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RESEARCH REPORT

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Effects of tip-manipulated stylet angle on intubation using the GlideScope® videolaryngoscope in children: A prospective randomized controlled trial

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Abstract

Background: An optimal endotracheal tube curve can be a key factor in successful intubation using the GlideScope videolaryngoscope.

Aims: This study aimed to evaluate the effects of tube tip-modified stylet curve on the intubation time in children.

Methods: Children aged 1-5 years were randomly assigned to either the standard curve (group S, n = 60) or tip-modified curve (group T, n = 60) groups. In group S, the endotracheal tube curve was similar to that in the GlideScope. In group T, a point approximately 1.5 cm from the tube tip was additionally angled to the left by 15°-20°. The primary outcome was the total intubation time, and the secondary outcomes were incidence of successful intubation in the first attempt, number of additional manipulations of the stylet curve, and visual analog scale (VAS) score for the easiness of intubation.

Results: The mean total intubation time was significantly longer in group S than that in group T (13.9 [10.8] vs. 9.0 [3.4] sec, mean difference, 4.9 s; 95% confidence interval [CI], 2.0-7.8; p = .001). All patients in group T were successfully intubated in the first attempt, whereas those in group S were not (100% vs. 93.3%, relative risk [RR], 0.11; 95% CI, 0.01-2.02; p = .1376). Three patients in group S could be intubated after modifying the ETT curve similar to that in group T. Operators reported that tracheal intubation was easier in group T than in group S (median [interquartile range] for VAS; 1 [1-2] vs. 2 [1-3]; p < .001).

Conclusions: Having additional angle of the endotracheal tube tip to the left could be a useful technique to facilitate directing and advancing endotracheal tube into the vocal cords.

KEYWORDS
airway management, intubation, laryngoscopes, pediatrics

1 | INTRODUCTION

Difficult airway management is one of the most challenging tasks for anesthesiologists and other clinicians. Visualization of the glottis during intubation trial is a key component of successful intubation. Videolaryngoscopes have a camera at the tip of the blade, which allows for indirect visualization of the glottis via a monitor. There are several reports regarding the usefulness of videolaryngoscopes in difficult intubation in adults [1,2] and children.[3] There are different types of videolaryngoscopes, and the GlideScope (GlideScope Cobalt AVL, Verathon Inc) is one of the most popular videolaryngoscopes with hyperangulated blades.

The airway management in pediatric patients can be challenging because of their unique anatomic and physiological characteristics.[4] The GlideScope can be used for difficult airway management in children.[3,5] However, although GlideScope could improve the visualization of glottis, the reported success rate was relatively low, approximately 50%-60%,[4] along with a prolonged intubation time when compared to direct laryngoscopy and other videolaryngoscopes.[6-8]

Manipulating the endotracheal tube (ETT) shape with the stylet can be a key factor in placing and advancing the ETT tip into the glottis.[9,10] ETT shape is usually formed similar to that of the GlideScope blade using a stylet.[10] However, additional handling is often required to place the tube tip into the glottis as it tends to be located on the right side of the laryngeal inlet during its insertion.[10] Additionally, the GlideScope blade may occupy a larger proportion of the oropharynx in pediatric patients, resulting in less space for manipulation of the ETT.[11] Advancement of the ETT can be difficult as the ETT tip become stuck against the anterior tracheal wall due to the shape of the GlideScope blade.[12]

Therefore, we hypothesized that additional angulation of the distal tube tip to the left could more likely facilitate the targeting of the ETT tip to the glottis and intubating using the GlideScope in children. To test this hypothesis, we evaluated the effects of tube tip-modified stylet curve on the intubation time, intubation success rate, and ease of ETT handling using the GlideScope in pediatric patients undergoing general anesthesia.

What is already known about this topic

The GlideScope videolaryngoscope can be used for children in whom airway management is difficult. Manipulating endotracheal tube shape with the stylet can be a key factor in placing and advancing the endotracheal tube tip into the glottis using the GlideScope.

What new information this study adds

Additional angulation of the distal tube tip to the left could make intubation easy and reduce intubation time using Glidescope in children. This can be a useful technique to facilitate directing and advancing endotracheal tube into the vocal cords using the Glidescope.

2 | METHODS

2.1 | Study population

This prospective, randomized controlled study was performed at the Seoul National University Hospital between December 2016 and November 2017. The study protocol was approved by the Institutional Review Board of Seoul National University Hospital (H1608-156-787) and registered at http://clinicaltrials.gov (number: NCT02952690, principal investigator: K.H.S., date of registration: November 2, 2016) prior to patient enrollment.

Children aged between 1 and 5 years who were scheduled for elective surgery under general anesthesia were enrolled. The exclusion criteria were active upper respiratory tract infection, history of asthma, other lung diseases, or American Society of Anesthesiology physical status >3.

The study was performed according to the ethical standards set by the 1964 Declaration of Helsinki and its later amendments. An anesthesiologist explained the study protocol to the children's parents a day before the surgery and obtained written informed consent.

2.2 | Randomization

A computerized random number was generated (http://www.randomizer.org) for simple randomization. A researcher who was not involved in this study prepared coded, sealed, and opaque envelopes that included the random number. The enrolled patients were allocated into either the standard curve group (group S) or tip-modified curve group (group T) with an allocation ratio of 1:1. The patients, guardians, and outcome assessor who measured the time during the intubation process were blinded to the group allocation. However, practitioners who performed intubation could not be blinded to the group allocation.

2.3 | Anesthesia and study protocol

Anesthesia induction was commenced with atropine 0.02 mg/kg, thiopental sodium 5 mg/kg or propofol 2.5 mg/kg, and rocuronium 0.6-1 mg/kg. Facemask ventilation with sevoflurane and 100% oxygen was performed, and neuromuscular blockade was monitored. When the single twitch response disappeared, the GlideScope blade was inserted along the midline of the tongue. When the epiglottis was identified on the screen, the scope was manipulated to obtain the best glottic view. The patients' heads were kept in a neutral position during the procedures.

The blade size was selected based on the patient's weight according to the manufacturer's guidelines (size 2 up to 10 kg and size 2.5 for 10-28 kg). Following the insertion of the GlideScope blade, the modified Cormack and Lehane (C&L) grade was scored.[3] External laryngeal manipulation was allowed if the C&L grade was ≥3. Subsequently, the ETT was inserted and advanced into the glottis according to the group allocation.

Time was measured from the insertion of the GlideScope until each time point. Intubation performers notified each time point of glottis visualization, placement of tube tip into the glottis, and completion of intubation. Intubation was considered complete when the proximal end of ETT balloon was advanced into the glottis. An investigator who was blinded to the group allocation recorded each time point. All intubations were performed by one of two experienced anesthesiologists (L.J.H. and K.H.S.).

All patients were intubated with a cuffed endotracheal tube (Mallinckrodt Hi-Lo; Mallinckrodt Medical). The tracheal tube size was based on Salgo et al.'s[13] recommendations. Endotracheal tube shape was determined using an intubation stylet (2 or 4 mm PORTEX® stylet; Smith Medical International Ltd) as follows: In group S, the ETT curve was similar to that of the GlideScope blade curve. In group T, a point approximately 1.5 cm from the tube tip was additionally angled to the left by 15°-20° (Figure 1). The angulation of the ETT was modified without the practitioners' knowledge, and the ETT was handed to them just before tracheal intubation to minimize potential bias.

A total of two intubation attempts were allowed with the assigned stylet curve. When intubation failed in the second attempt, additional manipulation of the stylet was performed at the discretion of the practitioner. When intubation was completed, bilateral lung sounds and capnography were assessed and mechanical ventilation was commenced.

2.4 | Outcome variables and statistical analysis

The primary outcome was the total intubation time, from the insertion of the GlideScope to the completion of endotracheal intubation. The completion of intubation was defined as visual confirmation of ETT cuff passage through the glottis and removal of the GlideScope. The secondary outcomes were time from glottis visualization to intubation, time to approaching the ETT tip to the glottis, number of attempts for glottis passage, incidence of successful intubation in the first attempt and that within 30 s, number of additional manipulations of the stylet curve, and visual analog scale score for ease of endotracheal intubation (0 = extremely easy, 10 = extremely difficult).[14,15]

The sample size was calculated based on a previous pediatric study, where the time to tracheal intubation was 36 s (18) using the GlideScope.[16] We assumed that additional modification of the ETT tip could decrease the time to intubation by 10 s. With an alpha error of 0.05 and a power of 80%, the required sample size was 52 per group using the PASS 2008 software (ver 8.0.16; NCSS statistical software). Considering a 15% attrition rate, we decided to enroll 60 patients per group (total 120 patients).

All data were analyzed using SPSS software (ver. 23.0; IBM Inc). Normality of data was tested using the Kolmogorov-Smirnov test. Data were expressed as number, mean (standard deviation, SD), or median (interquartile range, IQR). Categorical data were compared using the chi-square test between two groups, and Fisher's exact test was used when more than 20% of cells had expected frequencies <5. Continuous data were compared using the Student's *t* test or Mann-Whitney rank-sum tests between two groups. All *p*-values were two-sided, and $p < .05$ was considered statistically significant.

3 | RESULTS

A total of 120 children were randomized into group S (n = 60) and group T (n = 60). No patient was excluded after enrollment. Therefore, data of 120 patients were analyzed (Figure 2, CONSORT diagram). The baseline characteristics are demonstrated in Table 1.

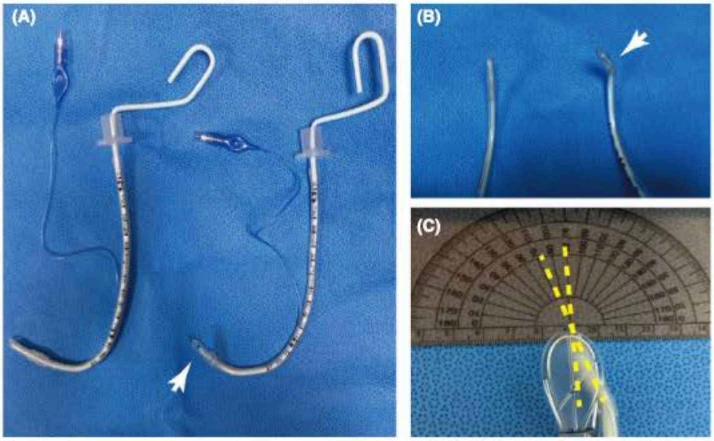

FIGURE 1 Shape of the endotracheal tube used in the study population. (A) and (B) Shape of the standard endotracheal tube curve (left) and the tip-modified curve (right). The arrows indicate the modification of the tip angle to the left. (C) The relationship between the GlideScope blade and endotracheal tube tip in the tip-modified curve group. In the tip-modified curve group, a point approximately 1.5 cm from the tube tip was additionally angled to the left by 15°-20° [Colour figure can be viewed at wileyonlinelibrary.com]

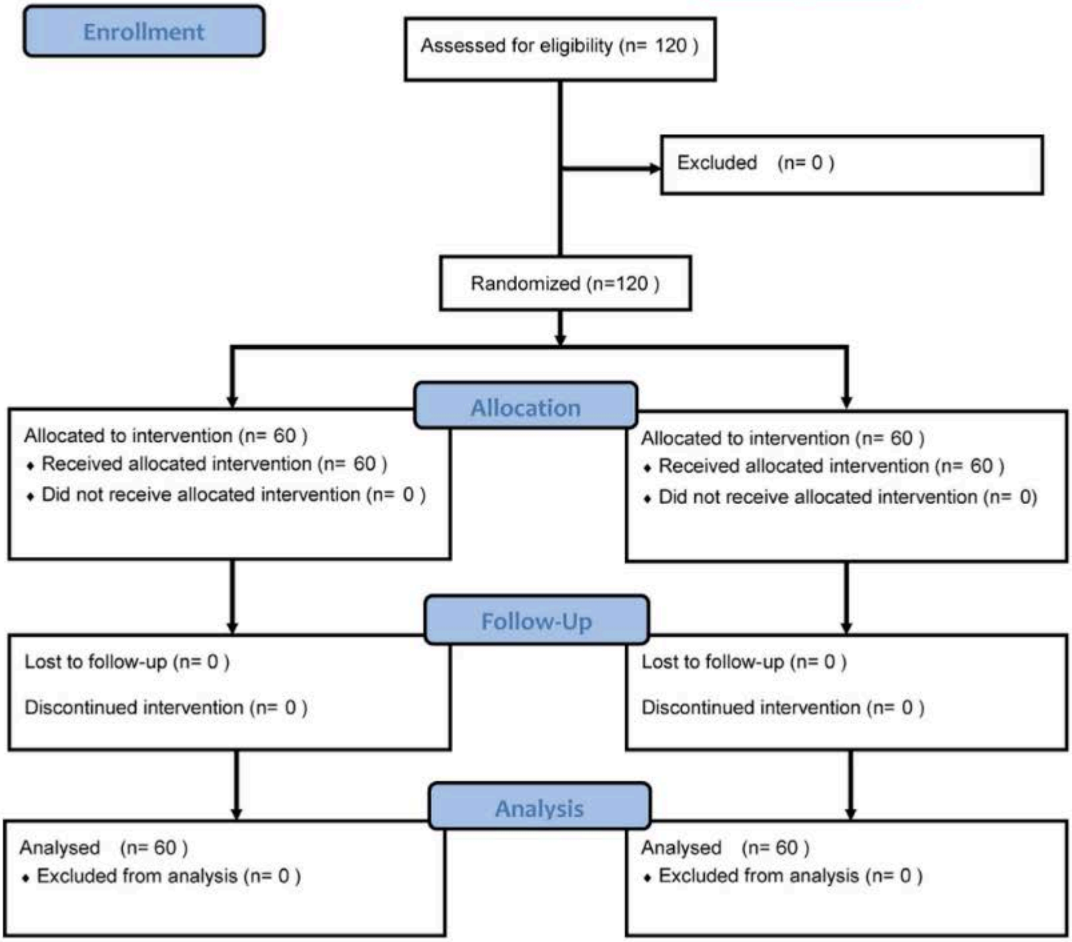

FIGURE 2 CONSORT diagram [Colour figure can be viewed at wileyonlinelibrary.com]

Table 2 summarizes the data for the intubation process between the two groups. Regarding the primary outcome, the total intubation time was significantly longer in group S than that in group T (13.9 [10.8 s] vs. 9.0 [3.4] sec, respectively; mean difference, 4.9 s; 95% confidence interval [CI], 2.0-7.8; p = .001). The time from glottis visualization to intubation and time to approaching the ETT into the glottis were significantly lower in group T compared with those in group S (p = .001 and p = .005, respectively).

In group S, successful intubation was possible in the first attempt in 56 (93.3%) patients and second attempt in 1 (1.7%) patient. Intubation was successful in the third attempt in the remaining 3 (5%) patients following modification of stylet angle. In these patients, the tip of ETT was modified similar to that in group T, and rotation was performed, while ETT was advanced. In contrast, all patients in group T were successfully intubated at the first attempt. However, this difference was not statistically significant (93.3% vs. 100%; relative risk [RR], 0.11; 95% CI, 0.01-2.02; p = .138). Intubation was completed within 30 s in 57 and 60 patients in groups S and T (95% vs 100%; RR, 0.14; 95% CI, 0.01-2.71; p = .195), respectively. The C&L grade was ≤2a in all patients, and external laryngeal manipulation, such as backward, upward, and rightward pressure, was not required in any of the patients.

Based on the visual analog scale, intubation was significantly easier in group T than that in group S (1 [1-2] vs. 2 [1-3], respectively; p < .001). There were no complications observed after tracheal intubation in any of the patients.

4 | DISCUSSION

In this study, additional angulation of the ETT tip to the left reduced intubation time using the GlideScope videolaryngoscope in pediatric patients. All intubations were successfully performed in the first attempt using ETT with a modified tip. Additionally, the practitioners found it easier to intubate the patients in group T compared with those in group S.

The videolaryngoscope has been an important tool in both anticipated and unanticipated difficult intubations. Especially, in the current situation of the global pandemic, there is a trend to use videolaryngoscopes as the first-line option for intubation, avoiding direct intubation.[17,18] Therefore, anesthesiologists have to be familiar with a particular videolaryngoscope being used to avoid prolonged intubation time and failed intubation.[17]

TABLE 1 Baseline characteristics of the standard curve group and tip-manipulated curve group

Variables	Standard curve group (*n* = 60)	Tip-modified curve group (*n* = 60)
Age (year)	2.7 (1.4)	3.1 (2.5)
Height (cm)	94.4 (10.9)	94.7 (13.4)
Weight (kg)	14.4 (3.8)	14.4 (3.9)
SEX (M/F)	39/21	33/27
Glidescope blade size (2/2.5)	11/49	10/50
Type of surgery		
General surgery	18	13
Otorhinolaryngologic surgery	12	10
Urologic surgery	9	5
Plastic surgery	8	14
Orthopedic surgery	6	9
Thoracic surgery	3	5
Neurosurgery	3	3
Opthalmic surgery	1	1

Note: Data are presented as mean (standard deviation, SD) or number.

The usefulness of the GlideScope in pediatric difficult airways has been proven.[3,19] Despite the fact that this videolaryngoscope can improve glottis visualization, the intubation time may be prolonged in pediatric patients.[16] According to a report by Kim et al[16]., the mean time for tracheal intubation was 23.8 (13.9) sec using a direct laryngoscope, whereas it was 36.0 (17.9) sec using the GlideScope in children. This might be due to a technical difficulty in ETT handling during intubation attempt.[20] This difficulty can be overcome using an optimal ETT curve.[9,10,21] An adult study using the GlideScope reported that optimal angulation of ETT could reduce the mean intubation time from 54.4 (28.2) sec to 47.1 (21.2) sec.[9]

Therefore, we hypothesized that additional curvature of ETT tip to the left could ease the targeting of ETT into the glottis and result in faster intubation compared with the standard curve. Our hypothesis was proven right as the time required to approach the glottis could be significantly reduced by approximately 2.4 s. Additionally, we could reduce the total intubation time by approximately 5 s. According to another pediatric study using the GlideScope, optimal angulation of the ETT curve could reduce the intubation time by approximately 3 s.[10] Although it might seem like a small difference, this finding is meaningful in pediatric patients with significant physiologic limits on the safe apnea time. Additionally, all intubation in the present study was performed by experts in pediatric anesthesia. Therefore, we speculated that the difference in the ETT handling time and intubation time would be higher and more clinically important when the intubation was done by less-experienced clinicians.

Along with targeting the tube tip into the glottis, the advancement of the ETT through the vocal cords is an important step for successful intubation. Irrespective of the ETT curve, operators may encounter technical difficulties while inserting the ETT just beyond the vocal cords from the arytenoid cartilages.[20] This problem is not uncommon in videolaryngoscopes with hyperangulated blades, such as the GlideScope.[22] Several techniques have been suggested to overcome this problem.[20] External laryngeal manipulation, ETT-loaded reverse

TABLE 2 Data of intubation process in two groups

Variables	Standard curve group (*n* = 60)	Tip-modified curve group (*n* = 60)	95% CIs mean difference	*p*-value
Cormack and Lehane grade (1/2a)	55/5	57/3		.717
Time to glottis visualization[a] (s)	3.9 (3.0)	3.5 (1.8)	0.4 (−5.0-1.3)	.360
Time to approaching ETT tip to glottis[a] (s)	8.4 (5.8)	6.0 (2.8)	2.4 (0.8-4.1)	.005
Total intubation time (s)	13.9 (10.8)	9.0 (3.4)	4.9 (2.0-7.8)	.001
Glottis visualization to intubation (s)	10.0 (10.0)	5.5 (2.6)	4.5 (1.9-7.1)	.001
No. of intubation attempts (1/2/3)	56/1/3	60/0/0		.126
VAS for the easiness of intubation	2 (1-3 [1-8])	1 (1-2 [1-4])		<.001
Additional angle correction (Y/N)	3 (5)	0		.244
Successful intubation at first attempt	56 (93.3)	60 (100)		.119
Successful intubation within 30 s	57 (95)	60 (100)		.244

Note: Data are presented as mean (SD), median (IQR [ranges]) or number (percentage).

Abbreviations: CI, confidence interval; ETT, endotracheal tube; VAS, Visual analog scale.

[a]Time from insertion of GlideScope to completion of each action.

camber, or stylet withdrawal can be used to pass the ETT through the glottis. Additionally, rotation of the ETT is another successful corrective maneuver for advancement into the vocal cords.[12,20]

We assumed that additional angulation of the tube tip to the left can facilitate rotating the ETT during advancement into the glottis. Three patients in group S required curve modification and were intubated successfully with additional angulation of the ETT tip to the left, similar to that in group T. Additionally, all intubations were successful in the first attempt in group T. Although the group difference in the success rate at the first attempt was not statistically significant, we thought that this finding would be clinically important. In this study, all ETTs were loaded forward camber, which could make the ETT advancement into the trachea more difficult.[9] The shape modification of the ETT tip is believed to prevent the tube tip from hitting the anterior vocal cord inlet and induce rotation of ETT to overcome the impingement at the glottis. Therefore, practitioners might have experienced easier intubation in group T than in group S.

In this study, the intubation success rate in the first attempt was 96.7%, which was similar to that in a previous adult study (96.2%).[23] According to pediatric reports, the success rate of first-attempt intubation varies from 53% to 98% [7,10,11,19,20,24] and is relatively lower in pediatric patients with difficult airways.[7,19] Additionally, the total intubation time was relatively shorter in our study compared with those in previous pediatric studies.[10,16] The mean time to intubation was 11.4 (8.3) sec in this study and 34.4 (16.5) sec in pediatric patients with C&L grade ≤2.[16] The total ETT handling time was 7.7 (7.5) sec, which was shorter than that (15.4-18.2 s) reported in a previous pediatric study.[10] The possible reason for this difference was that infants were not included in our study. The mouth cavity is relatively small in younger children, and therefore, handling of ETT to target the glottis may be difficult in them than that in older children.

Some limitations of this study should be mentioned. First, all intubations were performed by experts and not trainees. Considering that videolaryngoscope has become an important and popular tool, it is important to find more appropriate intubation techniques using videolaryngoscopes for trainees. Second, the practitioners who performed intubation could not be blinded to the group allocation. There might be the potential bias to the results. However, the preformed ETT was handed to practitioners just before intubation, when they focused on the videolaryngoscope monitor. Therefore, we assumed that the bias would be minimized. Finally, we did not include neonates and infants as well as children with difficult airways. Therefore, further studies are required to prove that our tip-modified curve would be useful in pediatric patients with a small oral cavity or an anteriorly located larynx. However, we believe that the additional angulation of the ETT tip to the left would be a useful technique to facilitate directing ETT into the vocal cords using the GlideScope videolaryngoscope.

In conclusion, additional angulation of the ETT tip to the left could reduce the total intubation time and ETT handling time during intubation with the GlideScope in children. Successful intubation was possible in the first attempt in all patients using the tip-modified curvature. This technique can be a useful option to facilitate directing and advancing ETT into the vocal cords using the GlideScope. Further studies regarding the effects of a tip-modified curve in ETT on intubation quality with the GlideScope in smaller children and those with difficult airways are needed.

CONFLICT OF INTEREST

The authors report no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

1. Lai HY, Chen IH, Chen A, Hwang FY, Lee Y. The use of the GlideScope for tracheal intubation in patients with ankylosing spondylitis. *Br J Anaesth*. 2006;97(3):419-422.
2. Malik MA, Subramaniam R, Maharaj CH, Harte BH, Laffey JG. Randomized controlled trial of the Pentax AWS, Glidescope, and Macintosh laryngoscopes in predicted difficult intubation. *Br J Anaesth*. 2009;103(5):761-768.
3. Lee JH, Park YH, Byon HJ, et al. A comparative trial of the GlideScope(R) video laryngoscope to direct laryngoscope in children with difficult direct laryngoscopy and an evaluation of the effect of blade size. *Anesth Analg*. 2013;117(1):176-181.
4. Stein ML, Park RS, Kovatsis PG. Emerging trends, techniques, and equipment for airway management in pediatric patients. *Paediatr Anaesth*. 2020;30(3):269-279.
5. Iwai H, Mouri H, Hirabayashi Y, Takeuchi M. Successful tracheal intubation using the GlideScope AVL in a pediatric patient with Pierre Robin syndrome. *Masui*. 2014;63(6):654-657.
6. Fiadjoe JE, Gurnaney H, Dalesio N, et al. A prospective randomized equivalence trial of the GlideScope Cobalt(R) video laryngoscope to traditional direct laryngoscopy in neonates and infants. *Anesthesiology*. 2012;116(3):622-628.
7. Park R, Peyton JM, Fiadjoe JE, et al. The efficacy of GlideScope® videolaryngoscopy compared with direct laryngoscopy in children who are difficult to intubate: an analysis from the paediatric difficult intubation registry. *Br J Anaesth*. 2017;119(5):984-992.
8. Cordovani D, Russell T, Wee W, Suen A, Cooper RM. Measurement of forces applied using a Macintosh direct laryngoscope compared with a Glidescope video laryngoscope in patients with predictors of difficult laryngoscopy: a randomised controlled trial. *Eur J Anaesthesiol*. 2019;36(3):221-226.
9. Jones PM, Turkstra TP, Armstrong KP, et al. Effect of stylet angulation and endotracheal tube camber on time to intubation with the GlideScope. *Can J Anaesth*. 2007;54(1):21-27.
10. Min JJ, Oh EJ, Shin YH, Kwon E, Jeong JS. The usefulness of endotracheal tube twisting in facilitating tube delivery to glottis opening during GlideScope intubation in infants: randomized trial. *Sci Rep*. 2020;10(1):4450.
11. Rabiner JE, Auerbach M, Avner JR, Daswani D, Khine H. Comparison of GlideScope videolaryngoscopy to direct laryngoscopy for intubation of a pediatric simulator by novice physicians. *Emerg Med Int*. 2013;407547(10):31.
12. Walls RM, Samuels-Kalow M, Perkins A. A new maneuver for endotracheal tube insertion during difficult GlideScope intubation. *J Emerg Med*. 2010;39(1):86-88.

13. Salgo B, Schmitz A, Henze G, et al. Evaluation of a new recommendation for improved cuffed tracheal tube size selection in infants and small children. *Acta Anaesthesiol Scand*. 2006;50(5):557-561.
14. Park S-J, Lee WK, Lee DH. Is the Airtraq optical laryngoscope effective in tracheal intubation by novice personnel? *Korean J Anesthesiol*. 2010;59(1):17-21.
15. McElwain J, Malik MA, Harte BH, Flynn NH, Laffey JG. Determination of the optimal stylet strategy for the C-MAC videolaryngoscope. *Anaesthesia*. 2010;65(4):369-378.
16. Kim JT, Na HS, Bae JY, et al. GlideScope video laryngoscope: a randomized clinical trial in 203 paediatric patients. *Br J Anaesth*. 2008;101(4):531-534.
17. De Jong A, Pardo E, Rolle A, Bodin-Lario S, Pouzeratte Y, Jaber S. Airway management for COVID-19: a move towards universal videolaryngoscope? *Lancet Respir Med*. 2020;8(6):555.
18. Hall D, Steel A, Heij R, Eley A, Young P. Videolaryngoscopy increases 'mouth-to-mouth' distance compared with direct laryngoscopy. *Anaesthesia*. 2020;75(6):822-823.
19. Karsli C, Armstrong J, John J. A comparison between the GlideScope® video laryngoscope and direct laryngoscope in paediatric patients with difficult airways – a pilot study. *Anaesthesia*. 2010;65(4):353-357.
20. Zhang B, Gurnaney HG, Stricker PA, Galvez JA, Isserman RS, Fiadjoe JE. A prospective observational study of technical difficulty with glidescope-guided tracheal intubation in children. *Anesth Analg*. 2018;127(2):467-471.
21. Balaban O, Tobias JD. Videolaryngoscopy in neonates, infants, and children. *Pediatr Crit Care Med*. 2017;18(5):477-485.
22. Bacon ER, Phelan MP, Doyle DJ. Tips and troubleshooting for use of the Glidescope video laryngoscope for emergency endotracheal intubation. *Am J Emerg Med*. 2015;33(9):1273-1277.
23. Aziz MF, Abrons RO, Cattano D, et al. First-attempt intubation success of video laryngoscopy in patients with anticipated difficult direct laryngoscopy: a multicenter randomized controlled trial comparing the C-MAC D-blade versus the Glidescope in a mixed provider and diverse patient population. *Anesth Analg*. 2016;122(3):740-750.
24. Ilies C, Fudickar A, Thee C, et al. Airway management in pediatric patients using the Glidescope Cobalt®: a feasibility study. *Minerva Anestesiol*. 2012;78(9):1019-1025.

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