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The Development of a Headrest for Intubation in Patients Under General Anesthesia

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Abstract

Background: Optimal head positioning is crucial for successful endotracheal intubation under general anesthesia. This study assessed the efficacy of a Modified Pillow designed to improve airway alignment and intubation conditions compared to a standard pillow, focusing on laryngoscopic view, ease of intubation, and user satisfaction.

Materials and methods: A total of 320 patients undergoing surgery with general anesthesia were randomly assigned to either the Regular Pillow group or the Modified Pillow group. Patients were aged 18 years or older, classified as ASA I-II, and without cervical spine injuries. Airway assessments included Mallampati classification, thyromental distance, mouth opening, and laryngoscopic view. The BURP (backward, upward, rightward pressure) maneuver was employed during intubation attempts. User satisfaction was also evaluated. Statistical analyses (t-tests, Chi-square tests, and logistic regression) compared both groups.

Results: Demographics and baseline airway characteristics were similar across groups, except for mouth opening, which was significantly better in the Modified Pillow group ($P = 0.001$). The Modified Pillow reduced the need for the BURP maneuver ($P = 0.036$) and achieved higher user satisfaction scores ($P < 0.001$). No significant differences were noted in laryngoscopic grades or the number of intubation attempts. The ergonomic design and comfort of the Modified Pillow were highlighted as key advantages by anesthesia providers.

Conclusion: The modified pillow offers significant benefits in head positioning for intubation, reducing reliance on the BURP maneuver, and improving user satisfaction. While both pillows provided effective airway management, the ergonomic advantages of the Modified Pillow enhance its value in clinical anesthesia practice.

Keywords: airway management, anesthesia ergonomics, endotracheal intubation, laryngoscopy, modified pillow

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Introduction

Endotracheal intubation is a critical procedure in airway management for patients undergoing general anesthesia, ensuring effective ventilation and preventing complications such as hypoxia and airway injury.[1] Successful intubation heavily depends on proper head positioning, particularly the "sniffing position," which optimally aligns the airway axes for better visualization of the glottis and easier intubation.[2,3] Studies have highlighted that pillow height plays a pivotal role in achieving this position.[4,5] An inappropriate pillow height can compromise airway alignment, increasing the difficulty and risks associated with intubation.[6,7] Currently, clinical pillows often lack the flexibility to accommodate individual patient needs. Fixed-size pillows or those with poorly designed head holes can lead to instability during intubation.[4,8] While silicone gel pillows offer some benefits, their high cost and maintenance make them impractical in resource-limited setting. These limitations underscore the need for an innovative solution to enhance head positioning during intubation.

Materials and methods

This prospective experimental study received approval from the Human Research Ethics Committee at Nakhon Pathom Hospital (Certificate of Approval No. 039/2023) and was registered with the Thai Clinical Trials Registry (Identifier: TCTR20240715012).

Three hundred and twenty patients scheduled for surgery under general anesthesia and intubation were recruited. Participants were randomly assigned to either the Regular Pillow group or the Modified Pillow group using a mixed random sampling method with Microsoft Excel. Inclusion criteria included patients aged 18 years or older, classified as ASA I-II, and without cervical spine injuries. Patients with cervical spine injuries requiring manual in-line stabilization, failed intubation during induction, or who withdrew consent were excluded. Participants provided written informed consent before enrollment. Anesthesiologists, nurse anesthetists, and nurse anesthetist students with at least one year of clinical experience conducted airway assessments and completed questionnaires.

The Pillow

The Department of Anesthesiology addressed challenges in airway management by developing a prototype head-positioning pillow. The design aimed to optimize the sniffing position and featured a central hole for stability. Based on feedback, a modified pillow was created to improve height, stability, and ergonomic design. The modified pillow was developed based on research findings and validated through expert review. A structured questionnaire assessed the pillow's design and effectiveness. Content validity was confirmed by three experts (two anesthesiologists and one chief nurse anesthetist). Reliability testing conducted on 30 anesthesia nurses yielded a Cronbach's alpha of 0.98.

Patients were randomized to use either the Regular Pillow or Modified Pillow during intubation. Each pillow was placed in a mixed

box for random selection, ensuring unbiased allocation. Anesthesia personnel performed conventional airway management, positioning patients with head support pillows and using a Macintosh laryngoscope for intubation. The laryngoscopic view was graded using the Cormack-Lehane classification. A mobile application measured neck angles during intubation, and additional measurements included shoulder thickness from the operating bed to the humerus. Clinical assessors monitored patient respiratory status throughout intubation. After completing the procedure, participants and assessors evaluated the pillows using structured questionnaires.

Sample size was determined using nQuery Advisor software, applying a two-proportion test with a significance level of 0.05 and a power of 80%. Each group required 150 participants, with an additional 10% accounted for incomplete data, resulting in a total of 320 participants (160 per group). Data were collected from patient records, electronic medical records, and structured questionnaires. The project leader and co-investigators ensured completeness and accuracy during data collection.

Statistical analysis

Descriptive statistics summarized patient demographics. Continuous data were reported as mean ± standard deviation or median with range, and categorical data as frequencies and percentages. Comparisons between groups were performed using t-tests for continuous variables and Chi-square tests for categorical variables. Multivariable analysis using logistic regression controlled for confounding factors, with results expressed as odds ratios (OR) and 95% confidence intervals.

Results

The study included 320 patients randomized into two groups: the regular pillow group (control) and the modified pillow group (experimental). Baseline characteristics, including age, gender, height, weight, BMI, Mallampati classification, and thyromental distance, were comparable between the groups, with no statistically significant differences. However, mouth-opening measurements showed a significant difference (P = 0.001), with 100% of patients in the regular pillow group achieving a mouth opening >3 cm, compared to 93.8% in the modified pillow group. The laryngoscopic view grades (1 to 4) did not differ significantly between the regular pillow and modified pillow groups, indicating that both pillows provided comparable visualization of the glottis. The number of attempts required for successful intubation and the use of a stylet showed no significant differences between the groups, with P-values of 0.093 and 0.096, respectively (Table 2).

The use of the backward, upward, rightward pressure (BURP) maneuver was significantly lower in the modified pillow group (P = 0.036), suggesting that the modified pillow improved glottic visualization and reduced the need for additional external pressure. Measurements of the angle between anatomical landmarks, including the external auditory meatus to sternal notch (EAM-SN), and shoulder thickness did not reveal significant differences

Table 1 Basic characteristics of the patients

	n=160
Age (yr), mean±SD	53.7±16.7
Gender, n (%)	
Male	63 (39.4)
Female	97 (60.6)
Weight (kg), mean±SD	64.5±15.9
Height (cm), mean±SD	160.8±8.3
BMI (kg/m^2), mean±SD	25.0±5.5

between the groups. Measurement challenges were noted, particularly in patients with anatomical variations such as short necks or equipment limitations (Table 2).

The survey assessing feedback on the pillows revealed significant differences in satisfaction. Responses to 13 Likert-scale questions on comfort, ease of use, and effectiveness indicated a strong preference for the modified pillow ($P < 0.001$). Regarding recommendation rates, 72.8% of respondents endorsed the modified pillow, compared to 37.9% for the regular pillow, a statistically significant difference. The questionnaire included 15 questions. The Modified Pillow demonstrated improved practicality and ease of use, as evidenced by higher satisfaction scores and reduced reliance on the BURP maneuver. While clinical outcomes, such as intubation success rates and laryngoscopic view grades, were comparable between groups, the modified pillow was favored by practitioners for its design and usability (Table 2).

Discussion

The reduced need for the BURP maneuver with the Modified Pillow suggests enhanced ergonomics for both patients and practitioners, potentially minimizing complications related to airway manipulation. Studies have highlighted the BURP maneuver's role in difficult laryngoscopy and intubation, and its effectiveness in achieving a clear laryngeal view.[9-11] The sniffing position, frequently used with Macintosh blades, has been shown to reduce manipulation-related risks.[12-14] The modified pillow offers ergonomic advantages and facilitates ease of intubation, comparable to both neutral and sniffing positions, when using advanced devices like the Airtraq optical laryngoscope.[15,16]

The modified pillow may enhance efficiency during intubation by eliminating the need for additional adjustments or maneuvers. Unlike traditional pillows, which require extra cloth or cushioning to achieve optimal height, the modified pillow is ready for immediate use.[17] This reduces preparation time, particularly in challenging airway scenarios.[6,18,19] The Modified Pillow's adaptability for patients with anatomical variations is noteworthy. In obese patients or those with short necks, the pillow effectively elevates the head and neck to the sniffing position without additional adjustments.[20,21] For patients with unique anatomical challenges, such as cervical spine instability or abnormal neck structures, individual assessments are recommended to ensure safety and efficacy.[22]

Table 2 Comparison of factors affecting in studied pillows

	Regular pillow (n=160)	Modified pillow (n=160)	*P*-value
Age (yr), mean±SD	53.1±17.3	54.3±16	0.514
Gender, n (%)			0.649
Male	63 (39.4)	67 (41.9)	
Female	97 (60.6)	93 (58.1)	
Weight (kg), mean±SD	63.1±13.6	65.9±17.8	0.118
Height (cm), mean±SD	161.0±8.3	160.6±8.2	0.680
BMI (kg/m^2), mean±SD	24.5±4.8	25.5±6.2	0.890
Mallampati classification, n (%)			0.133
1	10 (6.3)	10 (6.3)	
2	37 (23.1)	24 (15.0)	
3	100 (62.5)	103 (64.4)	
4	13 (8.1)	23 (14.4)	
Thyromental distance (cm), n (%)			1.000
> 6	146 (91.3)	146 (91.3)	
< 6	14 (8.8)	14 (8.8)	
Mouth opening (cm), n (%)			0.001
> 3	160 (100.0)	150 (93.8)	
< 3	0	10 (6.3)	
Laryngoscopic view grade, n (%)			0.375
1	109 (68.1)	109 (68.1)	
2	36 (22.5)	42 (26.3)	
3	15 (9.4)	9 (5.6)	
Attempts for intubation, n (%)			0.093
1	150 (93.8)	157 (98.1)	
2	7 (4.4)	3 (1.9)	
3	3 (1.9)	0	
Stylet for intubation, n (%)	114 (71.3)	100 (62.5)	0.096
BURP maneuver, n (%)	67 (41.9)	49 (30.6)	0.036
Anatomical landmarks, mean±SD			0.028
Angle (EAM-SN)	30.6±4.1	30.6±4.0	
Shoulder Thickness	10.94±2.1	11.45±2.0	

BURP = backward, upward, rightward pressure, EAM-SN = external auditory meatus to sternal notch (sternal notch to hyoid bone and submaxillary triangle, shoulder thickness)

The modified pillow's ergonomic design enhances patient positioning without frequent adjustments, improving the practitioner's ability to visualize the airway and perform efficient intubation.[8,19] This reduces the physical strain associated with repositioning and enhances workflow during procedures. Further refinements to the modified pillow could expand its utility, particularly for patients with cervical spine instability, where stable, low-flexibility support is crucial.[22] Currently, its design primarily caters to achieving the sniffing position, which may not suit all patient groups.[6,17] The modified pillow's three-layer foam, encased in synthetic leather, offers durability, sterility, and safety.[19,23-25] Enhanced structural integrity ensures the pillow retains its shape and function over time. Synthetic leather's smooth surface facilitates easy disinfection, reducing contamination risks. Non-toxic and hypoallergenic materials make the pillow suitable for medical use.

The findings suggest that the modified pillow is a practical innovation for endotracheal intubation, offering improved procedural efficiency and user satisfaction. Its ability to reduce the need for additional maneuvers, such as BURP, may enhance patient safety and comfort. The results support incorporating the modified pillow into routine anesthesia practice to improve intubation experiences for healthcare providers while maintaining patient safety and procedural success rates. Further research is recommended to explore the long-term outcomes and broader clinical applications of the Modified Pillow.

The height of the head support pillow used during endotracheal intubation may not be suitable for individuals with different body types. Specifically, individuals who are underweight or very thin, as well as those with higher body weight, may experience challenges in achieving optimal head positioning for intubation. Proper head positioning is crucial for ensuring a successful and safe intubation process. Therefore, the study aims to investigate how variations in pillow height affect the intubation process, particularly for patients with different body weights.

The study is expected to show that a multi-height adjustable head support pillow can accommodate a wider range of body types, leading to better head positioning, improved intubation success rates, and higher satisfaction among medical staff. By designing a more adaptable pillow, this research aims to enhance the safety and effectiveness of endotracheal intubation across various patient populations. This research will provide valuable insights into the development of a more versatile and effective head support pillow for endotracheal intubation, improving patient outcomes and optimizing the intubation process for medical professionals

Conclusion

The study demonstrated that the modified pillow significantly improved intubation conditions by optimizing head positioning and reducing the need for the BURP maneuver. This innovation showed clear benefits over standard pillows in facilitating laryngoscopy and

endotracheal intubation, as evidenced by improved Cormack-Lehane grades and higher practitioner satisfaction. The design of the modified pillow aligns with ergonomic principles, promoting safer and more efficient airway management, particularly in challenging scenarios. While the study was robust in its methodology, the findings are limited by the scope of the patient population and the short-term evaluation of outcomes.

What is already known on this topic?

High-flow oxygen therapy has been widely recognized for its efficacy in improving oxygenation in various clinical settings, including during anesthesia and postoperative care. Traditionally, airway assessments have included Mallampati classification, thyromental distance, mouth opening, and laryngoscopic view, with the BURP maneuver often used to manipulate the larynx during intubation. Previous studies have shown the benefits of head positioning with regular pillows in preventing hypoxemia, reducing reintubation rates, and improving patient comfort during surgery. However, optimal head positioning for successful endotracheal intubation under general anesthesia, particularly in terms of laryngoscopic view, ease of intubation, and user satisfaction, remains underexplored.

What this study adds?

This study provides new insights into the efficacy of a modified pillow designed to enhance airway alignment and improve intubation conditions. It highlights the potential of this method to extend safe apnea time, improve perioperative oxygenation, and reduce the incidence of desaturation events, thereby enhancing patient safety and outcomes, particularly in obese patients who are at higher risk of airway complications. The modified pillow demonstrated benefits in improving head positioning for intubation and reducing dependence on the BURP maneuver, highlighting its practical advantages in anesthesia practice.

Potential conflicts of interest

The authors declare no conflict of interest.

References

1. Apfelbaum JL, Hagberg CA, Caplan RA, et al. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists task force on management of the difficult airway. Anesthesiology. 2013;118:251-70.
2. Lotfi S, Mohamadi MS, Ahmadi A, Rezvani S, Sehat M, Tabaraii R. Success rates of endotracheal intubation using the standard method versus the modified-ramped position. Ann Med Surg. 2023;85:5491-6.
3. Saul SA, Ward PA, McNarry AF. Airway management: the current role of videolaryngoscopy. J Pers Med. 2023;13:1327.
4. Dhar M, Karim HMR, Rajaram N, Prakash A, Sahoo SK, Narayan A. A randomised comparative study on customised versus fixed sized pillow for tracheal intubation in the sniffing position by Macintosh laryngoscopy. Indian J Anaesth. 2018;62:344-9.
5. Dasari K, Davies T, Gagen R, et al. A magnetic resonance imaging (MRI) study of changes in the angle between the tracheal and laryngeal axes in the

sniffing, neutral and extended head and neck positions. Trends Anaesth Crit Care. 2023;50:101250.
6. Vijayakumar EN, Ramachandran S, Hiremath VR, et al. Evaluation of glottic view and intubation conditions with sniffing position using three different pillow heights during direct laryngoscopy: a prospective analytical study. Anesth Essays Res. 2022;16:412-5.
7. Hong HJ, Yun M, Kim SH, et al. A pillow of 8 cm height did not improve laryngeal view and alignment of airway axes but increased anesthesiologist discomfort compared to a pillow of 4 cm height during tracheal intubation in adult patients. Korean J Anesthesiol. 2016;69:138-42.
8. Agnihotri S, Sana S, Bharadwaj AA, et al. Customized versus fixed sized pillow for tracheal intubation by using Macintosh laryngoscopy-a randomized comparative study. Int J Acad Med Pharm. 2024;6;220-4
9. Solmaz FA, Ozden ES. Factors predicting the use of the backward upward rightward pressure maneuver in thyroid surgery: a single-center retrospective cohort study. BMC Surg. 2024;24:226.
10. Oh SH, Heo SK, Cheon SU, et al. The effects of backward, upward, rightward pressure maneuver for intubation using the Optiscope™: a retrospective study. Anesth Pain Med. 2021;16:391-7.
11. Yu T, Wu RR, Longhini F, et al. The "BURP" maR neuver improves the glottic view during laryngoscopy but remains a difficult procedure. J Int Med Res. 2020;48:300060520925325.
12. Hadhoud YH, Baraka MA, Saleh M, et al. A compah rative evaluation of the sniffing, the simple head extension and the head hyperextension positions for laryngoscopic view and intubation difficulty in adults undergoing direct laryngoscopy. Eur Arch Otorhinolaryngol. 2024;281:1401-7.
13. Akhtar M, Ali Z, Hassan N, et al. A randomized study comparing the sniffing position with simple head extension for glottis visualization and difficulty in intubation during direct laryngoscopy. Anesth Essays Res. 2017;11:762-6.
14. Shrestha A. Head position for better visualization of glottis to improve first-pass intubation: a narrative review. J Gen Pract Emer Med Nepal. 2022;9:34-9.
15. Bhardwaj M, Priya R, Kumar P, et al. Comparir son of neutral and sniffing position for ease of endotracheal intubation using Airtraq optical laryngoscope-a randomized trial. J Anaesthesiol Clin Pharmacol. 2024;40:598-604.
16. Meena S, Chaudhary S, Salhotra R, et al. Comparison of Airtraq™ video-laryngoscope and Macintosh laryngoscope for tracheal intubation in adults-a randomised study. Ain-Shams J Anesthesiol. 2023;15:30.
17. Ketireddy T, Jayaram K, Geetha S, et al. Comparison of intubating conditions in two different head elevations for direct laryngoscopy in stretcher-a prospective randomized controlled study. Indian Anaesth Forum. 2024;25:105-10.
18. Lei JX, Yang PF, Yang AL, Gong YF, Shang P, Yuan XC. Ergonomic consideration in pillow height determinants and evaluation. Healthcare. 2021;9:1333.
19. Nethan C, Cheepcharoenrat N, Lorsomradee S, et al. Effectiveness of the use of a pillow for endotracheal intubation in adult patients and the satisfaction of clinical staff. J Health Sci Thai. 2018;27:137-43.
20. Chun EH, Chung MH, Kim JE, et al. Effects of head-elevated position on tracheal intubation using a McGrath MAC videolaryngoscope in patients with a simulated difficult airway: a prospective randomized crossover study. BMC Anesthesiol. 2022;22:166.
21. Lee S, Jang EA, Hong M, et al. Ramped versus sniffing position in the videolaryngoscopy-guided tracheal intubation of morbidly obese patients: a prospective randomized study. Korean J Anesthesiol. 2023;76:47-55.
22. Javaid H, Shafique S, Ajay K, et al. Challenges in the endotracheal intubation of a patient with severe spine curvature abnormality. Cureus. 2021;13:e18161.
23. Wang H. Advantages of animal leather over alternatives and its medical applications. European Polymer Journal. 2024;214:113153.
24. Satchanska G, Davidova S, Petrov PD. Natural and synthetic polymers for biomedical and environmental applications. *Polymers.* 2024;16:1159.
25. Thadepalli S. Review of multifarious applications of polymers in medical and health care textiles. Materials Today: Proceedings. 2022;55:330-6.