

Comparison of a Low-cost 3D Printed Video Laryngo-Borescope Blade versus Direct Laryngoscope for Simulated Endotracheal Intubations

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Introduction: Direct laryngoscopy (Macintosh, Miller blades) is technically more challenging than video laryngoscopy due to a limited viewing angle (approximately 15 degrees for Macintosh blade) and requirement of aligning the glottic, pharyngeal and tracheal axes.¹ Existing video laryngoscopes have a wider viewing angle of 50-60 degrees and do not require the alignment of the airway axes for successful intubation.² Previous studies have demonstrated video laryngoscopes (e.g. Glidescope) have increased first pass success rates and improved Cormack-Lehane (CL) views.³⁻⁵ However, video laryngoscope systems can cost several thousand dollars and have limited blade options. Using three dimensional (3D) printing technology a blade can be designed and fabricated at an extremely low cost and accepts a low cost video borescope providing both the light and video source. In addition, the use of 3D printing technology opens the possibility of a wider variety of blade designs and blades tailored to individual patients' anatomy.

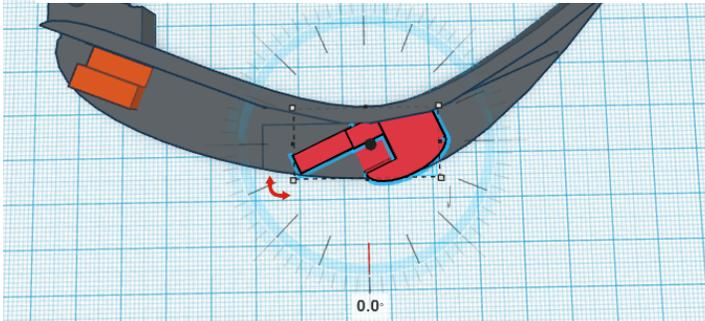
Purpose/Study objective: The purpose of this study was to compare the performance of a low-cost, 3D printed video laryngo-borescope blade (Image) and a standard Macintosh blade for endotracheal intubation. The two types of blades were compared for success rate and time to intubate on a difficult airway simulator.

Materials and Methods: A randomized control trial was conducted on physicians in an anesthesiology department in an academic medical center. The two primary outcomes examined were first pass intubation success rate and time to intubation. In addition, the best Cormack-Lehane view reported by the participants and the time to obtain the laryngeal inlet was recorded.

Results: A total of 64 physicians, 34 physicians in the Video Laryngo- Borescope blade (VLB group) and 30 physicians in the Mac blade (Mac group) were recruited for the study. The VLB group had a higher first pass intubation success rate with 94.1% compared to 60% with the Mac group, $P = 0.003$. The VLB group had a lower time to successful intubation with mean of 63.9 sec (SD 55.4 sec) than the MAC group with a mean of 108.2 sec (SD 91.8 sec), $P = 0.042$. One hundred percent of the VLB group had a Cormack-Lehane grade view of 1 or 2 compared to the Mac group of 21%, P value = 0.000. The VLB group had a lower average time to see the laryngeal inlet of 16.6 sec (SD 9.9 sec) compared to 39.1 sec (SD 41.1 sec) in the Mac group, P value = 0.001.

Conclusion: In the hands of anesthesia providers, the 3D printed blade showed superiority with first pass success rate, Cormack-Lehane view, and time to see laryngeal inlet. The data also suggests the 3D printed blade could be superior for time to intubate. In this preliminary study, the 3D printed video laryngo- borescope blade could be a feasible, low-cost option for difficult airway situations.

Image: Video laryngo-borescope blade in computer-aided design and actual 3D printed form.



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