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Effect of the Macintosh curved blade size on direct laryngoscopic view in edentulous patients

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ABSTRACT

Objective: In the present study, we compared the laryngoscopic view depending on the size of the Macintosh curved blade in edentulous patients.
Methods: Thirty-five edentulous adult patients scheduled for elective surgery were included in the study. After induction of anesthesia, two direct laryngoscopies were performed alternately using a standard-sized Macintosh curved blade (No. 4 for men and No. 3 for women) and smaller-sized Macintosh curved blade (No. 3 for men and No. 2 for women). During direct laryngoscopy with each blade, two digital photographs of the lateral view were taken when the blade tip was placed in the valleculae; the laryngoscope was lifted to achieve the best laryngeal view. Then, the best laryngeal views were assessed using the percentage of glottic opening (POGO) score. On the photographs of the lateral view of direct laryngoscopy, the angles between the line extending along the laryngoscopic handle and the horizontal line were measured.
Results: The POGO score was improved with the smaller-sized blade compared with the standard-sized blade (87.3% [11.8%] vs. 71.3% [20.0%], $P < 0.001$, respectively). The angles between the laryngoscopic handle and the horizontal line were greater with the smaller-sized blade compared to the standard-sized blade when the blade tip was placed on the valleculae and when the laryngoscope was lifted to achieve the best laryngeal view (both $P < 0.001$).
Conclusions: Compared to a standard-sized Macintosh blade, a smaller-sized Macintosh curved blade improved the laryngeal exposure in edentulous patients.

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1. Introduction

Proper selection of the size and shape of the laryngoscopic blade is a crucial component for achieving an optimal laryngeal view. The choice of blade generally depends on personal preference and patient anatomy. According to the manufacturer's instructions, a Macintosh curved blade No. 4 is for large adults and a No. 3 is for medium sized adults. Based on an expert opinion [1], a Macintosh blade No. 4 for men and a No. 3 for women can be used. In some studies, Macintosh blades No. 3 or 4 were selected at the discretion of the authors [2,3].

The anatomical features of the upper airway and dental condition affect the difficulty of endotracheal intubation. Prominent maxillary incisors complicate direct laryngoscopy by blocking the line of vision to the larynx. Direct laryngoscopy in edentulous patients has been considered to be easier because there are no teeth to protect [4]. However, the ease of intubation in edentulous patients has not been clinically investigated, and it has been suggested that the edentulous state makes it more difficult to align the laryngoscope to view the larynx [5]. Edentulism causes the collapse of the oropharyngeal space, such as reduced retropharyngeal space and decreased lower face height [6], which may affect direct laryngoscopy.

Thus, the optimal blade size in edentulous patients may be different from that in patients with normal teeth. The conventionally selected curved blade in patients with normal dentition may be relatively bigger in edentulous patients during direct laryngoscopy. In the present study, we hypothesized that a smaller-sized Macintosh curved blade would be better compared to a standard-sized Macintosh curved blade for direct laryngoscopy in edentulous patients, and compared different sized

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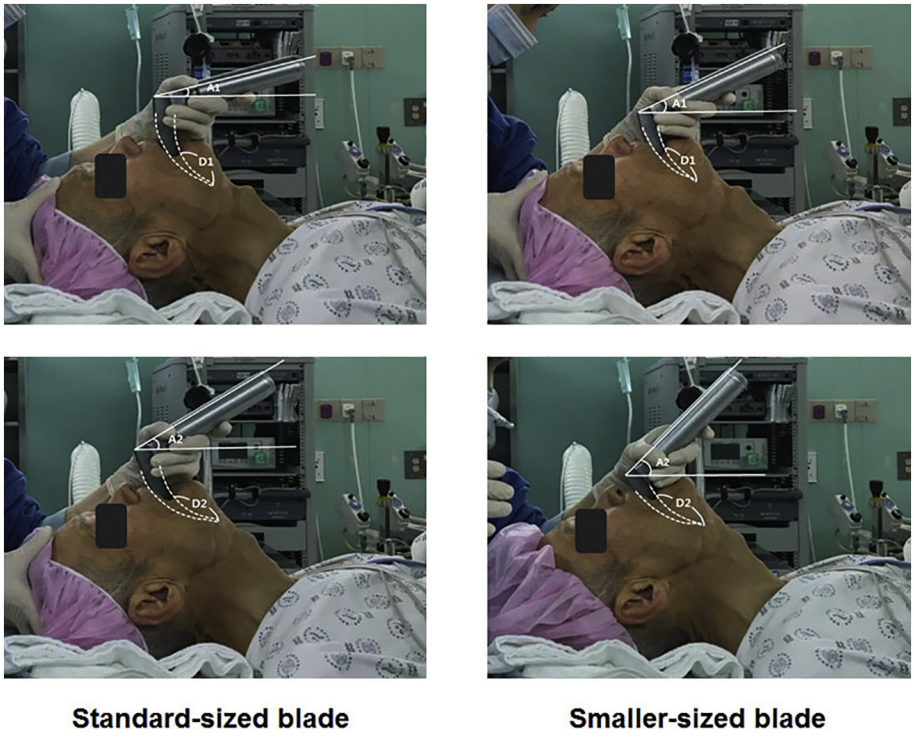

Fig. 1. Lateral view of direct laryngoscopy with different sizes of Macintosh curved blades. D1, distance along the inner curve from the laryngoscope tip to the point of contact of the blade with the lower lip when the blade tip was placed in the valleculae; D2, distance along the inner curve from laryngoscope tip to the point of contact of the blade with the lower lip when the laryngoscope was lifted to achieve the best laryngeal view; A1, angle between the line extending along the laryngoscopic handle and the horizontal line when the blade tip was placed in the valleculae; A2, angle between the laryngoscopic handle and the horizontal line when the laryngoscope was lifted to achieve the best laryngeal view.

blades in terms of the laryngoscopic view and the angles between the laryngoscope handle and the horizontal line (Fig. 1, A1 and A2) to expose the laryngeal structures during direct laryngoscopy in them.

2. Methods

This cross-over trial was approved by our medical center Institutional Review Board (No. 20160620/16-2016-76/071). Written informed consent was obtained from all patients. The trial was registered at the Clinical Research Information Service (KCT0002057).

Edentulous adult patients scheduled to undergo general anesthesia were enrolled in the study. Patients with known or suspected difficult airway, diseases or anatomical abnormalities in the upper airway, body mass index ≥30 kg cm^{-2}, risk of aspiration, or Cormack-Lehane grade 3 or 4 during direct laryngoscopy were excluded from the study.

General anesthesia was induced with intravenous propofol (1–1.5 mg kg^{-1}) and fentanyl (1.0–1.5 μg kg^{-1}), and muscle relaxation was achieved using rocuronium (0.8 mg kg^{-1}). An experienced board-certified anesthesiologist performed two direct laryngoscopies alternately with two different sized Macintosh curved blades in random order (in men, blade No. 3 and No. 4; in women, blade No. 2 and No. 3). The conventional size of the Macintosh curved blade was No. 4 for men and No. 3 for women, and the smaller-sized blade meant No. 3 for men and No. 2 for women. Randomization was based on a computer-generated program. During direct laryngoscopy, the operating table was at the same level as the anesthesiologist's anterior superior iliac crest. The laryngoscope blade was advanced towards the midline of the tongue base until the epiglottis was visualized. When the tip of a curved blade was engaged in the valleculae, the point where the blade touched the patient's lower lip was marked on the blade, and a digital photograph of the lateral view of direct laryngoscopy was taken using a digital camera placed at the level of the mandible. Then, the laryngoscope handle was lifted in an anterior-caudal direction to expose the laryngeal structures. When the best laryngeal view was achieved, the point of contact of the blade with the lower lip was marked on the blade, and another digital photograph of the lateral view of direct laryngoscopy was taken. The best laryngeal view was assessed using the percentage of glottic opening (POGO) score, which quantifies the glottic opening and ranges from 0% to 100%. A full view of the glottis from the anterior commissure to the interarytenoid notch was equivalent to a POGO score of 100%; no visualization of the glottic opening was equivalent to a POGO score of 0%. Mask ventilation was intermittently performed with 100% oxygen and sevoflurane to prevent desaturation if required. Endotracheal intubation was performed after evaluation of the laryngeal views during two laryngoscopies.

Using the marked points on the blade, the following distances were measured and recorded: the distance along the inner curve from the blade tip to the mark made on the blade when the blade tip was placed in the valleculae was defined as D1; the distance between the blade tip and the mark made on the blade when the laryngoscope was lifted to achieve the best laryngeal view was defined as D2 (Fig. 1). Difference between D2 and D1 (ΔD) with each blade was recorded. On the photographs taken during direct laryngoscopy, two lines were drawn: a line extending along the laryngoscopic handle and a horizontal line. The angles between these two lines were measured and recorded when the blade tip was placed in the valleculae (A1) and when the laryngoscope was lifted to achieve the best laryngeal view (A2) (Fig. 1). Difference between A2 and A1 (ΔA) with each blade was also recorded.

SPSS for Windows software (ver. 20; IBM Corp., Armonk, NY, USA) was used to conduct statistical analyses. Data normality was tested using the Shapiro-Wilk test. Categorical and continuous data were expressed as frequency (%) and mean (SD), respectively. The laryngeal view, distance between the laryngoscope tip and the point of contact on the lower lip, the angle between the laryngoscopic handle and horizontal line in the each step, ΔD, and ΔA were analyzed using a paired *t*-test or Wilcoxon's signed rank test. A *P*-value <0.05 was considered statistically significant.

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