



Original Article

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## Comparison of McGrath Mac Videolaryngoscopy and Macintosh Direct Laryngoscopy in Adults with Anticipated Difficult Airway: A Randomized Comparative Study

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### ABSTRACT

**Background:** Videolaryngoscopy may improve glottic visualization during tracheal intubation in patients with anticipated difficult airway anatomy, although this may come at the cost of longer intubation times. This study compared McGrath MAC videolaryngoscopy with Macintosh direct laryngoscopy in adults with anticipated difficult airways undergoing elective surgery.

**Methods:** This comparative study was conducted at Department of Anaesthesia. NAMO medical education & research institute, Silvassa, Dadra and Nagar Haveli, from October 2025 to September 2026. Seventy adults aged 18–60 years with ASA physical status I–II and at least one predictor of difficult airway were allocated by sealed opaque envelopes to McGrath MAC videolaryngoscopy (Group A, n=35) or Macintosh direct laryngoscopy (Group B, n=35). Outcomes included time to laryngoscopy, time to intubation, Cormack–Lehane grade, number of attempts, peri-intubation haemodynamics, oxygen saturation, and complications.

**Results:** Mean time to laryngoscopy was  $36.86 \pm 8.23$  seconds in Group A and  $19.23 \pm 6.19$  seconds in Group B; mean time to intubation was  $49.80 \pm 9.35$  and  $31.34 \pm 9.73$  seconds, respectively (both  $p < 0.0001$ ). Mean number of attempts was  $1.06 \pm 0.24$  versus  $1.26 \pm 0.44$  ( $p = 0.03$ ). Cormack–Lehane grade distribution was significantly different ( $p = 0.049$ ), with more grade I views in Group A. Haemodynamic and oxygen-saturation measurements did not differ significantly at the reported time points. Oesophageal intubation and post-extubation sore throat were each reported in one and three patients, respectively, in Group B and in none in Group A.

**Conclusion:** In this study of 70 adults with anticipated difficult airway anatomy, McGrath MAC videolaryngoscopy was associated with longer laryngoscopy and intubation times and a lower mean number of intubation attempts than Macintosh direct laryngoscopy. Haemodynamic and oxygen-saturation measurements showed no statistically significant between-group differences at the assessed time points. The comparative findings should be interpreted cautiously given the small sample size and the need to verify the categorical outcome analyses.

**Keywords:** McGrath MAC; videolaryngoscopy; direct laryngoscopy; anticipated difficult airway; tracheal intubation; Cormack–Lehane grade.

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## INTRODUCTION

Tracheal intubation is a core component of general anaesthesia, but difficult laryngoscopy and failed intubation remain important sources of perioperative harm. Failure to secure the airway promptly can lead to hypoxaemia, aspiration, airway trauma and, in severe cases, major morbidity or mortality. National audit data have highlighted the importance of anticipating airway difficulty, planning an appropriate first approach and ensuring timely access to alternative airway devices [1]. Preoperative predictors—including a higher Modified Mallampati score, reduced thyromental distance, restricted neck extension, obesity and a short neck—can identify patients in whom conventional laryngoscopy may be challenging, although no single predictor perfectly predicts difficulty.

The Macintosh laryngoscope remains a widely used device for direct laryngoscopy. Its blade is positioned to permit direct visualization of the laryngeal inlet, generally requiring alignment of airway axes and adequate manipulation of the head and neck. These manoeuvres can be difficult when neck movement is restricted or when airway anatomy is unfavourable. Videolaryngoscopes incorporate a camera near the blade tip and transmit an indirect view to a display, potentially improving visualization without requiring the same line of sight. Reviews and comparative studies have generally found improved glottic views and fewer failed intubations with videolaryngoscopy in selected adult populations, including patients with anticipated or simulated difficult airways [2–4]. However, improved visualization does not necessarily translate into faster tube delivery; device design, tube curvature, operator experience and familiarity may influence time to successful intubation.

The McGrath MAC videolaryngoscope combines a video display with a Macintosh-shaped blade. This familiar blade geometry may ease the transition for clinicians trained in conventional laryngoscopy, while the camera provides an indirect view of the glottis. Evidence specific to McGrath devices has varied by blade design and clinical setting. Studies involving the McGrath Series 5, other videolaryngoscopes and simulated difficult airways have reported differences in intubation time, first-attempt success and need for adjunctive manoeuvres [5–7]. Findings from one videolaryngoscope model cannot automatically be generalized to another because blade geometry and tube-delivery mechanics differ.

A clinically relevant comparison should therefore assess not only glottic visualization, but also the number of attempts, time to laryngoscopy and intubation, need for external laryngeal manipulation or a bougie, physiological responses, and complications. These outcomes are especially relevant when difficult airway anatomy is anticipated before elective surgery. The present study compared McGrath MAC videolaryngoscopy with Macintosh direct laryngoscopy in adults with at least one preoperative predictor of difficult airway undergoing elective surgery at a teaching hospital in Bhuj, Gujarat. The objectives were to compare intubation attempts and timing, Cormack–Lehane grade, peri-intubation haemodynamic variables and oxygen saturation, and recorded complications.

## MATERIALS AND METHODS

**Study design and setting:** This comparative study was conducted in the Department of Anaesthesia, NAMO medical education & research institute, Silvassa, Dadra and Nagar Haveli, India., from October 2025 to September 2026. Participants were allocated by an envelope method; 70 participants were included.

**Participants and eligibility:** Adults aged 18–60 years with American Society of Anesthesiologists (ASA) physical status I–II, scheduled for elective surgery under general anaesthesia with orotracheal intubation, were eligible if at least one difficult-airway predictor was present: Modified Mallampati score  $\geq 3$ , thyromental distance  $< 6$  cm, limited neck extension ( $< 35^\circ$ ), body mass index (BMI)  $\geq 30$  kg/m<sup>2</sup>, short neck, or cervical spine trauma/precautions. Patients with ASA physical status III or higher, age outside the specified range, Mallampati score I–II, emergency surgery, a requirement for nasal intubation, or refusal to participate were excluded.

Sample size and allocation: The planned sample size was 70, calculated from an estimated monthly case volume of 14 over 18 months (population estimate 252), 95% confidence level, 10% margin of error and 50% response distribution, followed by finite-population correction. Participants were allocated in a 1:1 ratio using opaque envelopes containing a computer-generated randomization code: Group A received McGrath MAC videolaryngoscopy with a size 3 or 4 Macintosh-type blade, and Group B received Macintosh direct laryngoscopy with a size 3 or 4 curved blade. Each group included 35 participants.

Anaesthesia and data collection: Pre-anaesthetic assessment included history, physical examination, height, weight, BMI and airway assessment. A trained anaesthetist who had performed at least 50 Macintosh intubations undertook intubation. Participants were fasted for at least six hours. Premedication included diazepam the night before surgery and, in theatre, oxygenation followed by ondansetron, glycopyrrolate, midazolam, propofol and succinylcholine. Standard monitoring included ECG, heart rate, non-invasive blood pressure and pulse oximetry. Patients were positioned supine in the sniffing position where appropriate; ramped positioning was used for patients with BMI >35 kg/m<sup>2</sup>, and manual in-line stabilization was used when cervical spine precautions applied. The assigned laryngoscope was used for intubation, and tracheal placement was confirmed by capnography. Anaesthesia was maintained with sevoflurane, nitrous oxide, oxygen and atracurium, with reversal and extubation according to the standard procedures.

Time to laryngoscopy was defined as the interval from the blade tip crossing the incisors to visualization of the glottis. Time to intubation was defined as the interval from picking up the endotracheal tube to confirmation by capnographic waveform or breath sounds. A failed first attempt was described as blade removal without intubation, intubation time exceeding 60 seconds, or desaturation. Heart rate, systolic and diastolic blood pressure, mean arterial pressure and oxygen saturation were recorded before induction, before laryngoscopy/intubation, and at 0, 1, 3, 5 and 10 minutes after intubation. Recorded procedural outcomes included Cormack–Lehane grade, number of attempts, blade blood staining, sore throat, oesophageal intubation, external laryngeal manipulation and bougie use.

Ethics and statistical analysis: The study was approved by the Institutional Ethics Committee (GAIMS/IEC/RESCH/2022/18), and written informed consent was obtained from participants. Data were analysed using IBM SPSS Statistics, version 25.0. Continuous variables were summarized as mean  $\pm$  standard deviation, and categorical variables as frequencies and percentages. The statistical tests used for between-group comparisons should be specified for each outcome. A two-sided p value of <0.05 was considered statistically significant.

## RESULTS

Seventy participants were included, with 35 assigned to each group. Baseline age, anthropometric measures and recorded airway predictors were broadly comparable between groups.

**Table 1. Participant characteristics**

| Characteristic                         | McGrath MAC (n=35) | Macintosh direct (n=35) | p-value |
|----------------------------------------|--------------------|-------------------------|---------|
| Age, years, mean $\pm$ SD              | 36.8 $\pm$ 11.4    | 38.57 $\pm$ 9.56        | 0.55    |
| Male, n                                | 17                 | 18                      | 1.00    |
| Female, n                              | 18                 | 17                      | 1.00    |
| Height, cm, mean $\pm$ SD              | 165.03 $\pm$ 7.04  | 165.60 $\pm$ 7.94       | 0.78    |
| Weight, kg, mean $\pm$ SD              | 73.11 $\pm$ 11.59  | 72.54 $\pm$ 11.46       | 0.82    |
| BMI, kg/m <sup>2</sup> , mean $\pm$ SD | 26.88 $\pm$ 4.26   | 26.43 $\pm$ 4.29        | 0.65    |

The distribution of difficult-airway predictors was similar between groups according to the reported tests. Participants could meet more than one criterion; separate summaries are presented for the principal recorded airway measures.

**Table 2. Preoperative airway assessment**

| Variable                                | McGrath MAC (n=35) | Macintosh direct (n=35) | p-value |
|-----------------------------------------|--------------------|-------------------------|---------|
| Modified Mallampati class III, n (%)    | 18 (51.4%)         | 16 (45.7%)              | 0.811   |
| Modified Mallampati class IV, n (%)     | 17 (48.6%)         | 19 (54.3%)              |         |
| Thyromental distance <6 cm, n (%)       | 20 (57.1%)         | 19 (54.3%)              | 1.00    |
| Thyromental distance $\geq$ 6 cm, n (%) | 15 (42.9%)         | 16 (45.7%)              |         |
| Neck extension restricted (<35°), n (%) | 12 (34.3%)         | 15 (42.9%)              | 0.623   |
| Neck extension not restricted, n (%)    | 23 (65.7%)         | 20 (57.1%)              |         |

McGrath MAC was associated with longer times to both glottic visualization and tracheal intubation. The mean number of attempts was lower and the Cormack–Lehane grade distribution differed between groups.

**Table 3. Intubation timing, Cormack–Lehane grade and attempts**

| Outcome                                | McGrath MAC (n=35) | Macintosh direct (n=35) | Comparison                            |
|----------------------------------------|--------------------|-------------------------|---------------------------------------|
| Time to laryngoscopy, s, mean $\pm$ SD | 36.86 $\pm$ 8.23   | 19.23 $\pm$ 6.19        | Mean difference 17.63 s; $p < 0.0001$ |
| Time to intubation, s, mean $\pm$ SD   | 49.80 $\pm$ 9.35   | 31.34 $\pm$ 9.73        | Mean difference 18.46 s; $p < 0.0001$ |
| Mean number of attempts $\pm$ SD       | 1.06 $\pm$ 0.24    | 1.26 $\pm$ 0.44         | Mean difference $-0.20$ ; $p = 0.03$  |
| Cormack–Lehane grade I, n              | 22                 | 20                      | $\chi^2 = 2.75$ ; $p = 0.049$         |
| Cormack–Lehane grade II, n             | 8                  | 7                       |                                       |
| Cormack–Lehane grade III, n            | 4                  | 6                       |                                       |
| Cormack–Lehane grade IV, n             | 1                  | 2                       |                                       |

Heart rate, oxygen saturation, systolic and diastolic blood pressure, and mean arterial pressure were measured serially. No between-group differences were statistically significant at the measured time points. The values below are presented as tabulated; units are beats/min, %, or mmHg as applicable.

**Table 4. Serial physiological measurements (mean  $\pm$ SD)**

| Time point     | Group A HR        | Group B HR         | p    | Group A SpO <sub>2</sub> | Group B SpO <sub>2</sub> | p-value |
|----------------|-------------------|--------------------|------|--------------------------|--------------------------|---------|
| Pre-induction  | 88.20 $\pm$ 16.52 | 89.97 $\pm$ 15.34  | 0.76 | 98.57 $\pm$ 0.88         | 98.69 $\pm$ 0.87         | 0.60    |
| Pre-intubation | 81.26 $\pm$ 14.84 | 83.09 $\pm$ 15.00  | 0.40 | 98.80 $\pm$ 0.93         | 99.00 $\pm$ 0.77         | 0.35    |
| 0 min          | 85.03 $\pm$ 16.43 | 86.09 $\pm$ 17.18  | 0.94 | 98.20 $\pm$ 0.93         | 98.31 $\pm$ 1.11         | 0.61    |
| 1 min          | 98.00 $\pm$ 18.50 | 101.86 $\pm$ 18.71 | 0.40 | 98.06 $\pm$ 1.24         | 98.26 $\pm$ 1.27         | 0.49    |
| 3 min          | 93.57 $\pm$ 18.49 | 93.89 $\pm$ 18.60  | 0.94 | 98.43 $\pm$ 1.01         | 98.51 $\pm$ 0.96         | 0.74    |
| 5 min          | 96.40 $\pm$ 18.25 | 90.91 $\pm$ 16.14  | 0.19 | 99.06 $\pm$ 0.73         | 99.06 $\pm$ 0.64         | 1.00    |
| 10 min         | 87.57 $\pm$ 17.88 | 85.91 $\pm$ 13.82  | 0.62 | 99.26 $\pm$ 0.56         | 99.31 $\pm$ 0.53         | 0.69    |

Note: Group A = McGrath MAC; Group B = Macintosh direct. HR = heart rate; SpO<sub>2</sub> = peripheral oxygen saturation.

**Table 5. Serial blood pressure and mean arterial pressure (mean  $\pm$ SD)**

| Time point     | Group A SBP        | Group B SBP        | p    | Group A DBP       | Group B DBP       | p    | Group A MAP       | Group B MAP       | p-value |
|----------------|--------------------|--------------------|------|-------------------|-------------------|------|-------------------|-------------------|---------|
| Pre-induction  | 129.29 $\pm$ 14.81 | 128.09 $\pm$ 12.60 | 0.64 | 81.00 $\pm$ 10.18 | 78.03 $\pm$ 9.98  | 0.16 | 97.10 $\pm$ 11.01 | 94.71 $\pm$ 10.10 | 0.24    |
| Pre-intubation | 123.71 $\pm$ 13.97 | 121.49 $\pm$ 13.09 | 0.39 | 76.57 $\pm$ 10.89 | 73.57 $\pm$ 10.59 | 0.19 | 92.29 $\pm$ 10.94 | 89.54 $\pm$ 10.44 | 0.20    |
| 0 min          | 126.40 $\pm$ 13.63 | 122.66 $\pm$ 14.68 | 0.18 | 76.71 $\pm$ 10.43 | 75.11 $\pm$ 10.89 | 0.50 | 93.28 $\pm$ 10.55 | 90.96 $\pm$ 11.24 | 0.30    |
| 1 min          | 129.54 $\pm$ 13.18 | 135.23 $\pm$ 13.69 | 0.06 | 81.40 $\pm$ 10.09 | 82.71 $\pm$ 10.32 | 0.57 | 97.45 $\pm$ 9.84  | 98.71 $\pm$ 10.56 | 0.58    |
| 3 min          | 125.26 $\pm$ 9.83  | 130.71 $\pm$ 14.01 | 0.06 | 80.06 $\pm$ 8.48  | 79.31 $\pm$ 11.36 | 0.75 | 95.12 $\pm$ 7.42  | 97.95 $\pm$ 11.38 | 0.21    |
| 5 min          | 116.37 $\pm$ 13.40 | 122.00 $\pm$ 11.70 | 0.06 | 74.49 $\pm$ 8.15  | 75.94 $\pm$ 10.04 | 0.48 | 88.45 $\pm$ 7.61  | 91.30 $\pm$ 9.81  | 0.15    |
| 10 min         | 122.86 $\pm$ 8.55  | 119.26 $\pm$ 11.08 | 0.11 | 70.97 $\pm$ 8.25  | 72.60 $\pm$ 9.74  | 0.38 | 88.27 $\pm$ 6.86  | 87.44 $\pm$ 9.77  | 0.63    |

Note: SBP = systolic blood pressure; DBP = diastolic blood pressure; MAP = mean arterial pressure. Values in mmHg.

Adverse events and adjunct use were uncommon. Oesophageal intubation and post-extubation sore throat were observed only in the Macintosh group. Between-group differences in blade blood staining, external laryngeal manipulation and bougie use were not statistically significant.

**Table 6. Procedural complications and adjunctive manoeuvres**

| Outcome                                   | McGrath MAC (n=35) | Macintosh direct (n=35) | p-value |
|-------------------------------------------|--------------------|-------------------------|---------|
| Blood staining of laryngoscope blade: yes | 2 (5.7%)           | 3 (8.6%)                | 1.00    |

|                                      |            |            |             |
|--------------------------------------|------------|------------|-------------|
| Blood staining: no                   | 33 (94.3%) | 32 (91.4%) |             |
| Post-extubation sore throat: yes     | 0          | 3 (8.6%)   | Not applied |
| Oesophageal intubation: yes          | 0          | 1 (2.9%)   | Not applied |
| External laryngeal manipulation: yes | 1 (2.9%)   | 5 (14.3%)  | 0.37        |
| Bougie use: yes                      | 2 (5.7%)   | 5 (14.3%)  | 0.42        |

## DISCUSSION

In this study of adults with anticipated difficult airway anatomy, McGrath MAC videolaryngoscopy was associated with a more favourable reported Cormack–Lehane distribution and a lower mean number of intubation attempts than Macintosh direct laryngoscopy. These findings support the potential value of indirect visualization when conventional line-of-sight laryngoscopy may be challenging. Systematic reviews have reported that videolaryngoscopy can improve glottic views and reduce failed intubation in adults, particularly in anticipated or simulated difficult airways [3,4]. A randomized comparison of C-MAC and direct laryngoscopy in predicted difficult airways also reported higher first-attempt success with video assistance, although the C-MAC is not identical to the McGrath MAC device [6].

The principal trade-off in the present study was time. Both time to laryngoscopy and time to intubation were longer with McGrath MAC. This is clinically plausible: visualization may improve while tube delivery remains technically demanding, especially when the operator is less familiar with the device or when tube angulation and stylet positioning require additional manoeuvres. Trials of McGrath Series 5 have also reported longer intubation times in some settings, whereas results vary with operator experience, airway scenario and blade design [5,7]. Because the present study used the Macintosh-shaped McGrath MAC blade, evidence from hyperangulated models should be interpreted cautiously.

The mean number of attempts was lower in the McGrath group, and the study recorded no oesophageal intubations or post-extubation sore throat in that group, compared with one and three events, respectively, in the Macintosh group. These event counts are small, and the study was not large enough to establish reliable differences in uncommon complications. The reported rates of external laryngeal manipulation and bougie use were also numerically lower with McGrath MAC but not statistically significant. Larger trials and systematic reviews suggest that videolaryngoscopy may reduce failed intubation and some forms of airway trauma, but effects on individual complications and physiological outcomes are not uniform [3,4,8].

Haemodynamic variables and oxygen saturation were broadly similar between groups at the measured time points. Both groups showed expected post-intubation variation, but no statistically significant between-group differences were reported. These findings should not be interpreted as proof of equivalence, particularly with 35 participants per group. The practical interpretation is that, in this sample, the main apparent differences concerned laryngoscopic view, attempts and time rather than measured physiological response.[9]

The study's strengths include a prospective comparative approach, envelope-based allocation, a defined group of patients with airway difficulty predictors, standardized monitoring and recording of multiple clinically relevant outcomes. Limitations include the small, single-centre sample and potential variation in operator skill. The difficulty criteria also represent a heterogeneous population and do not necessarily predict performance in every form of actual difficult airway.

## CONCLUSION

Among 70 adults with anticipated difficult airway anatomy undergoing elective surgery, McGrath MAC videolaryngoscopy was associated with a lower reported mean number of intubation attempts and a more favourable reported Cormack–Lehane grade distribution than Macintosh direct laryngoscopy. However, laryngoscopy and intubation took longer with McGrath MAC. Recorded haemodynamic variables and oxygen saturation did not differ significantly between groups, while oesophageal intubation and post-extubation sore throat were observed only in the Macintosh group; these uncommon events are too few to support firm comparative conclusions. The findings suggest that McGrath MAC may be a useful option when difficult airway anatomy is anticipated, provided operators are trained and time considerations are addressed.

## Declarations

**Ethics approval:** Institutional Ethics Committee, Gujarat Adani Institute of Medical Sciences, Bhuj (GAIMS/IEC/RESCH/2022/18).

**Informed consent:** Written informed consent was obtained from participants.

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## Conflicts of interest: None

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