Original article

# Comparison of the C-MAC™ 'D' blade with AirTraq® for endotracheal intubation in patients with simulated limitation of cervical movements

**Madhu Rao*, Anitha Nileshwar, Nandeesha N**

Email: drmadhurao412@gmail.com

## Abstract

**Background:** Direct laryngoscopy and tracheal intubation with manual in-line stabilisation is the standard practice for trauma victims while securing the airway when cervical injury/instability is suspected. The use of videolaryngoscopes eliminates the need to align the three axes, avoids movement at cervical joints, allows viewing around the corner and improves glottic view. **Aim:** Comparison of C-MAC™'D'Blade and AirTraq® for endotracheal intubation in patients with simulated limitation of cervical movements. **Methodology:** This was a prospective, randomised study conducted on 52 consenting patients requiring intubation. They were assigned to undergo intubation using C-MAC™'D'Blade (n=26) or AirTraq® (n=26) by an anaesthesiologist experienced in the use of both laryngoscopes while MILS was provided. **Results:** Laryngoscopic view was similar in the two groups: grade 1 in 16 (61.5%) and 21 patients (81.8%) in the 'D'blade and AirTraq® groups respectively with the remaining having a grade 2 view.The median time for laryngoscopy was less (13 s) in the 'D' blade compared to AirTraq® group (19.6 s) and was statistically significant ($p$= 0.036) but clinically insignificant.The intubation time was comparable ($p$=0.094). Most patients in both groups were intubated successfully in the first attempt. Requirement of airway manipulation to optimise view, postoperative sore throat and blood on the endotracheal tube was comparable. Good overall satisfaction score was obtained in bothgroups. **Conclusion:** Both C-MAC™ 'D'Blade and AirTraq® when used for intubation in patients with simulated limitation of cervical movements provide similar videolaryngoscopic view, time for laryngoscopy and intubation, and overall satisfaction score.

**Keywords:** AirTraq®, C-MAC, D Blade, endotracheal intubation, limited cervical movements

## Introduction

Endotracheal intubation of patients with limitation of cervical movements can be a challenge even to the most experienced anaesthesiologist. In cases of cervical spine immobility or instability, direct laryngoscopy is the fastest and easiest method of securing airway but movements are observed in the atlanto-occcipital and atlantoaxial joints while the subaxial cervical segments subjacent to and including fourth cervical segment are minimally displaced.[1,2] Hence patients with polytrauma are assumed to have spinal cord instability until proven otherwise and adequate measures taken to stabilise the spine in these patients.[3] This is achieved by tracheal intubation with manual-inline stabilisation (MILS) which is the standard of care when cervical injury is suspected.[4,5] However, there is no question that MILS, when correctly performed, will reduce head extension but at the cost of the worsening laryngoscopic view.[4, 6-8]

Videolaryngoscopes aid tracheal intubations in patients with difficult airways, like the ones created

**Madhu Rao,** MD
*Senior Resident in Anaesthesiology, Kasturba Medical College, Manipal*

**Anitha Nileshwar,** MD, FRCA
*Professor and Head of Anaesthesiology, Kasturba Medical College, Manipal*

**Nandeesha N,** MD
*Formerly, Associate Professor of Anaesthesiology, Kasturba Medical College, Manipal*

**How to cite this article:** Rao M, Nileshwar A, N Nandeesha. Comparison of the C-MAC™ 'D' blade with AirTraq® for endotracheal intubation in patients with simulated limitation of cervical movements. Ind J Resp Care 2014; 3(1):357-63.

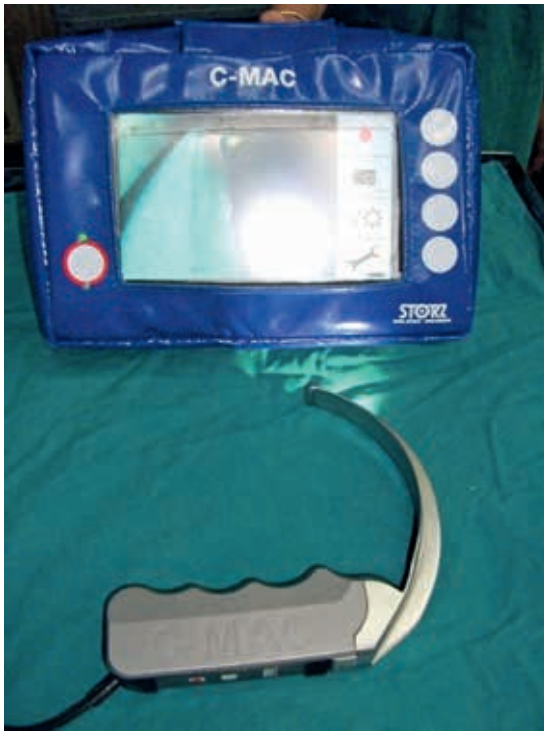


***Figure 1:*** The C-MAC™ videolaryngoscope

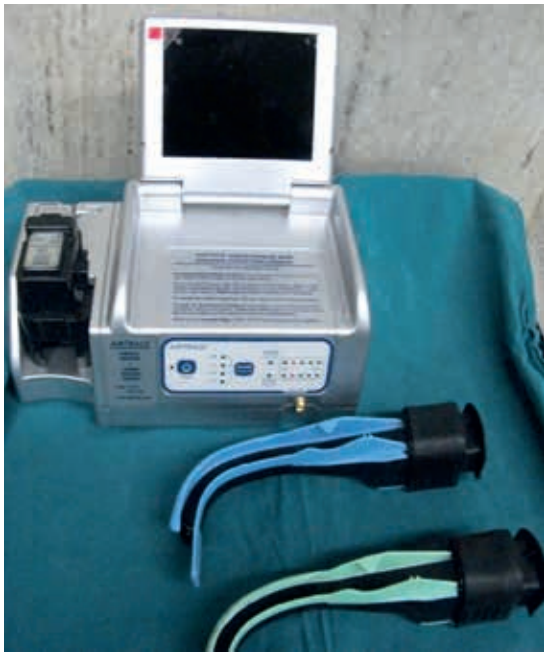

***Figure 2:*** AirTraq videolaryngoscope

due to limited cervical spine movement. They may eliminate the need to align the oral, pharyngeal and laryngeal axes to attain the best view of the glottis.[9] C-MAC *(Figure 1)* and the AirTraq® *(Figure 2)* are two such videolaryngoscopes. AirTraq® has a guiding channel to aid endotracheal intubation whereas C-MAC™ is similar to Macintosh laryngoscope. The D blade is half moon shaped, with a higher angulation of 60° as compared to 18° in the conventional C-MAC™, Macintosh blade. This study was designed to compare the AirTraq® and the C-MAC™ 'D' blade for endotracheal intubation in patients with simulated limitation of cervical movements.

## Methodology

This study was commenced after obtaining approval of institutional ethical committee and informed consent from patients. A total of 52 patients, between 18-65 years of age, either gender, weighing 40 – 80 kg, height 150 – 180 cm, of ASA PS I and II, scheduled for elective surgery under general anaesthesia requiring orotracheal intubation were included. Patients excluded were those requiring awake tracheal intubation, rapid sequence induction of anaesthesia, Mallampati Class IV, mouth opening <2.5 cm, thyromental distance <6 cm, temporomandibular joint dysfunction, limited cervical spine movement and neck surgeries requiring throat pack/nasogastric tube.

Patients were assigned to one of two groups: Group D (C-MAC™ 'D' blade) or Group A (AirTraq®) using a computer generated random number sequence. The observations were made by Observer 1- Postgraduate in anaesthesiology, who examined patients a day prior to surgery and ensured that the inclusion criteria were met and none of the exclusion criteria were present, Observer 2- one of two senior anaesthesiologists experienced in the management of difficult airway who performed all intubations and Observer 3- Consultant anaesthesiologist in-charge of the case who provided manual in-line stabilisation (MILS) and monitored patients.

All patients were premedicated with Tab Lorazepam 1 mg (if < 50 kg) or 2 mg (if >50 kg) orally the night before and at 6 AM on the day of surgery. Standard guidelines for fasting before surgery were followed. All patients were monitored with electrocardiogram Lead II, noninvasive blood pressure (NIBP) and pulse oximeter ($SpO_2$), capnograph ($ETCO_2$) and a peripheral nerve stimulator (PNS). General anaesthesia was induced with propofol 2-2.5 mg/kg, fentanyl 2 µg/kg. Muscle relaxation was

achieved with vecuronium 0.1 mg/kg, and patients were ventilated with isoflurane in oxygen. Three minutes later, direct laryngoscopy was performed by Observer 2 using a Macintosh blade to grade the laryngoscopic view (Cormack and Lehane) to rule out unanticipated difficult airway. The pillow under the head was removed and MILS provided by Observer 3 *(Figure 3)*. Standing to the left of the patient and facing him/her, both mastoid processes were grasped by the thumb, and the occiput was cupped in the hands. While avoiding axial traction, forces equal and opposite to those created by the anaesthesiologist who was intubating was applied so as to prevent or minimise head and neck movement.

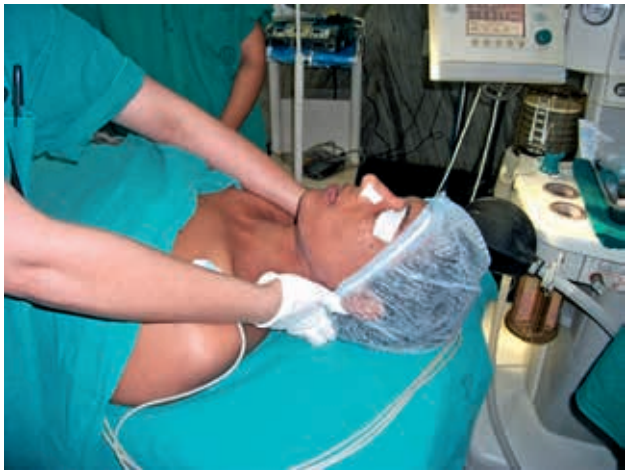

***Figure 3:*** Manual inline stabilisation

Once the responses to train-of-four stimulation were absent, endotracheal intubation was attempted as per group assigned. In Group D, C-MAC™ D Blade was used similar to a Macintosh blade but intubation was guided by the view obtained on the monitor and intubating with an ETT (7 mm ID in women and 8 mm ID in men) bent into a hockey stick shape using a stylet *(Figure 4)*. In Group A, AirTraq® was preloaded with an ETT (8 mm ID in males and 7 mm ID in females), introduced in the midline and guided till a glottic view was obtained on the monitor. The ETT was then introduced into the glottis *(Figure 5)*. In both groups, if only the epiglottis was visible, an attempt was made to view some part or all of the vocal cords by lifting of epiglottis and/or external laryngeal manipulation as necessary and noted. A maximum of two attempts were permitted and if intubation failed (not possible, took > 120 s and two attempts), a third attempt was permitted using the second videolaryngoscope. If this failed, MILS was removed and the patient intubated conventionally with a Macintosh laryngoscope.

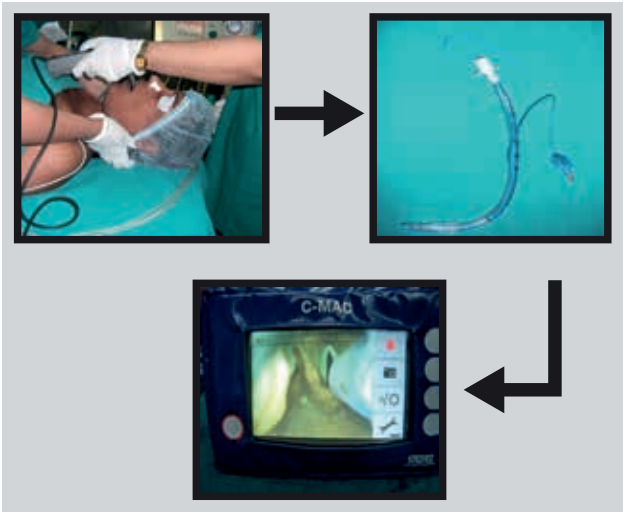


***Figure 4:*** Endotracheal intubation with C-MAC

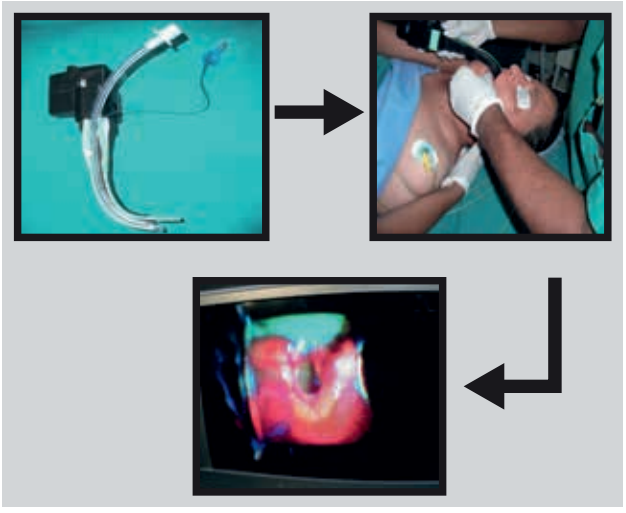

***Figure 5:*** Endotracheal intubation with AirTraq®

The following observations were made:

1) Videolaryngoscope view was graded as (a) Grade 1- All portions of the glottis seen i.e. both vocal cords, arytenoids and the glottic chink (b)Grade 2- Only posterior part of vocal cords and arytenoids seen (c) Grade 3- Only epiglottis seen; not possible to lift it up.
2) Time taken for intubation: (2a) Time to laryngoscopy was recorded as time from beginning of insertion of videolaryngoscope

into oral cavity to obtaining optimal laryngeal view. (2b) Time to intubate was recorded as time from beginning of insertion of endotracheal tube into the oral cavity (C-MAC™) or from sliding of ETT from the guiding channel (AirTraq®) to visualisation of the black line of the tube just above the vocal cords and (2c) The total time was the sum of the time taken for laryngoscopy and intubation until intubation was achieved.

If intubation was unsuccessful in the first attempt, the second attempt excluding the period of interposed ventilation was timed. The total time was then calculated as the sum of the individual attempts.

3) Any airway manipulations required such as external laryngeal manipulation, lifting of epiglottis and jaw was noted.
4) The number of intubation attempts was counted as each approach of the ETT from the tongue to the glottic entrance after visualisation of the glottis.
5) An overall satisfaction score of the intubating conditions was rated on a scale from 0 to 2 as 0-*Poor*, intubation not possible with the designated videolaryngoscope even after external laryngeal manipulation, two attempts or intubation time >120s.

   1- *Moderate*, external laryngeal manipulation required to visualise vocal cords, or two attempts required but intubation time < 120 s.

   2- *Good*, no external laryngeal manipulation required, intubation successful within 1st attempt, within 120 s.
6) Any trauma during intubation was assessed by presence or absence of blood on the endotracheal tube after extubation.
7) Sore throat was graded as
   0- No complaints or evidence of sore throat or hoarseness
   1- Patient c/o minimal sore throat but observer found no hoarseness as compared to preoperative quality of voice
   2- Patient c/o moderate sore throat or observer found moderate hoarseness
   3- Patient c/o severe sore throat or observer found marked hoarseness.

## Statistical analysis

The sample size was determined to be 26 in each group to obtain a 25% difference in the incidence of an overall satisfaction score of 2, with an alpha of 0.05 and power of 80%. Fifty two patients were included for statistical analysis and SPSS version 16.0 was used to compute it. Continuous, quantitative data with normal distribution were analysed using independent t test. Mann Whitney U test was used to analyse quantitative data with non-normal and expressed as median, 25th and 75th percentile values. Chi square test was used to analyse qualitative data.

## Results

Most demographic data including age, height and distribution of ASA physical status in both the groups were comparable. Although there was a statistically significant difference in the weight and body mass index between the groups, the differences were not clinically significant *(Table 1)*. Though there was female preponderance in both the groups, the gender distribution between the two groups was similar.

The videolaryngoscopic view obtained in both groups was either grade 1 or 2. Greater number of patients in AirTraq group had laryngoscopy Grade 1 as compared to 'D' blade group but the difference was neither clinically or statistically significant *(Table 2)*.

The median (range) time for laryngoscopy was shorter in the 'D' blade group [13 (8.3 - 20.5) s] than in the AirTraq® group [19.6 (11.2 – 38.2) s]. The median (range) intubation time was shorter in the 'D' blade group [18.5 (13.7 – 15.7) s] than in the AirTraq® group [15.7 (7.0 – 33.27)s]. The total time calculated as the sum of the above values [median (range)] was slightly shorter in the 'D' blade group [34.5 (24.8 – 73.5) s] as compared to AirTraq® group [40.1 (23.3 – 80.86) s]. However, none of these time differences were clinically significant *(Table 2)*.

Most of the patients in both groups were intubated in the first attempt *(Table 2)*. Most patients in both groups were intubated without any requirement of airway manipulations *(Table 2)*. Out of the 5 patients

requiring manoeuvres in the AirTraq® group, 3 patients specifically required lifting up of epiglottis and 1 out of 6 patients in the 'D' blade group required lifting up of jaw.

Good overall satisfaction score, *i.e.*, 2 was obtained in 17 patients (65.4%) and 19 patients (73.1%) of patients in the 'D' blade group and AirTraq® group. A moderate score, *i.e.*, 1 was obtained in 9 patients (34.6%) and 7 patients (26.9%) of the 'D' blade and AirTraq® groups respectively *(Table 6)*. Poor score, i.e., 0 was not obtained in any cases *(Table 2)*.

The incidence of complications was similar between the two groups. Twenty one (80.8%) patients complained of no sore throat while five (19.2%) patients complained of minimal sore throatbut no hoarseness of voice in both groups. Blood was seen on the endotracheal tube in 2 patients (7.7%) and 4 patients (15.4%) in the 'D' blade and AirTraq® groups respectively *(Table 2)*.

***Table 1:*** Demographic data

| Demographic data | Group D | Group A |
|---|---|---|
| Age (years) Mean ± SD | 39.77 ± 8.42 | 35.04 ± 12.63 |
| Gender n (%)<br>Male<br>Female | <br>7 (26.9)<br>19 (73.1) | <br>5 (19.2)<br>21 (80.8) |
| ASA Physical Status n (%)<br>ASA 1<br>ASA 2 | <br>22 (84.6)<br>4 (15.4) | <br>20 (76.9)<br>6 (23.1) |
| Weight (kg) Mean ± SD | 62.38 ± 10.53 | 56.27 ± 10.49 |
| Height (cm) Mean ± SD | 157.96 ± 8.25 | 158.69 ± 9.45 |
| BMI (kg/m²) Mean ± SD | 24.93 ± 3.53 | 22.18 ± 3.41 |

*Independent t test, #Chi- square test, NS= not significant

***Table 2:*** Laryngoscopy and intubation characteristics

| Parameter | Group D | Group A | P value |
|---|---|---|---|
| Videolaryngoscopic view n (%)<br>Grade 1<br>Grade 2 | <br>16 (61.5)<br>10 (38.5) | <br>21 (81.8)<br>5 (19.2) | <br>0.126* |
| Time for laryngoscopy and intubation (s)<br>T1<br>T2<br>Total time | <br>13 (8.3 – 20.5)<br>18.5 (13.7 – 50.7)<br>34.5 (24.8 – 73.5) | <br>19.6 (11.2 – 38.2)<br>15.7 (7.0 – 33.27)<br>40.1 (23.3 – 80.86) | <br>0.036*<br>0.094*<br>0.784* |
| Number of intubation attempts n (%)<br>1<br>2 | <br>24 (92.3)<br>2 (7.7) | <br>25 (96.2)<br>1 (3.8) | <br>0.552** |
| Number of patients requiring airway manipulations (OELM, lifting up of epiglottis or jaw) n (%) | 6 (23.1) | 5 (19.2) | 0.734** |
| Overall satisfaction score n (%)<br>2<br>1<br>0 | <br>17 (65.4)<br>9 (34.6)<br>0 | <br>19 (73.1)<br>7 (26.9)<br>0 | <br>0.548** |
| Complications<br>Sore throat n (%)<br>None<br>Minimal<br>Blood on endotracheal tube n (%) | <br><br>21 (80.8)<br>5 (19.2)<br>2 (7.7) | <br><br>21 (80.8)<br>5 (19.2)<br>4 (15.4) | <br><br><br><br>0.27** |

*Mann Whitney U Test; **Chi square test

## Discussion

This study compared C-MAC™ and the 'D' blade with AirTraq® for endotracheal intubation in patients with simulated limitation of cervical movements. In our study cervical spine immobilisation was achieved using manual in line stabilisation. Turkstra *et al* in their study had concluded that cervical spine motion was 53%, 95%, and 60% less during laryngoscopy with AirTraq® as compared to the Macintosh blade at the occiput-C1, C2-C5, and C5-thoracic motion segments.[9] However in their study, neck immobilisation was not used during measurement of motion. There are no such studies that have measured movement of cervical spine segments when C MAC™ was used. A combination of usage of a videolaryngoscope and MILS would be expected to decrease cervical spine movements to a larger extent. The initial laryngoscopy with a regular Macintosh blade was incorporated to ensure patient safety and to rule out any unanticipated difficult laryngoscopy or intubation before simulating the limitation on cervical spine movements.

Since no standard scale for videolaryngoscopic view grading was available when the study was commenced, we used a descriptive grading similar to Cormack and Lehane depending on the extent to which the larynx was visualised. Most patients had grade 1 view and the rest had a grade 2 view, supporting the evidence that videolaryngoscopes improve the glottic view in anticipated difficult visualisation. When the time for laryngoscopy between the 2 groups was compared in this study, it was found to be statistically significant in favour of the 'D' blade group. However, this was not clinically significant as the time taken was a few seconds apart (median values of 13 and 19.6 s, p=0.036). Similarly the time for intubation, though not statistically significant went in favour of AirTraq® group as compared to 'D' blade group (median values of 15.7 and 18.5 s, p= 0.094). These minimal differences may be attributed to the fact that both the instruments have different shape, structure and methods of insertion into oral cavity. Additionally, intubation method varies, *i.e.*, from outside in the 'D' blade group and from a preloaded side channel in the AirTraq® group.

In this study, patients in both the groups were successfully intubated in the first attempt in most of the cases. One patient in the AirTraq® group who required a second attempt had maloccluded teeth which caused difficulty in inserting the AirTraq® in the midline. In the 'D' blade group, two patients required a second attempt. In both cases, good videolaryngoscopic views were obtained. The difficulty was in directing the tube towards cords, with the tube moving posterior both times. This finding is similar to the study by McElwain *et al* who concluded that in a difficult airway situation like the one simulated by us, the use of an optimal stylet strategy would be useful.[9]

Optimisation manoeuvres were utilised almost equally in both groups of patients. Three of the patients in the AirTraq® group specifically required the lifting of epiglottis with an upward pressure for view optimisation. Lifting up of jaw was required in one patient in the 'D' blade group. We observed that introduction of the AirTraq® video laryngoscope into the oral cavity was difficult and took longer time (38, 33, 28 s) in 3 patients as the instrument was hinging against the chest. In one case with MILS, mouth opening could not be increased and the tongue was falling back on the palate. So, the instrument was introduced from the side rather than the midline. This could possibly be due to the relatively large size of the instrument. Also one patient in the 'D' blade group had a loose upper incisor causing difficulty in introducing hence we experienced difficulty in introducing the instrument though the proximal end of the blade is flat and has been designed to help in patients with limited mouth opening.

Intubating conditions assessed as per the overall satisfaction score was found to be good in most patients of both groups. The complications i.e. incidence of minimal sore throat and blood on endotracheal tube were similar in both groups.

There are a few limitations of this study. Firstly, blinding could not be achieved amongst the persons performing laryngoscopy and providing MILS. Secondly, the study was conducted on patients with normal cervical spinal anatomy and stability.

Extrapolating this study to patients with injury/instability of the cervical spine is acceptable but can undergo further evaluation in that subgroup of patients. Thirdly, this study was carried out by experienced anaesthesiologists. Hence, results may differ in the hands of less experienced users.

## References


1. Sawin PD, Todd MM, Traynelis VC, *et al.* An in vivo cinefluoroscopic study of subjects without cervical abnormality, *Anaesthesiology* 1996; **85**:26–36.
2. Horton WA, Fahy L, Charters P. Disposition of the cervical vertebrae, atlanto-axial joint, hyoid and mandible during x-ray laryngoscopy. *Br J Anaesth* 1989; **63**:435–8.
3. Dooney N, Dagal A. Anaesthetic concerns in acute spinal trauma. *Int J Crit Illn Inj Sci* 2011; **1**:36–43
4. Robitaille A. Airway Management in the Patient with Cervical Spine Instability. *Anaesthesiology Rounds* 2008; **7**(3); Issue 3.
5. Rao BK, Singh VK, Ray S, Mehra M. Airway management in trauma. *Ind J Crit Care Med* 2004; **8**:98-105.
6. Nolan JP, Wilson ME. Orotracheal intubation in patients with potential cervical spine injuries. An indication for the gum elastic bougie. *Anaesthesia* 1993; **48**:630–3.
7. Thiboutot F, Nicole PC, Tre´panier CA, Turgeon AF, Lessard MR–Effect of manual in-line stabilization of the cervical spine in adults on the rate of difficult orotracheal intubation by direct laryngoscopy: a randomized controlled trial. *Can J Anesth.* 2009; **56**:412–8.
8. Turkstra TP, Craen RA, Pelz DM, Gelb AW. Cervical spine motion: a fluoroscopic comparison during intubation with lighted stylet, GlideScope, and Macintosh laryngoscope. *Anesth Analg* 2005; **101**:910-5.
9. McElwain J, Malik MA, Harte BH, Flynn NH, Laffey JG. Determination of the optimal stylet strategy for the C-MA videolaryngoscope. *Anaesthesia* 2010; **65**:369-78.