

APPARATUS

A comparison of the Seeing Optical Stylet and the gum elastic bougie in simulated difficult tracheal intubation: a manikin study

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Summary

Management of the difficult airway is one of the major challenges that anaesthetists face. The flexible fiberoptic scope is widely available but its use requires a level of skill, training and continued practice that is not universally found in all anaesthetists, particularly trainees. The Seeing Optical Stylet is a new, semirigid fiberoptic stylet 'scope. We compared the Seeing Optical Stylet with a gum elastic bougie in a simulated Cormack and Lehane Grade 3 laryngoscopy in a manikin. Forty-four anaesthetists were timed while intubating the manikin's trachea with both devices. The mean (SD) time taken with the Seeing Optical Stylet was 20.8 (9.3) s and with the bougie 30 (19.8) s ($p = 0.001$). Oesophageal intubation occurred six times with the bougie but did not occur with the Seeing Optical Stylet ($p = 0.011$). We conclude that the Seeing Optical Stylet may be superior to the bougie in difficult tracheal intubation. We feel that the results of this manikin trial are sufficiently encouraging to proceed to a clinical trial in patients.

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Management of the difficult airway is one of the major challenges that anaesthetists face. It is a leading cause of anaesthetic morbidity [1] as it produces a situation which can lead to patient hypoxia as well as airway trauma, dental damage and exaggerated cardiovascular responses as the anaesthetist repeatedly attempts tracheal intubation. The majority of these situations arise because the larynx is poorly visualised on direct laryngoscopy [2, 3]. It is well recognised that it is difficult reliably to predict these problems before induction of anaesthesia [4].

In the UK, the gum elastic bougie is a popular device in the management of difficult intubations, although several attempts may be required to intubate the trachea rather than the oesophagus [5, 6]. Over the past 15 years, there has been a proliferation of devices and intubation aids designed to assist in the management of the difficult airway [7]. The use of fixed fiberoptic devices such as the Augustine [8], Bullard [9], Upsher [10] or Wu [11] 'scopes has been advocated in this situation. The flexible

fiberoptic laryngoscope is widely available but its use requires a level of skill, training and continued practice which is not universally found in all anaesthetists, particularly trainees.

A new, semirigid fiberoptic endoscope called the Shikani, or Seeing Optical Stylet (Clarus Medical Systems, Minneapolis, MN) has recently been developed. It is a high-resolution endoscope consisting of a fiberoptic bundle housed in a stainless steel stylet [12]. A tracheal tube is loaded onto the instrument and is fixed onto a locking device that can be adjusted so that the distal end of the tube lies just proximal to the tip of the endoscope (Fig. 1). On the proximal end of the endoscope, there is an eyepiece that the operator can look down or onto which a camera can be attached. As a result, the operator is effectively looking out of the distal end of the tracheal tube. The instrument has an upward curve at its distal end which facilitates passage behind the epiglottis, and the tip can be passed into the trachea under direct vision.



Figure 1 Seeing Optical Stylet used in the study.

Illumination is provided by batteries housed in the endoscope's handle, making the device easily portable. Alternatively, an adaptor is available which allows the endoscope to be fitted to the handle of a normal laryngoscope. The utility of the Seeing Optical Stylet has been studied in adults who were not predicted to be difficult intubations [12, 13], where initial reports of its performance were encouraging. It has also been studied in children whose tracheas were predicted to be difficult to intubate [14]. We are unaware of any work examining its usefulness in difficult intubation in adults. In this study, we compared the Seeing Optical Stylet to the gum elastic bougie in tracheal intubation of a manikin adjusted to have a Cormack and Lehane Grade 3 laryngoscopic view [15].

Methods

We contacted the South-east Wales Local Research Ethics Committee with details of the study. In their view, formal ethical approval is not required for volunteer, laboratory based studies that do not involve patients. A Laerdal Airway Management Trainer manikin (Laerdal Medical Ltd, Orpington, UK) was set up to provide a

Cormack and Lehane Grade 3 view with a size 3 metal Macintosh laryngoscope fixed in the manikin's mouth using a system of clamps (Fig. 2). A laryngoscope with a rechargeable battery was used to ensure consistent illumination for all attempts. Although the participating anaesthetists could hold the laryngoscope, they could not improve the view. We used Eschmann re-usable bougies (tracheal tube introducer; SIMS Portex, Hythe, UK), and no single bougie was used > 10 times. Participants were given a brief opportunity to handle the Seeing Optical Stylet and received simple instructions on its use before the study started.

A pilot study using the Seeing Optical Stylet to intubate the trachea of a manikin with a Grade 3 laryngoscopic view revealed the population standard deviation to be 9 s. For a clinically significant difference of 5 s, 44 participants were needed for a study with a power of 0.95 of showing significance at the $p < 0.05$ level. All 44 participants were anaesthetists working at the University Hospital of Wales, Cardiff, UK. Verbal consent was obtained at the outset, no-one was obliged to participate and volunteers were free to withdraw at any time. The intubation time for each participant was recorded anonymously and no attempt was made to analyse results according to any of the volunteer's characteristics such as grade, experience or gender. Each anaesthetist was invited to perform tracheal intubation both with the bougie and with the Seeing Optical Stylet, which were presented in random order. The primary end-point was the time, in seconds, taken to achieve successful ventilation of the lungs with a self-inflating bag. The presence or absence of oesophageal intubation was also recorded.

The results for time taken to intubate were analysed using the Wilcoxon signed rank test for paired non-parametrical data and the data for oesophageal intubation analysed using Fisher's exact test. The statistical program used was SPSS 12 (SPSS UK Ltd, Woking, Surrey).



Figure 2 Manikin used for the study with Macintosh laryngoscope fixed in place – lateral view and view from the head end.

Table 1 Oesophageal intubations and times taken for successful tracheal intubation with the Seeing Optical Stylet and the gum elastic bougie. Values are number or mean (SD) [range].

	Seeing Optical Stylet <i>n</i> = 44	Gum elastic bougie <i>n</i> = 44
Oesophageal intubations; <i>n</i>	0*	6
Mean time to intubation; s	20.8 (9.3) [11–62]†	30 (19.8) [13–120]

*Significantly different from gum elastic bougie group, $p = 0.001$ (Wilcoxon signed rank test).

†Significantly different from gum elastic bougie group, $p = 0.026$ (Fisher's exact test).

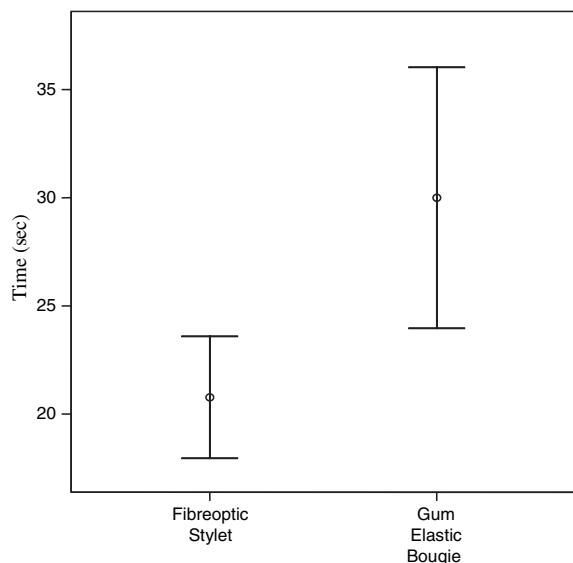


Figure 3 Mean and 95% confidence intervals for time to successful tracheal intubation with the gum elastic bougie and Seeing Optical Stylet.

Results

The mean [range] anaesthetic experience of the participants was 12 [2–31] years. The mean time to successful intubation using the Seeing Optical Stylet was 20.8 s and with the gum elastic bougie 30 s ($p = 0.001$) (Table 1). The means and 95% confidence intervals are shown in Fig. 3. Oesophageal intubation occurred six times with the bougie (14%), which was recognised when use of the self-inflating bag failed to inflate the lungs. Subsequent attempts at intubation were successful in all six cases. No instance of oesophageal intubation occurred with the Seeing Optical Stylet ($p = 0.011$).

Discussion

Although the use of a manikin does not fully reproduce laryngoscopic conditions in patients, it does allow for the

evaluation of equipment and techniques in situations that lead to intubation difficulties in humans [1]. Rigid fibrescopes have yet to gain widespread popularity despite having been on the market for many years [16–18]. This randomised crossover study shows that the Seeing Optical Stylet is a simple and effective tool that requires minimal tuition for the management of a Grade 3 laryngoscopic view. In comparison with a gum elastic bougie, placement of the tracheal tube was faster and less likely to result in oesophageal intubation. It could be argued that the Seeing Optical Stylet had a slight advantage over the bougie in that the tracheal tube was already preloaded onto it before the clock started. However, balancing this is the fact that all participants were extremely familiar with the gum elastic bougie, whereas few had ever seen the fibreoptic stylet before, let alone had prior experience in its use.

It has been suggested that the optimum technique when using the Seeing Optical Stylet is without a laryngoscope blade; the operator simply puts his or her fingers into the anaesthetised patient's mouth, lifting the tongue and jaw forward to create a space for the endoscope to pass. We developed a slightly modified technique for using the fibreoptic stylet in this study. We think that it is preferable to use a normal Macintosh laryngoscope to lift the tongue, partly because every anaesthetist will be familiar with its use and partly because it creates a larger space in the oropharynx. Similar techniques have been described in combination with fibreoptic stylets [19]. We feel that this would further improve the learning curve required to become proficient in the use of the new 'scope.

It can be argued that the gold standard for managing difficult intubation is the flexible fibreoptic laryngoscope. This may well be true in experienced hands but the reality is that this is not yet considered a core skill and not all anaesthetists are able to maintain their proficiency to a high enough standard. In addition, it is not always the most appropriate tool when an unexpected difficult intubation arises. The Seeing Optical Stylet is easy to master; sliding the tip of the endoscope beneath the epiglottis is much the same technique as with a bougie and is familiar to all anaesthetists. This brings the glottic opening into view and since the Seeing Optical Stylet is rigid, manoeuvring it into the trachea requires no great skill. It is also cheaper and less susceptible to damage from misuse than flexible fibreoptic laryngoscopes.

Drawbacks of the new device are that nasal intubation is impossible and it has no suction port if secretions or blood are present in the airway. Also, the J-shaped curve of the 'scope does not allow its tip to be passed very far beyond the vocal cords so, unlike the flexible fiberscope, it cannot be used to inspect the distal trachea or bronchi.

In summary, we think this new rigid fiberoptic scope may find a niche in difficult intubations where 'Plan A' has failed, especially for trainees, where its use may produce less airway and dental trauma and less exaggerated cardiovascular changes. We conclude that the results of this manikin trial are sufficiently encouraging to proceed to a clinical trial in patients.

References

- 1 Weiss M, Schwarz U, Gerber A. Difficult airway management: comparison of the Bullard laryngoscope with the video-optical intubation stylet. *Canadian Journal of Anesthesia* 2000; **47**: 280–4.
- 2 Cook TM. A new practical classification of laryngeal view. *Anaesthesia* 2000; **55**: 274–9.
- 3 Rose DK, Cohen MM. The incidence of airway problems depends on the definition used. *Canadian Journal of Anesthesia* 1996; **43**: 30–4.
- 4 Tse JC, Rimm EB, Hussain A. Predicting difficult endotracheal intubation in surgical patients scheduled for general anaesthesia: a prospective blind study. *Anesthesia and Analgesia* 1995; **81**: 254–8.
- 5 Wilson ME. Predicting difficult intubation. *British Journal of Anaesthesia* 1993; **71**: 333–4.
- 6 Latta IP, Stacey M, Mecklenbrgh J, Vaughan RS. Survey of the use of the gum elastic bougie in clinical practice. *Anaesthesia* 2002; **57**: 379–84.
- 7 Rosenblatt WH, Wagner PJ, Overssapien A, Kain ZN. Practice patterns in managing the difficult airway by anesthesiologists in the United States. *Anesthesia and Analgesia* 1998; **87**: 153–7.
- 8 Kraft P, Krenn CG, Fitzgerald RD, Pernerstorfer T, Fredrick P, Weinstabl C. Clinical trial of a new device for fiberoptic orotracheal intubation (Augustine Scope™). *Anesthesia and Analgesia* 1997; **84**: 606–10.
- 9 Dyson A, Harris J, Bhatia K. Rapidity and accuracy of tracheal intubation in a mannequin: comparison of the fiberoptic with the Bullard laryngoscope. *British Journal of Anaesthesia* 1990; **65**: 268–70.
- 10 Pearce AC, Shaw S, Macklin S. Evaluation of the Upsher scope: a new rigid fiberscope. *Anaesthesia* 1996; **51**: 561–4.
- 11 Smith CE, Pinchak AB, Sidhu TS, Radesic BP, Pinchak AC, Hagen JF. Evaluation of tracheal intubation difficulty in patients with cervical spine immobilization: fiberoptic (Wu scope) versus conventional laryngoscopy. *Anesthesiology* 1999; **91**: 1253–9.
- 12 Agro F, Cataldo R, Carassiti M, Costa F. The seeing stylet: a new device for tracheal intubation. *Resuscitation* 2000; **44**: 177–80.
- 13 Young CF, Rosenblatt WH. Comparison of the Shikani Optical Stylet to direct laryngoscopy for orotracheal intubation by a first year resident. *Anesthesiology* 2004; **101**: A605. <http://www.asaabstracts.com/strands/asaabstracts/abstract.htm;jsessionid=188F0B2D0C2CC112D361D0F5C9E65FF9?year=2004&index=8&absnum=486> (accessed 29 March 2006).
- 14 Pfitzner L, Cooper MG, Ho D. The Shikani seeing stylet for difficult intubation in children: initial experience. *Anaesthesia and Intensive Care* 2002; **30**: 462–6.
- 15 Cormack RS, Lehane J. Difficult intubation in obstetrics. *Anaesthesia* 1984; **39**: 1105–11.
- 16 Bein B, Wortman F, Scholz J, et al. A comparison of the intubating laryngeal mask airway and the Bonfils Intubating fibrescope in patients with predicted difficult airways. *Anaesthesia* 2004; **59**: 668–74.
- 17 Ezrit T, Szmuk P, Warters RD, Katz J, Hagberg CA. Difficult airway management practice patterns among anesthesiologists practicing in the United States: have we made progress? *Journal of Clinical Anesthesia* 2003; **15**: 418–22.
- 18 Levitan RM, Kush S, Hoiander JE. Devices for difficult airway management in academic emergency departments: results of an emergency survey. *Annals of Emergency Medicine* 1999; **33**: 694–8.
- 19 Saruki N, Saito S, Sato J, Takashi T, Tozawa R. Difficult airway management with the combination of a fiberoptic stylet and McCoy laryngoscope. *Canadian Journal of Anaesthesia* 2001; **48**: 212–3.