

**ORIGINAL ARTICLE****Comparing Intubating Conditions in Elective Adult Surgical Patients: A Study of Airtraq Laryngoscope vs. Macintosh Laryngoscope**<sup>1</sup>Ambika Kumari, <sup>2</sup>Ritika Srivastava<sup>1</sup>Department of Anaesthesiology, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh, India;<sup>2</sup>Department of Anaesthesiology, Major S D Singh Medical College & Hospital, Farukhabad, Uttar Pradesh, India**ABSTRACT:**

**Background:**Endotracheal intubation stands as the benchmark for airway management during the administration of general anesthesia. This study aims to assess and compare the intubating conditions achieved using the Airtraq laryngoscope and the Macintosh laryngoscope in elective adult surgical patients. **Methods:**A prospective study conducted at a hospital involved 100 adult patients who met the inclusion criteria and willingly participated after providing informed consent in the Department of Anesthesia. Following the initial assessment, patients were transferred to the operating room, where intravenous lines were established, and monitoring devices were connected. The assignment of patients to either the Airtraq or Macintosh group was determined through the use of sealed envelopes. **Results:**Our study revealed a comparison of the mean age, sex distribution, and Body Mass Index (BMI) among patients in both groups. The results indicated no statistically significant differences between the two groups in these parameters. **Conclusion:**In summary, our study concludes that the Airtraq laryngoscope presents a novel approach to tracheal intubation, particularly in cases involving anticipated and unanticipated difficult airways. The Airtraq demonstrated a notable reduction in the difficulty of tracheal intubation and the level of hemodynamic stimulation when compared to the Macintosh laryngoscope.

**Keywords:**Laryngoscope, Airtraq, Macintosh, Intubation

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**INTRODUCTION**

Endotracheal intubation, often revered as the "Gold Standard," stands as the paramount technique for managing airways in the realms of general anesthesia and critical care. Its multifaceted advantages include facilitating the delivery of anesthetic gases and oxygen through positive pressure ventilation without the undesirable consequence of stomach inflation.<sup>1</sup> Additionally, it provides a conduit to the tracheobronchial tree, enabling essential tasks such as pulmonary hygiene and drug administration. Notably, endotracheal intubation ensures the isolation of the respiratory tract from the gastrointestinal system, thereby mitigating the potential peril of gastric content aspiration. Furthermore, this technique enhances surgical access to intricate areas like the head and neck. Delving into the historical evolution of optimal head positioning for direct laryngoscopy, Sir Ivan Magill's pivotal contributions in 1936 cannot be overstated. Magill advocated the strategic use of a pillow under the occiput, emphasizing its role in raising and extending the head to achieve the most favorable laryngeal exposure. He ingeniously conceptualized the "sniffing position," describing it as the natural head position during an inhalation attempt, thereby setting a foundational precedent for effective laryngoscopy.<sup>2</sup> Preparation for successful endotracheal intubation is a meticulous process that encompasses a thorough airway assessment, the systematic assembly,

and rigorous verification of airway equipment, culminating in the deliberate attainment of the sniffing position. The alignment of the operating table's height with the laryngoscopist's naval emerges as a crucial factor in this process, creating an optimal straight line between the operator's eye and the patient's upper airway. While the history of the laryngoscope traces its roots back to the middle of the eighteenth century, it is only in the early decades of the twentieth century that the visualization of the vocal cords gained paramount significance in the field of anesthesia. The continuous refinement of techniques and equipment has since elevated endotracheal intubation to a cornerstone in airway management, underscoring its pivotal role in ensuring patient safety and procedural success.

The invention of the laryngoscope in 1854 by Manuel Patricio Rodriguez Garcia marked a significant milestone in the field of medical instrumentation.<sup>3</sup> This early device laid the groundwork for the continuous evolution of tools used in airway management. Expanding on this historical trajectory, the 1870s saw the pioneering work of Trendelenburg from Germany, who achieved a breakthrough by performing the first endotracheal anesthesia in humans. This critical advancement set the stage for further exploration and innovation in the realm of airway management. Fast forward to 1941, Robert Miller's ingenuity led to the design of a laryngoscope blade that featured a distinctive curve on the bottom

and a curved distal tip. This innovative creation, now widely recognized as the Miller blade, revolutionized the field by contributing to more optimal intubating conditions. The subsequent years witnessed ongoing modifications and refinements to laryngoscope blades, aimed at enhancing their functionality and effectiveness in airway management procedures. One of the prominent components in this evolution is the Macintosh blade. This widely used laryngoscope blade is strategically manipulated with the left hand, while the right thumb and index finger skillfully open the patient's mouth. As the blade advances deeper into the oral cavity, its tip is positioned with precision between the base of the tongue and the pharyngeal surface of the epiglottis, specifically within the vallecula. This maneuver serves the dual purpose of lifting the tongue and pharyngeal soft tissues, thereby exposing the glottis opening for efficient and successful intubation.<sup>4</sup>In contrast, the Airtraq laryngoscope introduces a novel design philosophy, allowing for the visualization of the glottis without the strict requirement of aligning the oral, pharyngeal, and tracheal axes. The insertion process involves placing the Airtraq in the midline of the oral cavity and skillfully sliding the blade around the tongue into the posterior pharynx. The depth of insertion is judiciously determined by reaching the vallecula. Before the Airtraq's main body reaches the vertical plane, practitioners strive to visualize laryngeal structures. To optimize this process, the blade is occasionally elevated against the dorsal face of the tongue with minimal upward pressure, facilitating the indirect lifting of the epiglottis. These advancements underscore the dynamic nature of medical instrumentation and techniques, demonstrating an ongoing commitment to refining tools and methodologies to ensure the utmost safety and efficacy in airway management procedures. The collaborative efforts of innovators across time have significantly contributed to the evolution of these essential medical tools, benefiting healthcare practitioners and, ultimately, the patients they serve.

Airway management stands as a critical aspect in the domain of anesthesia, given its pivotal role in preventing adverse respiratory events. Disturbingly, a substantial 75% of ASA (American Society of Anesthesiologists) closed claims are attributed to complications arising from respiratory issues. Within this spectrum, inadequate ventilation takes center stage, contributing significantly to 38% of cases.<sup>5</sup> Following closely are complications related to oesophageal placement of the tracheal tube, accounting for 17%, and difficulties encountered during intubation, which constitute 18% of reported incidents. The gravity of these statistics is further accentuated by the unfortunate reality that around 600 patients lose their lives each year in developed countries due to complications linked to airway management. This distressing situation becomes even more alarming in underdeveloped regions, where

challenges in airway management exacerbate the potential for graver outcomes. In response to this pressing concern, the aim of the current study is to delve into the comparative assessment of intubating conditions facilitated by two notable tools: the Airtraq laryngoscope and the Macintosh laryngoscope. By specifically targeting elective adult surgical patients, the study adopts a focused approach to evaluating the performance, safety, and overall efficacy of each instrument in optimizing intubation conditions. Understanding the intricacies of airway management is paramount, as it directly correlates with patient safety and well-being during medical procedures. The deliberate choice of elective adult surgical patients as the study's cohort provides a controlled environment for the assessment of these tools, offering nuanced insights that can potentially inform best practices and contribute to the ongoing refinement of airway management protocols.<sup>6</sup>As the medical community grapples with the challenges posed by adverse respiratory events, the anticipated findings of this study hold the promise of advancing our collective understanding of optimal intubation conditions. These insights have the potential to drive improvements in clinical practices, reduce complications, and, ultimately, enhance patient outcomes in the critical domain of airway management. The study, therefore, assumes a crucial role in contributing to the broader goal of patient safety and quality healthcare delivery.

## MATERIALS AND METHODS

A prospective study was conducted at a hospital, focusing on 100 adult patients who met the specified inclusion criteria. The study participants were enrolled after obtaining informed consent in the Department of Anesthesia. The inclusion criteria encompassed patients with ASA (American Society of Anesthesiologists) physical status 1, 2, and 3, aged 18 years or older, and those who provided valid informed consent.

On the other hand, exclusion criteria were defined to exclude patients with severe cardiovascular, hepatic, or renal diseases, mental illnesses, those who were unconscious or severely ill (ASA physical status IV), and individuals requiring nasal intubation. The methods employed in the study included the utilization of the Samson and Young modification of Mallampatti grading. This involved placing the patient in a sitting position with maximal mouth opening, protruding tongue, and without phonation. The observer's eye was positioned at the level of the patient's mouth, and the visibility of the faucial pillars, uvula, soft palate, and hard palate was recorded and classified into four grades:

- Grade I: Faucial pillars, uvula, soft palate, and hard palate visible
- Grade II: Uvula, soft palate, and hard palate visible

- Grade III: Base of uvula or none, soft palate, and hard palate visible
- Grade IV: Only hard palate visible

Following this assessment, patients were transferred to the operating room, where intravenous lines were initiated, and monitors were connected. The allocation of patients to either the Airtraq or Macintosh group was performed using sealed envelopes, ensuring a randomized and unbiased distribution. This meticulous methodology underscores the comprehensive approach adopted in the study, encompassing patient selection based on specific criteria and employing standardized grading systems for airway assessment. The randomized allocation of patients to different intubation techniques adds a layer of scientific rigor, enabling the study to draw meaningful conclusions about the comparative effectiveness of the Airtraq and Macintosh laryngoscopes in the specified population. The study protocol involved a systematic approach to monitor physiological parameters and administer premedication to the subjects. Prior to induction, heart rate, blood pressure, and SpO<sub>2</sub> were measured as baseline values. Premedication was then administered, consisting of Inj. Glycopyrrolate at a dosage of 0.2 mg and Inj. Fentanyl at a rate of 2 mcg/kg. Following premedication, the patients were subjected to preoxygenation with 100% oxygen at a flow rate of 6 liters per minute for a duration of 3 minutes. Induction was subsequently initiated using Inj. Thiopentone at a dosage of 5 mg/kg, supplemented with a neuromuscular blocker (NDP). Face mask ventilation was employed for a period of 3 minutes.

During this process, the Cook's modification of Cormack and Lehane grading was utilized to assess the laryngeal view. Additionally, the Intubation Difficulty Score was documented to provide a comprehensive evaluation of the intubation procedure, taking into account various factors contributing to difficulty. In the event that intubation with the Airtraq laryngoscope was unsuccessful, and oxygen saturation was maintained, a strategic shift to the Macintosh blade was implemented for intubation. Conversely, if saturation levels decreased during the Airtraq attempt, the protocol involved resorting to mask ventilation with 100% oxygen. Subsequently, intubation with the Macintosh laryngoscope was pursued to ensure effective airway management. This meticulous and systematic approach, involving the administration of premedication, preoxygenation, induction, and the use of different laryngoscopic tools based on the success or failure of intubation attempts, reflects a well-structured methodology aimed at capturing comprehensive data on airway management and ensuring patient safety throughout the procedure. The inclusion of standardized grading systems further enhances the depth of the study's evaluation of intubation conditions and difficulties encountered.

## RESULTS

In our study, a comprehensive analysis of patient

demographics revealed no statistically significant differences between the two groups in terms of mean age, sex distribution, and Body Mass Index (BMI). This initial comparison provided a balanced baseline, ensuring that any subsequent observations could be attributed to the specific laryngoscopic techniques rather than demographic variations. The distribution of patients according to Mallampatti grading, as presented in Table No. 2, further characterized the study population based on anatomical considerations. Cormack and Lehane grades were then used to assess the laryngeal view, revealing noteworthy disparities between the Airtraq and Macintosh groups. Notably, 92% of patients in the Airtraq group achieved a Cormack and Lehane grade of 1, while only 44% of patients in the Macintosh group attained the same grade. The statistical analysis confirmed these differences to be significant. Moreover, no patients in the Airtraq group experienced a Cormack and Lehane grade of 3 or 4, whereas 8% of patients in the Macintosh group fell into the CL grade 3 category. These findings underscore the superior laryngeal visualization achieved with the Airtraq laryngoscope. The mean duration of intubation emerged as another crucial parameter, revealing a statistically significant difference between the two groups. The Airtraq group exhibited a notably shorter mean intubation duration of 11.07 seconds compared to the Macintosh group, where the mean duration was 17.19 seconds. This finding, validated by Levene's T test, suggests that the Airtraq laryngoscope facilitated faster and potentially more efficient intubation. However, it's essential to note that a subset of patients experienced trauma to the airways, with 4 patients in the Airtraq group and 6 patients in the Macintosh group reporting soft tissue injuries. While the incidence of trauma is an important consideration, further investigation into the nature and severity of these injuries would provide a more comprehensive understanding of the safety profile associated with each laryngoscopic technique. Finally, the operator's subjective assessment of ease of intubation revealed noteworthy trends. A higher proportion of patients in the Airtraq group achieved a grade 1 ease of intubation (56 patients) compared to the Macintosh group (32 patients). Conversely, a smaller proportion in the Airtraq group (2 patients) experienced a grade 2 ease of intubation compared to the Macintosh group (12 patients). These subjective ratings further support the notion that the Airtraq laryngoscope may offer advantages in terms of ease and efficiency during intubation procedures. In summary, our study presents a thorough examination of patient characteristics, laryngeal views, intubation durations, incidence of trauma, and subjective assessments of ease of intubation. The results suggest favorable outcomes associated with the Airtraq laryngoscope in terms of laryngeal visualization, intubation speed, and operator-perceived ease. However, the observed soft tissue injuries emphasize the need for a

comprehensive risk-benefit analysis in the clinical context.

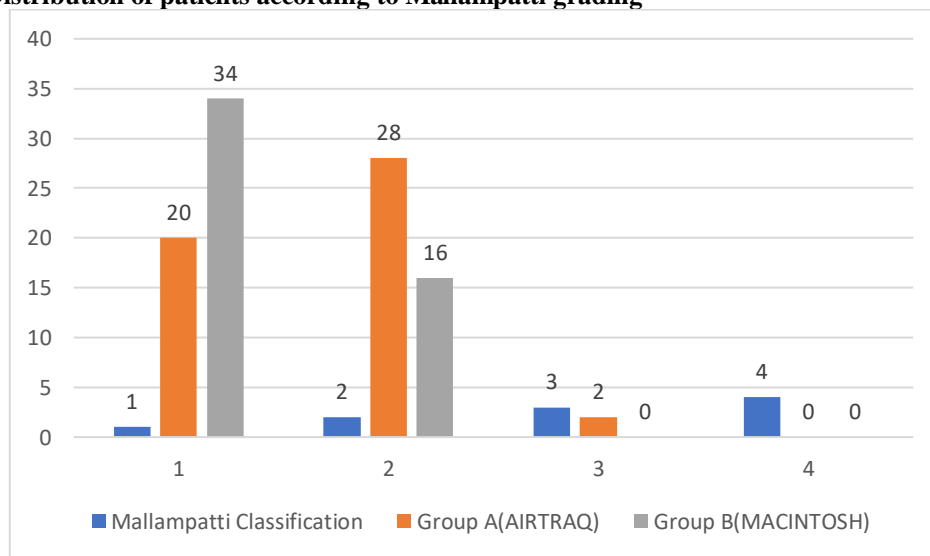
**Table 1: Demographic variables in group A and Group B**

Parameter Assessed	Group A(AIRTRAQ)		Group B(MACINTOSH)	
	Mean	SD	Mean	SD
Age, yr	35.78	13.24	36.56	12.72
Body Mass Index	25.36	4.311	24.82	3.314

**Table 2: Distribution of patients according to Mallampatti grading**

Mallampatti Classification	Group A(AIRTRAQ)	Group B(MACINTOSH)	P value
1	20 (40%)	34 (68%)	>0.05
2	28 (56%)	16 (32%)	
3	2 (4%)	0 (0%)	
4	0 (0%)	0 (0%)	

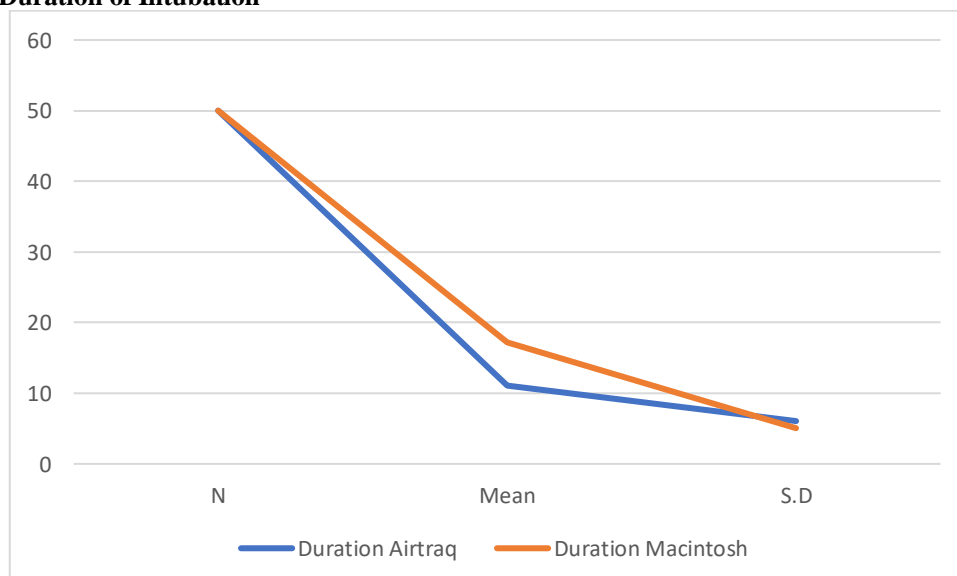
**Figure 1: Distribution of patients according to Mallampatti grading**



**Table 3: Duration of Intubation**

Parameter assessed	Group	N	Mean	S.D
Duration	Airtraq	50	11.07	6.056
	Macintosh	50	17.19	5.052

**Figure 3: Duration of Intubation**



## DISCUSSION

The mastery of airway management represents a cornerstone skill for anesthesiologists, as the intricacies of tracheal intubation often hinge on the challenges encountered during direct laryngoscopy. Despite the wealth of available information, the reliable prediction of difficulties in tracheal intubation remains an ongoing challenge, leading to the recognition of challenging intubations only after the induction of anesthesia. This unpredictability, particularly in cases of unanticipated difficult intubations, poses significant risks, especially in patients predisposed to gastric regurgitation, those challenging to ventilate with a mask, or individuals with limited cardiopulmonary reserves. Understanding the anatomical dynamics during direct laryngoscopy is pivotal to navigating these challenges. In the supine position with the head neutrally positioned, the laryngeal axis assumes an almost horizontal orientation. Simultaneously, the pharyngeal axis inclines at an approximate angle of 30–45 degrees from the horizontal axis, while the oral axis stands almost perpendicular to the laryngeal axis.<sup>7</sup> Achieving successful direct laryngoscopy necessitates the alignment of the oral, pharyngeal, and laryngeal axes. Elevating the head by around 10 cm, achieved through the placement of pads beneath the occiput, serves to optimize the alignment of the laryngeal and pharyngeal axes, facilitating an optimal view of the glottis opening. In the evaluation of intubating conditions, the Intubation Difficulty Score (IDS) emerged as a valuable tool. Conceived by Adnet and colleagues in 1997, IDS integrates subjective and objective criteria, offering both a qualitative and quantitative framework for assessing the progressive nature of difficulty encountered during intubation. Recognized for its comprehensive nature, IDS plays a pivotal role in evaluating the myriad challenges posed during intubation, providing valuable insights that contribute to the ongoing refinement of clinical practices and the enhancement of patient safety within the realm of anesthesia. In summary, the complexities of airway management, particularly during tracheal intubation, demand a multifaceted understanding of anatomical relationships and a thorough evaluation of potential challenges.<sup>8</sup> The utilization of the Intubation Difficulty Score represents a significant advancement, enabling a nuanced and comprehensive assessment of the difficulties encountered during the intubation process. By integrating subjective and objective criteria, IDS contributes to a more profound understanding of the intricacies involved in airway management, ultimately improving the quality of care and patient outcomes in the field of anesthesia.

The Intubation Difficulty Score (IDS) serves as a valuable metric for assessing the complexity of intubation procedures, assigning a value of '0' when full visualization of the laryngeal aperture is achieved during laryngoscopy, with the vocal cords seen to be adequately abducted. Any deviation from this ideal

scenario incrementally increases the difficulty score, with the overall IDS being the cumulative sum of all variations from the defined 'ideal' intubation.<sup>9</sup> In the context of the Airtraq laryngoscope, the study notes that the insertion of the device, obtaining a full view of the glottis, and subsequently intubating the trachea were generally easy tasks without major complications. The unique design of the Airtraq, allowing the tracheal tube to be attached to the side of the blade with its tip visible on the viewfinder, facilitates a clear and straightforward approach. Once the glottis is centered in the viewfinder, advancing the tube into the trachea becomes a seamless process. However, the study highlights a specific challenge associated with the Airtraq laryngoscope. Inserting the device too close to the glottis may restrict the initial movement of the tube, potentially leading to intubation failure.<sup>10</sup> To overcome this issue, the study recommends the "back and up maneuver," which involves withdrawing the device away from the glottis and lifting it upward before attempting intubation. This maneuver proves effective in addressing the challenge of inserting the Airtraq too closely to the glottis.

Drawing parallels with a study conducted by Chrisen H. Maharaj, Elma Buckley, Brian H. Harte, and John G. Laffey titled "Endotracheal intubation in patients with cervical spine immobilization – A comparison of Macintosh and Airtraq laryngoscopes," the current study finds similar trends. In Maharaj's study, the Macintosh group exhibited higher IDS scores, with 28 out of 40 patients having a score of 1 or more, compared to only 2 patients in the Airtraq group. Additionally, in the Macintosh group, 8 patients had IDS scores of 5 or greater, indicating moderate to severe intubation difficulty. These consistent findings between studies underscore the potential advantages of the Airtraq laryngoscope in terms of reducing intubation difficulty. The cumulative evidence from both studies emphasizes the reliability and relevance of the IDS in evaluating the challenges associated with different laryngoscopic techniques, further supporting the notion that the Airtraq laryngoscope may offer advantages in facilitating smoother and less challenging intubation procedures compared to traditional devices like the Macintosh laryngoscope.<sup>11</sup> The comparison of intubation times between the Macintosh and Airtraq laryngoscope groups across different studies provides valuable insights into the efficiency of these devices in diverse settings. In a study led by Maharaj et al using manikins, the time for intubation with the Macintosh group was reported as 14.2 seconds, whereas the Airtraq group demonstrated a quicker intubation time of 9.5 seconds. This finding suggests that the Airtraq laryngoscope may offer a time advantage over the Macintosh laryngoscope in simulated scenarios. In another study conducted by S.K. Ndoko et al at the Jean Verdler Public University Hospital in France, involving 106 morbidly obese patients, the mean time

to intubate using the Airtraq was 24 seconds, while the Macintosh laryngoscope exhibited a longer mean time of 56 seconds. This study underscores a consistent trend seen in manikin simulations, where the Airtraq laryngoscope tends to achieve faster intubation times compared to the Macintosh laryngoscope. Furthermore, both studies investigated the occurrence of airway trauma. In Maharaj et al's study using manikins, minor airway trauma was noted in 8 out of 100 patients in the Airtraq group and 12 out of 100 patients in the Macintosh group, with all injuries being to the soft tissues. Importantly, these findings were not deemed statistically significant. The study by Maharaj et al also highlighted a significant reduction in the incidence of airway trauma when using the Airtraq laryngoscope compared to the Macintosh laryngoscope in simulated scenarios with Laerdal Airway Trainer and SimMan Manikin.<sup>12</sup> This finding suggests that the use of the Airtraq laryngoscope may contribute to a lower risk of airway trauma in both easy and simulated difficult airway scenarios. In summary, these studies collectively suggest that the Airtraq laryngoscope demonstrates a consistent trend of achieving faster intubation times compared to the Macintosh laryngoscope, particularly in simulated scenarios. Additionally, there is a potential benefit in terms of a reduced risk of airway trauma associated with the use of the Airtraq laryngoscope. However, it's essential to note that these findings are based on manikin simulations and studies in morbidly obese patients, and the applicability to real-world clinical scenarios may require further exploration.

## CONCLUSION

In conclusion, the findings from the studies evaluating the Airtraq laryngoscope in comparison to the Macintosh laryngoscope collectively suggest that the Airtraq presents a novel and advantageous approach to tracheal intubation, particularly in patients with both anticipated and unanticipated difficult airways. Notably, the Airtraq laryngoscope demonstrated a consistent reduction in the difficulty of tracheal intubation, as well as a decrease in the degree of hemodynamic stimulation when compared to the traditional Macintosh laryngoscope. The unique design features of the Airtraq, including its ability to provide a clear view of the glottis and facilitate easier intubation, contributed to the observed improvements in intubation difficulty scores and procedural efficiency. The reduction in intubation times, both in manikin simulations and clinical studies, suggests that the Airtraq laryngoscope may offer a time advantage over conventional laryngoscopic techniques. Moreover, the reported decrease in the incidence of airway trauma with the Airtraq, particularly in simulated scenarios, adds to the overall favorable profile of this device. The potential benefits of the Airtraq laryngoscope in terms of improved

intubation outcomes and reduced procedural challenges make it a promising tool for airway management, especially in cases where difficulty is anticipated. It is important to note that while these conclusions are drawn from available studies, further research and clinical trials may be warranted to validate these findings in diverse patient populations and clinical settings. Nevertheless, the collective evidence suggests that the Airtraq laryngoscope represents a valuable advancement in airway management, offering potential advantages in terms of efficacy, safety, and reduced procedural difficulties.

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