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APPARATUS

A comparison of the Truview® blade with the Macintosh blade in adult patients

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Summary

The Truview® blade facilitates a view of the vocal cords by indirect laryngoscopy. We prospectively compared the view obtained at laryngoscopy and intubating conditions of Truview (Group 1) or Macintosh (Group 2) blades in 170 patients who were scheduled to undergo general anaesthesia. We studied pre-operative airway evaluation, laryngoscopic view, duration of intubation, maximal force applied during intubation, anaesthetist's estimation of intubation effort on a 1–3 scale, bleeding, teeth and soft tissue damage, and postoperative stridor and hoarseness. The results demonstrated that, whilst the Truview produced a better laryngoscopic view and less maximal force applied during intubation, the duration of intubation was longer. No significant difference was found in the anaesthetist's estimation of intubation effort, tooth damage or post-operative stridor and hoarseness. Significantly fewer patients suffered bleeding and soft tissue damage following intubation with the Truview than with the Macintosh blade. The Truview blade is a useful option for tracheal intubation in patients with normal and anticipated difficult airways.

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The majority of tracheal intubations performed daily are easy and effortless. However, difficult tracheal intubation, which occurs in 1.5–13% of general anaesthetics [1, 2], can be associated with serious morbidity and mortality [3]. There has been considerable effort to identify the optimal pre-operative test to predict the possible occurrence of difficult intubation [4–7]. However, unanticipated difficult intubation remains a significant problem [8]. In a case of difficult intubation, either the larynx cannot be visualised using conventional direct laryngoscopy, or the larynx is visualised but it is difficult to pass the tube into the trachea. Airway devices and equipment have been developed to help overcome this obstacle. Some, such as the laryngeal mask airway, are inserted blindly and do not require visualisation of the vocal cords. Others, such as fibreoptic devices, enable an indirect view of the vocal cords. The Truview® EVO™ blade (Truphatek Holdings Ltd, Netanya, Israel) belongs to this latter group. It facilitates an indirect view of the vocal cords although it is placed and handled like a standard laryngoscope, with Macintosh or Miller blades. The Truview blade is based on a combination of an optical system with a specially profiled 12.8 mm slim steel blade. The optical apparatus provides a 42° angled deflection view through a 15-mm eyepiece. The angle of view facilitates vision in patients with limited neck extension. The Truview eyepiece can be connected to an endoscopic camera head with a monitor, allowing audience viewing of the procedure for training purposes. In addition, the Truview blade has a port that connects to the auxiliary oxygen flow meter of the anaesthesia machine (flow rate of 4–6 $l.min^{-1}$), which prevents misting and clears secretions from the lens and provides continuous oxygen insufflation during intubation (Fig. 1).

The aim of this study was to compare laryngoscopy and intubation using the Truview blade and using the Macintosh blade in a group of adult patients with a usual distribution of airway characteristics

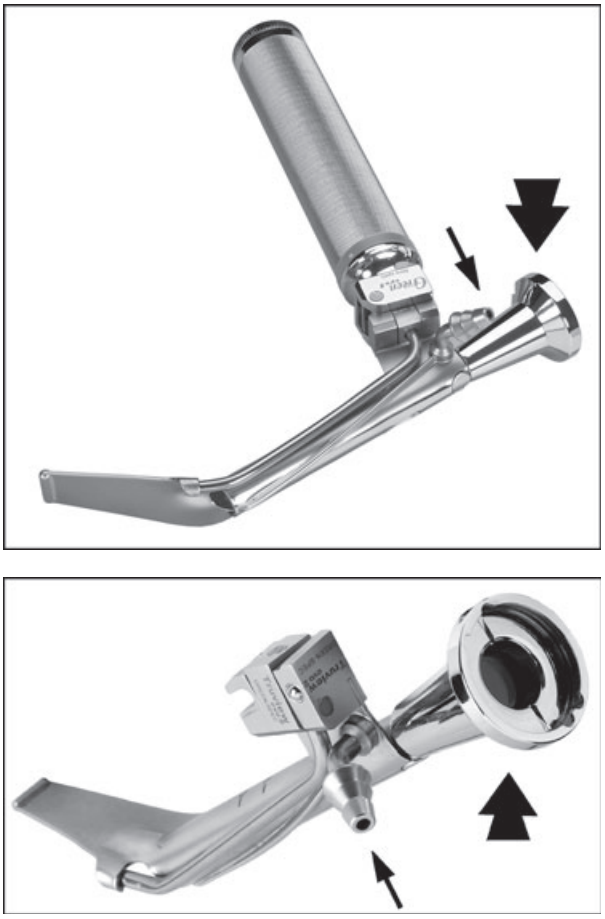

Figure 1 Truview EVO laryngoscope in various positions. Upper plate show side view, lower plate shows operator's view. Wide arrow points at the eyepiece; slim arrow shows the connection to the auxiliary oxygen flow meter.

Methods

Following approval of the local Ethics Committee, we conducted a prospective study of adult patients who were scheduled to undergo elective surgery requiring general anaesthesia and tracheal intubation. Signed informed consent was obtained from each patient who agreed to participate in the study. Sample size was calculated based on differences in Cormack laryngoscopic view grade 1 between the groups (based on preliminary pilot data) and difficult intubation being 13% of the surgical population [2]; using a paired two-tailed *t*-test with an α error of 0.05 and a β error of 0.1.

Exclusion criteria included: American Society of Anesthesiologists (ASA) grade ≥ 4, coagulopathy or use of anticoagulants, indication for rapid sequence induction of anaesthesia and surgery involving the oral cavity, larynx, pharynx or neck, where postoperative sore throat may occur from surgical factors.

The patients were randomly divided into two groups: intubation using a laryngoscope equipped with a Truview (Group 1) or with a Macintosh (Group 2) blade.

Protocol

Pre-operative airway evaluation was performed by anaesthetists who were unaware of the patient's group allocation. Airway evaluation included: opening of the mouth (normal ≥ 3 cm or restricted), thyromental distance (normal ≥ 6.5 cm or abnormal if shorter), condition of the teeth (normal, loose or denture), temporomandibular joint (TMJ) mobility (normal or restricted), neck movement (normal or restricted), mandibular size (normal or micrognathia), and Mallampati oropharyngeal view according to the revised scoring of Samsoon and Young [9]. The anaesthetist had to give a YES/NO answer to whether the intubation would be difficult. It was a subjective, unguided decision, based on the patient's anatomy and the anaesthetist's own experience.

On the day of the surgery, the patient received oral metoclopramide 10 mg and diazepam 10 mg pre-operatively. On arrival in the Operating Room, the patient was monitored using non-invasive blood pressure, electrocardiogram and pulse oximeter, and intravenous access was established. The lungs of the patient were pre-oxygenated for 5 min prior to intubation. The anaesthetic consisted of propofol (2–3 $mg.kg^{-1}$) and fentanyl (0.001–0.002 $mg.kg^{-1}$), followed by suxamethonium (1 $mg.kg^{-1}$). Three anaesthetists, each with at least 2 years experience, performed the intubations. Each anaesthetist had performed at least five preliminary intubations using the Truview blade prior to the start of the study. Size 7.0–7.5 tracheal tubes were used in females, and size 8.0–8.5 in males. During laryngoscopy, an assistant timed the period from introducing the laryngoscope into the mouth until inflating the cuff of the tube. The maximal force applied during intubation was measured in kg using a Digital Force Gauge (Mark-10 Corporation; Hicksville, NY) handle connected to the evaluated blade. When initial intubation failed, the anaesthetist was instructed to act according to his/her preference, such as changing blades, patient position or applying external laryngeal pressure. The number of attempts until the tube was in place was recorded, as were the occasions of changing the laryngoscope blade for another size or type of blade. The anaesthetist evaluated the difficulty in performing the intubation (on a scale of 1–3, with 1 = easy and 3 = difficult) and the laryngeal view according to the Cormack-Lehane classification [10]: in grade I, the glottis is fully exposed; in grade II, the glottis is partially exposed; in grade III, only the epiglottis is seen; in grade IV the epiglottis is not seen. Heart rate, blood pressure and haemoglobin

oxygen saturation were recorded throughout intubation and thereafter. Following surgery, the patient was evaluated by the postanaesthesia care unit anaesthetist for symptoms of sore throat. The incidence of broken teeth, soft tissue oedema, bleeding from gums or lips, stridor or hoarseness were recorded as well.

Data was collected for each patient concerning age, gender, weight, pre-anaesthesia airway evaluation, intubation parameters, and postextubation symptoms.

Statistical analysis

A commercial software package (STATISTICA, Statsoft, Tulsa, OK) was used. Continuous variables were tested by analysis of variance (ANOVA). When normality (tested by Levine's test for the homogeneity of variance) was not confirmed, the non-parametric Mann–Whitney test was applied. Categorical variables were tested with Pearson's Chi-squared test. Significance level was set at $p < 0.05$.

Results

Demographic and airway assessment data are shown in Table 1. There was a statistically significant difference between the groups in mean weight of the patients. Also, there was a significantly higher oropharyngeal Mallampati view and a higher number of restricted cervical or TMJ mobility in Group 1 (Truview).

Throughout the study period, the patients' oxygen saturation remained at 95% or greater. Intubation variables are summarised in Table 2. The Cormack view was significantly lower in Group 1. The duration of intubation was significantly longer in Group 1, and the maximal force applied during intubation was greater in Group 2 (Macintosh).

Cases that were defined by the intubating anaesthetist as difficult (difficulty scale = 3) were analysed separately. These results are shown in Table 3. The duration and the maximal force applied during these intubations were significantly greater than the easy (difficulty scale = 1, 2) intubations ($p < 0.001$ for both). The Cormack view was significantly better in Group 1 than in Group 2, and the maximal force applied during intubation was higher in Group 2 than in Group 1.

Intubation and postextubation complications are shown in Table 4. More patients in Group 2 suffered from damage to soft tissue or bleeding gums or lips. Studying the cases of patients who suffered soft tissue damage or bleeding from both groups (28 patients), we found that significantly greater force had been applied during intubation (mean maximal force 15.3 (SD 4.3) kg) compared to the 142 patients who did not suffer such complications (mean maximal force 9.5 (SD 4.5) kg), $p < 0.001$.

Overall, 138 intubations were successful at the first attempt, 10 at the second attempt and three only at the third attempt. The mean maximal force applied during

Table 1 Demographic and airway assessment data.

	Group 1 Truview blade ($n = 80$)	Group 2 Macintosh blade ($n = 90$)	p value
Age; years	60 (12)	48 (18)	NS
Weight; kg	79 (13)	74 (13)	0.04*
Sex; F : M	44 : 36	48 : 42	NS
ASA grade 1/2/3	24/41/13 33%/51%/16%	19/53/18 21%/59%/20%	NS
Mouth opening Normal/restricted	75/5	90/0	0.02
Thyromental distance Normal/abnormal	72/8	81/9	NS
Dental status: Normal/loose/dentures	65/9/9	66/5/19	NS
Cervical mobility Normal/restricted	67/13	88/2	0.001*
TMJ mobility Normal/restricted	76/4	89/1	0.03*
Mandibular size Normal/micrognathia	74/6	83/7	NS
Mallampati view Class 1/2/3/4	20/30/27/3	40/45/5/0	0.001*
Expected difficulty No/Yes	64/16	80/10	NS

Data presented as mean (SD) or number of patients.
NS, not significant; ASA, American Society of Anesthesiologists grade; TMJ, temporomandibular joint.
*Significantly higher or more abnormal cases in Group 1.

Table 2 Intubation variables.

	Group 1 Truview blade ($n = 80$)	Group 2 Macintosh blade ($n = 90$)	p value
Duration of intubation; s	33 (12)	24 (13)	< 0.001*
Cormack view			
grade 1/2/3/4	69/7/0/0	41/43/6/0	< 0.001**
Maximal force applied; kg	7.2 (3)	13.5 (5)	0.002**
Changing the blade			
Yes/No	1/79	2/88	NS
Successful laryngoscopic attempt			
1/2/3	76/3/1	80/8/2	NS
Lowest oxygen saturation during intubation; %	98.8 (1)	99.7 (1)	NS
Difficulty performing the intubation			
1/2/3	55/20/5	72/11/7	NS

Data presented as mean (SD) or number of patients.
NS, not significant.
*Significantly higher in Group 1 (Truview).
**Significantly lower in Group 1.

Table 3 Details of difficult intubation cases.

	Group 1 Truview blade ($n = 80$)	Group 2 Macintosh blade ($n = 90$)	p value
No. of patients with difficult intubation	5/80 (6.3%)	7/90 (7.7%)	NS
Duration of intubation; s	62 (16)	51 (23)	NS
Cormack view:			
1/2/3/4	5/0/0/0	1/2/4/0	0.01*
Maximal force applied; kg	8.3 (3.3)	16.1 (4)	0.007*

Data presented as mean (SD) or number of patients.
NS, not significant.
*Significantly lower in Group 1 (Truview) compared to Group 2.

Table 4 Intubation and postextubation complications.

	Group 1 Truview blade ($n = 80$)	Group 2 Macintosh blade ($n = 90$)	p value
Damaged tooth			
Yes/No	0/80	1/89	NS
Soft tissue damage			
Yes/No	2/78	18/72	< 0.001*
Bleeding gums/lips			
Yes/No	0/80	8/82	< 0.001*
Sore throat			
Yes/No	4/76	5/85	NS
Stridor			
Yes/No	1/79	0/90	NS
Hoarseness			
Yes/No	0/80	1/89	NS

Data presented as number of patients.
NS, not significant.
*Significantly lower in Group 1 (Truview).

laryngoscopy was significantly lower in the first attempt to intubate (9.4 (SD 4.7) kg) compared to the second (14.9 (SD 5.7) kg) or third attempts (13.2 (SD 3.8) kg), $p = 0.002$.

In the pre-operative evaluation, 26 patients were expected to have a difficult intubation and 144 were not. When analysing expected-to-actual difficult intubation (difficulty = 1 vs difficulty = 2, 3), we found that the anaesthetist's expectation had a sensitivity of 0.42, a specificity of 0.94, a positive predictive value of 0.69, a negative predictive value of 0.83, and an accuracy of 0.81.

Discussion

In this study we found that the Truview blade provided a better laryngoscopic view than the Macintosh blade. It required significantly less force and resulted in less soft tissue trauma following intubation. However, intubation using the Truview took longer than using the Macintosh blade. This may be due to the greater experience of anaesthetists with the Macintosh blade. Although the anaesthetists who participated in this study had practiced with the Truview blade several times prior to starting the study, their experience with the new device was less than that with the Macintosh blade. In addition, the use of the Truview blade requires the user to perform intubation in an indirect

manner, seeing the tube through the lens. At first, as the anaesthetist is looking through the Truview lens, he/she focuses on the vocal cords, and does not see the tube at all. The tube needs to be advanced blindly until its tip enters the Truview visual field. Thereafter, the tube should be introduced through the vocal cords while looking through the lens. Performing this manoeuvre requires good eye–hand co-ordination and some practice. This may be another reason for the difference in duration of intubation between the groups.

The results of this study show that when the anaesthetist faces difficulty in laryngoscopy, he/she tends to apply more force during intubation and the patient has a higher risk of intubation and postextubation complications. In addition, difficult intubations took longer than the easy ones, as expected. In standard intubations with direct laryngoscopy, such as when using the Macintosh blade, the anterior structures of the larynx are pulled forward while the teeth or gums are utilised as a pulley for maximal exposure of the peri-tracheal area to provide the best conditions to draw a direct line between the eyes of the operator and the tracheal aperture. The Truview blade is designed to enable indirect laryngoscopic view; thus, the anaesthetist applies less force on the anterior larynx, resulting in fewer patients with bleeding and soft tissue damage. The main limitation of this study was that it was not blinded due to the unfeasibility of blinding the anaesthetist to the laryngoscope type being used. In addition, there were significant differences between the groups in weight and in several pre-operative airway parameters. We have no explanation for these differences. However, the parameters that differed between the two groups were mostly poorer in the patients of the Truview blade group. Therefore, we believe valid conclusions can be drawn from this study.

In this study we found that the pre-operative airway evaluation carries positive and negative predictive value to meet actual difficult intubation of 0.69 and 0.83, respectively. Indeed, although evaluating the airway meticulously, the anaesthetist's prediction of difficult intubation was still poor [4–7].

We conclude that the Truview blade may be a useful option to consider in the management of patients' airways.

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