

A Comparison of Cervical Spine Movement during Tracheal Intubation when Using a Pentax Airway Scope or the GlideScope Video Laryngoscopy with Fluoroscopy

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Abstract

Background: Cervical spine movement does occur during intubation and in patients with cervical spine injuries; the result can have devastating neurologic outcomes. Video laryngoscopes provide a better view of the glottis and less cervical spine movement.

Objective: The purpose of this study is a comparison of cervical spine motion during tracheal intubation between the GlideScope video laryngoscopy and the Pentax Airway Scope. The primary outcome is the difference in cervical spine motion. The cervical spine motion was recorded using fluoroscopic video and the angular displacement of the spine was measured by a radiologist. The secondary outcome is the hemodynamic changes after intubation.

Methods: Into Pentax Airway Scope and GlideScope video laryngoscopy groups, we randomly allocated two hundred and one patients who underwent elective non-cardiac surgery and require general anesthesia with tracheal intubation. All patients underwent general anesthesia with the same induction medications, muscle relaxant and narcotics. During airway maneuvers, a fluoroscopy was used to record cervical spine movements from the occiput down to C5 level. Vital signs were recorded after successful intubation. All images were measured by the radiologist consultant. Using the classic AutoCAD program and the angles between adjacent levels were calculated and shown as a number.

Results: The Pentax Airway Scope and GlideScope induced the greatest cervical spine movement in the C1-C2 segments, during each stage of the laryngoscopies. Cervical spine motion was not statistically different using either video laryngoscope at the five segments studied. The hemodynamic changes after intubation showed after the first and second minutes and there were significantly less systolic blood pressure and diastolic blood pressure changes in the Pentax group.

Conclusion: Cervical spine movement during tracheal intubation is not significant difference between the Pentax Airway Scope and the GlideScope.

Keywords: Cervical spine movement; Intubation; Video laryngoscope

Introduction

The Macintosh laryngoscopy is widely used as the standard laryngoscopy for tracheal intubation. For providing the best view of the glottis, it is necessary to align the oral, pharyngeal, and laryngeal axes. Cervical spine movement occurs during intubation. In patients with cervical spine injuries, this movement can result in devastating neurologic outcomes. When tracheal intubation is required for patients with an injured cervical spine, manual in-line stabilization (MILS) is a useful technique to stabilize the cervical spine [1-3]. The disadvantage of MILS is that it makes a laryngoscopy more difficult, because the angle between the oral and pharyngeal axes becomes acute at the back of the tongue [4]. A flexible fiber optic bronchoscope can be used to minimize cervical spine movement, but it requires an expert's skill for its use and maintenance.

The video laryngoscope is an alternative laryngoscopy that provides a better view of the glottis and less cervical spine movement. An unsighted view of the glottis using rigid fiber optic laryngoscopes requires less cervical spine extension [1,5]. The advantages of new video laryngoscopes are their ease of use and maintenance.

The GlideScope video laryngoscope (Verathon Inc., Bothel, WA, USA) is an indirect laryngoscopy in which the light source and digital camera are located at the tip of the laryngoscope blade enabling visualization of the vocal cord via a 7-inch LCD monitor [1-3,5]. The GlideScope blade No. 3 size is 82 mm. in length, 14.5 mm. in height and 20 mm. in width.

Previous studies have shown that the use of a GlideScope reduced cervical spine motion, as compared with the Macintosh blade [1,2].

The Pentax Airway Scope (Pentax Corporation: Tokyo, Japan) is composed of a handle and disposable blade. The image is displayed on a 2.4-inch LCD monitor built into the top of the handgrip [4-11]. The Pentax blade size is 131 mm. in height, 9.6 mm. in length and 49 mm. in width. A previous study has shown through the use of radiographs that there is less cervical spine movement during tracheal intubation with the Pentax Airway Scope than a Macintosh laryngoscope [7].

Therefore, in this study the cervical spine motion during tracheal

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intubation was compared for the GlideScope video laryngoscopy and the Pentax Airway Scope without MILS, because we were concerned about the actual cervical spine movement during a video laryngoscope.

Methods

The study was approved by the Ethic Committee of Songklanagarind Hospital in the province of Songkhla, Thailand, and it was designed as a prospective randomized study. All patients gave their informed consent after receiving written information about the study. Two hundred and one patients were invited to participate in the study between August 2009 and November 2011.

Inclusion criteria included ASA physical status I-III patients, aged sixteen to seventy-five years old, who had elective non-cardiac surgery requiring general anesthesia with tracheal intubation. Exclusion criteria included gastroesophageal reflux disease, a body mass index greater than 35 kg/m², the possibility of pregnancy, previous neck surgery, an unstable or abnormal cervical spine, known difficulties with the airways, or a suspected difficult airway.

The allocation sequence was generated by block randomization with a computer generated random list. Patients were randomized into either the Pentax Airway Scope or the GlideScope groups. Tracheal intubation was performed by one of two anesthetists and each anesthetist had experience with both devices.

The primary outcome is the difference in cervical spine motion. The cervical spine motion was recorded using fluoroscopic video to measure by a radiologist the angular displacement of the spine. The secondary outcome is the hemodynamic changes after intubation.

The patients were placed on the operating table with the cervical spine in the neutral position. Each patient was equipped with standard monitoring techniques, including electrocardiography, non-invasive blood pressure measurement, and pulse oximetry. For each patient, a cuffed endotracheal tube was prepared along with a fitted stylet. (ID 7.5 mm for females and 8.0 mm for males). Before oxygenation, a baseline radiograph using digital fluoroscopy was taken with the patient in a neutral position. The digital fluoroscope was positioned for a lateral view of the patient's cervical spine and kept in that position throughout the examination period. Administration of one hundred percent oxygen by mask was performed and anesthesia was induced with fentanyl 1-2 mcg/kg and propofol 2-2.5 mg/kg and paralyzed with rocuronium 0.9 mg/kg. Then patients underwent a laryngoscopy with 1 staff and 1 third year resident anesthesiologist. The order in which the laryngoscopes were used was randomly assigned at the start of the study, based on the number drawn from a random number table. When intubation was completed, the correct placement was confirmed by capnography and bilateral auscultation of the lung. During the airway maneuvers, fluoroscopy was used to record movements from the occiput down to C5. All images were exported into a USB drive as either a JPG or TIF file. Vital signs were recorded every minute for five minutes and then every three minutes until twenty minutes had passed. Each intubation sequence was divided into four stages: baseline stage, mouth opening, glottis visualization (only the posterior part of the vocal cord was seen and tube insertion up to the glottis aperture), intubation (penetration of the tube inside the trachea and removal of the stylet).

All images were measured by a third year resident anesthesiologist under the radiologist consultant. The reference line (Figure 1) for the occiput (C0, McGregor line) was defined by a line between the posterior margin of the hard palate and the opisthion. The C1 reference line connected the anterior and posterior arches of the atlas. The C2-

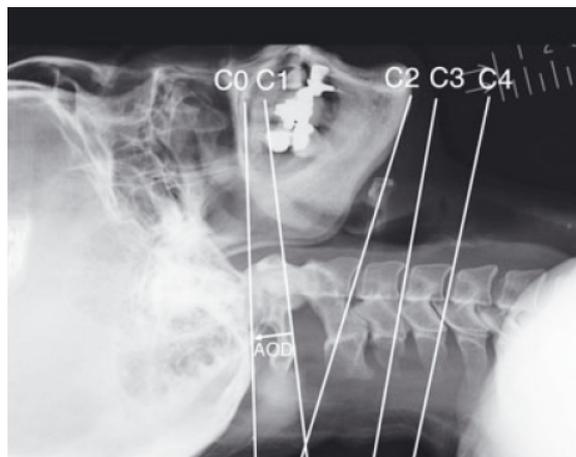


Figure 1: The reference line.

C5 reference was the tangent through the anterior and posterior basal plates of respective vertebral bodies. The angles between adjacent levels were calculated based on differences between the angles. Positive angles denote neck extension, and negative angles denote neck flexion [7]. All images were measured by using the classic AutoCAD (computer-aided design) program, which can be used to quickly dimension and angular command. The angles between adjacent levels were calculated and shown as a number.

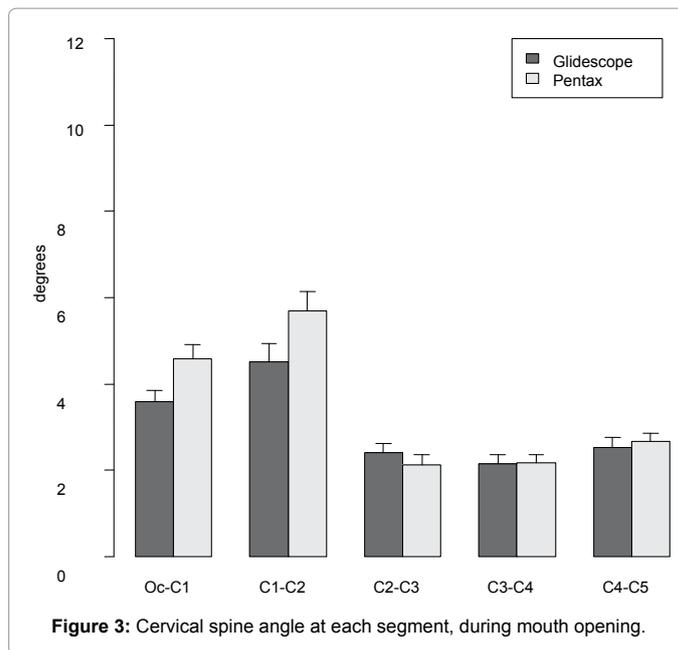
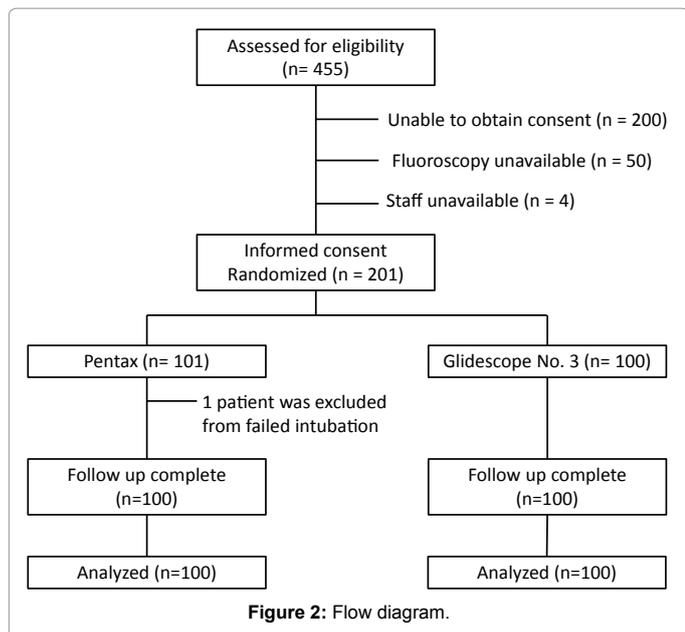
Sample size was calculated based on a previous study [2]. The sample size was calculated to be eighty-five patients per group with power analysis at 90% power and 0.05 level of significance. After including 10% drop out, we recruited 100 patients per group. A reduction in spinal movement amplitude of five degrees between the two techniques would be clinically relevant. But we chose a difference of two degrees because the advantages of video laryngoscopes in reducing cervical spine movement.

Continuous data was analyzed by independent Student's t-test for normal distribution data and by Mann-Whitney U test for non-normal distribution data. Results are expressed as mean \pm SD for normal distribution data and mean (range) for non-normal distribution data. A p-value less than 0.05 were considered to be statistically significant.

Results

In total, two hundred and one patients were recruited. One hundred and one in the Pentax Airway Scope group and one hundred in the GlideScope group. One patient in Pentax Airway Scope group was excluded because of failed intubation (Figure 2). The patients consisted of eighty-four men and One hundred sixteen women. The patients' characteristics are shown in Table 1. Cervical spine motion was compared for the Pentax Airway Scope versus the GlideScope video laryngoscope for all of the two hundred patients. The mean \pm SD of the difference degrees from baseline of the cervical spine motion at each segment and each stage are shown in Figure 3 (mouth opening), Figure 4 (glottis visualization) and Figure 5 (intubation). No significant difference was found between the techniques at any level (p-value between 0.06 and 0.99).

The secondary outcome is the hemodynamic changes after intubation. Our study showed that the effect of laryngoscopy and tracheal intubation on blood pressure increased significantly after the first and second minutes when using the GlideScope video laryngoscope as shown in Figure 6.

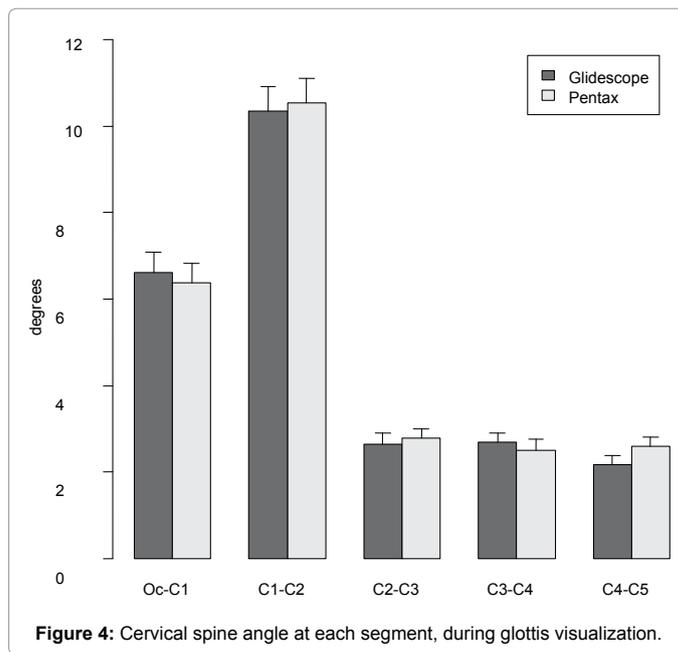


	Pentax (n=100)	Glidescope(n=100)	P-value
Sex (male/female)	44/56	40/60	0.667
Age: mean (SD) (year)	41.48 (14.75)	47.78 (13.22)	0.003 *
Body weight (kg)	59.9 (11.30)	60.73 (10.44)	0.592
Height (cm)	160.6 (7.76)	159.7 (9.26)	0.462
BMI (kg/m ²)	23.21 (3.99)	23.84 (3.77)	0.251
Mallampati grade			
1	37	34	0.580
2	60	59	
3	2	3	
4	1	1	
TMD (cm)	6.7 (0.51)	6.8 (0.50)	0.235
ICG (cm)	4.51 (0.50)	4.56 (0.39)	0.477
Full neck flexion (n)	100	100	
Full neck extension (n)	100	100	
Type of surgery			
General surgery	27	32	0.203
Neurosurgery	41	32	
Orthopedic surgery	25	27	
ENT	0	4	
Gynecologic	7	5	
ASA classification			
I	9	12	0.752
II	7	73	
III	14	15	
External laryngeal compression			
Yes	5	5	0.746
No	95	95	

Table 1: Demographic data. TMD: Thyromental distance, ICG: Interincisor gap, *p<0.05.

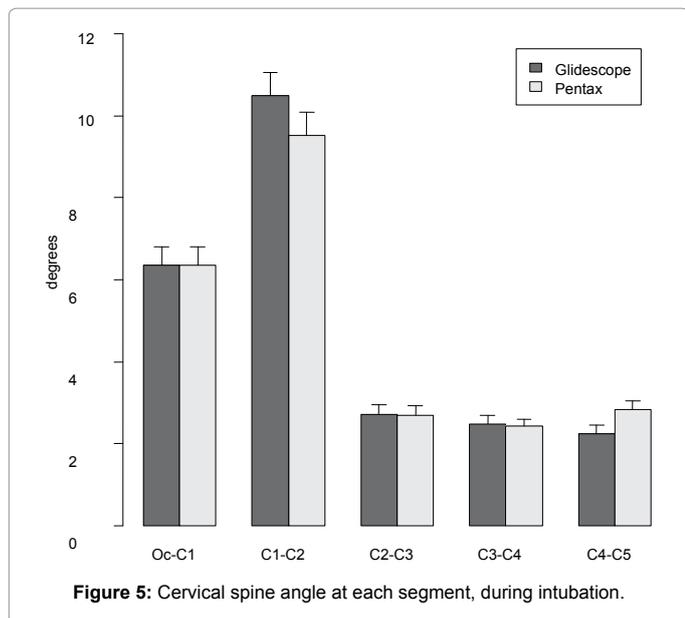
Discussion

Our study has demonstrated that intubation using the Pentax and Glidescope video laryngoscopes caused movement of the cervical spines. Our results showed that both the Pentax and GlideScope



induced the greatest cervical spine movement of the C1-C2 segments at each stage of the laryngoscopy. Panjabi and colleagues stated that a rotation of over twenty degrees in the sagittal plane exceeds the upper limits of the physiologic motion [12]. The mean difference in degrees of cervical spine movement during intubation at C1-C2 level was 10.49 in the GlideScope video laryngoscopy group and 9.52 in the Pentax Airway Scope group. These results showed that cervical spine motion fell within the range defined by Panjabi et al. Cervical spine motion was not statistically different both video laryngoscopes at the five segments studied.

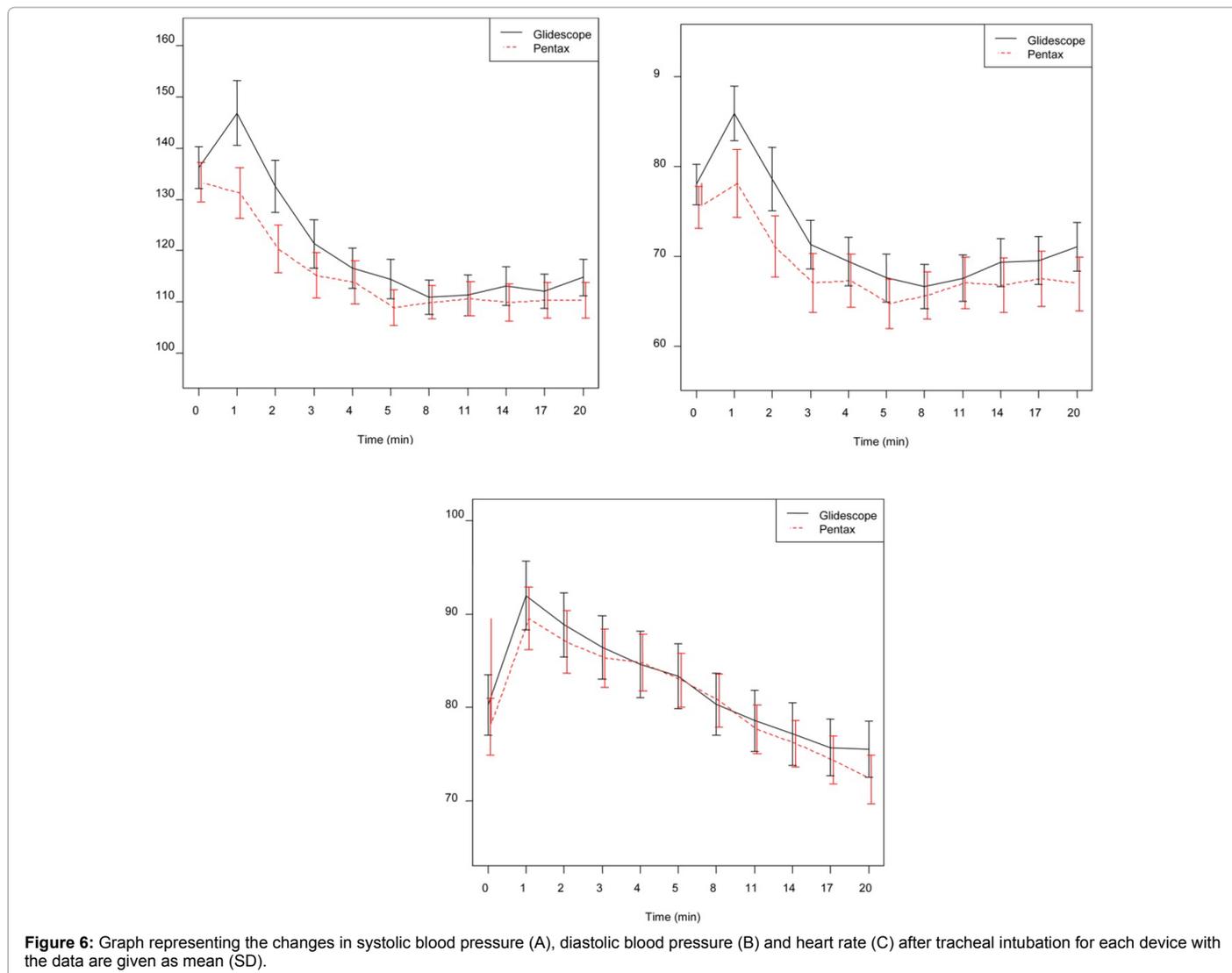
Direct laryngoscopy using the Macintosh laryngoscope involved significant extension of the cervical spine and the greatest movement of the atlanto-occipital and C1-C2 segments. When using the Macintosh



laryngoscope, it is necessary to align the pharyngeal and laryngeal axis and this results in extension of the occiput and the occiput-C1 interspace, with flexion below C2 [13,14].

Timothy and colleagues found that cervical spine motion was reduced by 50% at the C2-5 segment for the GlideScope versus Macintosh laryngoscopy during intubation with manual-inline stabilization [1]. Our study showed both video laryngoscopes were reduced cervical spine movement at C2-C5 without manual-inline stabilization. This suggests that use of the video laryngoscope might be beneficial if the injury is between C2 and C5. Another suggestion is manual-inline stabilization might not be performed during intubation with the video laryngoscope.

Our study classified the intubation sequence into four stages, and we found that the greatest cervical spine movement occurred during the glottis visualization and intubation period in both techniques. During mouth opening, the cervical spine movement was less induced with using GlideScope video laryngoscopy but there is no significant difference between the Pentax Airway Scope and the GlideScope. We explained that the blade size in the Pentax is larger than the glideScope blade No. 3 so when using the Pentax during the mouth opening stage



needs more cervical spine movement to apply the blade. There are not any definite angles between the adjacent cervical spine segments during laryngoscopies for each technique (Macintosh or video laryngoscopes). The primary outcome is the difference of cervical spine motion and less movement should establish the best technique, but there is no significant difference in motion between the techniques.

One patient in the Pentax group changed to the GlideScope because the Pentax cannot elevate the epiglottis and the cord is more anterior. Intubation was successful using the GlideScope with blade no.4. We reviewed the anesthetic record and found that the airway assessment was similar to the other patients. The laryngoscopic view was seen as grade two after intubating with the GlideScope. As in this case, the fact that it cannot elevate the epiglottis may be the disadvantage of the Pentax Airway Scope. There are some disadvantages of the Pentax Airway Scope, and the most crucial one is that the Pentax Airway Scope has only one fixed-size AWS blade. Thus when the blade is too short to reach beneath the epiglottis and lift it, intubation with the AWS becomes difficult [15].

The hemodynamic change after intubation is the secondary outcome. Our results show that at the first and second minutes after intubation, there were significantly fewer SBP and DBP changes in the Pentax group, excluding the heart rate. We assume that the Pentax can pass the endotracheal tube more easily and in less time than the GlideScope group. Malik and colleagues demonstrated that the duration of intubation attempts was longer with the GlideScope than the Pentax and the intubation difficulty scale (IDS) [16], a qualitative scale incorporating multiple indices of intubation difficulty was lowest in the Pentax [3]. Our results were compatible with this study that showed the Pentax producing the least hemodynamic stimulation.

Finally, there are several limitations to our study. First the anesthetist could not be blind to the equipment that was used. The anesthetist may have been biased and potentially effected the cervical spine movement. Second, radiographic biases were also possible, because the angle was measured by a third year resident anesthesiologist. Third, we did not perform manual-inline stabilization; the degree of cervical spine movement could have changed much more.

In conclusion, cervical spine movement during tracheal intubation is not significant difference between the Pentax Airway Scope and the GlideScope and should be preferred in patients with suspected spine injury.

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