Preoxygenated for 3 mins with 100% oxygen using a tight-fitting mask and Bain's breathing system. Patients were administered IV Inj. Fentanyl (1-2 mcg/kg) and induced with IV Inj. Propofol (2 mg/kg). After checking mask ventilation Inj. Vecuronium (0.12 mg/kg) IV was administered. After loss of all twitches in train-of-four, laryngoscopy was performed. Anaesthesiologist who was not involved in performing pre-operative MMT and ULBT, assessed the laryngoscopic view at intubation. With the help of a Macintosh laryngoscope of size 3 or 4 blade laryngoscopy was performed. Using Cormack and Lehane grading assessment of glottic visualization was done. In this study, difficult laryngoscopy was considered when Cormack and Lehane view showed grade 3 and 4. After evaluation, if difficulty was encountered and the first attempt gives class 3 or 4 laryngoscopic view, external laryngeal pressure was applied/ change of blade/ adjustment of head position was done as required for the situation and same was recorded.

Statistical analysis:

Data collected was computed on Microsoft Excel (window 10, 2016) and was analyzed by Statistical Package for Social Science (SPSS version 16.0). Data was expressed in frequency and percentage. To elucidate the associations and comparisons between different parameters, the chi square test was used as a nonparametric test. Sensitivity, Specificity, PPV and NPV were explained to compare MMT and ULBT. Cormack and Lehane classification were considered as the gold standard.
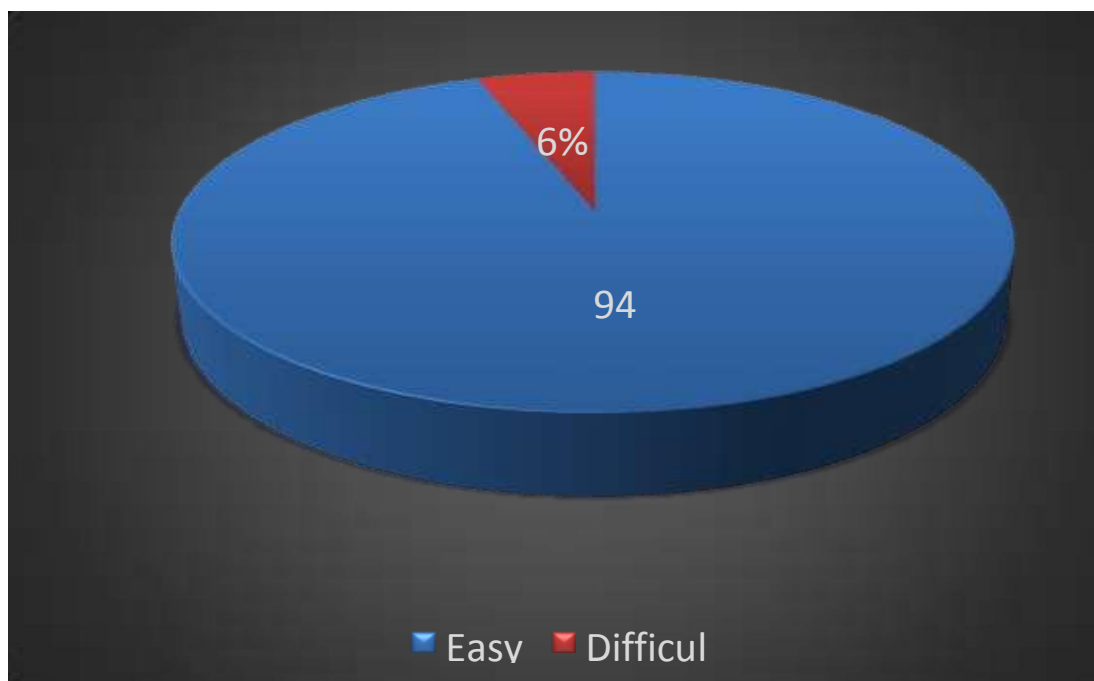
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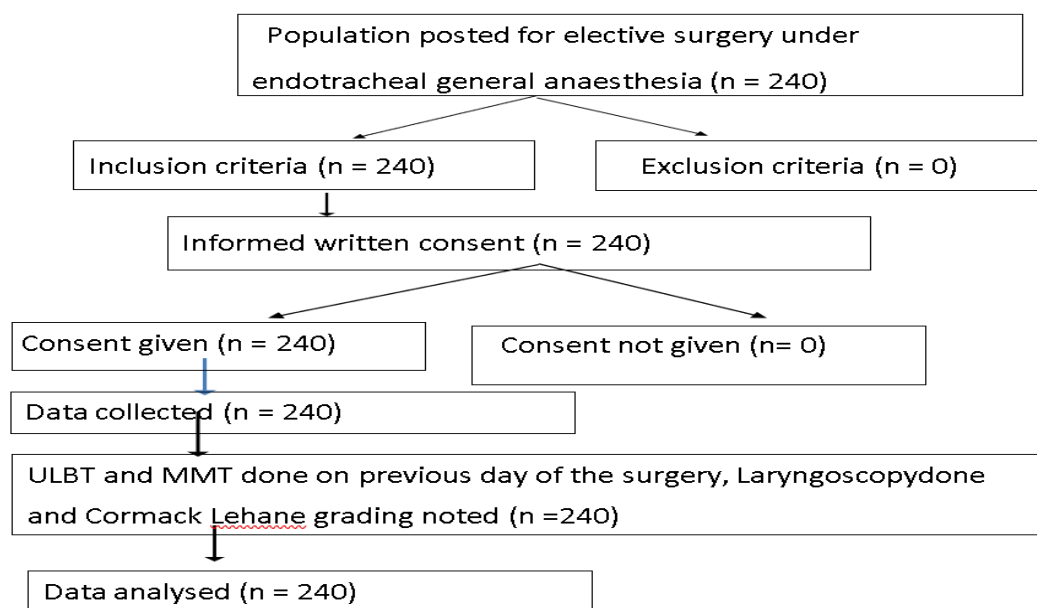
RESULTS

FIG. NO. 1: CLASSIFICATION OF PARTICIPANTS ACCORDING TO MMT AS EASY AND DIFFICULT INTUBATION

According to MMT, 94% of the participants were easy i.e., belonged to MMT Class 1 and 2 whereas 6% of the participants were difficult, i.e., MMT class 3 and 4.

TABLE NO. 1: DISTRIBUTION OF PARTICIPANTS ACCORDING TO ULBT

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ULBT	No. of participants	Percentage (%)
GRADE I	141	58.8
GRADE II	87	36.3
GRADE III	12	5
Total	240	100

141 (59%) participants of 240, belonged to ULBT class I, 87 (36%) were class II and 12 (5%) were class III.
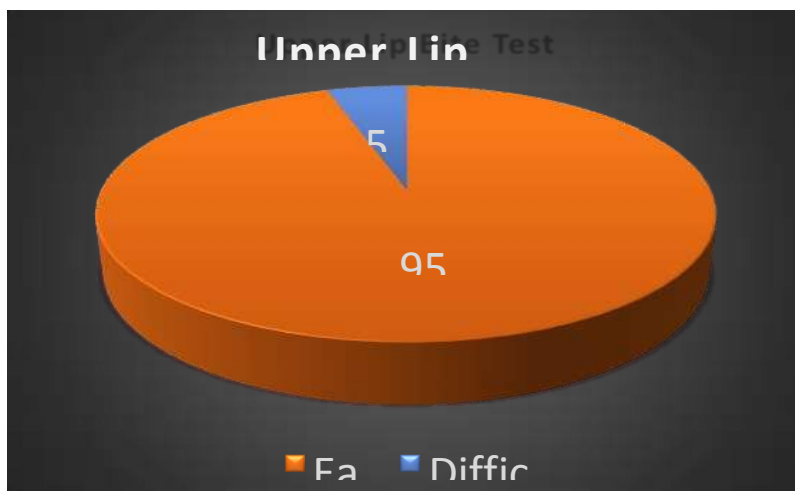

Fig. no. 2 CLASSIFICATION OF PARTICIPANTS ACCORDING TO ULBT AS EASY AND DIFFICULT INTUBATION

According to ULBT, 95% of the participants were easy i.e., ULBT Grade 1 and 2 whereas 5% of the participants were difficult, i.e., ULBT Grade 3.

TABLE NO. 2 CLASSIFICATION OF PARTICIPANTS ACCORDING TO CORMACK AND LEHANE CLASSIFICATION AND EASE OF INTUBATION

Cormack and Lehane	No. of participants	Percentage (%)
Easy	224	93.3
Difficult	16	6.7
Total	240	100

According to Cormack and Lehane classification, 93% of the participants were easy i.e., belonged to Grade 1 and 2, whereas 7 % of the participants were difficult i.e., Grade 3 and 4

TABLE NO. 3 COMPARISON OF MMT CLASSIFICATION WITH CORMACKAND LEHANE GRADING

| | | | Cormack and Lehane grading | | | | |
			GRADE I	GRADE II	GRADE III	GRADE IV	Total
MMT	CLASS I	Count(%)	70 (57.4)	46 (45.1%)	2 (12.5%)	0	118 (49.2%)
	CLASS II	Count(%)	48 (39.3)	53 (52%)	8 (50%)	0	109 (45.4%)
	CLASS III	Count(%)	3 (2.5%)	3 (2.9%)	6 (37.5%)	0	12 (5%)
	CLASS IV	Count(%)	1 (0.8%)	0	0	0	1 (0.4%)
Total		Count	122 (100%)	102 (100%)	16 (100%)	0	240 (100%)

Chi-Square Tests			
	Value	Df	P value (<0.05 is significant)
Pearson Chi-Square	45.625	6	**<0.001**

A total of 13 patients were identified as difficult intubation according to MMT but on doingdirect laryngoscopy, 16 participants were found to have difficult intubation, according to Cormack and Lehane grading.

TABLE NO. 4: SENSITIVITY, SPECIFICITY, PPV AND NPV OF MMT

MMT	CORMACK AND LEHANE GRADING		
	Easy (CL grade 1 and2)	Difficult (CL grade 3 and 4)	
Easy (MMT- I and II)	217 (96.9%)	10 (62.5%)	227 (94.6%)
Difficult (MMT - III and IV)	7 (3.1%)	6 (37.5%)	13 (5.4%)
Total	224 (100%)	16 (100%)	240 (100%)

Symmetric Measures		Value Error[a]	Asymp. Std. Error[a]	Approx . T[b]	Approx. Sig.	Exact Sig.
Measure of Agreement	Kappa	.377	.120	5.869	<0.001	<0.001
N of Valid Cases		240				
a. Not assuming the null hypothesis.						
b. Using the asymptotic standard error assuming the null hypothesis.						

On comparison of the test group MMT with the gold standard of Cormack and Lehane the test group has a sensitivity of **37.5 %** and specificity of **96.9%**. The test has a positive predictive value of **46.2%** and Negative predictive value of **95.6%.** The test and the gold standard agree on 223 out of 240 having a diagnostic accuracy of **92.917%**. The Kappa value of 0.377 indicates Moderate agreement with a p value of <0.001.

TABLE NO.5: COMPARISON OF ULBT WITH COMRACK AND LEHANEGRADING

ULBT		Cormack and Lehane Grading				Total
		GRADEI	GRADEII	GRADEIII	GRADE IV	
GRADE I	Count	85	55	1	0	141
	(%)	(69.7%)	(53.9%)	(6.2%)		(58.8%)
GRADE II	Count	36	45	6	0	87
	(%)	(29.5%)	(44.1%)	(37.5%)		(36.2%)
GRADE III	Count	1	2	9	0	12
	(%)	(0.8%)	(2.0%)	(56.2%)		(5.0%)
Total	Count	122	102	16	0	240
	(%)	(100%)	(100%)	(100%)		(100%)

Chi-Square Tests			
	Value	Df	P value (<0.05 is significant)
Pearson Chi-Square	103.865	4	<0.001

A total of 12 patients were identified as difficult intubation according to ULBT but on doing direct laryngoscopy, actually 16 participants were found to be difficult.

TABLE NO. 6: SENSITIVITY, SPECIFICITY, PPV AND NPV OF ULBT

| Upper Lip Bite Test | Cormack Lehane | | Total |
	Easy (CL grade 1 & 2)	Difficult (CL grade 3 & 4)	
Easy (ULBT class 1 & 2)	221 (98.7%)	7 (43.8%)	228 (95.0%)
Difficult (ULBT class 3)	3 (1.3%)	9 (56.2%)	12 (5.0%)
Total	224 (100%)	16 (100.0%)	240 (100.0%)

Symmetric Measures		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.	Exact Sig.
Measure of Agreement	Kappa	.621	.110	9.736	**<0.001**	**<0.001**
N of Valid Cases		240				
a. Not assuming the null hypothesis.						
On b. Using the asymptotic standard error assuming the null hypothesis.						

comparison of the outcome of Upper Lip Bite Test with the gold standard of Cormack and Lehane grading, the ULBT has a sensitivity of 56.2 % and specificity of 98.7%. The test has a positive predictive value of 75% and Negative predictive value of 96.9%. The test and the gold standard agree on 230 out of 240 having a diagnostic accuracy of 95.83%. The Kappa value of 0.621 indicates Very Good agreement with a p value of < 0.001.

TABLE NO. 7: COMPARISON OF MMT AND ULBT IN TERMS OFOUTCOME

	MMT	ULBT
SENSITIVITY	37.50	56.20
SPECIFICITY	96.90	98.70
POSITIVE PREDICTIVE VALUE	46.20	75.00
NEGATIVE PREDICTIVE VALUE	95.60	96.90
DIAGNOSTICACCURACY	92.92	95.83
P VALUE	< 0.001	< 0.001

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DISCUSSION

The purpose of performing a pre-operative airway evaluation is to predict or diagnose difficult airway and be prepared with essential equipments and techniques. Anticipation of difficult airway provides ample opportunity and time to prepare and manage the situation more effectively and safely, limiting thenegative outcomes. An ideal predictive test should be quick to perform, accurate and reliable. It should predict difficult intubation having high sensitivity, so that it will identify most of the patients in whom intubation will be truly difficult, thus lowering the risk of unanticipated difficult/failed intubation.

There are various pre-operative airway assessment tests like Wilson risk score, Inter-Incisor gap, Horizontal length of mandible, Head and neck movements, Modified Mallampati Test (MMT), sternomental distance, thyromental distance which can be used to predict difficult intubations. In this study we have compared modified Mallampati test (MMT), a commonly used test, and upper lip bite test (ULBT) in terms of sensitivity, specificity, positive predictive value, negative predictive value and accuracy, to know their ability to predict difficult intubation.

In 2003, Khan and his colleagues [8] proposed a new test for predicting difficult intubation which is, Upper Lip Bite test which confirms both jaw subluxation and buck teeth. They recommended the use of ULBT as a substitute to the most widely used Modified Mallampati Test. The ULBT has been used asa simple bedside test which is easy to demonstrate to the patients and very convenient to perform as a bedside test. This test does not need use of additional light, phonation restriction or need of sitting position of the patient. These different classes were distinctively demarcated & portrayed to decrease the inter observer variability rate. This test will help to foresee the difficulties in intubation because of the ability of wide range & freedom of movements of mandible and the architecture of teeth which have a pivot role in easing the laryngoscopic intubation. Mandibular movement is a combined movement of skeletal hard tissue, ligament, and soft tissue. But, there are some limitations in ULBT as ULBT does not consider parameters like mandibular space, relative tongue & pharyngeal size & narrow high arched palate and for ULBT to be tested, patient should have dentition and should be cooperative to understand and perform test.

Wilson et al[9] Did a study on predictors for difficult intubation and found various risk factors like including head and neck movement (P = 0.001), jaw movement (P = 0.001), receding mandible (P = 0.001), weight (P = 0.05) and buck teeth (P= 0.001).

In this present study, the incidence of MMT class III and IV was 5.5% whereas, it was 22% as reported by Hester et al[10] in 2007. Incidence of ULBT class III was 12 (5%) while in the study by Hester et al[10] it was 6 (12%). In this present study, sensitivity of ULBT was higher (56.2 vs 37.5%) than MMT. Safavi et al[11] reported that ULBT is a

better predictor of difficult laryngoscopy as a single test or in combination with MMT as a bedside screening test than MMT. The sensitivity of MMT in our study was 37.5% which is far too low as compared with study by Khan et al[8] (82.4%), Balakrishna et al[7] (71.43%) and Swapnil et al[12] (75%) but more than in the study by Hester et al[10] (11%). The sensitivity of MMT lies within a wide range from 34%-66% as per a meta-analysis done by Lee et al.[13]

The results of our study showed that the sensitivity (56.2 vs 37.5%) and PPV (75 vs 46.20%) of ULBT was more than MMT. Whereas specificity (98.70 vs 96.90), NPV (96.90 vs 95.60 %) and accuracy (95.83 vs 92.92%) of both the tests were similar. Khan et al.[8] found the specificity (88.7 vs 66.8%) and accuracy (88 vs 67.7 %) of the ULBT to be better than the MMT, but the sensitivity, PPV and NPV of both tests were similar. The results of our study were comparable with the study done by Sinharay and Chavan[14] where, the sensitivity, accuracy, PPV and NPV (88.46%, 92%, 71.87%, 97.45% respectively) of ULBT were higher than MMT and both tests had similar specificity.

The specificity of both the tests were high (MMT 98.7%; ULBT 96.90%) and difference between them was not found to be statistically significant. Khan et al[10], in their study found that specificity of ULBT is higher than MMT (MMT 89%; ULBT 92%) and the difference was statistically significant.

In routine clinical practice, anaesthesiologists are more bothered with unanticipated difficult airway (i.e. false negative predictions) which leave them unready for the situation. In this present study, the incidence of false negative for MMT was 4.4 %. And with ULBT, it was 3.1 % of total ULBT class, 96.9 % were found to be true negative which is found to be greater than the previous study by Khan et al [10] and Swapnil et al [12] which was 83.7% and 88% respectively. And 95.6 % were found to be true negative among MMT classes and that is higher when compared to Khan et al [10] and Swapnil et al [12] which was 63.0% and 84% respectively. Both these tests can be considered as good predictors of easy intubation, as both these tests have negative predictive value of more than 90%.

Wilson[9] stated that, "No single test is likely to be perfect, therefore, it remains essential that every anaesthetist must be trained and equipped to deal with the now much less common, unexpected failure to intubate.
In spite of various airway assessment tests, no single test is 100% accurate. So, it is advisable to use combination of different tests or the use various scoring systems for predict predicting difficult laryngoscopy/ intubation.

CONCLUSION: Both tests are good predictors of difficult intubation when used as single pre- operative bedside screening tests. We concluded from our study that, for predicting difficult endotracheal intubation, ULBT is a

better than MMT with more sensitivity, accuracy, PPV, NPV. ULBT can be included in the protocol of standard airway assessment.

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