Original Article

A Randomized Comparative Study Between Airtraq and McCoy for Intubation in Patients with Cervical Spine Injury

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Abstract

Background: This study was done to compare Airtraq and McCoy for intubation characteristics and hemodynamic parameters following endotracheal intubation in patients undergoing anterior cervical discectomy and fusion (ACDF) surgery. **Materials and Methods:** After Institutional Ethical Committee approval, a prospective randomized comparative study was designed on forty American Society of Anesthesiologists I and II patients involving single level ACDF surgery. Following standard anesthesia protocol and manual in-line stabilization applied along with a cervical collar or pin traction for immobilization, tracheal intubation was performed either with Airtraq or McCoy. The time taken for intubation, intubation difficulty score (IDS), comfort grading, and hemodynamic parameters were noted following intubation. The categorical data were compared using Chi-square test and the continuous variables were compared between the groups using paired sample *t*-test. Repeated ANOVA was tested for hemodynamic data at each measurement time point and Tukey *post hoc* was used for within the group comparisons at different timings following intubation. **Results:** The mean intubation time was 24.41 ± 14.8 s in Airtraq group (Group A) which was statistically significant compared to McCoy group (Group M) 38.96 ± 15.55 s ($P = 0.001$). The IDS and comfort grading was statistically significant in Group A compared to Group M. The changes in hemodynamic vitals following intubation were comparable in both the groups. **Conclusion:** Airtraq improves the grade of glottic visualization with minimal assistance. It also minimized the time taken for intubation had stable hemodynamics with increased comfort to the anesthetist.

Key words: Airtraq, cervical spine injury, immobilization, McCoy laryngoscope

Introduction

Anterior cervical discectomy and fusion (ACDF) surgery is done in patients with clinical or traumatic cervical disc prolapse and degenerative cervical disc disease. These patients usually have a compromised neurological function. Airway and intubation maneuvers may further compromise the neurological insult. Minimal cervical motion is desirable during such maneuvers. Mask ventilation and intubation with a cervical collar *in situ* becomes mandatory in such specific situations. Various airway devices have shown to augment the easy placement of endotracheal tube and at the same time result in minimal cervical motion, even with a cervical collar *in situ*.[1,2] McCoy laryngoscope blade is traditionally used in the airway management of such cases in our practice. Airtraq is an optical laryngoscope that uses magnifying wide-angle mirrors, a light emitting diode light source, and a tracheal tube guide channel to aid in rapid visualization and passage of an endotracheal tube. First, it permits visualization of the glottis without alignment of the oropharyngeal axes and secondly allows intubation without hyperextension of neck. Both McCoy and Airtraq have shown to be effective in managing airway in difficult airway situation and in simulated patients with a cervical collar.[3] But there is no reported literature showing their comparison in patients with cervical spine disease *per se*. The primary objective of our study was to compare the intubation characteristics of Airtraq and McCoy. The secondary objectives include intubation effects on hemodynamics, complications, and comfort grading in patients undergoing ACDF surgery with cervical immobilization.

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Materials and Methods

A prospective randomized comparative study was designed on forty American Society of Anesthesiologists (ASA) I and II patients involving single level ACDF following Institutional Ethical Committee approval. All the patients were assessed for the neurological deficit with American Spinal Injury Association (ASA I) impairment scale.[4] Inclusion criteria included written informed consent, aged between 18 and 60 years, body mass index <35, patients of both gender, patients with traumatic cervical disc prolapse and degenerative cervical disc disease involving C3–C6 levels, and patients with ASA I impairment scale C–E and undergoing elective surgery requiring general anesthesia with oral endotracheal intubation. Patients with anticipated difficult airway, patients with risk of pulmonary aspiration of gastric contents, pregnant patients, and patients with pathology other than traumatic or degenerative cervical pathology, atlantoaxial dislocation, pathology involving C1–C2 and C7 levels, patients with ASA I impairment scale A and B and airway distortion were excluded from the study.

Cervical immobilization was achieved in all the patients either with pin traction or with a rigid cervical collar. Mouth opening was measured accordingly. All the patients received a standardized general anesthesia. Monitoring included ECG, noninvasive arterial pressure, SpO_2, and end-tidal carbon dioxide. All patients were premedicated with fentanyl 1.5 μg/kg and glycopyrrolate 5 μg/kg intravenous 5 min before induction. Manual in-line stabilization (MILS) was provided to all the patients by an experienced neurosurgeon not involved in the study. Anesthesia was induced with 5–7 mg/kg of pentothal sodium titrated till the loss of eyelash reflex. After establishment of mask ventilation, anesthesia was supplemented with sevoflurane 2.0–2.5% in oxygen and neuromuscular blockade for tracheal intubation was provided with atracurium 0.6 mg/kg. Patients with difficult mask ventilation were excluded from the study. Intubation was attempted with an appropriate endotracheal tube after attainment of optimal intubating conditions. Patients were randomized using RAND (MS-Excel) to undergo either Airtraq intubation (Group A) or intubation with McCoy (Group M). A single experienced anesthesiologist (>50 intubations) in both McCoy and Airtraq techniques performed all intubations.

Steps for McCoy intubation: At the time of laryngoscopy with McCoy, if Cormack–Lehane grading of glottis was found to be 1 or 2, hinge of McCoy was not used for intubation. If grading was >2, then hinge was used to improve glottic visualization. An intubating bougie was used if still there was no improvement with hinge.

Modified intubation difficulty score (IDS) described by Adnet *et al.* was used to grade McCoy and Airtraq aided intubation [Appendix 1].[5] An IDS score = 0, 0–5, >5, and ∞ is labeled as easy, slight difficulty, moderate to major difficulty, and impossible intubation.

The time taken from removal of the face mask for placement of the airway gadget to successful tracheal intubation and connecting the endotracheal tube to the anesthesia breathing circuit was noted down as the intubation time for both the techniques.

Failure to intubate was considered when the placement of the airway gadget was not possible or more than three attempts taken for intubation and when intubation time was more than 120 s. Before shifting to traditional technique for intubation (MacIntosh blade) with or without collar, the modified IDS was noted for this failed technique. Other assisted techniques like Sellick's maneuver and use of bougie were added as per the requirement. Other parameters such as failure to intubate (>3 attempts or >120 s), desaturation episodes (SpO_2<90%), and airway trauma (blood observed on lips, teeth or oral mucosa, or the device) during intubation were noted.

The intubating anesthesiologist was also asked to scale the comfort grading (0 - uncomfortable and 1 - comfortable) during the use of both the techniques for intubation.

Statistical analysis

Sample size of 40 for the study was estimated by taking into consideration the results of one previous study [G*power 3.1.9.2; Buchner, Erdfelder, Faul and Lang *et al*; Germany; copyright (C) 1992-2014]. The median IDS (interquartile range [IQR]) was 4 (1–6) in Airtraq group and 0 (0–1) in McCoy.[3] The estimation of sample size from median and IQR values is not a direct calculation and this is available in very few statistical softwares. The median is pretended as the mean. As any standard normal distribution have its 25th and 75th percentiles about two-third of the standard deviation (SD) away from 0. Hence, the IQR for a normal distribution is going to be approximately four-third of an SD. The SD for Airtraq group is calculated as 3.8 and 0.75 for the McCoy group. The effect size was calculated as 1.46. The power of 95% with alpha error of 0.05 requires a sample size of 11 in each group. As dropout of cases would be expected, total sample size of 40 (20 in each group) was taken for undertaking this study.

Statistical analysis was performed using NCSS version 9 statistical software "(NCSS, LLC. Kaysville, Utah, USA, 2013. ncss.com/software/ncss)." The normality of the data was tested using Anderson–Darling test. The continuous data were displayed as a mean ± SD and categorical data as a number with percentage. The categorical data were compared using Chi-square test and the continuous variables were compared between the groups using paired sample *t*-test. A two-sided $P < 0.05$ was considered significant for all tests. Repeated ANOVA was tested for hemodynamic data at each measurement time point and Tukey–Kramer *post hoc* was used for within the group comparisons at different timings following intubation.

Results

A total of forty patients (twenty in each group) were recruited for the study and the data were analysed. The data were found

to be normally distributed in both the groups. The demographic data are shown in Table 1.

The mean intubation time was 24.41 ± 14.8 s in Airtraq group which was statistically significant compared to McCoy group 38.96 ± 15.55 s ($P = 0.001$) [Figure 1].

The IDS score and comfort grading was statistically significant in Group A compared to Group M [Table 2]. All the patients in Airtraq group had easy intubation, whereas only 20% patients in McCoy group had this. Other 80% of patients in McCoy group had slight difficulty in intubation. Airway trauma and bleeding were comparable in both the groups. The success rate for intubation was 100% for both the airway gadgets and no patient had any desaturation episode [Table 3]. The changes in heart rate (HR) and mean arterial pressure following intubation were comparable in both the groups, respectively, except for the HR change just before intubation which was statistically significant but clinically within the normal range [Figures 2 and 3].

The hemodynamic data were statistically significant following intubation within both the groups. And within the group comparisons for hemodynamic data following intubation demonstrated a significant difference ($P < 0.05$) [Figures 4 and 5].

The ASA I impairment scale was compared preoperatively and postoperatively in both the groups. None of the patients had any further neurological deterioration [Table 4].

Table 1: Demographic data

Demographic profile	Mean±SD/*n* (%)		*P*
	Group Airtraq (*n*=20)	Group McCoy (*n*=20)	
Age	42.85±12.04	42.8±11.9	0.831
Gender (male: female)	14:6	16:4	0.46
Weight	58.15±10.91	62.05±10.92	0.831
Level of pathology (%)			
Cervical 3	3 (15)	8 (40)	0.2
Cervical 4	5 (25)	2 (10)	
Cervical 5	9 (45)	9 (45)	
Cervical 6	3 (15)	1 (5)	
Type of pathology (%)			
Degenerative PIVD	14 (70)	17 (85)	0.26
Traumatic PIVD	6 (30)	3 (15)	
Mallampati grading (%)			
1	9 (45)	10 (50)	0.29
2	9 (45)	5 (25)	
3	2 (10)	5 (25)	
Neck circumference	36.79±3.71	36.43±4.61	0.983
MHD	5.21±0.95	5.69±0.95	0.081
TMD	7.94±1.45	8.26±2.01	0.983
SMD	15.33±2.07	14.58±2.37	0.081
Mouth opening	4.45±0.97	4.88±0.71	0.433
History of snoring (%)	3 (15)	2 (10)	0.632
Cervical collar (%)	14 (70)	16 (80)	0.46
Anticipated difficult airway (%)	1 (5)	2 (10)	0.54
Difficult mask ventilation (%)	0 (0)	0 (0)	-
MILS (%)	4 (20)	1 (5)	0.151

PIVD: Prolapsed intervertebral disc, MHD: Mentohyoid distance, TMD: Thyromental distance, SMD: Sternomental distance, MILS: Manual in-line stabilization, SD: Standard deviation

Table 2: Comparison of intubation difficult scoring and grading in both the groups

IDS	Number of patients (%)		*P*
	Group Airtraq	Group McCoy	
0 (easy)	20 (100)	4 (20)	0.000
0-5 (slight difficulty)	0 (0)	16 (80)	
>5 (moderate to major difficulty) (%)	0	0	
∞ (impossible) (%)	0	0	

IDS: Intubation difficulty score

Discussion

Airway management in patients with cervical spine injury carries an added risk of neurological injury.[6] To avoid such mishaps, minimal cervical motion and utmost care during airway management is the criterion. Minimal cervical motion is achieved either with MILS, Philadelphia collar, pin traction, or combination maneuvers. On the other hand, application of these maneuvers increases the difficulty grade for intubation.[7] Studies have shown increased use of newer laryngoscope blades and equipment to minimize the cervical motion and to improve the glottis vision during airway management such cases.[8] McCoy laryngoscope with levering mechanism is commonly used in both emergency and elective scenarios, especially in relatively easy grades of intubation. Others include light wand stylet, intubating laryngeal mask airway (ILMA), Airtraq, video laryngoscope, fiber optic bronchoscope, etc. Literature has shown wide use and comparison of these techniques with their varied advantages and complications.[1,2]

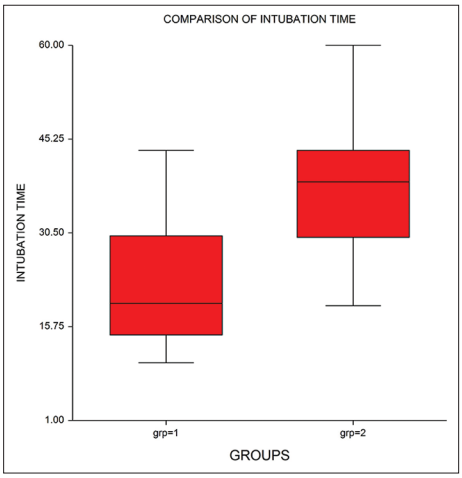

Figure 1: Box plot comparing time taken for intubation in both the groups. Grp-1: Airtraq group, Grp-2: McCoy group

Airtraq has come up in a long way in the airway management of anticipated difficult intubation with good mouth opening of at least 18 mm in adults. Literature has reported minimal cervical motion with Airtraq which was comparable with McCoy laryngoscope.[2] There are very few studies regarding airway management with Airtraq and McCoy blade and actual cervical spine injury. Durga *et al*. have compared Airtraq with McCoy in normal patients immobilized with a cervical collar and MILS simulating cervical spine injury.[3] This current study was undertaken to compare McCoy which is commonly used and Airtraq, currently gaining popularity in the airway management of patients with actual cervical spine injury with respect to intubation time, intubation difficulty scoring, hemodynamic changes following intubation, complications following intubation, and comfort grading of the operator.

Table 3: Comparison of airway parameters in both the groups

Parameters	Median (IQR)/*n* (%)		*P*
	Group Airtraq	Group McCoy	
Comfort grading	0 (0)	9 (45)	0.00065
Intubation failure	Nil	Nil	-
Desaturation episodes	Nil	Nil	-
Airway trauma	Nil	Nil	-
Airway complications	Nil	Nil	-

IQR: Interquartile range

The findings of our results displayed that the mean intubation time and IDS was significantly less with Airtraq compared to McCoy in patients undergoing cervical spine surgery. The comfort grading was significantly better with Airtraq. Our results were in consistent with the findings of a study by Tolon *et al*. They compared Airtraq with Macintosh and reported that the duration of intubation time was significantly less with Airtraq compared to Macintosh and Cormack grading and IDS score values were high in Macintosh group.[9] Arino and Sherren suggested the best glottis view achieved with minimal force required for intubation with Airtraq in both normal and difficult airway scenarios compared to other

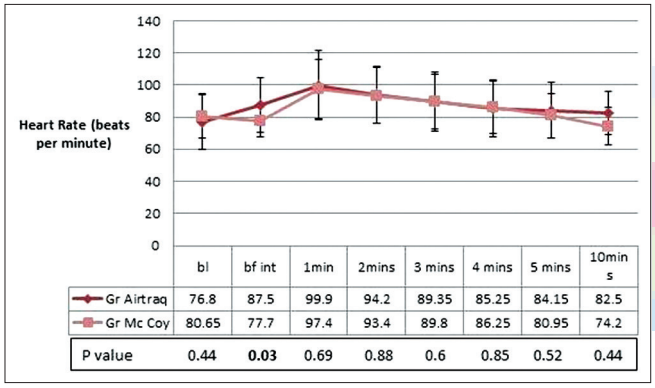

Figure 2: Comparison of heart rate following intubation in both the groups. Gr: Group, bl: Baseline, bf int: Before intubation, Min: minute, Mins: Minutes

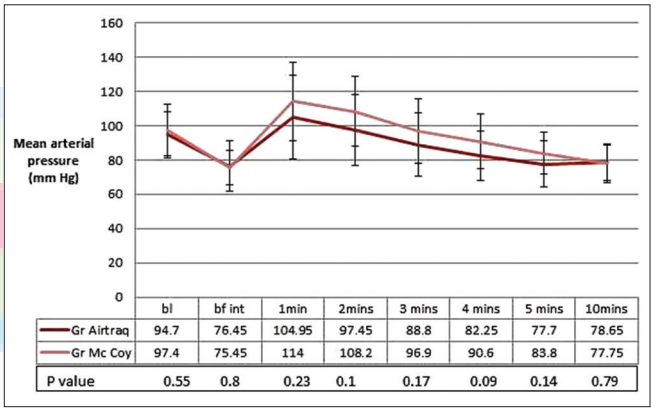

Figure 3: Comparison of mean arterial pressure between the groups. Gr: Group, bl: Baseline, bf int: Before intubation, Min: Minute, Mins: Minutes

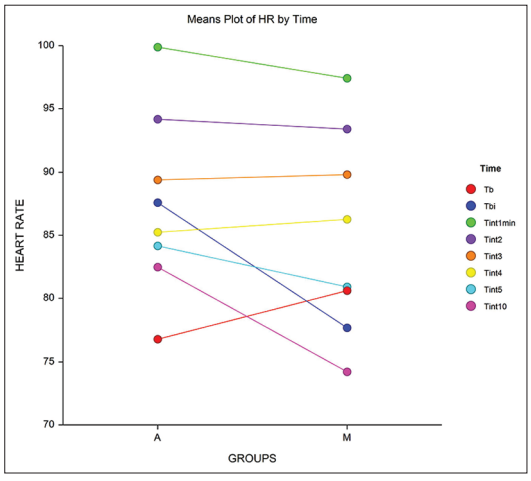

Figure 4: Changes in heart rate by time within the two groups. HR: Heart rate, T: Time, b: Baseline, bi: Before intubation, Int: Intubation

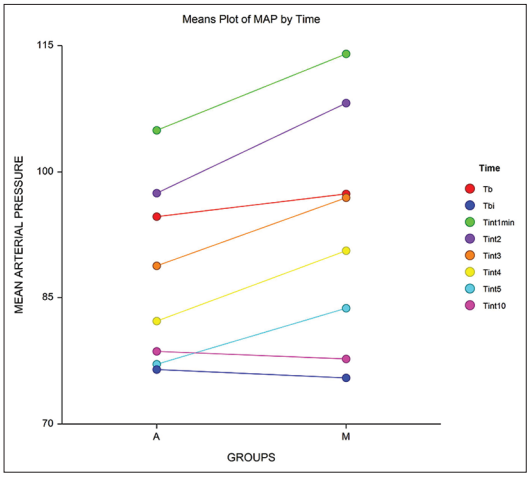

Figure 5: Changes in mean arterial pressure by time within the two groups. MAP: Mean arterial pressure, T: Time, b: Baseline, bi: Before intubation, Int: Intubation

Table 4: Comparison of American Society of Anesthesiologists I impairment scale in the pre- and post-operative period in both the groups

ASA I impairment scale	Group Airtraq (%)		Group McCoy (%)		*P*
	Preoperative	Postoperative	Preoperative	Postoperative	
A=Complete: No sensory or motor function is preserved in the sacral segments S4-S5	0	0	0	0	0.07
B=Incomplete: Sensory, but not motor, function is preserved below the neurologic level and extends through sacral segments S4-S5	0	0	0	0	
C=Incomplete: Motor function is preserved below the neurologic level, and most key muscles below the neurologic level have muscle grade <3	5 (25)	5 (25)	3 (15)	3	
D=Incomplete: Motor function is preserved below the neurologic level, and most key muscles below the neurologic level have muscle grade ≥3	4 (20)	4 (20)	11 (55)	11	
E=Normal: Sensory and motor functions are normal	11 (55)	11 (55)	6 (30)	6	

ASA I: American Society of Anesthesiologists I

airway devices.[10,11] Our study too has displayed statistically significant improved comfort with Airtraq compared to McCoy laryngoscope. Minimal manipulation was required to achieve a fine, premium, and high-quality view of the larynx.

A study conducted by Kaki *et al*. has shown that Airtraq was more easier to place with less trauma when compared to Macintosh in mannequins by novice medical students.[12] Other studies too have shown easy learning curve and good maneuverability with Airtraq.[13-15] Amor *et al*. compared Macintosh blade with Airtraq for intubation in simulated patients with immobilized cervical spine. The success rate for intubation with Airtraq was found to be high with less hemodynamic fluctuations compared with Macintosh blade.[16] In contrast, an earlier study by Chalkeidis *et al*. has shown statistically increased time taken for intubation with Airtraq compared to Macintosh laryngoscope. But the assistance to the anesthesiologist was less frequently required with Airtraq.[17] Arslan *et al*. compared Airtraq with LMA CTrach device for intubation in patients simulated for cervical spine injury with rigid cervical collar. Airtraq consumed significantly less time for intubation with lesser incidence of mucosal damage.[18]

Ali *et al*. have compared Airtraq with McCoy in patients using a rigid neck collar in patients with simulated difficult laryngoscopy. Though the number of attempts and overall intubation success rate was comparable with both the techniques, the time required for intubation was less with Airtraq.[19] Till date, only one study completely negated the success rate with Airtraq along with its complications.[20]

No studies were reported with patients with an actual cervical spine injury. Amathieu *et al*. have evaluated the incorporation of Airtraq as one of the emergent airway devices for difficult airway management. They have reported the success rate for intubation with Airtraq was 97% in such a scenario.[21] The success rate for intubation with Airtraq was 100% in our study. Airtraq improves the success rate compared to McCoy and can be introduced successfully in difficult airway algorithm. Difficult airway management armamentarium may include Airtraq as one of such devices for emergent services. A meta-analysis by Hirabayashi *et al*. have shown weightage of Airtraq over Macintosh blade in the management of difficult airway.[22] Similarly, Abdullah *et al*. have found that the success rate for intubation was significantly better with Bonfils compared to McCoy blade. The operating assistance required was increased with McCoy blade.[23]

There are very few studies where Airtraq was compared with other devices in patients with actual cervical spine injury. There are reports of successful and safe intubation in pediatric patients undergoing cervical spine injury.[24] Morbidly obese patients are another category where the intubation time plays a crucial role in preventing desaturation at the time of airway manipulation. Definitive airway was established with Airtraq with shorter apnea time compared to Macintosh laryngoscope blade.[25] In our study, we have not included pediatric and obese patients. Airtraq may play an important role in the airway management of patients with cervical spine injury where cervical immobilization increases the difficulty grading for intubation too.

Cervical spine motion is frequently encountered during airway management. A meta-analysis by Wainscott has shown minimal motion with fiber optic intubation and light wand stylet followed by ILMA and other devices. Airtraq was almost comparable with McCoy with respect to cervical motion.[26] Another recent study by Hindman *et al*. has shown that the force exerted by Macintosh blade introduction was significantly greater. The extension of occiput – C2 required for visualization of the glottis was more with Macintosh blade compared to Airtraq.[27]

The HR and the blood pressure following intubation were comparable in both the groups. Previous studies have displayed less hemodynamic fluctuations with Airtraq compared to Macintosh blade, C-MAC, and GlideScope.[16,28,29] Rather, Maharaj *et al*. have shown a better hemodynamic profile with Airtraq compared to Macintosh blade.[30] Bilgin and Bozkurt have shown a comparable hemodynamic profile with CTrach,

ILMA, and McCoy blade.[31] Moreover, McCoy *et al*. have shown less hemodynamic stimulations with McCoy compared to Macintosh blade.[32] This study has got one major limitation. Since the study was not blinded, there was a possibility of bias.

Conclusion

Airtraq improves the grade of glottic visualization with minimal assistance. It also minimized the time taken for intubation, stable hemodynamics with increased comfort to the anesthetist. Airtraq may be used as a definitive alternative to McCoy for airway management with cervical spine injury, where cervical immobilization maneuvers further increase the difficulty grade for intubation.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Appendix 1

Number	McCoy laryngoscope	Airtraq
N1	Number of intubation attempts >1	Number of intubation attempts >1
N2	Number of operators >1	Number of operators >1
N3	Number of alternative intubation techniques used Hinge used - 1 Bougie used - 2 Others (Magill forceps, etc.,) - 3	Number of alternative intubation techniques used Hinge used - 1 Others used - 2
N4	Glottic exposure (Cormack-Lehane Grade 1)	Glottic exposure (Cormack-Lehane Grade 1)
N5	Lifting force required during laryngoscopy Normal - 0 Increased - 1	Lifting force required during Airtraq placement Normal - 0 Increased or change in position of Airtraq required - 1
N6	Necessity for external laryngeal pressure No - 0 Yes - 1	Necessity for external laryngeal pressure No - 0 Yes - 1
N7	Position of the vocal cords at intubation Abduction/not visualized - 0 Adduction - 1	Position of the vocal cords at intubation Abduction/not visualized - 0 Adduction - 1