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Original Article

# Mallampati classification without tongue protrusion can predict difficult tracheal intubation more accurately than the traditional Mallampati classification

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ABSTRACT

*Introduction:* The modified Mallampati classification (m-MMT) is the most popular technique for predicting difficult tracheal intubation. However, tongue protrusion may sometimes hide the oropharynx when the distance of the mouth opening is short, and this may lead to false-positive (FP) estimations of difficulty. The purpose of this study is to determine whether the Mallampati classification with no tongue protrusion (NT-MMT) can predict difficult tracheal intubation more accurately than the traditional m-MMT method.
*Methods:* A total of 748 patients requiring endotracheal intubation were enrolled in this study. They were evaluated by m-MMT and by NT-MMT prior to surgery. After induction of general anesthesia with muscle relaxation, all patients underwent direct laryngoscopy, and the best glottic view was recorded as defined by the grading system of Cormack and Lehane. The preoperative assessment data and the intubation findings were used to determine the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of the aforementioned tests in predicting difficult intubation.
*Results:* NT-MMT classification scored higher in all parameters than m-MMT. Similarly, the coefficient of reliability of Spearman's $\rho$ test was higher with NT-MMT than with m-MMT.
*Conclusion:* NT-MMT is easy to perform and was more accurate in predicting difficult tracheal intubation than m-MMT.


## 1. Introduction

Perioperative management of the patient is the liability of a medical attendant. An understanding of risk factors before general anesthesia is an important factor for safe perioperative management. When performed properly, the Mallampati classification [1] (MMT) is reported to be a simple, reproducible, and reliable method for preanesthetic airway assessment. MMT considers the anatomy of the oral cavity and is particularly concerned with the visibility of the base of the uvula, faucial pillars (the arches in front of and behind the tonsils) and soft palate. Scoring may be done with or without phonation. MMT provides a rough estimate of the tongue size relative to the oral cavity, and a high MMT score is associated with difficult intubation and a higher incidence of sleep apnea [2]. In addition, a high MMT score is an independent predictor for difficulty with mask ventilation during the induction of anesthesia [3].

Originally, MMT graded the patient based on visualization of structures in the oropharynx with maximal mouth opening and tongue protruding. MMT has three classes: class 1, faucial pillars, soft palate, and uvula could be visualized; class 2, faucial pillars and soft palate could be visualized, but uvula was masked by the base of the tongue; and class 3, only the soft palate could be visualized. Samsoon and Young developed the original three-point scale of MMT to a four-point scale [4] adding class 4, soft palate not visible. A class 1 view suggests ease of intubation and a class 4 view suggests a poor laryngoscopic view. MMT and the modified MMT (m-MMT) are the most popular techniques for predicting difficult tracheal intubation. However, one study found that although the MMT scale correlates well with the Cormack and Lehane classifications [5], it lacks the sensitivity to predict difficult tracheal intubation [6,7]. It is thought that the accuracy of MMT and m-MMT in predicting difficult intubation is lowered when the mouth opening is short or when the patient is obese. There is a possibility that the reported lack of sensitivity of MMT and m-MMT scales results from operator error and imprecise adherence to the procedure.

Both tests are performed with the patient in the seated position, the head held in a neutral position, the mouth wide open,

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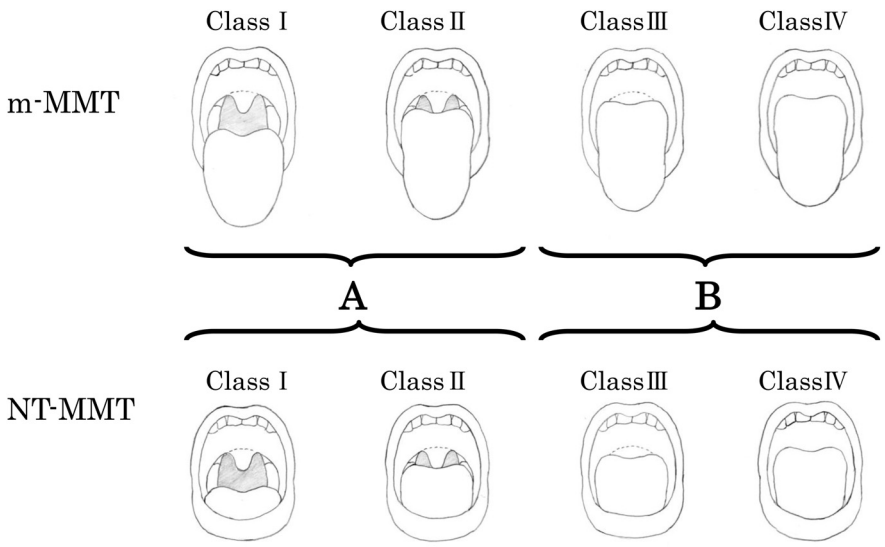


**Fig. 1.** Criteria of m-MMT and NT-MMT. (A) Predicted easy intubation group and (B) predicted difficult intubation group.

and the tongue protruding to its maximum. If the patient arches the tongue, it is possible that the uvula is falsely obscured. In our experience, tongue protrusion may sometimes hide the structure of the oropharynx when the distance of mouth opening is <40 mm, and this may lead to a false-positive (FP) estimation of intubation difficulty by MMT or m-MMT. The aim of this study was to compare the predictive value of the Manabe-style no tongue protrusion technique (NT-MMT) with the traditional m-MMT approach, and the study revealed that NT-MMT was better for predicting difficult tracheal intubation.

## 2. Materials and methods

Approval for this study was obtained from the Institutional Review Board of the Kagoshima University and after obtaining informed consent, we enrolled ASA1-2 patients over 15 years, who were scheduled for elective surgical procedures requiring endotracheal intubation. The exclusion criteria included abnormality or deformities of the tongue, pharynx or larynx, or prior history of surgery in these regions. Patients with serious abnormality or deformities of the mandible and maxilla were also excluded.

Patients were evaluated by m-MMT and NT-MMT by anesthetists who were not involved in airway intubation at the preoperative round. When making estimations using the NT-MMT approach, we gave verbal instructions to the patient to yawn or breathe in through the mouth after saying 'ah' without sticking out their tongue in either instance. The pharyngeal structures were then evaluated and the best view (lowest class) was recorded. The classification follows m-MMT and is as follows: class 1, full visibility of tonsils, uvula, and soft palate; class 2, visibility of hard and soft palate, upper portion of tonsils and uvula; class 3, visibility of the soft and hard palate and base of the uvula; and class 4, visibility of only the hard palate (Fig. 1). The age, gender, height, weight, and the interincisor gap of all participants were also recorded.

Following induction of general anesthesia with muscle relaxation, all patients underwent direct laryngoscopy, and the best glottic view was recorded as defined by the grading system of Cormack and Lehane as grade 1 (full view of the glottis), grade 2 (glottis partly exposed, anterior commissure not seen), grade 3 (only epiglottis seen), or grade 4 (epiglottis not seen).

We only examined cases where patients were administered vecronium (>0.1 mg/kg) or rocuronium (>0.6 mg/kg) for their laryngoscopy. The laryngoscopy was performed by a highly experienced anesthetist with a Macintosh-type laryngoscope. When making assessments using the Cormack and Lehane grading system, no external laryngeal pressure was applied. Briefly, the sniffing position was achieved by placing a 9-cm cushion under the patient's head [8], and the head retroflexion or jaw thrust maneuver was performed if needed. Grade 1 or 2 indicates easy intubation, whilst grade 3 or 4 suggests that difficult intubation is likely.

The preoperative assessment data and the intubation findings were used to determine the accuracy of NT-MMT and m-MMT in predicting difficult intubation. We evaluated the same patient by m-MMT and NT-MMT, and the acquired data were divided into two groups. Class I or II patients were considered easy to intubate, whilst class III or IV patients were considered difficult to intubate.

Assignment to m-MMT or NT-MMT class III or IV and Cormack and Lehane grade 3 or 4 were deemed 'true positive (TP)'. Assignment to m-MMT or NT-MMT class III or IV and Cormack and Lehane grade 1 or 2 were deemed 'false positive (FP)' and assignment to m-MMT or NT-MMT class I or II and Cormack and Lehane grade 1 or 2 were deemed 'true negative (TN)'. Finally, assignment to m-MMT or NT-MMT class I or II and Cormack and Lehane grade 3 or 4 were deemed 'false negative (FN)' (Fig. 2). We calculated sensitivity {TP/(TP + FN)}, specificity {TN/(TN + FP)}, positive predictive value {TP/(TP + FP)}, negative predictive value {TN/(TN + FN)} and accuracy {(TP + TN)/(TP + TN + FP + FN)}. The reliability coefficient ($\rho$) between both m-MMT or NT-MMT and Cormack and Lehane

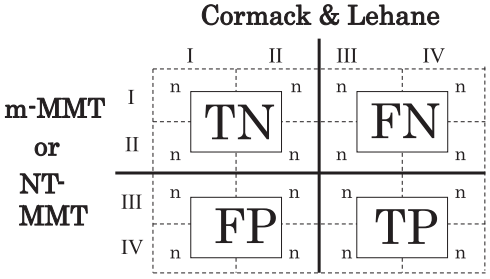


**Fig. 2.** Evaluation parameters. TP (true positive): a difficult intubation that had been predicted to be difficult (MMT class III or IV and Cormack and Lehane grade 3 or 4); FP (false positive): an easy intubation that had been predicted to be difficult (MMT class III or IV and Cormack and Lehane grade 1 or 2); TN (true negative): an easy intubation that had been predicted to be easy (MMT class I or II and Cormack and Lehane grade 1 or 2); and FN (false negative): a difficult intubation that had been predicted to be easy (MMT class I or II and Cormack and Lehane grade 3 or 4).