Evaluating the Impact of Direct, Direct Video, and Indirect Video Laryngoscopy Training on the Proficiency of Medical Students in Performing Direct Laryngoscopy: A High-Fidelity Manikin-Based Assessment

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Introduction

Endotracheal intubation (ETI) is a common, potentially lifesaving, procedure frequently encountered in both emergency and surgical settings. It is one of the most important manual skills in anesthesiology, subject to a learning curve like any other manual skill [1]. Consequences of a failed intubation are severe, often leading to oxygen desaturation, arrhythmias, cardiac arrest, brain damage, and mortality [2].

With the advent of new ETI tools, such as video laryngoscopy, and acknowledging the role of operator skill, our investigation aimed to discern the most effective method of medical education for medical students acquiring this crucial skill. Specifically, we compared Direct Laryngoscopy (DL) against Indirect Video Laryngoscopy (IVL) and Direct Video Laryngoscopy (DVL). Metrics used in our analysis included achievement of successful intubation, time to successful intubation, dental injury, Numeric Rating Scale (NRS) to assess the trainee's perception of their performance, and confidence level of performing intubation in real-life scenarios.

We hypothesized that utilizing DVL as the training modality will lead to improved outcomes in assessment with DL during a high-fidelity manikin simulation. We anticipate increased successful intubation rates, decreased time to successful intubation, lower rates of dental injury, higher self-perception scores on the NRS scale, and increased confidence levels during real-life intubation scenarios compared to pre-assessment results. This anticipated improvement is expected to be more pronounced in the DVL group than the DL group, making our study particularly relevant as the first to directly compare all three modalities simultaneously.

Methods

- 31 Participants were randomized into cohorts: DL, IVL, and DVL. Cohorts completed a demographics survey then a DL pre-assessment following a standardized video on DL. Evaluation metrics included: achievement of successful intubation, time to successful intubation, dental injury, self-reported NRS assessing the trainee's performance perception, and NRS assessing the confidence level of performing intubation in real-life. Training began with a PowerPoint presentation discussing the basics of DL.
- The DL cohort trained with only DL using a Macintosh (mac) 3 blade mounted to a handle, IVL trained via GlideScope, and DVL trained via a hybrid tool, using the same laryngoscope used in DL with a camera mounted to the blade. Participants then completed a DL post-assessment. Both pre- and post-assessments were carried out using the Laerdal platform, Laerdal Learning Application (LLEAP) software and Laerdal manikins.
- The time to intubation was measured from the intubation blade touching the lips to the attachment of the bag-valve mask. Simulation operators received visual feedback for successful intubation through an on-screen avatar within the LLEAP software. The avatar displayed "assisted ventilation" when the endotracheal tube was correctly placed in the trachea. In the case of right mainstem intubation, only the right lung showed "assisted ventilations," while esophageal intubations resulted in no displayed data during ventilation. Dental injury was observed during the encounter. Intubations resulting in right mainstem ventilation, esophageal intubation, or lasting longer than the designated 5 minutes were deemed unsuccessful for the purposes of this study. Review of video occurred if necessary for analysis.
- Statistical analysis, including ANOVA and Tukey Contrast Test, was employed to analyze pre- and post-assessment data. The study aimed to comprehensively evaluate the effectiveness of different intubation education techniques and their influence on participant performance and confidence levels. Data analysis focused on an n of 21, excluding participants with prior intubation experience, straying from the n of 31 initially recruited.

Acknowledgements

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Results

Figure 1: Pre- and post-assessment results with successful intubation metric.

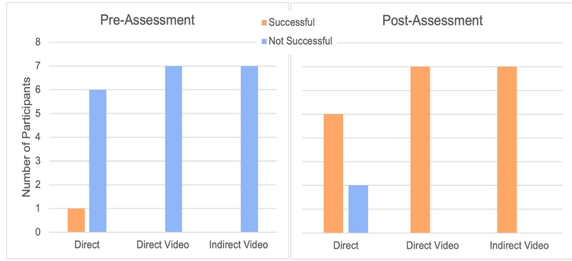


Figure 2: Pre- and post-assessment results with dental injury metric.

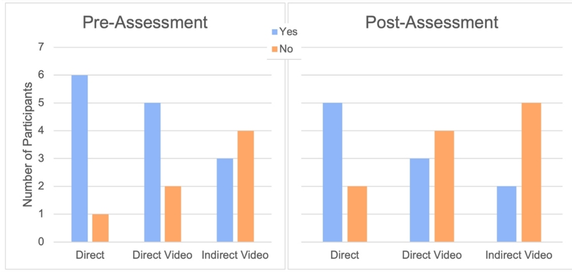


Figure 3: Post-assessment time to intubation of participants who successfully intubated within 5 minutes.

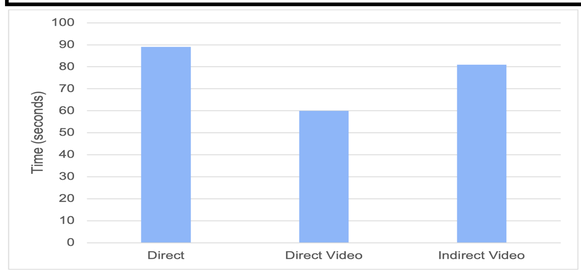


Figure 4: Pre- to post-assessment average difference of NRS response to question "How did you feel you performed in this simulation?"

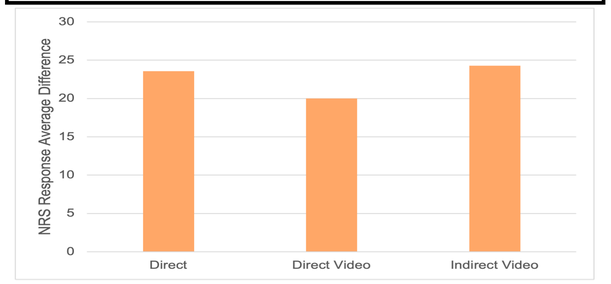
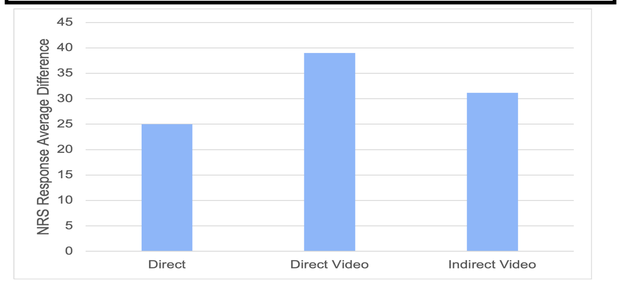


Figure 5: Pre- to post-assessment average difference of NRS response to question "How confident do you feel in your ability to perform a real-world intubation?"



Discussion

Participants with prior intubation experience were excluded (n=21). Assessment of outcomes based on modality, employing ANOVA and Tukey Contrast Tests, yielded no statistical significance. While the results of this study were not statistically significant, visually evident distinctions suggest a complex interplay of factors.

- Video-based modalities demonstrated a notable 100% positive difference in successful intubations, surpassing the direct modality, which exhibited a 57% positive difference (Figure 1).
- Dental injury analysis yielded the greatest reduction in the DVL cohort (Figure 2).
- DVL demonstrated the quickest time to intubation during post-assessment at 60 seconds, exceeding the IVL and DL group by 21 and 29 seconds, respectively (Figure 3).
- NRS of participant self-perception demonstrated the smallest average difference from pre- to post-assessment in the DVL cohort, with the greatest difference seen in the IVL group (Figure 4).
- NRS of participant confidence in performing intubation in a real-world intubation demonstrated the largest average difference within the DVL cohort from pre- to post-assessment, with the smallest difference in the DL cohort (Figure 5).

The metrics chosen are of importance due to their implication in real-life scenarios.

- Achievement of successful intubation and time to successful intubation are of utmost importance. An individual's ability to quickly and accurately perform an intubation is a crucial, life-saving technique.
- Dental injury is a key metric for evaluation as it is a common complication in intubation [3,4]. Techniques to mitigate undue pressure on teeth are essential, though injury may still occur due to other factors including dental condition [5].
- Evaluation of qualitative aspects of how participants feel following training are vital for a well-rounded, confident, and competent practice.

Although participants were trained with different modalities, they were consistently evaluated with DL. This assessment was chosen due to broader application.

- 2017 study found video laryngoscopy (VL) availability was highest in main operating departments, but less than half of other locations including the intensive care unit, emergency department and obstetrics theatres [6].
- It is likely, not all hospitals will have access to VL, requiring physicians to utilize skills to perform DL.

Conclusion

While the data presented in this study was not statistically significant, visual observations were made from the results suggesting superiority in video-based training. The DVL cohort demonstrated dominance in four of the five metrics, while IVL was predominant in the fifth metric. The observations made from this study warrant further investigation with a larger, more diverse population.

References

1. Breckwoldt, J., Klemstein, S., Brunne, B., Schnitzer, L., Mochmann, H.-C., & Arntz, H.-R. (2011). Difficult prehospital endotracheal intubation - predisposing factors in a physician based EMS. *Resuscitation*, *82*(12), 1519–1524.
2. Buis, M. L., Maissan, I. M., Hoeks, S. E., Klimek, M., & Stolker, R. J. (2016). Defining the learning curve for endotracheal intubation using direct laryngoscopy: A systematic review. *Resuscitation*, *99*, 63–71.
3. Vogel, J., Stübinger, S., Kaufmann, M., Krastl, G., & Filippi, A. (2009). Dental injuries resulting from tracheal intubation--a retrospective study. *Dental Traumatology: Official Publication of International Association for Dental Traumatology*, *25*(1), 73–77.
4. Owen, H., & Waddell-Smith, I. (2000). Dental trauma associated with anaesthesia. *Anaesthesia and Intensive Care*, *28*(2), 133–145.
5. Neto, J. M., Teles, A. R., Barbosa, J., & Santos, O. (2023). Teeth Damage during General Anesthesia. *Journal of Clinical Medicine Research*, *12*(16). https://doi.org/10.3390/jcm12165343
6. Cook, T. M., & Kelly, F. E. (2017). A national survey of videolaryngoscopy in the United Kingdom. *British Journal of Anaesthesia*, *118*(4), 593–600.