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An Angulated Laryngoscope for Routine and Difficult Tracheal Intubation

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A previous study of tracheal intubation in a large series of patients found that multiple attempts at intubation were required in 18% of patients, and that, in 4%, a laryngoscope blade other than that originally selected was required for the successful tracheal intubation.[1]

While the curved laryngoscope blade does follow an anatomical arc from teeth to larynx, the upper part of the laryngoscopists view is always partly diminished anteriorly by the curvature of the blade. The view is significantly impaired when optimal placement of the laryngoscope blade is restricted by limited atlanto-occipital extension or by a large tongue or short mandible.

Direct laryngoscopy in such circumstances can be facilitated by using an angulated straight-bladed laryngoscope. I have designed and tested such a blade.

DESCRIPTION OF THE BLADE

The new laryngoscope blade is essentially a straight blade modified by bending forward through 45° at the midpoint (fig. 1).

The horizontal spatula has a small horizontal step and a vertical component that is significantly lower than that in the Macintosh blade. The blade tip is beaded on its underside. The lamp is 2 cm from the tip, and focuses directly above the midpoint of the blade tip.

The blade is made in three lengths from tip to angle: 6.7 cm, 8 cm, and 9.3 cm. It is made with hook-on or screw-on fittings.

The view provided (fig. 2) is framed by the laryngoscope and the right side of the patient's mouth similar to that seen with the Macintosh blade.

Just as the curve on the Macintosh blade can obscure the entire view of the larynx, so may the angle of this new blade also do this. It is then necessary to have a mechanism to see around this corner. A prism has been cut from a transparent acrylic material. It has a flat base that fits flush to the laryngoscope blade, just proximal to the angle. The leading face slopes at an angle of 62° to refract the light optimally. The top surface rises at an angle calculated to prevent loss of light. A view of the larynx is obtained by looking through the rear face of the prism. A pair of steel lugs on the blade form a taper fitting, and this allows the prism to be rapidly attached to the blade when required. The intermediate length blade can be used as a plain straight blade for use in children.

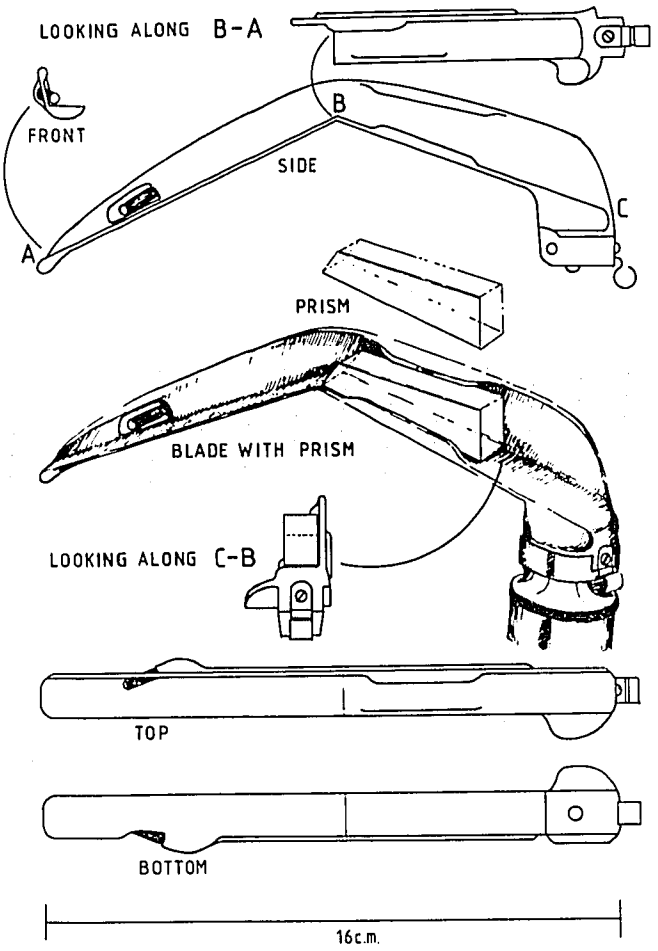

FIG. 1. Scale drawings of angulated laryngoscope. The top diagram shows the aspect normally seen when the anesthetist looks forwards from the angle along the distal part of the blade in the direction BA.

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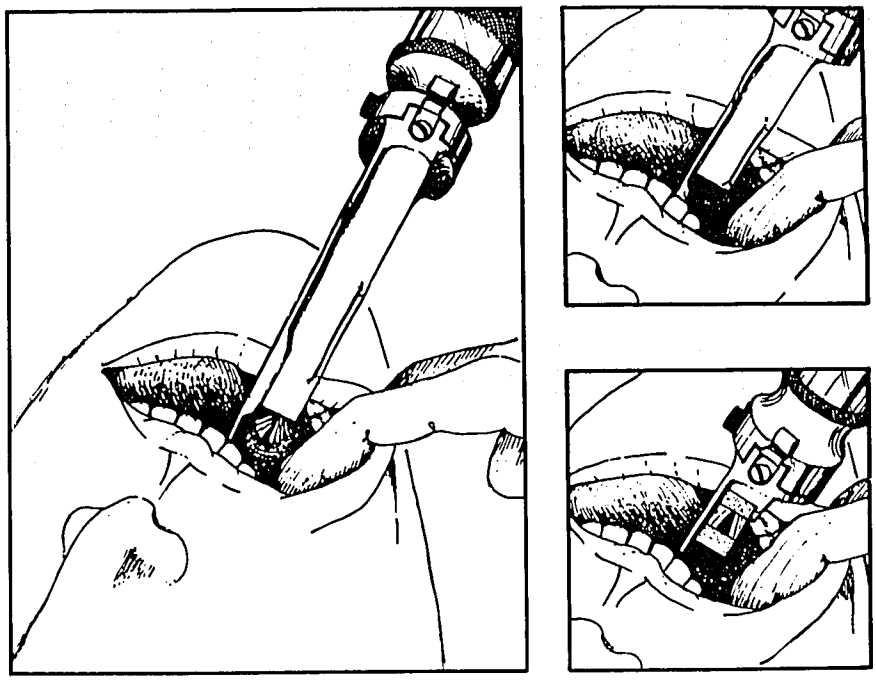

FIG. 2. (*left*) This drawing shows the insertion of the angulated laryngoscope through the oropharynx, to give a direct view of the larynx. (*top, right*) Drawing illustrates the uncommon situation where the structures push the laryngoscope angle well back in the pharynx obscuring any view of the epiglottis or larynx. (*bottom, right*) This drawing shows how attachment of the prism now affords an indirect view of the larynx.

TECHNIQUE FOR USING THE INSTRUMENT

Without Prism. This laryngoscope is used very much like a conventional straight-bladed laryngoscope, and, in the majority of cases, there is no need to use the prism. The blade is inserted from the right corner of the mouth, in the groove between the right tonsil and tongue. As with other rigid laryngoscopes, exposure is generally better when insertion is made from the side of the mouth, while there is more room to manipulate an endotracheal (ET) tube if a midline insertion is chosen. Care is taken to hold the tongue to the left and to avoid levering the blade on the upper teeth. Greater total angulation even than that of the Macintosh blade reduces the risk of pressure on the upper teeth when exposing the larynx. As with the straight blade, the tip is alternately advanced and the handle rotated backwards (fig. 3). This is continued until the tip reaches the esophagus, then the blade is withdrawn slightly until the larynx is exposed, the epiglottis being held forward by the blade.

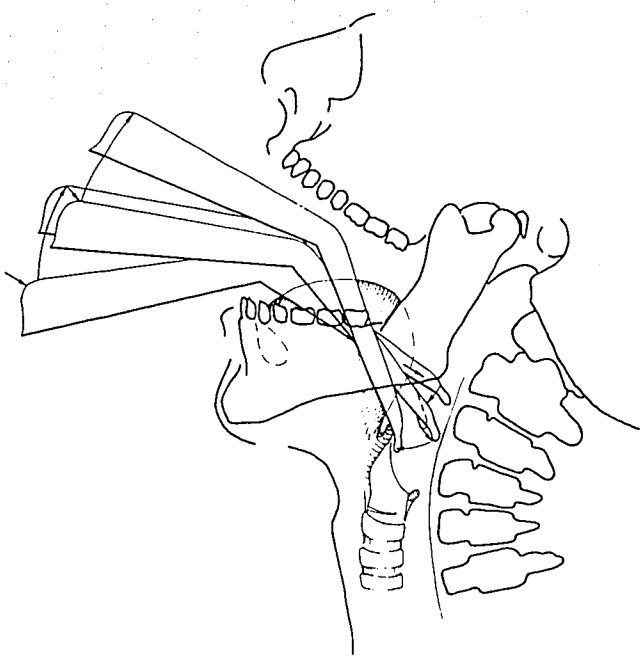

FIG. 3. As with other straight blades, the distal segment is progressively advanced and rotated.

In effect, the blade can be considered a short straight blade (to get around tight corners) with an offset handle designed to avoid contact with the upper teeth (fig. 4). It is sometimes helpful for an assistant to pull the right corner of the mouth upwards and, where necessary, depress the larynx posteriorly and to the left to improve exposure.

Used in this way, without the prism, the endoscopist is looking along the straight part of the distal end of the blade along BA (fig. 1). Experience has shown that the best exposure of the larynx is obtained using the longest blade possible.

With Prism. Occasionally, when a patient's mouth is so small as to necessitate a short blade, or when the patient has a large tongue or short mandible, the blade

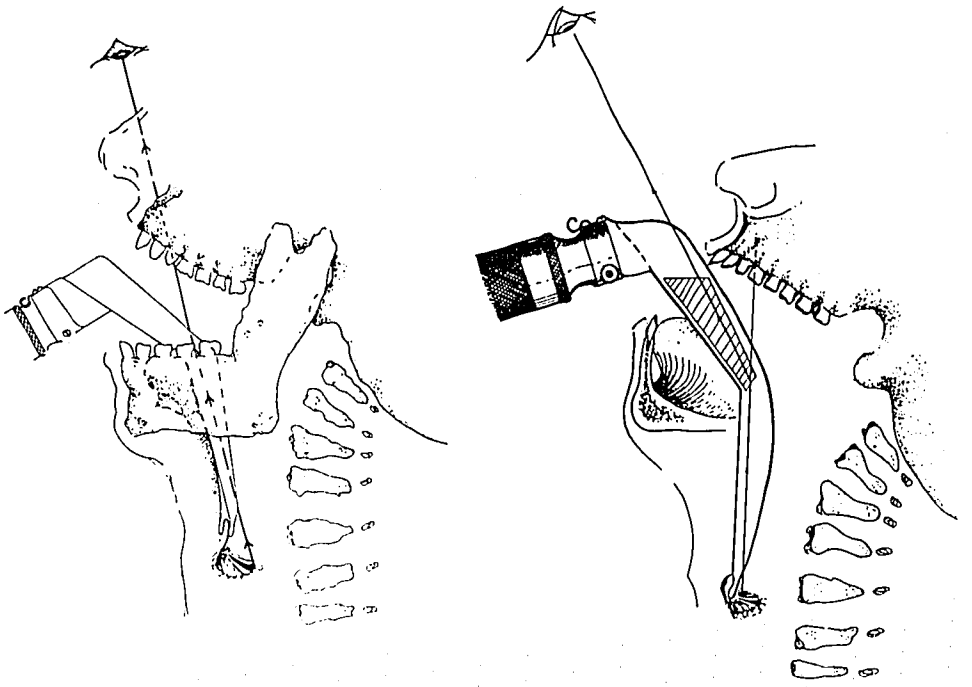

FIG. 4. (*left*) The way the laryngoscope is used on almost all occasions. Even in the majority of otherwise difficult laryngoscopies, by looking down the right side of the maxilla, the observer can see at least the posterior commissure (and generally much more) when the lip is pulled upwards and outwards. (*right*) The laryngoscope angle cannot be pulled forward sufficiently for the larynx to be seen directly. It has been necessary to attach the prism, now providing an indirect view around the corner.

angle must be inserted further into the oropharynx. The view of the larynx may then be completely obscured. The prism is then required (figs. 2, 4). The prism allows the anesthetist looking along the line CB (fig. 1) to see the larynx. Thus, when the prism is used, because the image of the larynx is rotated by 34°, the anesthetists head is higher and further forward than with the previous approach. Often, a curved stylet will then be required to direct the tip of the ET tube anteriorly.

To prevent condensation of moisture on the prism, the author recommends that a fine film of antifog preparation (*e.g.*, "Ultra Stop"®, Pro-med, Vienna) be applied to the leading and trailing surfaces of the prism. Some users prefer to warm the prism (mounted on the laryngoscope and kept dry by wrapping in a polythene bag) in water at 50° C prior to use. The user will need to employ one method when prior clinical examination indicates the likelihood of difficult tracheal intubation.

CLINICAL EXPERIENCE

Over a 5-yr period, this laryngoscope has been used regularly in the author's anesthetic practice encompassing more than 3,500 tracheal intubations, and was wholly successful. In the past 2 yr, attempted laryngoscopy in 12 patients with a Macintosh laryngoscope (made to test the possibility of difficulty suggested by prior clinical examination) failed to elevate the epiglottis or expose the larynx. In each of these cases, the angulated laryngoscope displayed the larynx adequately, and the prism has rarely been required. Five patients whose tracheas the author had found extremely difficult to intubate prior to the development of this laryngoscope, and two others whose attempted tracheal intubation had been abandoned by colleagues, were among those successfully intubated with this new instrument. In all of these, major anatomical abnormalities (poor neck extension, short mandible, or large tongue) had prevented visualization of the larynx when the Macintosh blade was used, despite satisfactory muscle relaxation and optimal head positioning.

Thirty-three evaluators of this laryngoscope are finding it useful both in routine cases and in patients in whom tracheal intubation was otherwise difficult. Eight have advised that they have had no difficulty displaying the larynx with this instrument in patients in whom previous tracheal intubation had been extremely difficult or impossible. One considers this the laryngoscope of choice for his weekly list in a "spinal unit" where he regularly anesthetizes patients with cervical vertebral fractures.

The angulated blade feels different than other blades, and, hence, practice is essential.[2] Similarly, practice with the prism many times is recommended before having to use it in a situation requiring its use.

DISCUSSION

The problem of reducing the incidence of failed tracheal intubation and unintentional intubation of the esophagus is complex, and the solution requires more than development of improved instruments. The endoscopist must first be able to recognize when tracheal

intubation is likely to be difficult,[5] and understand and be able to use the variety of instruments available. Ideally, an instrument will be useful for both the routine and difficult tracheal intubation. In this context, the new laryngoscope offers advantages over currently available models, combining attractive features of both straight and curved bladed laryngoscopes and the refraction that is possible when a prism is used.

The epiglottis is lifted directly. This avoids the situation where the hyoid bone cannot be displaced forward and the epiglottis continues to obstruct a view of the larynx.[4] In addition, the back of the tongue is completely flattened out to give a direct line of vision. The low profile permits insertion into a smaller mouth opening. So far, the correct length blade has never failed to display the larynx. However, it can be expected to fail in patients in whom the mouth opening is very small (under 2.5 cm), or where there is severe limitation of head extension on neck ("intubation angle"[5] under 95°).

This laryngoscope has a similar shape to the Siker[6] laryngoscope profile (but is less bulky than that instrument). Both the new blade and the Siker blade can be used in routine laryngoscopy, but are especially indicated where prior clinical examination suggests that laryngoscopy could be difficult or impossible with presently available laryngoscopes. The only contraindication to this new laryngoscope is in patients at risk for vomiting in whom rapid sequence induction and tracheal intubation is indicated and whose trachea is considered to be easy to intubate with the Macintosh laryngoscope, because, in this situation, the Macintosh blade has been found marginally quicker to use. In contrast to the Siker blade, which has a C-shaped cross section, this new blade has an inverted L (Γ)-shaped cross section. Consequently, in the majority of laryngoscopies, a direct view of the larynx is obtained. The prism facility of the new laryngoscope, although rarely required, provides greater convenience than the mirror (and its inverted image) that is always required with the Siker. In addition, the use of a single angle and provision of three sizes allows closer fitting and less risk of failing to insert the instrument when restricted mouth opening or head extension reduce intra-oral space.

In contrast with the Macintosh blade, because there is no curve on the horizontal component of the angulated laryngoscope, impairment of the view is rarely a problem. The use of a single angle, rather than a continuous curve, requires less compression of the tongue where its anterior displacement is restricted by the mandible, hyoid bone, and palato-glossal arch. The "inverted L" cross section of the blade leaves room for easy manipulation of an ET tube or Magill forceps in the mouth.

The new laryngoscope provides improved tracheal intubation conditions, resulting in fewer delayed and failed tracheal intubations.

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Neuromuscular Function Monitoring Comparing the Flexor Hallucis Brevis and Adductor Pollicis Muscles

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To monitor the response to muscle relaxants, the adductor pollicis muscle response to ulnar nerve stimulation is commonly observed or recorded. Occasionally, because of inaccessibility, the hand muscles are difficult to monitor in the operating room. The orbicularis oculi and flexor hallucis brevis muscles have been described as alternative sites for neuromuscular function monitoring.[1] Previous studies, however, have demonstrated