Manoeuvres used to clear the airway during fibreoptic intubation

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Fibreoptic orotracheal endoscopy under general anaesthesia may be more difficult to perform if the upper airway cannot be fully cleared. We have studied the effectiveness of jaw thrust, lingual traction and the application of both manoeuvres simultaneously, in opening up the orolaryngeal airspace in 30 ASA group 1 or 2 patients aged between 16 and 70 yr undergoing elective general surgery requiring orotracheal intubation. Airway clearance was assessed fibreoptically at soft palate level by observing whether or not the uvula or soft palate was apposed to the base of the tongue, and at epiglottic level by observing whether or not the epiglottis was apposed to the posterior pharyngeal wall. Lingual traction with Duval's forceps cleared the tongue away from the uvula and soft palate significantly more times than did jaw thrust ($P<0.05$). Jaw thrust cleared the epiglottis away from the posterior pharyngeal wall more frequently than did lingual traction ($P=0.052$). Applying both jaw thrust and lingual traction simultaneously cleared the airway at both soft palate and epiglottic level in every patient. When used alone, jaw thrust and lingual traction fail to produce full airway clearance in a significant number of patients. Combined jaw thrust and lingual traction clears the airway more effectively but requires two assistants.

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Orotracheal and nasotracheal fibreoptic intubation can be performed in both awake and anaesthetized patients.1 Awake patients usually maintain clear airways but in anaesthetized patients, muscle tone is reduced and the soft palate, base of tongue, and epiglottis all approximate to the posterior pharyngeal wall.2±5 Partial or complete obstruction of the airway may make fibreoptic endoscopy more difficult and, therefore, techniques that open up the airway are required. In fibreoptic nasal intubation, head extension, chin lift, and jaw thrust can be fully applied, but in fibreoptic oral intubation, although head extension is possible, the chin lift manoeuvre cannot be fully applied because the mouth must be kept open. The three main ways of resolving this problem are: to use intubating airways;16-11 to apply jaw thrust with the mouth open;12-15 or to apply lingual traction.16-19 Intubating airways, such as the Berman6 or Ovassapian7 airways, are often very useful as they not only clear the airway but also tend to direct the fibrescope tip towards the vocal cords. When using these devices, however, it has been shown that sometimes multiple manipulations are required and that endoscopy and intubation may be prolonged or may fail.19-22 Alternative fibreoptic techniques may, therefore, be required. Orotracheal fibreoptic intubation without the use of intubating airways may be facilitated either by jaw thrust with the mouth open or by lingual traction, at the discretion of the endoscopist. There have been no controlled trials comparing the relative effectiveness of these two manoeuvres in opening up the orolaryngeal airspace in anaesthetized patients. It would be useful to know which method is most effective, if any, as this information might enable anaesthetists to perform fibreoptic endoscopy and intubation more swiftly and reliably. This study, therefore, aimed to compare and contrast airway clearance produced by jaw thrust (with the mouth open), with lingual traction, and with both manoeuvres applied simultaneously.

Methods
The investigation was approved by the South Birmingham Local Research Ethics Committee and informed, written consent was obtained from each patient. Thirty ASA class 1 or 2 patients aged between 16 and 70 yr undergoing elective general surgery that required orotracheal intubation as part of their anaesthetic management were studied. Patients with morbid obesity (Body Mass Index >35), oesophageal reflux, or known or suspected difficult intubation were excluded from the study.
Each patient’s airway was assessed preoperatively and the Mallampati score and thyromental distance were recorded. Electrocardiogram, indirect arterial pressure, arterial oxygen saturation, and carbon dioxide concentrations were monitored. Glycopyrrolate 200–400 μg was administered i.v. and the patient was given 100% oxygen. Anaesthesia was induced with fentanyl 1 μg kg⁻¹ and propofol 2.5 mg kg⁻¹ followed by atracurium 0.5 mg kg⁻¹ and the patient’s lungs were ventilated with isoflurane in oxygen, using a face mask attached to a circle system, until muscle relaxation was complete.

Upper airway endoscopies were performed using an Olympus LF2 fiberoptic laryngoscope attached to an endoscopic video camera system and a videotape recorder. Videotape recordings of the endoscopies were made following General Medical Council guidelines. The investigation team comprised an anaesthetist experienced in fiberoptic endoscopy (VKD or JPM) and two assistants. The first assistant, another anaesthetist (JES), stood on the patient’s right-hand side and the second assistant, a trained operating department assistant, stood on the patient’s left-hand side. The assistants were blinded from the television screen and were unaware of the findings during the endoscopy. Three airway manoeuvres were carried out on each patient and all the patients acted as their own control.

The patient’s head rested on a single pillow and the atlanto-occipital joint was extended. The first assistant applied firm jaw thrust, keeping the patient’s mouth open, and the operator then advanced the fibrescope, onto which had been threaded a tracheal tube, into the mouth along the dorsum of the tongue. Airway clearance at the level of the soft palate was assessed by observing whether or not the uvula, or uvula and soft palate, were in contact with the dorsum of the tongue. The fibrescope was then advanced into the oropharynx and airway clearance at epiglottic level was assessed by observing whether or not the epiglottis was in contact with the posterior pharyngeal wall. If the uvula, or the uvula and base of uvula, touched the tongue or if the sides of the epiglottis touched the posterior pharyngeal wall, the airway was classified as partially obstructed at the respective levels. If the whole of the soft palate was in contact with the tongue or if the sides and tip of the epiglottis were in contact with the posterior pharyngeal wall, the airway was classified as completely obstructed at the respective levels. If these structures were not in contact, the airway was classified as clear at the respective levels.

The fibrescope was then removed and the first assistant applied a large-sized Duval’s lung forceps to the tongue and carefully lifted the tongue anteriorly until minimal resistance was felt. Lingual traction was applied in the vertical plane so that the lower incisors did not make contact with the ventral surface of the tongue. The forceps were then held in the second assistant’s left hand while his right hand maintained extension of the atlanto-occipital joint. The fibrescope was advanced into the mouth and oropharynx and airway clearance at soft palate and epiglottic level was assessed as before.

The fibrescope was removed from the mouth again and the first assistant applied jaw thrust, keeping the mouth open, in addition to the lingual traction. The fibrescope was again advanced into the mouth and oropharynx and airway clearance was assessed as described. The fibrescope was advanced through the vocal cords, into the trachea and down to the carina. The Duval’s forceps were removed and the tracheal tube was passed over the fibrescope into the trachea to complete the intubation. The dorsal and ventral surfaces of the tongue were examined for any signs of injury. Anaesthesia and surgery then proceeded as usual. The videotape recording was later reviewed to validate the observations. A maximum time of 90 s was allowed for the investigation. If the observations could not be completed within this time limit, the patient was withdrawn from the trial and intubated immediately. All patients were visited next day and asked if they had a sore throat or sore tongue, and the tongue was again examined.

Airway clearance when using jaw thrust and lingual traction at soft palate and epiglottic level were compared using Fisher’s exact test. The associations between airway clearance, when using both jaw thrust and lingual traction, and the patients’ Mallampati scores were analysed using Fisher’s exact test.

### Results

Patient characteristics are shown in Table 1. After induction of anaesthesia, the lungs of all the patients were easy to ventilate with a face mask and anaesthetic system. All the endoscopic examinations were completed within the 90 s time limit and arterial oxygen saturation did not fall below 96% in any patient. All patients had thyromental distances greater than 6 cm. Twenty patients had Mallampati scores of 1, nine had Mallampati scores of 2 and one had a Mallampati score of 3. No other predictors of difficult intubation were found on airway examination.

Table 2 shows the number of clear and partially or fully obstructed airways at soft palate and epiglottic level. At soft palate level, with jaw thrust, the airways of six patients were obstructed. The uvula and base of uvula only were in apposition to the tongue in four of these patients and both uvula and soft palate were in apposition to the tongue in the other two patients. At soft palate level, with lingual traction,
neither the soft palate nor the uvula were in apposition to the tongue in any patient. At epiglottic level, the sides, but not the tip, of the epiglottis were in apposition to the posterior pharyngeal wall in one patient with jaw thrust, and in seven patients with lingual traction. Lingual traction with Duval’s forceps cleared the tongue away from the soft palate significantly more times than did jaw thrust ($P<0.05$). Jaw thrust cleared the epiglottis away from the posterior pharyngeal wall more frequently than did lingual traction ($P=0.052$). Applying both jaw thrust and lingual traction as a combined manoeuvre cleared the airway at both soft palate and epiglottic level in every patient. The patient with the Mallampati score of 3 had both a fully obstructed airway at pharyngeal level with jaw thrust and also the sides of the epiglottis were apposed to the posterior pharyngeal wall with lingual traction. Again, the application of both manoeuvres completely cleared this patient’s airway. All the other patients with positive signs of partial or complete airway obstruction had the obstruction present at only one level and with only one of the manoeuvres.

At soft palate level with jaw thrust, significantly more patients with Mallampati 2 or 3 scores had uvula or uvula and soft palate in apposition to the tongue than did patients with Mallampati 1 scores (five out of 10 as apposed to one out of 20) (Table 3). At epiglottic level with jaw thrust, however, Mallampati scores were not significantly related to airway obstruction (one out of 10 as apposed to zero out of 20) (Table 3). With lingual traction, Mallampati scores were not related to airway obstruction at soft palate level nor at epiglottic level (Table 4).

As obese patients may be expected to have more airway obstruction under anaesthesia than non-obese patients, the 15 heaviest patients (mean weight 87.9 kg) were compared with the 15 lightest patients (mean weight 67.2 kg) with respect to obstruction with jaw thrust and with lingual traction (Table 5). Although lingual traction appeared to be less effective in fully clearing the epiglottis in heavier patients, the results did not achieve statistical significance in this sample ($P=0.39$). There was no statistically significant difference between the number of obstructions observed in males and females.

Fourteen (47%) of the patients had sore throats on the first post-operative day. In 11 patients, the sore throat was described as mild and in three patients as moderate. No patient complained of sore tongue. There were no symptoms or signs of injury to the tongue in any of the patients either immediately after intubation nor on the first post-operative day.
Discussion

Orotracheal fibreoptic intubation, both with and without intubating airways, is a widely practised and widely taught technique. This study aimed to identify problems that might occur when the procedure is carried out without using intubating airways and also attempted to investigate ways of alleviating these problems. The study shows that although jaw thrust with the mouth open is a very effective way of clearing the epiglottis away from the posterior pharyngeal wall, it is less successful in clearing the tongue away from the soft palate. Contrastingly, although lingual traction with Duval’s forceps is a very effective way of clearing the tongue away from the soft palate, it is less successful at fully clearing the epiglottis away from the posterior pharyngeal wall. Hence, when used alone, both manoeuvres fail to produce full airway clearance in a significant number of patients undergoing fibreoptic endoscopy under general anaesthesia. When both jaw thrust and lingual traction were applied simultaneously, however, all airways were fully cleared at both levels. These observations had clear endpoints and as all three manoeuvres were tested in each patient, the patients acted as their own controls. In this investigation, we studied patients with normal airways who were not expected to present with a difficult intubation. It is possible that the manoeuvres may be less successful in patients with a difficult intubation, but at present there are no data to confirm this.

As fibreoptic endoscopy relies on clear airspace ahead of the fibrescope tip, increasing airway obstruction may cause increasing difficulty. At pharyngeal level, apposition of the uvula base to the tongue did not usually cause undue difficulty as the fibrescope could be passed to one side of it. However, in the two patients with both uvula and soft palate apposed to the tongue, it was difficult to obtain a view of the larynx and several ‘blind’ attempts had to be made before the epiglottis was seen. At epiglottic level, when the sides of the epiglottis only were apposed to the posterior pharyngeal wall, with careful manipulations, it proved possible to pass the fibrescope beneath the tip of the epiglottis in all patients. No patient in our series had the tip of the epiglottis apposed to the posterior pharyngeal wall, but our previous experience suggests that when this circumstance does arise, endoscopy is particularly difficult.

Our figures also demonstrated that with jaw thrust, patients with Mallampati 2 or 3 scores had more incidents of obstruction at soft palate level than patients with Mallampati 1 scores. Also, the only patient with a Mallampati 3 score in our series had obstruction with both jaw thrust and lingual traction at both airway levels. Hence, potentially difficult conventional direct laryngoscopy may be associated with difficult fibreoptic laryngoscopy. When both manoeuvres were applied simultaneously, however, the airway was fully cleared. It would be useful to know whether the combined manoeuvre works as well in patients with possible or confirmed difficult laryngoscopy. Further work would be required to investigate this possibility. The combined technique is particularly helpful in fibreoptic training as inexperienced personnel have greater difficulty in performing endoscopy when airway clearance is less than perfect.

During general anaesthesia, posterior displacements of the tongue, soft palate, and epiglottis tend to close the airway. The primary manoeuvres used to clear the airway comprise chin lift, extension of the atlanto-occipital joint and anterior displacement of the mandible. These manoeuvres may be further refined by allowing the lips and teeth to separate slightly (triple airway manoeuvre) so that exhalation is not impeded. Considerably more mouth opening is needed during fibreoptic instrumentation and this may partly explain why partial or complete airway obstruction was seen in some of our patients. It is recognized that the mouth open position may compromise airway patency.

When electing to perform oral fibreoptic intubation without intubating airways, or if satisfactory airway clearance cannot be secured when an intubating airway is being used, perhaps the first manoeuvre to try is jaw thrust with the mouth open, as this is the simplest and least invasive approach. If this does not help because of apposition of the tongue and soft palate, then lingual traction might be applied by a trained assistant as there is a good chance that this manoeuvre will successfully treat this type of airway obstruction. A better alternative, if a second anaesthetist is present and familiar with the techniques, is to apply both manoeuvres simultaneously. The efficacy of the combined manoeuvre is one of the reasons why a known or suspected difficult intubation being managed under general anaesthesia should involve two anaesthetists. At present, it is not known whether using intubating airways or applying jaw thrust and lingual traction simultaneously is the more reliable way of clearing the airway in fibreoptic oro-tracheal intubation of patients known to be a difficult intubation.

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Manoeuvres used to clear the airway during fibreoptic intubation

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