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Original Article

Anaesthesia Section

A Cross-sectional Study to Assess the Need for Standardisation of the Modified Mallampati and Friedman's Scoring System

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ABSTRACT

Introduction: The Modified Mallampati (MM) grading and Friedman's Tongue Position (FTP) scores are two major scoring systems used to evaluate the oropharyngeal space. However, the current descriptions of performing these scores do not specify the route of breathing taken by the patient during the examination. The dynamic changes in the tongue and palate, in relation to the route of breathing, may contribute to the high interobserver variability in MM scoring.

Aim: To explore the differences in MM scores and Friedman's scores obtained during mouth breathing and nose breathing in order to standardise the scoring system.

Materials and Methods: A community-based cross-sectional study was conducted at the Departments of Anaesthesiology and Community Medicine at Believers Church Medical College Hospital in Central Kerala, India between April 2022 and October 2022, on 702 adults. MM scores and FTP scores were recorded separately for each person during mouth breathing and nose breathing. Socio-demographic variables such as age, gender, and Body Mass Index (BMI) were also collected. The data was analysed using the Z-test for proportions.

Results: The mean age of the study participants was 3.58±16.42 years. The majority of the participants were females (69.2%), and more than half (59%) were above 50 years of age. Out of the 135 participants with an MM Score-1 during mouth breathing, 99 (73.3%) had higher scores during nose breathing. For the 196 individuals with an MM Score-2 during mouth breathing, 87 (44.3%) had higher scores during nose breathing. Similarly, out of the 220 people with an MM score of -3 during mouth breathing, 106 (48.2%) had a Score-4 during nose breathing. A similar pattern was observed for the FTP scores.

Conclusion: The present study demonstrates significant variability in MM and FTP scores obtained during oral and nasal breathing, highlighting the need to standardise the route of breathing during examination. The study suggests that advising patients to breathe through the mouth may relax the tongue and improve the predictive value of MM grading.

Keywords: Friedman's tongue position, Mallampati score, Nasal breathing, Oral breathing

INTRODUCTION

Even in these modern times with advanced airway gadgets, the ability to predict difficult intubations is of significant importance in the practice of anaesthesia, as failure to do so could lead to life-threatening airway emergencies. The 2013 American Society of Anaesthesiologists guidelines for evaluation and management of the difficult airway recommend that, whenever feasible, an airway history and physical examination be conducted in all patients before the initiation of anaesthetic care. The airway physical examination prioritises several clinical elements, including the Mallampati classification (MM). The Mallampati grading has become a routine and standard technique for airway assessment over the years. Its main advantage is the ease and simplicity as a bedside test [1].

The Mallampati grade (score/classification) was first developed by Seshagiri Mallampati in 1985 [2]. As part of the examination, patients are asked to sit in a relaxed position with their heads in a neutral position. Then they are instructed to open their mouths fully and stick out their tongues as much as possible. A simple three-grade classification based on the visualisation of the tonsillar pillars, uvula, and soft palate is used to establish the correlation between Mallampati grade and the view of the airway on direct laryngoscopy [1].

The first modification of the Mallampati grade (score/classification) was reported by Samsoon GL and Young JR as they retrospectively reviewed a cohort of difficult intubations at their institution [3]. They added an additional classification, grade 4, where only the hard palate was able to be visualised. The MM system has subsequently replaced the original scoring system universally in clinical practice and is therefore used in the present study.

Friedman M et al., performed a further modified version of the Mallampati examination where they asked the patient to sit upright and relaxed with their head in the neutral position, similar to the MM grading, and had them open their mouth without sticking out their tongue. This was initially published as an "MM" grade but later changed the term to Friedman's Tongue Position (FTP). It was used as a screening tool for Obstructive Sleep Apnoea (OSA) [4].

The Mallampati grading system remains the most popular bedside screening test used for predicting difficult airway and is included in nearly all multivariable scores aimed at predicting Difficult Tracheal Intubation (DTI) [5-9]. The FTP test has been shown to correlate with objective parameters in the prediction of OSA [10]. These tests depend on the visual inspection of pharyngeal structures seen in patients in the sitting position with the head in a neutral position, mouth open as widely as possible, and the tongue extended to its maximum in MM and tongue inside the mouth for FTP, without phonation. However, several drawbacks exist, as demonstrated by poor reproducibility and high rates of interobserver variability [11-14].

One factor contributing to this might be the lack of clarity regarding the type of breathing (oral/nasal) the patient is expected to assume during the assessment. Both the MM and the Friedman tongue position tests are vague in terms of the dynamic variations associated with patients' breathing and the positions of the oropharyngeal structures during the assessment [15]. In a preliminary pilot study of 30 patients, the authors found that patients assuming nasal respiration during MM assessment had a MM assessment had a higher score compared to those with oral breathing. The present study is part of a larger study on MM scoring, where its role in predicting OSA is also being studied [16]. Therefore, the present

study aimed to conduct a community-based survey to assess the differences in MM grading and FTP scores when patients are directed to differentially assume oral and mouth breathing during the assessment.

MATERIALS AND METHODS

The present community-based cross-sectional study was jointly conducted by the Departments the Departments of Anaesthesiology and Community Medicine at Believers Church Medical College Hospital in Central Kerala, India between April 2022 and October 2022, after obtaining clearance from the Institutional Ethics Committee (IEC/2023/335).

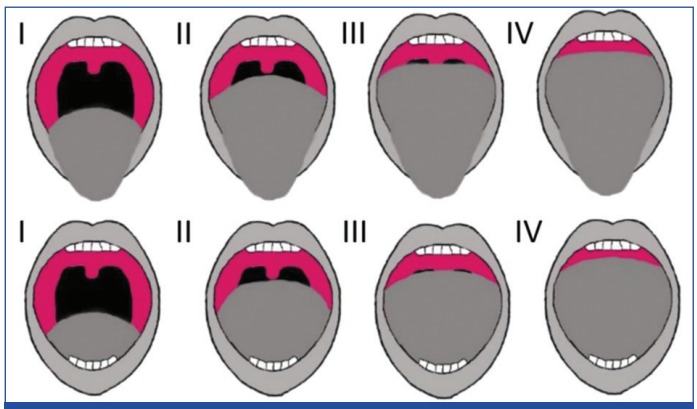
Inclusion and Exclusion criteria: Adults within the rural field practice area of the hospital, aged above 18 years and consenting to participate, were included in the study. The exclusion criteria included individuals with difficulty in mouth opening or nasal pathologies that might make airway assessment difficult, language barriers, and non willingness to participate.

A pilot study was conducted on 30 individuals, where a MM grade-1 was observed in 6 individuals (20%) and the rest of the grades had a higher percentage.

Sample size calculation: To capture even the lowest grade, the sample size was calculated based on a 20% prevalence using data from the pilot study, applying the formula 4 pq/d^2, where p=prevalence, q=100-p, and d=precision. Thus, p=20, q=80, d=3. A total of 725 individuals were examined, but in 23 of them, data was incomplete, resulting in a final sample size of 702.

Study Procedure

Data collected included socio-demographic details, anthropometric measurements, as well as MM and FTP scores during both mouth and nose breathing. Participants were seated on a chair at the same level as the examiner, with their heads in a neutral position, and were asked to open their mouths wide, protrude their tongues, and breathe through the mouth. The MM score [3] for each person was noted based on the structures seen, as follows: Class-I when soft palate, fauces, uvula, pillars are seen; Class-II when soft palate, fauces, uvula are seen; Class-III when soft palate, base of uvula seen; Class-IV when soft palate not visible at all [Table/Fig-1] [16]. The participant was then asked to relax and close their mouth. The same procedure was repeated, and the participant was asked to breathe through the nose while the scoring was being done. Similarly, FTP scores (which are similar to MM but with the tongue in a neutral position without protrusion [Table/Fig-1] [17]) were also noted during both oral and nasal breathing for all participants. Thus, four scores were obtained for each patient. BMI was calculated using the Asian Classification of BMI [18].



[Table/Fig-1]: Rows 1 and 2 shows progressive grades of Mallampati grades and FTP scores, respectively.

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 21.0. Categorical variables were expressed as percentages, and continuous variables were expressed as mean and standard deviation. The z-test for proportions was used to test for a significant difference between the two scoring techniques. A p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 702 participants fulfilled the inclusion and exclusion criteria. The majority of the participants were females (69.2%), and more than half (59%) were above 50 years of age [Table/Fig-2]. The mean age of the study participants was 53.58±16.42 years. As the community primarily consisted of rural and agrarian areas, the majority of the study participants (52.4%) had education only up to the 10th standard. About 73% of the study population had a Body Mass Index (BMI) of more than 23 kg/m^2, which, according to the Asian classification, is categorised as overweight.

S. No.	Variables	Number	Percentage
1.	**Gender**		
	Male	216	30.8%
	Female	486	69.2%
2.	**Age classification**		
	<31 years	70	10%
	31-50 years	218	31%
	51-60 years	148	21.1%
	>60 years	266	37.9%
3.	**BMI (Asian classification)**		
	<18.50 kg/m^2	26	3.7%
	18.51-22.99 kg/m^2	162	23.1%
	23-27.50 kg/m^2	299	42.6%
	>27.51 kg/m^2	215	30.6%

[Table/Fig-2]: Socio-demographic variables (N=702).

The grade of MM and FTP varied considerably between nasal and oral breathing in the same patients and across all categories. Most participants were found to have higher MM scores when they switched from mouth breathing to nasal breathing. This is evident from the decreased number of patients in the Nose breathing category for all scores up to score 3 when compared to the mouth breathing category across both FTP and MM grading separately. (Score 4 is the highest risk category, so patients can shift only up to category 4) [Table/Fig-3].

Score (N=702)	Friedman's Tongue Position (FTP), n (%)		Modified Mallampati (MM) Grade, n (%)	
	Mouth breathing	Nose breathing	Mouth breathing	Nose breathing
1	85 (12.1%)	61 (8.7%)	135 (19.2%)	62 (8.8%)
2	193 (27.5%)	123 (17.5%)	196 (27.9%)	162 (23.1%)
3	221 (31.5%)	186 (26.5%)	220 (31.3%)	172 (24.5%)
4	203 (28.9%)	332 (47.3%)	151 (21.5%)	306 (43.6%)

[Table/Fig-3]: Showing the frequency distribution of Mallampati scores.

Out of the 135 participants who had an MM score of I during mouth breathing, only 36 (26.7%) retained the same score during nasal breathing, while 99 participants (73.3%) had higher scores (Z-value=7.5, p=0.001). Similarly, out of 196 people who had an MM score of II during mouth breathing, only 85 (43.4%) remained as score 2, while 87 (44.3%) had higher scores during nasal breathing. Out of 220 people who initially had an MM score of III during mouth breathing, 106 (48.2%) had an MM score of Class-IV during nasal breathing, while only 87 (39.5%) retained their score as 3 (Z-value=4.40, p=0.001). This difference is significant, indicating the need to standardise the route of breathing when classifying patients according to the Mallampati classification [Table/Fig-4].

Mouth breathing scores	Nose breathing scores, n (%)				
	1	2	3	4	Total
1	36 (26.7%)	48 (35.6%)	18 (13.3%)	33 (24.4%)	135
2	24 (12.2%)	85 (43.4%)	57 (29.1%)	30 (15.3%)	196
3	2 (0.9%)	25 (11.4%)	87 (39.5%)	106 (48.2%)	220
4	0 (0%)	4 (2.6%)	10 (6.6%)	137 (90.7%)	151
Total	62	162	172	306	**702**

[Table/Fig-4]: Comparison of scores between mouth breathing and nose breathing {Modified Mallampati (MM)}.

A similar pattern was observed when studying the FTP. Out of the 85 people who had an MM score of 1 during mouth breathing, 52 (61.2%) had a score of 2 or higher during nasal breathing, while only 33 people (38.8%) remained as Score-1 (Z-value=3.68, p=0.003). Similarly, out of 193 people who had an MM score of II during mouth breathing, 74 (38.34%) had higher scores during nasal breathing (Z-value=1.100, p=0.28). Additionally, 104 (47.1%) out of the 221 people who had a score of 3 during mouth breathing had a Class-4 score during nasal breathing (Z-value=2.02, p=0.04). Therefore, the route of breathing needs to be standardised when classifying patients according to the FTP classification [Table/Fig-5].

Mouth breathing scores	Nose breathing scores				
	1	2	3	4	Total
1	33 (38.8%)	14 (16.5%)	12 (14.1%)	26 (30.6%)	85
2	27 (14%)	92 (47.7%)	56 (29%)	18 (9.3%)	193
3	1 (0.5%)	16 (7.2%)	100 (45.2%)	104 (47.1%)	221
4	0 (0%)	1 (0.5%)	18 (8.9%)	184 (90.6%)	203
Total	61	123	186	332	**702**

[Table/Fig-5]: Comparison of scores between Mouth Breathing and Nose Breathing {(Friedman's tongue position (FTP)}.

DISCUSSION

The present study among rural community dwellers in central Kerala revealed a significant difference in MM and FTP scores when assessed during mouth breathing compared to nose breathing. The majority of patients had higher MM grades when assessed during nose breathing. To the best of the authors knowledge, no study has compared MM scores during mouth versus nose breathing. Given the importance of preintubation airway risk assessment and the routine use of the MM, standardising the type of respiration before assessment and improving its predictive power for difficult intubation is of clear relevance for anaesthesiologists.

The MM grading has been popular among anaesthesiologists for a long time due to its simplicity and ease of assessment. However, increasing evidence showing its poor prognostic value [19], specificity [20], and high interexaminer variability [11-14] has reduced the confidence of anaesthesiologists in this classic clinical test. One factor that may be responsible for this variability is the breathing technique adopted by the patient during the assessment. Karkouti K et al., in their prospective study of 59 patients undergoing elective surgery, found that the interexaminer reliability kappa coefficient (κ) for MM was 0.31, which is considered poorly correlated [11]. Rosenstock C et al., conducted a prospective study of 120 patients undergoing elective surgery, comparing six tools for the assessment of difficult intubation, including Mallampati grading, and found an interexaminer reliability (κ) of 0.8 among experienced anaesthesiologists [12]. These investigators noted that the original instructions for MM staging were somewhat vague and "prone to classification errors." Sundman J et al., studied the interexaminer variability of Friedman's modification and also found high variability with a κ coefficient of 0.32 [13]. A meta-analysis of 55 studies involving 177,088 patients [18] showed that only 35% of the patients who underwent tracheal intubation with difficulties were correctly identified with the MM test. The pooled positive likelihood ratio was 4.1. A clinical test is considered to be diagnostically accurate if it has a positive likelihood ratio of >10. Yu JL and Rosen who studied the utility of MM grade and Friedman tongue position in the assessment of obstructive sleep apnoea, suggested that the variability in the breathing pattern of the patients might be a cause for the variability found in these tests [17]. While most patients assume oral breathing during MM assessment, this may not always be the case and might account for the variability in assessment and the poor reproducibility observed in many studies. Fluoroscopic studies [15] have demonstrated that during nose breathing with the mouth open, the soft palate descends to occlude the oral cavity to allow the nasal passages to be the path of least resistance into the airway. Also, while breathing through the mouth, the soft palate elevates to close off the nasopharynx, which might influence the visibility of oropharyngeal structures during airway assessment by the MM technique.

Having established that the route of breathing significantly affects the assessment of difficult intubation by MM grading, the next step forward would be to determine which route of breathing would accurately predict a difficult airway. The best way would be to evaluate the correlation between MM grades obtained by these two techniques and the Modified Cormack Lehane grading [21]. This would help the authors further standardise the method of assessing MM grades to better correlate with the actual difficulty in airway management.

Having stated that, the investigators of the present study have consistently observed significant tension created in the tongue and the palate, approximating them to each other, as the patients breathe through the nose. They also noted that the tongue relaxes inferiorly while breathing orally, which is the same direction to which the tongue is pushed off while performing a direct laryngoscopy. Thus, the authors suggest that advising the patient to breathe through the mouth would relax the tongue and improve the predictive value of Mallampati grading in the clinical setting.

The authors would like to emphasise the strength of the present study as the first of its kind to evaluate the impact of breathing (nasal/oral) on the MM score, and particularly as a community study.

Limitation(s)

The present study does not study the correlation between the MM grades obtained by the two techniques of examination with the actual difficulty in vocal cord visualisation and intubation by direct laryngoscopy.

CONCLUSION(S)

The MM score and FTP scores are very important clinical evaluation tools for assessing upper airway anatomy, although they have high interobserver variability. The present study has demonstrated that the route of breathing contributes significantly to the high interexaminer variability of difficult airway prediction by MM grading, as well as the Friedman tongue position scores. These airway evaluation tools need further standardisation, especially with respect to the route of breathing during examination. The present study also suggests that advising the patient to breathe through the mouth would relax the tongue and improve the predictive value of Mallampati grading.

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