Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.69980/3hra5z77

COMPARISON OF C-MAC C-BLADE AND D-BLADE VIDEO LARYNGOSCOPES FOR ENDOTRACHEAL INTUBATION IN ADULTS WITH CERVICAL SPINE PATHOLOGY UNDER MANUAL IN-LINE STABILISATION: A RANDOMISED CONTROLLED STUDY

Sukriti Atram[1], Shalakha Bhimjiyani[2]*

[1]Associate Professor, Department of Anaesthesiology and Critical Care, Grant Government Medical College and Sir JJ Group of Hospitals, Mumbai, India.
[2]Fellow in Chronic Pain Management, Ashirvad Institute of Pain Management, Mumbai, India.

***Corresponding author:** Dr Shalakha Bhimjiyani
*Gopal Krishna Nagar, Dawande Layout, Buldhana Road, Malkapur, India Email: bhimjiyani.shalakha@gmail.com

Abstract

Background and aims; Cervical spine pathology poses major challenges for airway management, and manual in-line stabilisation (MILS) can worsen laryngoscopic view and intubation conditions. The C-MAC video laryngoscope is available with a conventional Macintosh-type C-blade and a hyper angulated D-blade, but comparative data in patients with cervical spine disease are limited. This study compared the ease of endotracheal intubation using the C-blade and D-blade of the C-MAC video laryngoscope in adults undergoing elective cervical spine surgery under MILS.

Methods; In this single-blinded randomised controlled study, 60 ASA I–II adults scheduled for elective cervical spine surgery and requiring endotracheal intubation were enrolled. After standardised anaesthesia induction and application of MILS, patients were randomised to intubation with either the C-blade (Group C, n=30) or D-blade (Group D, n=30) of the C-MAC video laryngoscope, performed by an experienced anaesthesiologist. The primary outcome was time to successful intubation, defined as the interval from blade insertion at the lips to confirmation of tracheal placement by capnography. Secondary outcomes included time to best glottic view (best Cormack–Lehane grade), number of intubation attempts, use of external laryngeal pressure or bougie, haemodynamic responses, and complications.

Results;Demographic and airway characteristics, including age, sex, and Mallampati class, were comparable between the groups, although body mass index was higher in Group C. Mean time to intubation was similar with the C-blade and D-blade (42.57 ± 20.39 s vs 47.00 ± 14.29 s; P=0.2665). Time to best glottic view was significantly shorter with the D-blade compared with the C-blade (13.73 ± 3.19 s vs 15.57 ± 3.45 s; P=0.03). First-attempt success was achieved in 100% of patients in Group D and 96.7% in Group C, and overall Cormack–Lehane grades and subjective ease of intubation were comparable. External laryngeal pressure was required in 86.7% of C-blade intubations and in none with the D-blade (P<0.001), while the need for bougie and the low incidence of minor complications did not differ significantly. Haemodynamic variables and oxygen saturation remained comparable between groups at all time points.

Conclusion;In adults with cervical spine pathology undergoing surgery under MILS, the D-blade C-MAC video laryngoscope achieved faster optimal glottic visualisation and markedly reduced the need for external laryngeal pressure compared with the C-blade, while overall intubation time, success rate, and complication profile remained similar. Both blades appear suitable for use in this population, and selection may be guided by operator familiarity and specific airway characteristics.

Keywords: Cervical spine; video laryngoscope; C-MAC; D-blade; manual in-line stabilisation; intubation

Introduction

Cervical spine injury is a potentially devastating consequence of trauma or degenerative disease, and even minor secondary insults during airway management may worsen neurological outcome.(1,2) The reported prevalence of cervical spine injury among trauma patients is approximately 3–5%, with a higher incidence in those with head or facial trauma, reduced level of consciousness or focal neurological deficit.(3,10) Anaesthesiologists and emergency physicians are therefore particularly concerned that laryngoscopy and tracheal intubation could exacerbate a pre-existing spinal cord injury or contribute to secondary damage during perioperative and critical care management.(1-3)

To minimise cervical spine motion, current trauma and perioperative guidelines recommend the use of manual or mechanical cervical immobilisation in patients with suspected or confirmed cervical spine injury.(2-4) Manual in-line stabilisation (MILS) is widely used because it limits cervical displacement during orotracheal intubation more effectively than cervical collars alone, and can be applied rapidly at the bedside.(4) However, MILS restricts the head extension and neck flexion required to align the oral, pharyngeal and laryngeal axes, thereby worsening laryngoscopic view and making intubation more difficult.(2-4) In addition, rigid collars can reduce mouth opening, further complicating direct laryngoscopy.(2,3)

The classical sniffing position, which combines flexion of the lower cervical spine with extension at the atlanto-occipital joint, is considered optimal for direct laryngoscopy in patients with normal cervical anatomy.(5) In patients with cervical spine instability, this manoeuvre is undesirable because it may increase the risk of spinal cord compromise; consequently, airway management must balance the need to secure the airway rapidly with the imperative to avoid cervical movement.(1-3) Various alternative techniques, including fibreoptic bronchoscopy, intubating supraglottic airways and indirect laryngoscopy, have therefore been advocated in this setting.(2,3)

Video laryngoscopes have gained prominence as they provide an indirect view of the glottis without requiring alignment of the airway axes, and may thus facilitate intubation while limiting cervical movement.(1,2,6–9,11–16) The C-MAC video laryngoscope (Karl Storz, Germany) is a widely used device that incorporates a camera and light source near the distal third of the blade and displays the glottic view on an external monitor.(6,7,12) It is available with a conventional Macintosh-type C-blade, which is familiar to anaesthesiologists trained with direct laryngoscopy, and a hyper angulated D-blade designed for use in anterior larynx and difficult airway situations.(7-9,12-15) Manikin, paediatric and intensive care studies suggest that the D-blade may provide superior Cormack–Lehane grades and reduce the need for external laryngeal manipulation compared with conventional blades, although total intubation times are not always shorter and the more angulated tube path can be technically challenging.(8,9,11,14-16)

Most published work comparing the C-MAC C-blade and D-blade has been performed in manikins, simulated cervical spine immobilisation or specific subgroups such as paediatric or neonatal patients, and often in individuals without underlying cervical spine pathology.(8,11,13-16) Data comparing these blades in adults with true cervical spine disease undergoing surgery under MILS remain limited. There is a particular paucity of prospective randomised data evaluating both the time to optimal glottic visualisation and overall intubation performance, including need for adjuncts and complications, in this high-risk group.(1-3)

The present study was therefore designed to compare the ease of endotracheal intubation using the C-blade and D-blade of the C-MAC video laryngoscope in adult patients with cervical spine pathology undergoing elective cervical spine surgery with MILS. The primary objective was to compare the time taken for successful endotracheal intubation. Secondary objectives were to compare the time taken to obtain the best Cormack–Lehane view, the number of attempts, the requirement for external laryngeal pressure and bougie, haemodynamic responses and the incidence of complications with each blade.

Methods

This single-blinded, randomised controlled study was conducted in the Department of Anaesthesiology,Mumbai, after obtaining approval from the institutional ethics committee and written informed consent from all participants. The study adhered to the principles of the Declaration of Helsinki.

Study population

Sixty adult patients scheduled for elective cervical spine surgery under general anaesthesia requiring endotracheal intubation were enrolled.

Inclusion criteria

- Age ≥18 years.
- American Society of Anesthesiologists (ASA) physical status I–II.
- Mouth opening ≥2.5 finger breadths.
- Elective cervical spine surgery requiring orotracheal intubation.

Exclusion criteria

- Refusal to participate.
- Known or suspected hiatal hernia.
- Pregnancy.
- Serious systemic disease judged by the investigator to preclude study participation.

Sample size

The sample size was calculated using the prevalence of cervical spine injury reported by Milby et al. (3.7% among trauma patients).(10) Using the formula for cross-sectional studies n=Z2P(1−P)/d2$n=Z2P(1-P)/d2$, with $Z=1.96$ (95% confidence), P=0.037 and precision d=0.05, the minimum required sample size was 54.7. To compensate for potential dropouts and to ensure adequate power (80%) at a 95% confidence level, 60 patients were recruited.

Randomisation and blinding

Patients were allocated into two equal groups (n=30 each) using systematic random sampling; every alternate eligible patient was assigned to one of the two groups:

- Group C: intubation with the C-MAC C-blade.
- Group D: intubation with the C-MAC D-blade.

The anaesthesiologist performing the intubation could not be blinded to the device, but patients and the statistician analysing the data were blinded to group allocation, thereby achieving single-blinding.

Anaesthetic management

All patients underwent a standardised pre-anaesthetic evaluation on the day prior to surgery, including detailed medical history, general and systemic examination, and airway assessment (mouth opening, inter-incisor distance, and Mallampati class). In the operating room, standard monitoring was instituted: electrocardiography, non-invasive blood pressure, pulse oximetry, and end-tidal carbon dioxide ($EtCO_2$). Intravenous access was secured and patients were pre-oxygenated.

Anaesthesia induction was identical in both groups. Patients received intravenous midazolam 0.05 mg/kg and fentanyl 2 µg/kg, followed by propofol 2 mg/kg titrated to loss of consciousness.

Adequacy of mask ventilation was confirmed, after which rocuronium 1 mg/kg IV was administered to facilitate neuromuscular blockade.

Cervical immobilisation and intubation technique

Cervical spine immobilisation was achieved with manual in-line stabilisation (MILS). An assistant, standing at the head end, held the sides of the neck and mastoid processes to prevent flexion, extension, and rotation of the head and neck throughout laryngoscopy and intubation.

Tracheal intubation was performed by an experienced anaesthesiologist who had successfully completed at least 20 intubations with the C-MAC video laryngoscope prior to the study. Laryngoscopy was carried out using either the C-blade (Group C) or the D-blade (Group D) according to group allocation. The endotracheal tube, pre-shaped as per the operator's preference, was advanced into the glottis under video guidance. External laryngeal pressure (BURP) and a bougie were used as adjuncts when deemed necessary by the operator.

Successful intubation was confirmed by the presence of three consecutive $EtCO_2$ waveforms on capnography. A maximum of three attempts or 120 seconds was allowed with the assigned blade; if intubation failed within this limit, the device was considered unsuccessful and the airway was subsequently secured at the anaesthesiologist's discretion using an alternative technique. A failed attempt was defined as either inability to intubate the trachea or abandonment of the device in favour of another airway device. After intubation, anaesthesia was maintained with oxygen, nitrous oxide, and sevoflurane or isoflurane, with intermittent boluses of rocuronium as needed. Neuromuscular blockade was reversed at the end of surgery with neostigmine 0.05 mg/kg and glycopyrrolate 8 µg/kg IV.

Outcome measures

Primary outcome

- Time to successful intubation: interval (in seconds) from insertion of the laryngoscope blade at the level of the lips to confirmation of endotracheal tube placement by capnography (three consecutive $EtCO_2$ waveforms).

Secondary outcomes

- Time to best glottic visualisation: time (in seconds) from blade insertion at the lips to attainment of the best Cormack-Lehane (CL) grade.
- Cormack–Lehane grade at best view.
- Number of attempts required for successful intubation.
- Need for external laryngeal pressure (BURP).
- Use of adjuncts such as bougie.
- Subjective ease of intubation (very easy, easy, or difficult).
- Number of operators required.
- Complications during intubation (soft tissue or dental injury, oesophageal intubation, laryngospasm, desaturation).

Haemodynamic variables-systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR)-as well as oxygen saturation (SpO_2) were recorded at baseline (T0), immediately after induction (T1), immediately after intubation (T2), and at 3, 4, 5, 10, 15 and 20 minutes after intubation (T3, T4, T5, T10, T15, T20).

Statistical analysis

Data were collected on a standardised proforma and entered into a Microsoft Excel spreadsheet, then analysed using STATA statistical software. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as number (percentage). Baseline demographic and airway characteristics, as well as intubation and haemodynamic variables, were compared between the two groups.

Student's t-test for independent samples was used for comparison of continuous variables following assessment for normality. Categorical variables were analysed using Chi-square test or Fisher's exact test where appropriate. A P value <0.05 was considered statistically significant.

Results

Patient characteristics

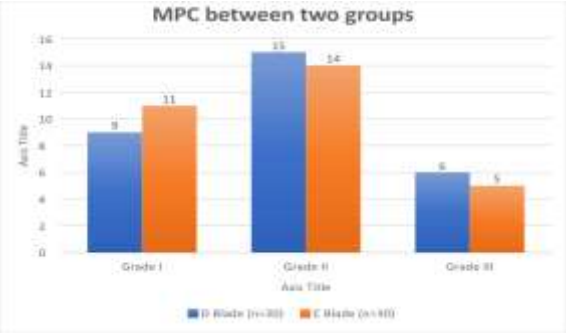
A total of 60 patients were analysed, with 30 in Group C (C-blade) and 30 in Group D (D-blade). Demographic and airway characteristics are summarised in graph 1 and 2

Gender distribution was similar between groups: males comprised 56.67% in Group C and 60% in Group D, while females accounted for 43.33% and 40%, respectively (P=0.99). Mean age was comparable (42.60 ± 12.79 years in Group C vs 41.5 ± 11.47 years in Group D, P=0.727). Body mass index (BMI) differed significantly between groups, with a higher mean BMI in Group C than Group D (27.89 ± 1.11 kg/m² vs 23.11 ± 4.19 kg/m², P<0.001).

Mallampati class distribution was similar: in Group C, 36.67%, 46.67% and 16.66% of patients were classified as Mallampati I, II and III, respectively, compared with 30%, 50% and 20% in Group D (P=0.849).



Graph 1



Graph 2

Intubation profile

The intubation characteristics are presented in Table 2. Mean time to successful intubation was comparable between the C-blade and D-blade (42.57 ± 20.39 s vs 47.00 ± 14.29 s, P=0.2665). In contrast, the time taken to achieve the best glottic view was significantly shorter with the D-blade than with the C-blade (13.73 ± 3.19 s vs 15.57 ± 3.45 s; P=0.03).

First-attempt success was high in both groups: 100% (30/30) in Group D and 96.7% (29/30) in Group C; a single patient in Group C required a second attempt (P>0.99). Cormack–Lehane grade at best view did not differ significantly between groups: CL I in 30% vs 36.7%, CL IIa in 36.7% vs 43.3%, CL IIb in 23.3% vs 13.3% and CL III in 10% vs 6.7% in Group C and Group D, respectively (P=0.701).

The subjective ease of intubation was similar: very easy in 13.3% vs 10%, easy in 66.7% vs 76.7%, and difficult in 20% vs 13.3% in Group C and D, respectively (P=0.686). in most cases, intubation was completed by a single operator (96.7% in Group C vs 93.3% in Group D; P>0.99).

External laryngeal pressure was required significantly more frequently with the C-blade than with the D-blade (86.7% vs 0%; P<0.001). Bougie use was comparable between groups (20% in Group C vs 13.3% in Group D, P=0.73). The overall incidence of complications was low and similar: one patient (3.3%) in each group had a minor complication (soft tissue or dental injury, P>0.99), and no oesophageal intubation, laryngospasm or significant desaturation was documented.

Figure 3: Mean time to intubation comparison between two groups (parametric t test)

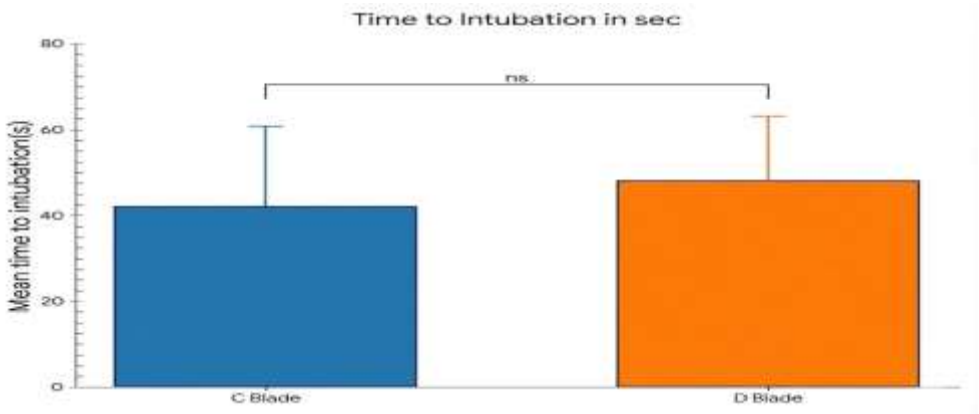
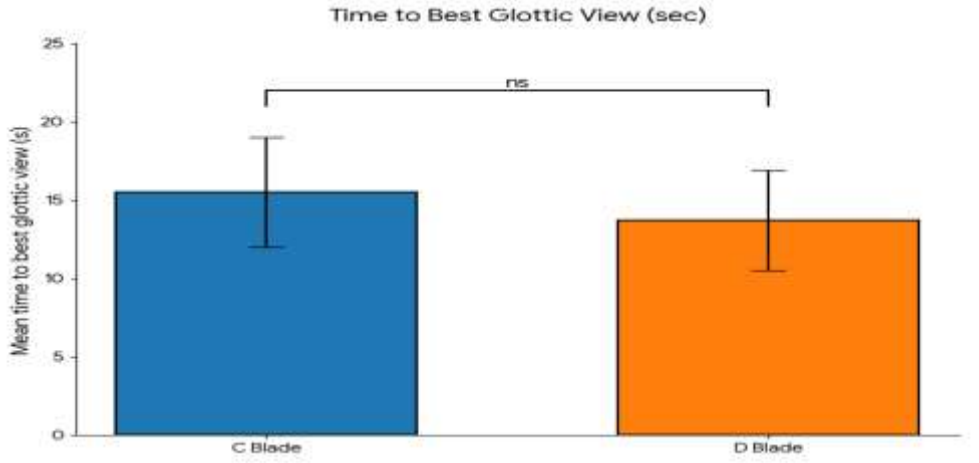


Figure 4: Mean time to best glottic view comparison between two groups (parametric t test)



Haemodynamic variables and oxygen saturation

Haemodynamic parameters and oxygen saturation at predefined time points are shown in Tables 3 and 4. Mean SBP, DBP and MAP at baseline and subsequent time points (T0 to T20) were comparable between the two groups; no statistically significant differences were observed at any time point.

Heart rate followed a comparable pattern in both groups, with a modest increase around intubation followed by gradual return towards baseline; mean values at each time point did not differ significantly between groups. Oxygen saturation remained high in both groups throughout, with mean SpO_2 ≥98% at all time points and no clinically important desaturation episodes.

In summary, both blades achieved similarly high intubation success rates and comparable total intubation times, but the D-blade provided faster optimal glottic visualisation and eliminated the need for external laryngeal pressure, with similar haemodynamic stability and complication rates in adult patients with cervical spine pathology.

Fig 5: Mean SBP comparison between the groups



Fig 6: Mean DBP comparison between the groups

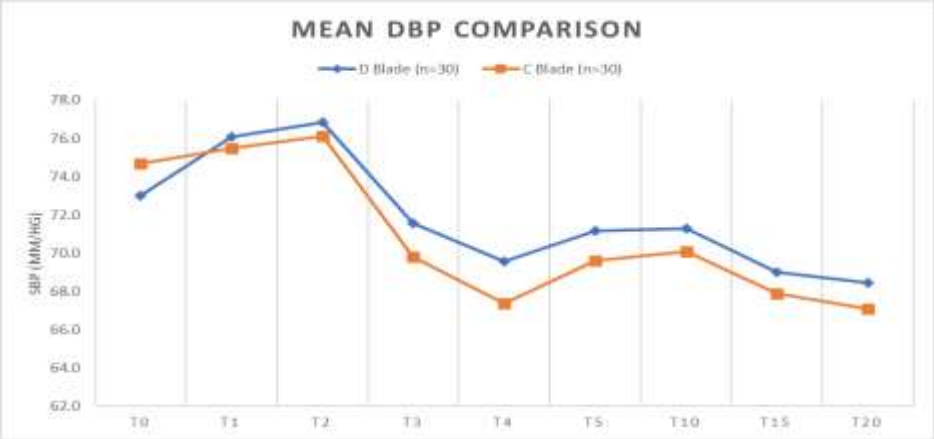


Fig 7: Mean MAP comparison between the groups



Figure 8: Mean HR comparison between the groups

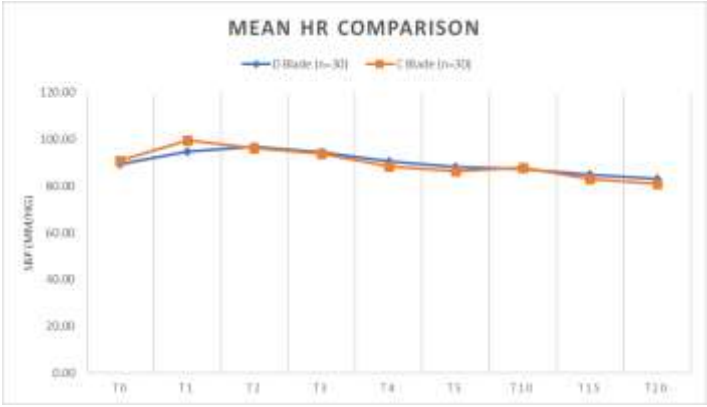


Figure 9: Spo2 comparision between the groups



Discussion

This randomised controlled study compared the performance of the C-MAC C-blade and D-blade video laryngoscopes in adults with cervical spine pathology undergoing elective surgery with manual in-line stabilisation (MILS). The principal finding is that, although total time to successful intubation and success rates were comparable between the two blades, the D-blade provided significantly faster attainment of the best glottic view and eliminated the need for external laryngeal pressure, without increasing complications or haemodynamic instability. These results suggest that both blades are effective in this high-risk population, but the D-blade may offer specific advantages in optimising laryngoscopic view under cervical immobilisation.

Cervical spine injury and instability impose the dual challenge of minimising cervical movement while rapidly securing the airway, and MILS though recommended can worsens glottic visualisation and intubation conditions.(1-4) Video laryngoscopes have been advocated in this context because they can provide an improved indirect view of the glottis without the need to align the oral, pharyngeal and laryngeal axes.(1,2,6-9,11-16) The C-MAC video laryngoscope, with its Macintosh-like C-blade and more angulated D-blade, is particularly attractive because it allows anaesthesiologists to choose between a familiar geometry and a hyper angulated option for difficult airways.(6-9,12-15) In our study, the D-blade's design translated into significantly shorter time to best glottic view and complete avoidance of external laryngeal pressure, supporting its utility in the presence of cervical spine pathology and immobilisation.

Patient and airway characteristics

Baseline demographic and airway variables were largely comparable between the groups, with similar distributions of age, sex and Mallampati class. This indicates that randomisation successfully balanced key predictors of difficult intubation, thereby minimising confounding from anatomical airway differences. The higher body mass index (BMI) observed in the C-blade group might theoretically predispose to more challenging laryngoscopy; however, Mallampati distribution was similar and no clinically important differences in intubation difficulty, attempts or complications were detected. In paediatric patients, **Hajiyeva et al.** also reported that demographic variables, including weight, did not significantly influence comparative performance between C-MAC and direct laryngoscopy when video laryngoscopy was employed, supporting the notion that video assistance can partially mitigate BMI-related difficulty when other airway parameters are acceptable. (11)

Intubation performance: times, attempts, and glottic view

Time to successful intubation is defined from blade insertion to capnography confirmation—did not differ significantly between C-blade and D-blade, despite the D-blade providing a faster best glottic view. This pattern is consistent with the work of **Kilicaslan et al.**, who found that although the C-MAC D-blade yielded better Cormack-Lehane grades and reduced dental pressure compared with the C-blade and Macintosh blade, overall intubation times remained similar across devices in simulated difficult airways.(9) Similarly, in children with simulated cervical spine immobilisation, **Sinha et al.** observed better glottic visualisation with the D-blade but no significant difference in total tube insertion time compared with the Macintosh-type C-blade.(15)

In our study, the D-blade reduced the time to optimal Cormack–Lehane view by nearly 2 seconds on average, but the additional time required to manipulate the pre-shaped endotracheal tube along the more angulated path appeared to offset this advantage. Conversely, once a satisfactory view was obtained with the C-blade, its Macintosh-like geometry may have facilitated more intuitive tube advancement due to operator familiarity, as suggested by the ICU study of **Noppens et al.**, in which C-MAC Macintosh blades performed similarly to traditional Macintosh laryngoscopes when used by experienced clinicians.(12) The very high first-attempt success rates in our series (100% with D-blade and 96.7% with C-blade) further underscore that both blades can be used effectively in this patient population when handled by trained operators.

Adjuncts, external manipulation and ease of intubation

One of the most striking differences in our study was the requirement for external laryngeal pressure: 86.7% of patients in the C-blade group needed external manipulation compared with none in the D-blade group. This finding is in keeping with the observations of **Sabry et al.**, who reported that the C-MAC D-blade provided superior laryngoscopic views compared with the McCoy laryngoscope in patients with cervical immobilisation, thereby reducing the need for additional manoeuvres to visualise the glottis.(8) In paediatric patients, **Hajiyeva et al.** similarly demonstrated that the C-MAC D-Blade improved glottic visualisation compared with direct laryngoscopy, although intubation times remained comparable.(11) Our results extend these observations to adults with true cervical spine pathology, reinforcing the ability of the hyperangulated D-blade to optimise glottic view without external laryngeal pressure in the presence of MILS.

Despite the clear reduction in external laryngeal pressure with the D-blade, the overall subjective ease of intubation (very easy/easy/difficult) and the need for a bougie were similar between blades. This mirrors the experience of **Sinha et al.**, who found that although the D-blade improved laryngoscopic view in children with simulated cervical spine injury, the success of intubation, intubation time and need for adjuncts were comparable between D-blade and Macintosh-type blades.(15) Taken together, these findings suggest that while the D-blade simplifies visualisation, it does not completely eliminate the need for adjuncts or specific technique adaptations, particularly regarding tube shaping and advancement.

Operator factors

All intubations in this study were performed by anaesthesiologists who had completed at least 20 prior intubations with the C-MAC videolaryngoscope. This level of experience likely contributed to the high overall success rates and low complication rates, and may have attenuated differences in performance between the two blades. In a prospective ICU study, **Noppens et al.** highlighted the importance of familiarity with the C-MAC device for successful intubation under challenging conditions, while **Goel et al.** noted that proficiency with C-MAC improved neonatal intubation outcomes compared with Miller laryngoscopy as experience accumulated.(12,13) Our findings should therefore be interpreted in the context of experienced users; in less experienced hands, the learning curve for the D-blade might be steeper, potentially affecting intubation times and the need for adjuncts.

Haemodynamic responses and oxygenation

The haemodynamic responses to laryngoscopy and intubation were similar with both blades. SBP, DBP, MAP and HR showed modest, transient increases around intubation, followed by a return towards baseline, with no statistically significant differences between groups at any time point. This agrees with the general conclusions of **Austin et al.** and **Wiles**, who emphasised that while airway instrumentation in cervical spine injury is inherently risky, careful technique and minimisation of multiple attempts are more critical determinants of haemodynamic stability than the specific device used.(1,2) Oxygen saturation remained ≥98% throughout the peri-intubation period in both groups, and no clinically important desaturation events occurred. Given that hypoxaemia and haemodynamic swings can exacerbate secondary neurological injury in cervical spine patients, these findings are reassuring and support the safety of C-MAC-guided intubation with either blade when conducted under controlled conditions. (1-3)

Safety and complications

The overall incidence of complications in our study was low and comparable between blades, with one minor dental injury in the C-blade group and one mucosal injury in the D-blade group. No oesophageal intubation, laryngospasm or significant desaturation was reported. **Kilicaslan et al.** previously reported that the D-blade exerted significantly less dental pressure than both the C-blade and Macintosh blade in simulated difficult airway scenarios, suggesting a potential protective effect against dental injury.(9) Although our sample size was not sufficient to demonstrate a statistically significant difference in dental trauma, our findings are consistent with the broader literature indicating that C-MAC videolaryngoscopy, including the D-blade, can be used safely in patients at risk of cervical spine injury when performed by experienced anaesthesiologists.(8,9,11-16)

Comparison with existing literature

Our results integrate well with existing evidence on video laryngoscopy in cervical spine immobilisation. **Austin et al.** and **Wiles** highlighted the dual challenge of maintaining cervical stability while ensuring effective airway management, recommending the judicious use of video laryngoscopes to reduce neck movement and improve glottic visualisation.(1,2) The work of **Sabry et al.**, **Hajiyeva et al.**, **Sinha et al.**, **Jain et al.** and **Kilicaslan et al.** consistently shows that the C-MAC D-blade and other hyper angulated video laryngoscopes offer superior laryngoscopic views compared with conventional or direct devices in cervical immobilisation or simulated cervical spine injury, even though overall intubation times and success rates are often similar.(8,9,11,14-16) Our study adds to this body of literature by demonstrating that, in adults with actual cervical spine disease undergoing surgery under MILS, the D-blade confers similar advantages in glottic visualisation and reduced need for external manoeuvres, without compromising safety or efficiency.

Strengths.

- It was conducted prospectively in adults with actual cervical spine pathology requiring strict immobilisation, rather than in healthy volunteers or manikins with simulated immobilisation, thereby enhancing clinical applicability.
- A standardised anaesthetic technique, clear outcome definitions and blinded data analysis add to its methodological robustness

limitations

- . The study was conducted at a single centre with a relatively small sample size, which may limit generalisability and the ability to detect small differences in rare complications. Operators were experienced with the C-MAC device, so results may not directly extrapolate to less experienced users or emergency settings.
- BMI differed between groups, although airway characteristics such as Mallampati class were comparable; this imbalance may have introduced unmeasured confounding.
- Future research could focus on larger, multicentre trials comparing C-blade and D-blade across a broader spectrum of difficult airway predictors, including obesity, restricted mouth opening and craniofacial anomalies, as well as in emergency and intensive care settings.
- Comparative studies examining learning curves, operator preference, and adjunct use with the D-blade may further refine best practices for device selection and technique. Until such data are available, our findings support the use of both C-MAC C-blade and D-blade in adults with cervical spine pathology under MILS, with a potential preference for the D-blade when rapid optimisation of glottic view and minimisation of external laryngeal pressure are desirable.

Clinical implications and future directions

For adult patients with cervical spine pathology undergoing surgery under MILS, our findings support the use of both C-MAC C-blade and D-blade as effective and safe options. The C-MAC D-blade may be particularly advantageous when rapid optimisation of the glottic view and avoidance of external laryngeal pressure are priorities, whereas the C-blade offers a familiar Macintosh-type geometry that many anaesthesiologists may find easier for tube delivery. Building on the work of **Hajiyeva et al.**, **Sinha et al.** and **Kilicaslan et al.**, training programmes should emphasise not only blade selection but also appropriate stylet shaping and technique for hyperangulated videolaryngoscopes, as these factors strongly influence tube delivery and overall success. (9,11,15)

Future studies should include larger, multicentre trials encompassing a broader range of difficult airway predictors and exploring outcomes in emergency, ICU and prehospital environments.(1-3,11-16) Comparative work focusing on learning curves, ergonomics, operator preference and the integration of video laryngoscopes with other airway adjuncts will further refine best practice for airway management in patients with cervical spine instability.

Conclusion

In adult patients with cervical spine pathology undergoing elective surgery under manual in-line stabilisation, the C-MAC D-blade provided faster achievement of the best glottic view and markedly reduced the need for external laryngeal pressure compared with the C-blade, while overall intubation time, first-attempt success, haemodynamic responses and complication rates remained comparable between the two blades. Both blades can therefore be used effectively and safely in this high-risk population, and device choice may be guided by operator familiarity and the need to optimise glottic visualisation under cervical immobilisation.

Declarations

Conflict of interest: The authors declare no conflict of interest.
Financial support and sponsorship: Nil.

Ethical approval

The study was approved by the Institutional Ethics Committee,Mumbai. Written informed consent was obtained from all participants.

Data availability

The datasets generated during and or analysed during the current study are available from the corresponding author on reasonable request

References:

1. Wiles MD. Airway management in patients with suspected or confirmed traumatic spinal cord injury: a narrative review of current evidence. Anaesthesia. 2022;77(10):1120-8.
2. Austin N, Krishnamoorthy V, Dagal A. Airway management in cervical spine injury. Int J Crit Illn Inj Sci. 2014;4(1):50-6.
3. Melesse DY, Tesema TT, Mekonnen ZA, Chekol WB. Airway management for individuals with suspected or confirmed traumatic cervical spine injuries: a comprehensive review and analysis. Perioper Care Oper Room Manag. 2024;35:100325.
4. Manoach S, et al. Manual in-line stabilization for acute airway management of suspected cervical spine injury: historical review and current questions. Ann Emerg Med. 2007;50(3):236-45.
5. Alvarado AC, Panakos P. Endotracheal tube intubation techniques. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025–. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560730/.
6. Cavus E, Kieckhaefer J, Doerges V, Moeller T, Thee C, Wagner K. The C-MAC video laryngoscope: first experiences with a new device for video laryngoscopy-guided intubation. Anesth Analg. 2010;110(2):473-7.
7. Cavus E, Callies A, Doerges V, et al. The C-MAC videolaryngoscope for prehospital emergency intubation: a prospective, multicentre, observational study. Emerg Med J. 2011;28(8):650-3.
8. Sabry LA, Shaarawy SS, Ellakany MH, Elmasry AA. Comparison between C-MAC D-blade and McCoy laryngoscopes in intubating patients during cervical immobilization. Res Opin Anesth Intensive Care. 2016;3:122-8.
9. Kilicaslan A, Topal A, Tavlan A, Erol A, Otelcioglu S. Effectiveness of the C-MAC video laryngoscope in the management of unexpected failed intubations. Braz J Anesthesiol. 2014;64(1):62-5.
10. Milby AH, Halpern CH, Guo W, Stein SC. Prevalence of cervical spinal injury in trauma. Neurosurg Focus. 2008;25(5):E10.
11. Hajiyeva K, Can ÖS, Baytaş V, Yıldırım Güçlü Ç. Comparison of the C-MAC D-Blade videolaryngoscope and direct laryngoscope in pediatric patients: randomized controlled trial. Ulus Travma Acil Cerrahi Derg. 2021;27(4):421-6.
12. Noppens RR, Geimer S, Eisel N, David M, Piepho T. Endotracheal intubation using the C-MAC video laryngoscope or the Macintosh laryngoscope: a prospective, comparative study in the ICU. Crit Care. 2012;16(3):R103.
13. Goel S, Choudhary R, Magoon R, Sharma R, Usha G, Kapoor PM, et al. A randomized comparative evaluation of C-MAC video-laryngoscope with Miller laryngoscope for neonatal endotracheal intubation. J Anaesthesiol Clin Pharmacol. 2022;38(3):464-8.
14. Jain D, Dhankar M, Wig J, Jain A. Comparison of the conventional C-MAC and the D-blade C-MAC with the direct laryngoscopes in simulated cervical spine injury: a manikin study. Braz J Anesthesiol. 2014;64(4):269-74.
15. Sinha R, Ray BR, Sharma A, Pandey RK, Punj J, Darlong V, et al. Comparison of the C-MAC video laryngoscope size 2 Macintosh blade with size 2 C-MAC D-Blade for laryngoscopy and endotracheal intubation in children with simulated cervical spine injury: a prospective randomized crossover study. J Anaesthesiol Clin Pharmacol. 2019;35(4):509-14.

16. Jain D, Bala I, Gandhi K. Comparative effectiveness of McCoy laryngoscope and C-MAC videolaryngoscope in simulated cervical spine injuries. J Anaesthesiol Clin Pharmacol. 2016;32(1):59-64