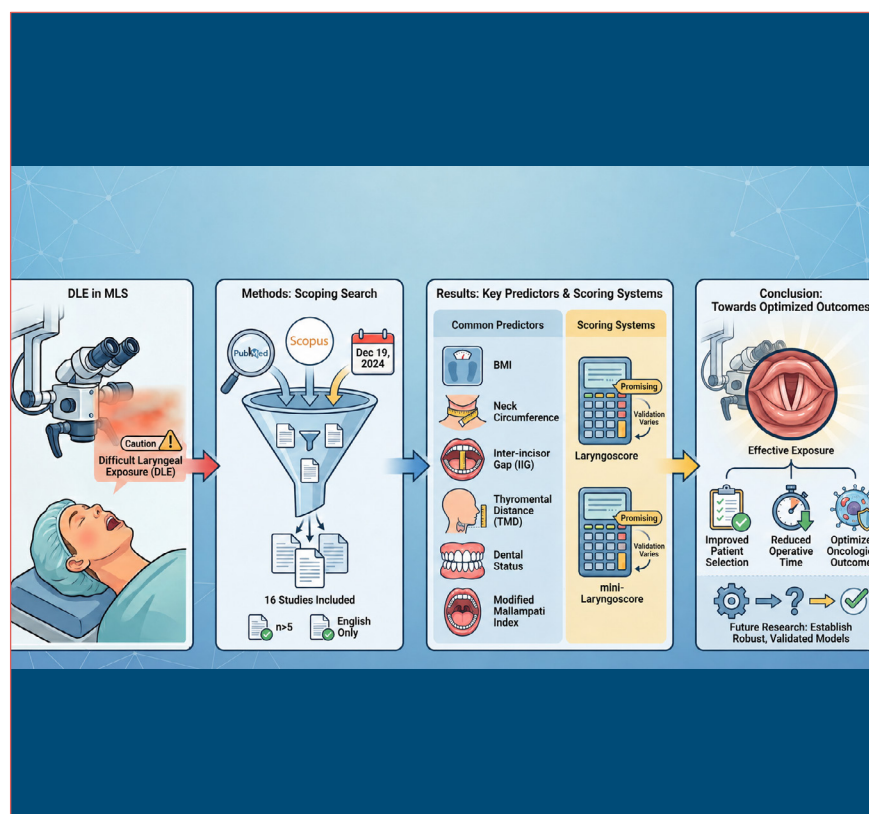


Prediction of difficult laryngeal exposure in microlaryngoscopy: a scoping review

Claudia Valenziano^{1,2}, Alberto Paderno^{1,2}, Camilla Zimello^{1,2}, Giuseppe Mercante^{1,2}

¹ Department of Biomedical Sciences, Humanitas University, Milan, Italy; ² Otorhinolaryngology Unit, IRCCS Humanitas Research Hospital, Rozzano (MI), Italy



Cover figure. Prediction of difficult laryngeal exposure.

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Correspondence

Claudia Valenziano

E-mail: claudia.valenziano@humanitas.it

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Summary

Objective. To conduct a scoping review on difficult laryngeal exposure (DLE) prediction in microlaryngoscopy (MLS). The aim was to identify effective predictive scoring systems or parameters for predicting transoral exposure.

Methods. A comprehensive search was conducted in PubMed and Scopus, with the final search performed on December 19th, 2024. Studies assessing preoperative predictors of DLE in MLS were included if they reported accuracy measures. Studies not in English, with insufficient data, and with sample size < 5 patients were excluded.

Results. Sixteen studies were analysed. Common predictors included body mass index, neck circumference, inter-incisor gap, thyromental distance, dental status, and the modified Mallampati index. Scoring systems like the Laryngoscore and the mini-Laryngoscore showed promise but varied in external validation.

Conclusions. DLE prediction for MLS remains underdeveloped. Validated predictive tools could improve patient selection, reduce operative times, and optimise oncological outcomes by ensuring effective exposure. Further research is needed to establish robust predictive models.

Keywords: exposure, transoral surgery, laryngeal, prediction scoring

Introduction

Adequate laryngeal exposure is essential for microlaryngoscopy (MLS) to ensure optimal visualisation of the surgical field and safe instrument manipulation.

During suspension laryngoscopy, visualising the glottic structures – especially the anterior commissure – can sometimes be challenging¹. The reported prevalence of difficult laryngeal exposure (DLE) varies widely, ranging from 1.5% to 33.9%. This challenge can lead to prolonged operative times, surgical trauma, diagnostic errors, or incomplete procedures, which is especially problematic in oncological cases²⁻⁷. Numerous strategies have been explored to manage DLE, including applying external laryngeal counterpressure, elevating the patient's head in the flexion-flexion position, and using laryngoscopes with different shapes or smaller sizes⁸⁻¹¹. Additionally, novel ventilation methods, such as high-frequency jet ventilation and high-flow nasal oxygenation, have improved visualisation of the surgical field¹²⁻¹⁵. Despite these methods, achieving adequate laryngeal exposure continues to be challenging in specific cases.

Several potential preoperative predictors of DLE have been studied. The most frequently reported include body mass index (BMI)^{2,5,6,16-25}, neck circumference (NC)^{2,6,7,16,17,22,23,25}, upper jaw dental status^{18-21,23-25}, interincisor gap (IIG)^{18-21,23-25}, a history of previous head and neck surgery and/or radiotherapy^{18-21,23-25}, and the Modified Mallampati Index (MMI)^{5-7,16,18-26}. However, results across studies have been inconsistent. In 2014, Piazza et al. introduced the Laryngoscore, a preoperative tool designed to predict glottic visibility based on 11 clinical factors¹⁸. In 2019, a simplified version, the mini-Laryngoscore, was developed by the same research group, focusing on 3 key predictors: IIG, upper jaw dental status, and thyroid-mental distance (TMD)²¹. Validating these scores in diverse patient populations and enhancing them with additional variables are essential to ensure their reliability and applicability. To date, the external validity of the mini-Laryngoscore has been tested only once in a study by Clarysse et al.²³.

This introduction highlights the need for preoperative predictors of DLE which must be objective, reproducible, and easy to obtain. For these reasons, a scoping review was conducted to critically evaluate existing literature on DLE prediction for MLS. The objective was to identify the most effective score for predicting difficult exposure or, if lacking, to determine the optimal parameters to combine for developing a new, reliable predictive score.

Materials and methods

This study was performed according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. This review of previously published studies did not require institutional review board approval, nor informed consent. No review protocol was registered for this study.

This scoping review was conducted according to the PICOS tool: *Patients* (P), adults undergoing MLS; *Intervention* (I), preoperative predictive parameters/tool of DLE; *Comparator* (C), comparison of patients with difficult exposure with those without; *Outcomes* (O), laryngeal exposure situation; *Study design* (S), prospective and retrospective case-control studies.

PubMed, Scopus, and Cochrane Library databases were searched for relevant publications. Relevant keywords, phrases, and medical subject headings (MeSH) terms were used according to each database requirement. As an example, the following queries was used for PubMed:

1) ((“Laryngeal exposure”[Title/Abstract] OR “Endoscopic exposure”[Title/Abstract] OR “Surgical exposure”[Title/Abstract] OR “Exposure scoring”[Title/Abstract] OR “Visibility scoring”[Title/Abstract] OR “Laryngeal visibility”[Title/Abstract] OR “Operative field exposure”[Title/Abstract] OR “Operative field visualization”[Title/Abstract]) AND (“Transoral surgery”[Title/Abstract] OR “Laryngeal surgery”[Title/Abstract] OR “Microlaryngeal surgery”[Title/Abstract] OR “Laryngoscopy”[Title/Abstract] OR “Endoscopic surgery”[Title/Abstract])) AND (“Outcome measures”[Title/Abstract] OR “Scoring”[Title/Abstract] OR “Assessment”[Title/Abstract] OR “Evaluation”[Title/Abstract])).

2) ((measures[Title/Abstract] OR scoring[Title/Abstract] OR assessment[Title/Abstract] OR measurement[Title/Abstract] OR “scoring system”[Title/Abstract] OR scale[Title/Abstract] OR evaluation[Title/Abstract] OR index[Title/Abstract] OR grading[Title/Abstract]) AND (“laryngeal exposure”[Title/Abstract] OR laryngeal[Title/Abstract] OR larynx[Title/Abstract]) AND (exposure[Title/Abstract] OR visualization[Title/Abstract] OR access[Title/Abstract] OR “glottic exposure”[Title/Abstract])) AND (“Transoral Surgery”[MeSH Terms] OR “Endoscopic Surgery”[MeSH Terms] OR “Laryngoscopy”[MeSH Terms] OR “transoral surgery”[Title/Abstract] OR “transoral laryngeal surgery”[Title/Abstract] OR “transoral laser surgery”[Title/Abstract] OR “endoscopic surgery”[Title/Abstract] OR “minimally invasive surgery”[Title/Abstract] OR microlaryngoscopy[Title/Abstract])).

Bibliographies of the selected papers were checked for additional eligible studies. The last research was carried out on December 19th, 2024. Two independent reviewers (CV and AP) conducted the search sequentially evaluating the titles, abstracts, and then full text of the selected papers to minimise selection bias and errors. Systematic data extraction from the included studies was made using a structured data-charting form, independently compiled by one author (CV) to extract the following characteristics: number of patients (total, with and without DLE); predictive parameters and scores for DLE; intraoperative assessment method for DLE; sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under curve (AUC) of each parameter; exclusion criteria of each study. Finally, another author checked for accuracy (CZ). Eventual disagreements between reviewers were solved by discussion and consensus between them. Studies evaluating preoperative predictors of DLE in MLS and reporting diagnostic accuracy measures such as sensitivity, specificity, PPV, NPV, and AUC, were included and critically analysed. Studies were excluded if they (a) were not in English, (b) reported insufficient data or data were not extractable, and (c) included less than 5 patients. No publication date was imposed, but articles had to be already published in a peer-reviewed journal. See Figure 1 for the PRISMA flow diagram.

Results

Numerous studies explored strategies to predict DLE. This review has provided 16 studies, whose characteristics are presented in Table I. Each study identified several predictive parameters and some proposed scores, analysed in Table II.

Preoperative endoscopy

Office-based laryngoscopic grading demonstrated a strong correlation with laryngeal exposure during operative laryngoscopy. Specifically, a grade of 2 or more was highly sensitive and specific in identifying cases of DLE²⁷.

Objective metrics

Objective metrics have been extensively studied and identified as key predictors of DLE. BMI has shown to play a significant role, with values exceeding 25 kg/m² consistently associated with a higher risk of DLE¹⁶. NC is another critical parameter. Studies have demonstrated that larger NCs, particularly those over 40 cm, are strongly correlated with increased difficulty in achieving adequate laryngeal exposure⁶. This relationship has been consistently observed

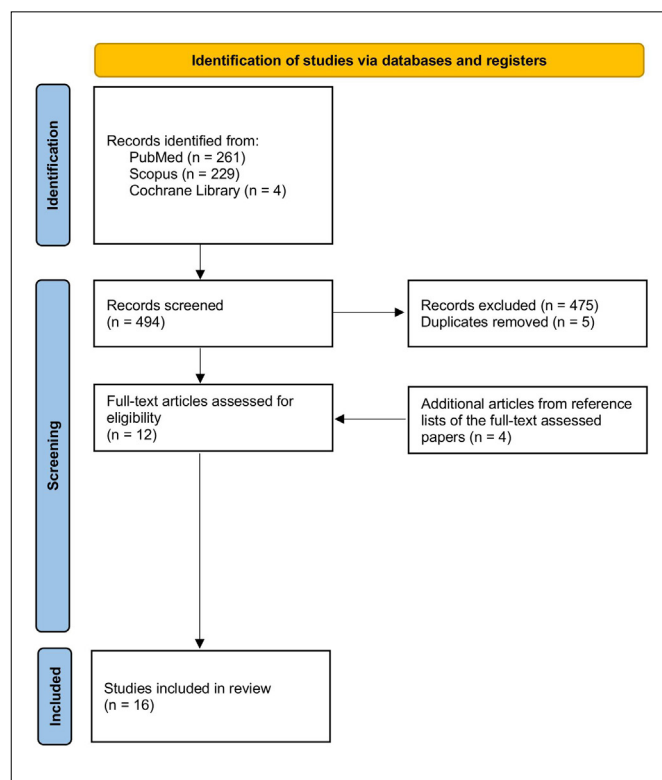


Figure 1. PRISMA flow diagram of article screening.

across various thresholds ranging from 34.2 to 42 cm^{7,16,22,26}. Table III shows all the different proposed NC cut-off values and their accuracy. Interestingly, one study also highlighted neck length, identifying lengths below 15.3 cm as an additional risk factor for DLE²⁶. These findings emphasise the impact of obesity on laryngeal visualisation.

Atlanto-occipital (A-O) extension, a measure of neck mobility, has also been implicated in DLE. Limited extension, defined as angles below 19.5°, was shown to significantly increase the likelihood of difficult exposure⁷.

TMD is another well-established parameter, with reduced measurements – commonly below 5.5 cm – consistently associated with increased risk^{16,21,22,24}. Table IV summarises the various proposed TMD cut-off values along with their corresponding accuracy. Other anatomical features – such as prominent or irregular upper jaw dentition, micrognathia, and macroglossia – were frequently observed in patients experiencing DLE^{18,19,21,23,25}. Patients with a history of neck surgery or radiotherapy were also significantly more likely to encounter DLE²³.

The MMI²⁸ has been extensively studied for its predictive power^{17,20,22,24}. It has shown a robust statistical correlation with DLE across multiple studies. Notably, Hekiart et al.

Table I. Characteristics of the studies included.

First author (year)	Study design	Number of participants	Number of DLE patients (%)
Hsiung (2004) ⁵	Prospective observational	56	19 (33.9)
Roh (2005) ¹⁶	Prospective observational	73	13 (17.8)
Hekiert (2007) ¹⁷	Prospective observational	63	31 (49.2)
Pinar (2009) ⁶	Prospective observational	93	22 (23.7)
Piazza (2014) ¹⁸	Prospective observational	319	43 (13.5)
Paul (2016) ⁷	Prospective observational	117	31 (26.5)
Tirelli (2019) ¹⁹	Prospective observational	136	31 (22.8)
Arjun (2019) ²⁰	Prospective observational	32	8 (25)
Incandela (2019) ²¹	Prospective observational	310	45 (14.5)
Kharrat (2022) ²	Prospective observational	71	19 (26.8)
Liu (2022) ²²	Prospective observational	95	22 (23.2)
Nerurkar (2022) ²⁶	Prospective observational	42	10 (23.8)
Clarysse (2024) ²³	Prospective observational	103	18 (17.5)
Manjunath (2024) ²⁹	Prospective observational	69	9 (13)
Nautiyal (2024) ²⁴	Prospective observational	150	27 (18)
Teixeira (2024) ²⁵	Prospective observational	80	24 (30)

Table II. Predictive parameters and scores for DLE in MLS.

Parameter	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	AUC	OR	95% CI	p value
Rigid laryngoscopic grading ≥ 2 ²⁷	93.3	100	-	-	0.97	-	-	-
BMI ($> 25 \text{ kg/m}^2$) ¹⁶	61	70	30	89	-	-	-	-
NC (variable) ^{7,16,22,26}	45.5-90	38-83.6	32-45.5	83.6-89	-	NA	NA	NA
Neck length ($< 15.3 \text{ cm}$) ²⁶	63	60	-	-	-	-	-	-
A-O extension ($< 19.5^\circ$) ⁷	80	8.3	-	-	-	3.64	0.89 - 14.88	0.07
TMD (variable) ^{16,22}	61-86.4	72.6-73	33-48.7	89-94.6	0.82	NA	NA	NA
History of neck surgery and/or radiotherapy ²³	-	-	-	-	-	4.23	1.16-15.44	0.03
MMI ²²	54.5	84.9	52.2	86.1	0.69	4.54	1.48-13.97	0.008
Score	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	AUC	OR	95% CI	p value
LS ≥ 6 ^{18,20,21,23}	63-87.5	75-86	40-53.8	94-94.7	0.73-0.74	-	-	-
LS ≥ 4 ¹⁹	80.6	51.4	32.9	90	0.73	-	-	-
Mini-LS ^{23,25}	-	-	60	76.9	0.71-0.73	-	-	-
New Prediction Model by Clarysse ²³	-	-	-	-	0.84	-	-	-
New Prediction Model by Teixeira ²⁵	-	-	76.2	86.4	0.89	-	-	-

PPV: positive predictive value; NPV: negative predictive value; AUC: area under curve; OR: odds ratio; 95% CI: 95% confidence interval; BMI: body mass index; NC: neck circumference; A-O extension: atlanto-occipital extension; TMD: thyroid-mental distance in neck full extension; MMI: Modified Mallampati Index; LS: Laryngoscore; Mini-LS: mini-Laryngoscore.

identified the Mallampati score as the only significant independent predictor. Interestingly, this correlation held true for both obese and non-obese patients, with obesity providing no additional predictive information when the Mallampati score was already elevated ¹⁷.

Multiparametric scoring systems

To enhance the predictive accuracy of DLE, various multiparametric scoring systems have been proposed. Among these, the Laryngoscore has been widely used. With a cut-off score of 6, it demonstrates good overall accuracy ¹⁸. However, external validation studies have revealed variability in its performance, suggesting that further research is needed to refine its applicability and establish an optimal threshold ^{19-21,23,24}.

The mini-Laryngoscore, a simplified version of the original system, offers similar predictive accuracy while being easier to use ²¹. Despite its promise, it also requires further validation to confirm its effectiveness across diverse patient populations ^{23,25}.

More recently, Clarysse et al. developed a scoring system incorporating just 3 parameters – IIG, dental status, and prior treatments – which showed high predictive value ²³. Similarly, Teixeira et al. proposed a model that combined NC, IIG and dental status, yielding comparable accuracy ²⁵.

Areas of uncertainty

The IIG has emerged as an important predictor. Reduced gaps, particularly under 4 cm, have been linked to higher rates of DLE ^{18,21}. However, research suggests that a threshold of 5 cm might provide better predictive accuracy. Furthermore, treating IIG as a continuous variable enhanced its predictive value ²³. Despite these findings, some studies have reported no significant correlation between IIG and DLE, indicating potential variability in its reliability ¹⁹.

Intraoperative assessment method

The most used intraoperative assessment method for DLE relies on visualising the anterior commissure during direct laryngoscopy, with the classification ranging from complete (class 0) to impossible visualisation (class IV) ^{18,21}. In all studies utilising this method, DLE is defined as class III and IV.

Discussion

Numerous studies have explored strategies to predict DLE. The review conducted with the abovementioned queries has identified 16 studies. However, the available literature has several limitations. Firstly, all but one ¹⁸ of the studies are

Table III. Neck circumference: different cut-off values proposed and their accuracy.

NC cut-off (cm)	OR	95% CI	p value
> 40 ⁶	12.82	1.29-127.37	0.03
> 39.5 ¹⁶	4.04	1.16-14.13	0.02
> 34.2 ⁷	3.73	0.87-16.04	0.08
> 42 ²²	-	0.5-0.78	0.05
> 39.8 ²⁵	1.4	1.1-1.9	-

NC: neck circumference; OR: odds ratio 95%; CI: 95% confidence interval.

Table IV. Thyroid-mental distance: different cut-off values proposed and their accuracy.

TMD cut-off (cm)	OR	95% CI	p value
< 5.5 ¹⁶	4.4	1.25 - 15.4	0.02
< 6 ²¹	4.59	1.11 - 18.98	0.04
≤ 7.2 ²²	0.07	0.01 - 0.39	0.002

TMD: thyroid-mental distance; OR: odds ratio; 95% CI: 95% confidence interval.

single-centre, with most studies having a small sample size that could hinder the evaluation of a relatively rare event as difficult exposure ^{20,23-26}. Another key issue is the exclusion criteria. To better reflect daily practice, studies should ideally avoid restrictive criteria ^{18,23,26}. Excluding patients with previous head and neck surgery and/or radiotherapy introduces a potential bias, excluding a significant portion of patients who may need MLS ^{2,6,7,16,22}. Manjunath and colleagues, for instance, excluded patients with glottic cancer – a major indication for MLS – reducing the study's reliability in this setting ²⁹. Additionally, other authors excluded patients with lesions obscuring glottic structures; this may represent a confounding factor since the lesion might be itself the indication for transoral surgery ^{7,20}. Finally, unspecified ² or subjective parameters like the visual analogue scale ¹⁷ and the Cormack-Lehane score ^{6,7,16,22} have been used to assess exposure difficulty intraoperatively, though this may limit reproducibility.

It is also important to note the limited comparability between studies, due to the use of different types of laryngoscopes, varying patient positions, and the lack of a standardised definition of DLE. In some studies ^{7,16}, a modified version of the Cormack and Lehane scale is used, defining DLE as the condition where only the arytenoids are visible or when the entire glottis and arytenoids are hidden. The Cormack and Lehane scale is commonly employed by anaesthesiologists to assess whether the laryngeal view is adequate for endotracheal intubation ³⁰⁻³². However, in lar-

ngology, even slight differences in laryngeal exposure can significantly impact the surgical outcomes, which could suggest that this scale might not be the most appropriate choice for laryngology studies. Other studies^{18,19,25}, define DLE based on exposure of the anterior commissure and the size of the laryngoscope required to visualise it.

Instrument availability between different centres may also act as a confounding factor. The Zeitel's suspension system³³ (used to create both the Laryngoscore and the mini-Laryngoscore by Piazza et al.^{18,21}) allows to get an optimal visualisation of the anterior commissure even when classic table-hold suspension systems fail to achieve it. However, it is not universally used and this may at least partly explain the differences in cut-off of different predictors described by different authors. External validation of these predictive scores should therefore use the same set of laryngoscopes and suspension system.

While Wang et al.³³ provide a valuable quantitative synthesis of predictors for DLE, their study included just independent predictors, excluding from analysis the existing scores such as the Laryngoscore, and does not focus on clinical applicability and practicality in routine settings. In contrast, this scoping review aims to critically evaluate not only individual predictive parameters but also the external validation and clinical usability of multiparametric scoring systems. Moreover, the present review incorporates a broader discussion of real-world limitations – including variability in DLE definitions, surgical instrumentation, and preoperative assessment methods – that are often overlooked. This broader approach supports the need for a clinically oriented, comprehensive framework to guide future tool development and validation.

Preoperative endoscopy

The utility of office-based rigid laryngoscopy, particularly with a 70° endoscope, has been highlighted as a valuable screening tool for predicting DLE. A strong correlation has been demonstrated between laryngoscopic grading in the office setting and intraoperative exposure, with grades based on glottic and anterior commissure (AC) visualisation²⁹. Grade 1 represents full visualisation of the AC without undue tongue traction, grade 2 indicates AC visualisation only during phonation or with moderate tongue traction, and grade 3 denotes the inability to visualise the glottis despite moderate traction. While this system offers a reliable framework, it has limitations. For instance, the study did not account for malignant lesions. It also did not incorporate flexible laryngoscopy, which is often the primary tool for evaluating laryngeal pathology. Additionally, the

potential for interrater variability may introduce subjectivity into assessments, though experienced practitioners can typically mitigate this concern. Some patients also poorly tolerate office-based 70° rigid laryngoscopy, potentially causing false DLEs becoming good exposures under general anaesthesia and myorelaxation in the operating room.

Objective metrics

A reliable predictive tool should be objective, reproducible, and feasible in an outpatient setting. Teixeira et al.²⁵ deemed certain parameters difficult to measure in a reliable way in the outpatient setting, suggesting their exclusion for preoperative predictive models despite their statistical significance:

- the sternum-mental distance (SMD)^{2,6,7,16,22,25}, though statistically significant in Pinar et al.'s study when less than 13.9 cm in full neck extension⁶;
- the hyoid-mental distance (HMD)^{2,6,16,25,34}, though showing significance in Pinar's correlation analysis, with a threshold less than 6 cm in full neck extension⁶;
- the thyroid-mandible angle (TMA)^{7,16,34}, though significant with a cut-off of > 120° in male and > 130° in female patients³⁴;
- the sternum-mental angle (SMA)²², though demonstrating a significant relationship with DLE in multivariate regression analysis when ≤ 22.5° in full neck extension;
- the degree of maximum neck flexion-extension, even if Piazza et al., Arjun and Dutta, and Nautiyal et al. found it statistically significant^{18,20,24};
- radiographic parameters².

The following parameters have also been evaluated but did not show a consistency in all the studies: height, weight, angle of neutral-to-extension, trismus, mandibular prognathism, mandibular retrognathism, mandibular tori, vertical incisor-thyroid distance, horizontal incisor-thyroid distance, thyroid-incisor angle, anterior mandible height, and obstructive sleep apnoea syndrome.

Several objective metrics have been explored to predict DLE, with varying degrees of reliability and applicability. BMI consistently emerges as a significant predictor^{16,18,20}, with a threshold of > 25 kg/m² achieving moderate sensitivity and specificity¹⁶. The association between increasing BMI and difficult intubation has been well-documented³⁵, though Brodsky et al. suggested that NC might be a more accurate predictor³⁶. NC, which reflects upper body fat distribution, has shown a stronger correlation with central adiposity and DLE risk³⁷. However, studies evaluating NC as a predictor of DLE have yielded inconsistent results. While many authors reported significant associations between NC

and DLE^{6,7,16,22,25,26}, some did not^{2,17}, and the variability in reported cut-off values – ranging from 34 cm to 42 cm – highlights the challenge of standardising this parameter. Cervical spine characteristics, such as A-O extension, further complicate laryngeal exposure⁷. An A-O extension below 19.5° has been identified as a significant risk factor, underscoring the role of head and neck mobility. Liu et al. noted that parameters measured at full neck extension, including TMD, SMD, and SMA, exhibited higher sensitivity than other predictors²². However, the continuous nature of A-O extension and the practical challenges of measuring it, such as the need for a goniometer, limit its utility as a rapid assessment tool in clinical settings.

The IIG has proven to be another reliable predictor. While thresholds of < 4 cm are commonly cited^{18,21,25}, some studies, such as that by Clarysse et al., suggest a higher cut-off of 5 cm provides better predictive accuracy²³. However, findings remain mixed, with some researchers reporting no significant correlation¹⁹. Similarly, TMD has been frequently studied, though its cut-off values vary widely, ranging from 5.5 cm to 7.2 cm^{16,21,22,24}. Upper jaw dental status also plays a role, as prominent or abnormal dentition can impede laryngeal exposure by limiting mouth opening and posing a risk of dental injury^{18,19,21,23,25}.

Finally, anatomical abnormalities such as micrognathia and macroglossia have been statistically associated with DLE¹⁸, as has a history of prior neck surgery or radiotherapy²³. The MMI, despite mixed results, is frequently included in risk assessments. While some studies identify MMI as a significant predictor of DLE^{17,20,22,24}, others do not^{5,6,16,18}, reflecting the ongoing debate over its reliability.

For MMI, Hsiung et al.⁵, Roh and Lee¹⁶, Pinar et al.⁶, and Piazza et al.¹⁸ reported that it was not a good predictor of DLE; while Hekiart et al.¹⁷, Arjun and Dutta²⁰, Liu et al.²², and Nautiyal et al.²⁴ identified it as an important risk factor for DLE.

Continuous variables, such as BMI, NC, neck length, A-O extension, IIG, and TMD may complicate the application of a score in clinical practice, even because they require an established cut-off. While there is consensus on a BMI cut-off of > 25 kg/m², no consensus exists for the other values.

Multiparametric scoring systems

The integration of multiple predictors into scoring systems has the potential to enhance the precision of DLE risk assessments. The Laryngoscore, proposed by Piazza et al., is one of the most validated tools in this regard, showing good overall accuracy across diverse patient populations¹⁸. Despite its strengths, external validation studies have revealed variable sensitivity and specificity, suggesting that local

calibration of the score may be necessary^{19–21,23,24}. Tirelli et al. further validated the Laryngoscore by demonstrating its reproducibility across operators¹⁹, while Arjun and Dutta extended its application to the Indian population²⁰.

The mini-Laryngoscore, introduced by Incandela et al.²¹, offers a simplified alternative while maintaining similar accuracy. However, its limited validation underscores the need for further studies to confirm its reliability^{23,25}. Both the validation studies underscored the significance of the upper jaw dental status and IIG, while TMD did not exhibit an independent correlation with DLE.

Recently, novel predictive models, such as those by Clarysse et al.²³, Nautiyal et al.²⁴, and Teixeira et al.²⁵, have aimed to streamline DLE prediction by focusing on fewer parameters. Although promising, these models require validation to establish their accuracy and generalisability.

The integration of various independent predictors of DLE into a single score holds the potential to improve the precision of diagnosis. Notably, all the variables in the existing scores (except for the Laryngoscore which also includes trismus, mandibular prognathism and degree of neck flexion-extension) are among those found to be significant in our literature review, indicating that they are significant not only individually but also in combination.

Future directions

There is a need for multicentre studies with large sample sizes to further explore the variables (namely, BMI, NC, neck length, IIG, TMD, upper jaw dental status, micrognathia, macroglossia, history of previous open-neck surgery and/or radiotherapy, and MMI), validate existing scores and develop new predictive tools. These studies should have broad participant inclusion criteria, avoid subjective parameters, and ensure consistent use of precisely specified laryngoscope types, patient positioning, and outcome measures. For instance, the intraoperative assessment method for DLE can rely on visualising the anterior commissure during direct laryngoscopy, as suggested by Piazza et al.¹⁸. Additionally, factors such as NC, IIG and TMD have shown potential, but appropriate cut-off values must be defined for each.

The role of laryngoscopy, based on office-based 70° rigid laryngoscopy results²⁹, should also be explored, despite the potential for interrater variability because it is believed that an experienced clinician can generally make a reliable assessment, and the possible poor compliance of some patients. Finally, prospective studies are needed to assess the impact of DLE on surgical outcomes and complications.

Conclusions

Predicting difficult laryngeal exposure for MLS remains an evolving area. Even if numerous studies have already attempted to identify reliable preoperative predictors, no single parameter consistently predicts its occurrence. Commonly implicated factors include BMI, NC, IIG, TMD, upper jaw dental status, and the MMI. Although the Laryngoscore and mini-Laryngoscore have shown promising predictive capacity, their external validation has revealed variability. More recently proposed predictive models integrating key parameters (NC, IIG, and dental status) may improve accuracy, but these lack widespread validation as well.

Future research should strive for robust, multicentre, prospective studies that include large patient populations, consistent and objective measurement methods, and standardised definitions of difficult exposure. Validated predictive tools could enhance patient selection, reduce operative times, avert failed procedures, and guide treatment strategies, particularly in oncologic settings where optimal exposure is crucial for achieving safe, complete resections. Ultimately, a reliable, clinically feasible predictive model could improve surgical planning, patient counselling, resource allocation, and overall procedural success.

Conflict of interest statement

The authors declare no conflict of interest.

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Author contributions

CV: study conception, literature search, data extraction, manuscript drafting; AP: study conception, independent review of the literature search, methodological supervision, substantial manuscript revisions; CZ: literature search, data extraction, contribution to critical revision and editing; GM: scientific supervision, validation of results, critical revision of the manuscript.

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