Reported complications associated with the use of GlideScope® video laryngoscope - How can they be prevented?

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Abstract
Introduction
The use of the GlideScope® video laryngoscope has increased tremendously since its release in 2001. Compared to the Macintosh laryngoscope, its unique design allows an improved view of the glottis. During intubation, it decreases the need to anteriorly displace the lower jaw or manipulate the cervical spine. As a result, there is less sympathetic response to intubation and possibly fewer traumas to the dentition. Intubation may be performed on an awake patient more easily. The GlideScope® video laryngoscope plays a significant role in the management of routine and difficult airways. Unfortunately, the same unique design also requires the use of a stylet and introduces blind spots in the oropharynx during intubation. As a result of this drawback, cases of airway trauma have been reported. We have aimed to write a critical review discussing the complications and precautions associated with the use of the GlideScope® video laryngoscope.

Conclusion
The GlideScope® video laryngoscope is an improvement over the Macintosh laryngoscope as it reduces airway manipulation, but further research must be conducted in order to increase our understanding of the potential pitfalls associated with it and to develop strategies to avoid them.

Introduction
GlideScope® was developed by the Canadian surgeon John Pacey and became commercially available in late 2001. It allows real-time viewing of the airway and tube placement, and it is one of the more widely used video laryngoscopes available, with more than 300 associated publications in Medline1.

The purpose of this critical review is to provide a basic, concise overview of the GlideScope® video laryngoscope, with emphasis on the advantages and reported complications in literature, and to discuss strategies to optimise intubation technique.

Discussion
The authors have referenced some of their own studies in this review. These referenced studies have been conducted in accordance with the Declaration of Helsinki (1964) and the protocols of these studies have been approved by the relevant ethics committees related to the institution in which they were performed. All human subjects, in these referenced studies, gave informed consent to participate in these studies.

Types of GlideScope® video laryngoscopes
The reusable GlideScope® video laryngoscope has a 60-degree curve blade and comes in four sizes: 2, 3, 4 and 5, to facilitate intubations in infants weighing 1.8 kg to the morbidly obese. The unit consists of a portable colour video monitor which has a colour image of 320 × 240 pixels. Start-up is quick with a single button, and does not require any adjustment or white balance. It uses a 12V lithium rechargeable battery, with an average battery life of 90 minutes and 500 charge cycles. Other GlideScope® models include the GlideScope® advanced video laryngoscope designed for difficult and unpredictable airways, and the GlideScope® Ranger, optimised for rugged conditions in pre-hospital settings. Table 1 summarises the GlideScope® product range.

How GlideScope® works during intubation
In conventional laryngoscopy with the Macintosh laryngoscope, the patient’s head is positioned by flexing the lower cervical spine and extending the atlanto-occipital joint, known as ‘sniff the morning air’ position2.

It is believed that direct laryngoscopy aligns the oral, pharyngeal and laryngeal axes to aid in the direct visualisation of the glottis, as shown in Figure 13. In contrast, the camera is sited near the distal tip of the GlideScope® blade. When correctly positioned, the camera acts as the ‘eye’ of the operator and is situated in the pharynx of the patient. This enables the image of the glottis to be projected on the monitor, allowing the operator to see around the corner. The main advantage conferred by this technique includes an improved view of the glottis without the need to anteriorly displace the lower jaw and reduce cervical spine motion4. As a result, there is less sympathetic response to intubation and possibly less leverage force on the teeth5. Intubation may then be performed on an awake patient more easily6. Therefore, this technique has a significant role in the management of routine and difficult airways2.
Its similarities to the Macintosh laryngoscope, as compared with other video laryngoscopes like the Pentax, may contribute to greater user acceptability for most operators experienced with the Macintosh. For both the novice and experienced anaesthetists, it is easier to achieve successful intubation with the GlideScope® as compared with the Macintosh. Direct laryngoscopy generally requires a steeper learning curve and a longer duration to master the technique as compared with the GlideScope®.

**Problems encountered during the use of GlideScope®**

An interesting paradox is seen with the use of GlideScope®. Even though

**Critical review**

![Figure 1: Oral-pharyngeal-laryngeal axes not aligned.](image_url)

<table>
<thead>
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<th>Table 1. Range of GlideScope® products.</th>
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<tr>
<td><strong>GlideScope® video laryngoscope</strong></td>
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<td>Single use</td>
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<td>Key features</td>
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<tr>
<td>Suitable for patient weight</td>
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<td>Blade sizes (#)</td>
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<td>Digital video recording availability</td>
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CMOS, complementary metal-oxide semiconductor; GVL, GlideScope® reusable video laryngoscope; Li, lithium; SD, secure digital; TFT, thin film transistor; VGA, video graphics array.
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Table 2. Clinical pearls for intubation success and injury avoidance.

- Verathon recommends the insertion of the GlideScope® blade via the midline of the tongue to the epiglottis. This should be done under vision control.14.

- The GlideScope® may be used like a Macintosh laryngoscope to indirectly lift the epiglottis or produce a Miller’s lift.

- The use of the ETT stylet is recommended. A malleable stylet with a 60–90 degree curvature may be used. GlideRite® Rigid Stylet produced by Verathon is also available.

- Introducing the ETT close to the side of the blade helps to avoid blind, traumatic insertions as the space created by the presence of the blade allows direct visualisation of the styletted ETT, until its tip is seen on the monitor.14.

- To aid the passage of the ETT, once the tip is at the vocal cords, withdraw the stylet slightly, about 2–3 cm, before further ETT advancement. This avoids trauma to the vocal cords by the rigid stylet. Withdrawal of the laryngoscope or reduction of the lifting force allows the glottis to drop, which may also aid the passage of ETT.

- Always ensure that the tip of the ETT is observed during advancement—initially via direct vision, and then via the monitor when the tip disappears from direct view after further advancement. Avoid blind advancement of the ETT. This will reduce the risk of injury in the oral structures caused by the rigid stylet.17

- After intubation, as the GlideScope® is withdrawn, attention should be paid to the path of the ETT and possible injury to the oral cavity.18

- The use of soft-edge ETT (such as the Parker Flex-Tip™) may avoid trauma to the pharynx.17

- Insert the ETT with the bevelled tip facing against the blade of the GlideScope®.15

ETT, endotracheal tube.

Table 3. Clinical reports of complications associated with the use of GlideScope®.

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<th>Complications</th>
<th>Outcome</th>
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<tr>
<td>Hsu WT et al.19 Anesth Analg, 2007.</td>
<td>29-year-old ASA 1 male scheduled for rhinoplasty</td>
<td>Intubated with #7.5 ETT angled to a 60-degree curvature with a stylet. ETT had pierced right soft palate.</td>
<td>Surgeon diagnosed the injury during oral cavity examination intraoperatively. There was no bleeding at the palate and the ETT was removed uneventfully. Patient was discharged 3 days later without any untoward events.</td>
<td>Authors stressed that during the advancement of the ETT from the mouth to the pharynx, the tip of the ETT that could have damaged the soft tissue could not be monitored on the monitor.</td>
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<tr>
<td>Malik AM et al.17 Anesth Analg, 2007.</td>
<td>72-year-old male with congenital myotonia, previous Cormack-Lehane grade 3 laryngeal view and history of difficult intubation</td>
<td>Intubated with #8 ETT, mounted on manufacturer recommended GlideRite® Rigid Stylet, was inserted under GlideScope® vision. It perforated the right anterior tonsillar pillar.</td>
<td>Injury was indicated by blood in the retropharynx seen on the GlideScope® monitor. During the withdrawal of the GlideScope® blade, the injury was seen on the monitor. ETT was removed and the trachea was reintubated with a fiberoptic laryngoscope. No delay in extubation. Patient reported minimal throat soreness.</td>
<td>Easy grade 1 view on GlideScope®. However, ETT was passed through the oropharynx blindly until it was seen on the GlideScope® screen. Patients with congenital myotonia can be resistant to the effects of non-depolarising muscle relaxants which may have contributed to the mishap.</td>
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<td>Choo MK et al.(^ {15} ) Can J Anaesth, 2007.</td>
<td>65-year-old female who was scheduled for urological surgery</td>
<td>#7.5 ETT, preformed with stylet, was used for intubation. At the end of the case, it was noticed that the ETT had perforated the right palatopharyngeal fold.</td>
<td>Surgical consult was required for haemostasis with electrocautery. Patient was subsequently extubated after bleeding stopped. Patient required overnight hospitalisation for observation. Follow-up 6 weeks later showed good wound healing.</td>
<td>No resistance was encountered while passing the ETT into the oropharynx, but slight resistance was encountered as the ETT passed the laryngeal inlet.</td>
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<tr>
<td>Cooper RM et al.(^ {14} ) Can J Anaesth, 2007.</td>
<td>57-year-old female with hemifacial microsomia presented for facial scar revision. She exhibited features of a difficult airway including a small mouth and limited cervical extension.</td>
<td>Subsequent airway examination after intubation with direct laryngoscopy revealed Cormack-Lehane grade 4 view. The ETT was seen dissecting the right palatopharyngeal arch.</td>
<td>Bleeding was minimal. The dissection was surgically repaired with two sutures. Patient was discharged the next day any without further problems.</td>
<td>Good laryngeal view was obtained on the GlideScope®. There was difficulty in the introduction of the stiletted ETT into the larynx by the first operator. The second operator completed the intubation with the GlideScope®. No resistance was felt by the experienced laryngoscopist during the advancement of the ETT as it dissected the palatopharyngeal arch.</td>
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<tr>
<td>Hsu WT et al.(^ {20} ) Acta Anaesthesiol Taiwan, 2008.</td>
<td>72-year-old female presented for aortic valve replacement and coronary bypass grafting with severe aortic stenosis and coronary artery disease. She was edentulous.</td>
<td>The ETT had perforated her right palatopharyngeal arch, causing significant bleeding.</td>
<td>Upon the completion of cardiopulmonary bypass and surgery, blood was seen on the patient’s face. This prompted airway examination with direct laryngoscopy, which revealed the injury. There was persistent bleeding which required electrocautery for haemostasis. Patient remained intubated and mechanically ventilated for unrelated reasons.</td>
<td>Novice operator performed the intubation, supervised by an experienced GlideScope® user. Grade 1 Cormack-Lehane view was obtained with the GlideScope® easily. To bring the ETT (preformed with a malleable stylet) into view on the monitor, two attempts were required. Subsequent ETT manipulation was not difficult.</td>
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<tr>
<td>Hsu WT et al.(^ {20} ) Acta Anaesthesiol Taiwan, 2008.</td>
<td>38-year-old female with 40% total body-surface-area burn injuries (face, neck and thorax), inhalational injury and respiratory distress, required an ETT exchange. She had a difficult airway, Cormack-Lehane grade 4 view was obtained due to her burn injuries.</td>
<td>After removal of the existing ETT, a #7.0 ETT with a stylet was inserted through the vocal cords under GlideScope® visualisation. Examination of the oropharynx with direct laryngoscopy showed that the ETT had perforated the right palatoglossal arch.</td>
<td>The ETT was removed and reintserted under direct laryngoscopy after surgical consult. There was no active bleeding and the patient remained mechanically ventilated.</td>
<td>An experienced operator performed the intubation. Cormack-Lehane grade 2 view of the vocal cords was obtained with the GlideScope®. A contributory factor to the injury was the small oral cavity which contained a nasogastric tube, duodenal tube and an existing ETT.</td>
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All authors contributed to the concepƟon, design, and preparaƟon of the manuscript, as well as read and approved the final manuscript.

All authors abide by the AssociaƟon for Medical Ethics (AME) ethical rules of disclosure.

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<td>Magboul MM et al.18</td>
<td>80-year-old female with morbid obesity and difficult airway</td>
<td>#7 ETT, mounted on GlideRite™ Rigid stylet, perforated the retromolar trigone.</td>
<td>Injury was diagnosed by the surgeon during oral surgery. Repeat intubation with the same technique was uneventful. No delay in extubation or lingual nerve injury.</td>
<td>View of vocal cords and epiglottis seen. One attempt intubation with easy introduction of ETT.</td>
</tr>
<tr>
<td>Shields OK et al.16</td>
<td>49-year-old male with rheumatoid arthritis, obesity and predicted difficult airway, presented for emergency laparoscopy. Modified, rapid sequence inducƟon was performed.</td>
<td>GlideScope® #4 blade inserted by trainee and observed by specialist. The posterior soft palate was traumatised and the pharynx was filled with blood, which obscured the view of the vocal cords.</td>
<td>Pharyngeal succioning, cri-coid pressure release and mask ventilation, were required before the next attempt at intubation.</td>
<td>Injury occurred despite proper gentle technique and the absence of bleeding diathesis. The blade appeared to have no defects although the leading edge might have been sharp or malformed.</td>
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ASA 1, American Society of Anaesthesiology patient classification status 1 (normal healthy patient); ETT, endotracheal tube.

Clinical pearls for intubation success and injury avoidance are summarised in Table 2.

The common factor associated with intraoral injuries such as palatopharyngeal, anterior tonsillar pillar or soft palate perforations, is blind advancement of the endotracheal tube. Injuries have occurred despite apparent gentle technique and the lack of resistance encountered by the operator. When upward force is applied to the GlideScope® to achieve better laryngeal visualisaƟon, the tonsillar pillars and related structures may be stretched taut and become susceptible to perforation14.

This highlights the need for constant visual assessment of the tip of the endotracheal tube under direct vision during the initial oral-pharyngeal insertion, as well as during subsequent advancement of the tube on the GlideScope® monitor. In the interim, there may be a blind spot, depending on the patient’s oral anatomy15. A strategy to overcome such problems is to advance the endotracheal tube right next to the GlideScope® blade, near the midline. This provides maximal space for endotracheal tube advancement. The anatomy of the oral structures is demonstrated in Figure 2.

Figure 2: Picture of the oral cavity.

it provides an improved view when compared with direct laryngoscopy, that does not necessarily translate to better intubation success12. Due to the line of sight created by direct laryngoscopy, even in poor views, intubation may be possible with adjuncts like the bougie and stylet13. In contrast, even when a grade 1 or 2 Cormack and Lehane view is obtained with the GlideScope®, intu-Ɵbation may not be possible in the first attempt.

The manufacturer recommends a four-step technique when using the GlideScope®:

1. The GlideScope® is first intro-duced into the midline of the oral pharynx with the left hand.
2. The epiglottis is identified on the screen and the scope is manipu-Ɵlated to obtain the best glottic view.
3. The endotracheal tube is then guided into position near the tip of the laryngoscope by direct vision.
4. When the distal tip of the endo-tra-cheal tube disappears from direct view, it should be viewed on the monitor. Gently rotate or angle the tube to redirect as needed.

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There was one report of a palate injury caused by the leading edge of the GlideScope® video laryngoscope. At all times, the advancement of the blade should be midline, gentle and under vision if possible. After intubation, the oral airway should be examined during laryngoscope withdrawal. Details of reported complications associated with the use of GlideScope® are summarised in Table 3.

**Conclusion**

The GlideScope® video laryngoscope is a useful tool for intubation. It improves glottic view and reduces the need for airway manipulation. Despite its ease of use, thorough understanding of its unique characteristics is important in avoiding potential intubation injuries.

**References**


**For citation purposes:** Thong SY, Goh SY. Reported complications associated with the use of GlideScope® video laryngoscope—How can they be prevented? OA Anaesthetics 2013 Mar 01;1(1):1.