



# Airtraq, LMA CTrach and Macintosh Laryngoscopes in Tracheal Intubation Training: A Randomized Comparative Manikin Study

Trakeal Entübasyon Eğitiminde "Airtraq", "LMA CTrach" ve "Macintosh" Laringoskoplara: Randomize, Karşılaştırmalı Bir Manken Çalışması

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**Objective:** Training students on simulators before allowing their direct contact with patients is well accepted. There is no clinical or manikin-based simulation study in the literature comparing tracheal intubation with Airtraq, laryngeal mask airway (LMA) CTrach and Macintosh laryngoscopes performed by medical students having no prior intubation experience.

**Methods:** After obtaining written informed consents, 123 participants were included in the study. The participants were asked to intubate the manikin five times with each device randomly. After all the participants had completed their fifth intubations, the measurements were performed. The primary outcome variables were the first-attempt success rate and the time for a successful intubation, while the secondary outcome variables were to determine the scores of dental trauma, the difficulty visual analogue scale and the optimization manoeuvres.

**Results:** The LMA CTrach group revealed a significantly higher number of intubation attempts. The mean time for a successful intubation was the longest in the LMA CTrach group (17.66±8.22 s,  $p<0.05$ ). Students defined the Airtraq as the easiest to use and the Macintosh laryngoscope as the most difficult device to use and learn. Dental trauma severity was significantly lower in the Airtraq group than in the other groups ( $p<0.05$ ), and it was found to be 0 in 81.1% in the Airtraq group. The head extension optimization manoeuvre rate was significantly higher with the Macintosh laryngoscope than with the Airtraq laryngoscope ( $p<0.05$ ).

**Conclusion:** This study, in which different types of laryngoscopes were compared, revealed that the Airtraq laryngoscope has advantages, such as shorter intubation duration, less additional optimization manoeuvres, less dental trauma intensity and is easier to learn compared with the LMA CTrach and Macintosh laryngoscopes.

**Keywords:** Airway, tracheal intubation, laryngoscope

**Amaç:** Hastalar ile doğrudan teması izin vermeden önce öğrencilerin simülörler üzerinde eğitimi kabul edilen bir tekniktir. Daha önce entübasyon deneyimi olmayan tıp öğrencileri tarafından gerçekleştirilen Airtraq, Laryngeal Mask Airway (LMA) CTrach ve Macintosh laringoskop ile trakeal entübasyonu karşılaştıran klinik veya manken - bazlı bir simülasyon çalışması bulunmamaktadır.

**Yöntemler:** Yazılı bilgilendirilmiş onamların ardından, 123 katılımcı çalışmaya dahil edildi. Katılımcılardan rastgele her bir cihaz ile mankeni beş kez entübe etmeleri istendi. Tüm öğrenciler beşinci entübasyonu tamamladıktan sonra ölçümler yapıldı. Primer amaç birinci denemede başarı oranı, başarılı entübasyon zamanı, ikincil amaç dental travma, zorluk Görsel Analog Ölçeği ve optimizasyon manevralarını belirlemektir.

**Bulgular:** Entübasyon girişim sayısı LMA CTrach grubunda anlamlı olarak daha yüksekti. Başarılı entübasyon için ortalama süre LMA CTrach grubunda en uzundu (17,66±8,22 sn,  $p<0,05$ ). Öğrenciler öğrenme ve kullanma bakımından Airtraq'ı en kolay, Macintosh laringoskopu ise en zor olarak tanımladı. Dental travma şiddeti Airtraq grubunda diğer gruplardan anlamlı olarak daha düşüktü ( $p<0,05$ ) ve %81,1'inde 0 bulundu. Baş ekstansiyon optimizasyon manevra oranı Airtraq ile karşılaştırıldığında Macintosh laringoskop grubunda anlamlı olarak daha yüksekti ( $p<0,05$ ).

**Sonuç:** Farklı türde laringoskoplara karşılaştırıldığı bu çalışmada Airtraq'ın kısa entübasyon süresi, daha az ek optimizasyon manevraları, daha düşük dental travma şiddeti ve daha kolay öğrenilebilirliği ile avantajlı olduğu ortaya konulmuştur.

**Anahtar kelimeler:** Havayolu, trakeal entübasyon, laringoskop

## Introduction

Tracheal intubation is a life-saving process requiring experience. It is difficult for inexperienced medical staff to learn and perform this procedure. It has been reported in previous studies that the process of learning intubation with the Macintosh laryngoscope can be quite difficult and can take a long time (1, 2). Therefore, scientists focused their efforts on developing alternative optical laryngoscopes for facilitating the process with easy-to-use devices (3, 4). Both the Airtraq optical laryngoscope and laryngeal mask airway (LMA) CTrach provide a high-quality view of the glottis. The LMA CTrach is a modified version of

the intubating LMA and continuously provides video endoscopic imaging of the larynx and the intubation process during the tracheal intubation through LMA (5-7), while the Airtraq is a disposable indirect laryngoscope with a narrow curvature blade and a channel for endotracheal tube placement (8).

Training students on simulators before allowing their direct contact with patients is a well-accepted technique (9, 10). There are previous studies comparing Airtraq with Storz DCI and Bullard (3), the airway scope (11, 12) and the C-MAC and Glidescope (13) devices in manikin-based simulations. However, we did not come across any clinical or manikin-based simulation study comparing the LMA CTrach with the Airtraq and Macintosh laryngoscopes. In this study, we aimed to compare the uses of optical and Macintosh laryngoscopes by medical students having no prior tracheal intubation experience.

## Methods

This study (Ethical Committee Protocol No: 09.2011.0057) was approved by the Ethical Committee of the Marmara University Medical Faculty. Following the written informed consents, 123 fifth-year medical students without tracheal intubation experience were included in the study. The students enrolled in the study were undergoing Anaesthesia and Resuscitation internships and participated in groups of 15–20 on the dates specified by the medical school administration. For avoiding any kind of bias in the study, the participants were asked not to share the obtained information with the other intern groups. Following the briefing on the uses of the standard regular size Airtraq, adult size LMA CTrach and size 3 Macintosh laryngoscopes, the students watched video presentations on the use of each of these three devices. After the video presentations, the students were asked to intubate the normal airway manikin five times with each device. The order of the devices was randomized using a computer-generated random numbers table. A.S. generated the random allocation sequence and enrolled the participants. Then, A.S. assigned the participants to the test interventions. After all the students had completed their fifth intubations, the duration of endotracheal intubation, number of attempts, success rate, severity of the dental trauma and optimization manoeuvre use (head extension and rotation) were recorded in the course of the students' sixth intubations. The students were also asked to assess the ease of use and manoeuvrability of each of the three devices on a 100-mm visual analogue scale (VAS). At the end, all the participants filled in a short questionnaire of five questions (Table 1). All of the intubations were performed with a cuffed lubricated endotracheal tube with an inner diameter of 7.5 mm, while the rigid stylet was not used. The stopwatch was started as soon as the participants took the airway instruments in hand, and it was stopped when the endotracheal tube passed through the vocal cords. A different researcher other than the trainer maintained the records and verified the intubations through tracheal observations and the

Table 1. The short questionnaire about the Macintosh, Airtraq and LMA CTrach devices

*Please write M for Macintosh, A for Airtraq, and L for LMA CTrach:*

*0, very difficult; 100, very easy*

1. Which device was the easiest one to use in endotracheal intubation?

2. Which device is easier to learn?

3. With which device did you feel safer?

4. By which device do you think the complication rate should be higher?

5. Which device is more difficult to get used to?

LMA: laryngeal mask airway

inflation of the manikin's lungs. In case of failure in providing airway within 2 min or failure in completing the procedure, the oesophageal intubation was considered unsuccessful. As in the study of Savoldelli et al. (14), this study used the method of grading the applied pressure on teeth for measuring the severity of dental trauma: grade 0, no pressure; grade 1, mild; grade 2, moderate and grade 3, severe pressure. The participants were asked to reply to the question: 'If you consider the ease of use and learnability, which instrument would you prefer to use for intubation?' using a 100-mm VAS: 0, very easy to learn and use and 100, very difficult.

Students who did not provide written consent or who had previous intubation experience with one of the three instruments were excluded from the study. Both the researcher explaining the procedure and informing the students and the other researcher maintaining records were professional anaesthetists with four years' experience each.

## Statistical analysis

The Statistical Package for the Social Sciences software version 20.0 (Armonk, NY: IBM Corp, USA) was used for statistical analyses. The frequency, rate, average and standard deviation values were used for the descriptive statistics of the data. Distribution of the variances was controlled using the Kolmogorov–Smirnov test. While the Friedman test was used for the analysis of repeated measurements, the Wilcoxon, Cochran Q and McNemar tests were used for the sub-analyses. The Bonferroni correction was used. The data obtained after a preliminary study is in accordance with the standard effect size of 0.42. For a difference in intubation time between devices, of at least 2.5 s, with a standard deviation of 6 s (alpha: 0.05 and beta: 0.1) and 90% power, 120 participants were required.

## Results

One hundred and twenty-five medical students were asked to participate in the study. One did not accept and one was

Table 2. Comparison of intubation time

		Mean
Intubation time (s)	Macintosh	10.83±5.36
	Airtraq	11.02±5.31
	LMA CTrach	17.66±8.22 *
Friedman test. *Between groups, p<0.001. LMA: laryngeal mask airway		

Table 3. Difficulty visual analogue scale scores of devices

Macintosh	Airtraq	LMA CTrach
46.98±23.86	23.28±17.53*	29.67±22.63 <sup>†</sup>
*Compared with the Macintosh p=0.000, <sup>†</sup> Compared with the Airtraq p=0.002. LMA: laryngeal mask airway		

excluded because of her prior intubation experience. The data of 123 participants were analysed. The LMA CTrach group showed a significantly higher number of intubation attempts. The mean number of attempts for the Macintosh, Airtraq and LMA CTrach were 1.09±0.32, 1.22±0.51 and 1.28±0.66 times, respectively, (p<0.05). The mean time to successful intubation was the longest in the LMA CTrach group (17.66±8.22 s, p<0.001). The mean intubation duration with the Airtraq and Macintosh laryngoscopes were 11.02±5.31 s and 10.83±5.36 s, respectively (Table 2). According to the results of the questionnaires, the students found the Airtraq to be the easiest device to use and learn and stated that they felt safest while using the Airtraq. The students also stated that the Macintosh would be the most difficult device to get used to, and they would have a higher expectation of complications when using the Macintosh. Dental trauma severity was significantly lower in the Airtraq group than in the other groups (p<0.05), and it was found to be 0 in 81.1% of the Airtraq group. The difficulty VAS scores of the Macintosh were significantly higher than the scores of the Airtraq and LMA CTrach (p<0.05). The VAS scores of the Airtraq were significantly lower than the scores of the LMA CTrach (p<0.05) (Table 3). The head extension optimization manoeuvre rate was significantly higher with the Macintosh laryngoscope than with the Airtraq group (p<0.05). The rate of head extension in the LMA CTrach was not significantly different from the rates in the Macintosh and Airtraq groups. The use of rotation manoeuvres with the LMA CTrach was significantly higher compared with the Macintosh and Airtraq groups (p<0.05).

## Discussion

In the present study, medical students without any previous experience learned how to perform tracheal intubation using Airtraq, LMA CTrach and Macintosh laryngoscopes on manikins. While the Airtraq was found to be the easiest device to use and learn by the students, the LMA CTrach required the

highest rate of optimization manoeuvres and the longest time for a successful intubation.

Currently, Macintosh laryngoscope is primarily used for tracheal intubation and is considered as the gold standard (9). However, tracheal intubation attempts performed by inexperienced medical staff have a high failure rate (15, 16). Therefore, the authors of this article believe that training on the widely used video-laryngoscopic procedures may be included in the scope of internship programmes. The students who participated in the current study stated that using the Airtraq is easier than using the Macintosh laryngoscope and LMA CTrach, because these students found the Airtraq easier to learn and felt safe while using that device. On the other hand, as the students expressed in the questionnaires, they thought that the use of the Macintosh was the most difficult of all, and it also led to higher complication expectations compared to the others. Also this was in line with previous studies, where Airtraq was the most preferred instrument by the users in comparison with the Macintosh laryngoscope (17, 18). In a comparison for anaesthetized adult patients with Manual in Line Axial Stabilization, the Airtraq group had a significantly longer duration for both intubation and laryngoscopy, although the Airtraq provided an equal success rate of intubation as the Macintosh laryngoscope (19). Interestingly, according to experienced anaesthesiologists' assessment by the Intubation Difficulty Scale score, intubation with the Airtraq was again significantly easier than the Macintosh, although the duration for intubation was longer. In our study, the novice users mentioned the similar statement about the Airtraq; however, the intubation time was similar with the Macintosh.

In a meta-analysis of 24 trials including 1866 patients, it was concluded that alternative devices, particularly the Airtraq device, is associated with a statistically significant reduction in the rate of intubation failure at first attempt in patients with cervical spine immobilization (20). During our training period, we used adult manikins with normal airways. Even in situations where the spine is immobilized, the Airtraq device may also reduce the risk of intubation failure. Not only in adults but also in the paediatric population, the Airtraq was found to decrease the number of intubation attempts, the intubation time and the optimization manoeuvres, compared with the Macintosh laryngoscope (21). For children, the tracheal intubation time was longer and there was a statistically significant difference in intubation time between the Airtraq and Macintosh laryngoscopes (51.6±26.7 s vs. 22.8±6.1 s, respectively).

The difficulty scores of intubation were also found to be significantly lower for the LMA CTrach than the scores for the Macintosh laryngoscope (22). In morbidly obese patients, the LMA CTrach provided a shorter apnoea period compared to the Airtraq and Macintosh laryngoscopes, and similarly the LMA CTrach achieved a better quality of arterial oxygenation compared to the Macintosh laryngoscope (23). However,

er, experienced anaesthesiologists performed the intubation attempts in this study. Considering the learning process of the LMA CTrach device, the intubation duration was significantly higher in the LMA CTrach than in the other devices. The reason underlying that result may be the difficulty of providing a glottic view with CTrach. In the study of Arslan et al. (24), the LMA CTrach was compared with intubating ILMA. In this comparison, similar to our results, the median total time taken for tracheal intubation was shorter with the ILMA than with the LMA CTrach (78 (63-105) s vs 128 (98-221) s, respectively). In another study, the mean time for intubation using the CTrach was longer than for a direct laryngoscope and a Glidescope group (120 s, 100 s and 86 s, respectively) (25). The Airtraq laryngoscope provides a better glottic view by arranging the oral, laryngeal and tracheal axes (26). As a better glottic view is achieved by using the Airtraq, the number of optimization manoeuvres decreases correspondingly. In the current study the lowest optimization rate was found in the Airtraq group. Rotation optimization tactics were most frequently utilized in the LMA CTrach group. In the study of Malik et al. (22), intubation attempts with the CTrach took a longer time than the intubation time required by both the Macintosh and the Airwayscope. The number of optimization manoeuvres was also found to be higher in the CTrach group than for the other groups. However, Arslan et al. (27) reported less mucosal damage in the use of the Airtraq compared to the CTrach. The present study similarly indicated that there was less dental damage when the Airtraq was used for intubation, because the glottic view was easily provided and the requirement for optimization manoeuvres was low in the Airtraq.

As there is a guiding channel in the structure of the Airtraq, it enables an easier and faster intubation. Thus, not only is the number of manoeuvres decreased but also less effort is required for intubation. In other words, there are less haemodynamic changes in the clinic (28, 29). The results of the present study may be adapted to clinical practices excluding the cases in which the glottic view is extremely restricted due to blood or secretion.

### Study limitations

There are some limitations in this study to be discussed. The current study examined the presence and severity of dental trauma as a potential complication that may develop during orotracheal intubation. However, mucosal damage, and soft tissue or vocal cord trauma that may appear during the clinical practice could not be examined. As this is a manikin-based study, some complications such as salivation, bleeding or fogging could not be simulated. It was reported previously that for the maintenance of the visual clarity in video-laryngoscopes, the humidity of the environment should be more than 85%, and the scope temperature should be kept above 34 degrees (3). However, it is not the case for the Airtraq with its antifogging system.

## Conclusion

The data obtained from this study indicates that medical staff without previous endotracheal intubation experience can successfully use video-laryngoscopic devices for providing an airway. In this study, different types of optical laryngoscopes were compared. The Airtraq was found to have some advantages, such as shorter intubation time, less additional optimization manoeuvres, less dental trauma severity and easy learnability.

**Ethics Committee Approval:** Ethics committee approval was received for this study from the ethics committee of Marmara University School of Medicine.

**Informed Consent:** Written informed consent was obtained from patients who participated in this study.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept – A.S.; Design – A.S., D.D., F.Y.G.; Supervision – D.D., F.Y.G.; Resources – A.S., Ö.B.; Materials – A.S., Ö.B.; Data Collection and/or Processing – A.S., Ö.B.; Analysis and/or Interpretation – A.S., Ö.B., D.D., F.Y.G.; Literature Search – A.S., Ö.B.; Writing Manuscript – A.S.; Critical Review – A.S., D.D., F.Y.G.; Other – A.S., Ö.B.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study has received no financial support.

**Etik Komite Onayı:** Bu çalışma için etik komite onayı Marmara Üniversitesi Tıp Fakültesi'nden alınmıştır.

**Hasta Onamı:** Yazılı hasta onamı bu çalışmaya katılan hastalardan alınmıştır.

**Hakem Değerlendirmesi:** Dış bağımsız.

**Yazar Katkıları:** Fikir – A.S.; Tasarım – A.S., D.D., F.Y.G.; Denetleme – D.D., F.Y.G.; Kaynaklar – A.S., Ö.B.; Malzemeler – A.S., Ö.B.; Veri Toplanması ve/veya İşlemesi – A.S., Ö.B.; Analiz ve/veya Yorum – A.S., Ö.B., D.D., F.Y.G.; Literatür Taraması – A.S., Ö.B.; Yazıyı Yazan – A.S.; Eleştirel İnceleme – A.S., D.D., F.Y.G.; Diğer – A.S., Ö.B.

**Çıkar Çatışması:** Yazarlar çıkar çatışması bildirmemişlerdir.

**Finansal Destek:** Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

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