

# Comparison of Intubation Difficulty in Patients with and Without Obstructive Sleep Apnoea Syndrome

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## Abstract

**BACKGROUND/AIMS:** Obstructive sleep apnoea syndrome (OSAS) is a medical disease in which the upper respiratory tract is repeatedly blocked during sleep. Difficult intubation is more common among OSAS patients compared to the average population. Airway safety is also of importance for anaesthesia management. The prediction of difficult intubation may prevent many complications which can develop when attempting to establish the patency of the airway.

**MATERIAL AND METHODS:** Patients who were going to undergo ear-nose-throat operations were allocated into two groups, including 209 patients without OSAS (Group 1) and 113 patients with OSAS (Group 2). The neck circumference, the inter-incisor distance, the sterno-mental (SM) and the thyro-mental (TM) distances were measured; the Mallampati (MP) and the Cormack-Lehane (CL) tests were performed and recorded. It was evaluated whether these tests could be used as predictive markers for difficult intubation or not.

**RESULTS:** A neck circumference of above 40 cm, an inter-incisor distance lower than 4 cm, and MP and CL grades of 3 or 4 were found to be associated with difficult intubation. No association was found between difficult intubation and TM or SM. The rate of intubation difficulty was higher in the OSAS group.

**CONCLUSION:** We found that a short inter-incisor distance, a large neck circumference and a high Mallampati and CL degree were related to difficult intubation and OSAS. In line with these results, we concluded that OSAS is associated with intubation difficulty. We consider that pre-specifying these tests could reduce airway-related complication risks.

**Keywords:** Difficult intubation, obstructive sleep apnoea syndrome, anaesthesia

## INTRODUCTION

Obstructive sleep apnoea syndrome (OSAS) is characterized by persistent and recurrent obstruction of the upper airways during sleep.<sup>1</sup> A recent epidemiological study in adults showed that 49.7% of men and 23.4% of women have moderate to severe OSAS defined as an apnoea-hypopnoea index (AHI)  $\geq 15$ /hour.<sup>2</sup>

One study found a relationship between difficult intubation and OSAS and its severity.<sup>3</sup> The degree of difficulty in providing airway patency is parallel to hypoxic brain damage and the death risk. Therefore, airway control is significant in anaesthesia management in OSAS patients. The prediction

of difficult intubation allows for changes in the anaesthesia method, the preparation of auxiliary instruments and allows for the presence of an experienced specialist, hence reducing the complication risks.

An ample amount of tests have been defined for this purpose, including the Mallampati (MP) and Cormack-Lehane (CL) tests, the sterno-mental (SM) distance, the thyro-mental (TM) distance, the inter-incisor distance and neck circumference measurements.

The goal of this study was to assess intubation difficulty in patients with and without OSAS, as well as to establish intubation difficulty predicting tests.

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## MATERIALS AND METHODS

This study was conducted with Akdeniz University Clinical Research Ethics Committee's approval (ethics committee approval number: 70904504/141, date: 18.03.2015). ASA 1 or 2 patients aged 17–70 years who would undergo one or more of septoplasties, conchoplasty, uvulopalato-pharyngoplasty (UPPP), tympanoplasty, functional endoscopic sinus surgery, septorhinoplasty, mastoidectomy or tongue root resection due to any reasons were included in this study. The patients were informed about the study, and written consent was obtained from them prior to the study. The operations were performed by the same surgical team and the same anaesthesia team. Those patients without OSAS were classified as Group 1 (n=209), and those with OSAS were classified as Group 2 (n=113).

The inter-incisor distance, neck circumference, and thyro-mental and sterno-mental distances were measured and recorded. The oropharyngeal structures were evaluated and recorded according to the Modified Mallampati classification. This was performed when the patients were seated, their mouths were opened entirely, and their tongues were fully extended out. Sterno-mental and thyro-mental distance measurements were made with the head in full extension. The sterno-mental distance was defined as the distance between the highest end of the sternum and the end of the mandible; The thyro-mental distance was defined as the distance between the thyroid cartilage and the end of the mandible. The distance between the upper and lower incisors with the patient's mouth wide open was measured as the inter-incisor distance.

After full muscle relaxation following anaesthesia induction, the patient's head was positioned at extension at the atlanto-occipital joint and the upper cervical spine. The neck was placed in flexion from the inferior cervical spine, and intubation was performed. Laryngoscopy was performed using Macintosh 3 or 4 blades, and the appearance was evaluated and recorded according to the Cormack-Lehane classification. Intubation was defined as "easy" if intubation could be achieved at the first attempt with direct laryngoscopy and as "difficult" when an instrument and/or position change and/or tracheal pressure was required after laryngoscopy.

### Statistical Analysis

Categorical variables were expressed as frequency and percentage. Constant variables with a normal distribution were expressed as mean and standard deviation. Variables that did not fit the normal distribution were expressed as median and minimum-maximum. The Chi-square test was used in the analysis of the data. Data were analysed using IBM SPSS Statistics 18® (IBM Corp., Chicago, IL, USA) Copyright SPSS Inc.1989, 2010 software.

## RESULTS

Of a total of 322 patients, 92 (28.6%) were females, and 230 (71.4%) were males (Table 1). The male ratio was found to be significantly higher in Group 2 compared to Group 1 (p=0.00). The demographic characteristics of the patients are summarized in Table 2.

A significant difference was determined between the groups concerning intubation difficulty (p<0.01). The rate of difficult intubation was higher in the OSAS group (Table 3). Three of the patients with difficult intubation had a history of difficult intubation, while easily intubated patients did not have this history.

A relationship was determined between a neck circumference of over 40 cm and difficult intubation (p<0.01) (Table 4). The neck circumference was found to be over 40 cm in 84.8% of the patients in the OSAS group, and there was a significant difference between the OSAS group and the group without OSAS (p<0.01).

A significant association was found between the inter-incisor distance being smaller than 4 cm (p<0.01) (Table 4). The percentage of patients whose inter-incisor distance was 4 cm or below was 26.5% in the OSAS group, while this rate was 17.2% in the group without OSAS. A significant difference was determined between the groups (p<0.05).

No correlation was seen between the sterno-mental and thyro-mental distances and difficult intubation (p=0.40 and 0.23, respectively).

A significant association was determined between Mallampati 3 or 4 and difficult intubation (p<0.01) (Table 5). In our study, while the rate of Mallampati 3 or 4 was 31.0% in the OSAS group, this rate was 7.2% in the group without OSAS, and this difference was statistically significant (p<0.01).

A significant difference was determined between Cormack-Lehane grade of 3 or 4 and difficult intubation (p<0.01) (Table 5). In our study, while the rate of Cormack-Lehane grades of 3 or 4 was 34.8% in the OSAS group, this rate was 12.8% in the group without OSAS, and this difference was statistically significant (p<0.01).

## DISCUSSION

Airway control is essential in the anaesthesia management of OSAS patients. Many studies have found a link between OSAS and difficulty in intubating. Hiremath et al.<sup>3</sup> evaluated 15 patients with intubation difficulty and 15 control patients regarding clinical, polysomnography and radiology parameters in their prospective, case-controlled study investigating the relationship between OSAS severity and difficult intubation and they revealed a significant relationship between them. In that study, the Apnoea-hypopnea Index (AHI) was found to

**Table 1. Gender differences between groups**

	Gender		Total (n, %)
	Female (n, %)	Male (n, %)	
Group 1	79 (37.8%)	130 (62.2%)	209 (100%)
Group 2	13 (11.5%)	100 (88.5%)	113 (100%)
<b>Total</b>	92 (28.6%)	230 (71.4%)	322 (100%)

OSAS: obstructive sleep apnoea syndrome, Group 1: patients without OSAS, Group 2: patients with OSAS, n: number of the patients.

**Table 2. Quantitative differences between groups**

	Group 1 (n=209) (mean ± SD)	Group 2 (n=113) (mean ± SD)
Weight (kg)	74.2±14.7	88.5±13.4
Height (cm)	171±9.0	173.5±8.3
BMI	25.5±4.3	29.4±4.1
Age	34.5±12.0	45.1±8.8

OSAS: obstructive sleep apnoea syndrome, Group 1: patients without OSAS, Group 2: patients with OSAS BMI: Body Mass Index, \*p<0.05 was accepted as statistically significant. n: number of patients, SD: standard deviation.

be significantly higher in the difficult intubation group (patients with CL grade 4 were recorded as “difficult intubation” by the anaesthetist) compared to the control group; AHI was found to be greater than 10 in eight patients in the difficult intubation group and in two patients in the control group ( $p < 0.03$ ). In their retrospective study, Siyam and Benhamou<sup>4</sup> reported that intubation was more difficult in 36 OSAS patients than in the control group, and no significant association was found between OSAS severity and intubation difficulty. In another retrospective study,<sup>5</sup> 90 patients who had undergone UPPP surgery were included, and the rate of difficult intubation was found to be higher in the OSAS group than in the control group. In the same study, the patients were divided into three groups according to their AHI values and those with AHI of  $< 40$  were classified as the “mild OSAS” group, those with AHI of 40–70 were classified as the “moderate OSAS” group, and those with AHI of  $> 70$  were classified as the “severe OSAS” group. The incidence of difficult intubation was found to be higher only in those patients whose AHI was  $> 40$ . We also found the rate of intubation difficulty to be higher in the OSAS group ( $p < 0.01$ ).

Hiremath et al.<sup>3</sup> found those OSAS patients who had demonstrated intubation difficulty to be associated with an increased neck circumference. A short and large neck has been reported in the literature to be among the risk factors for intubation difficulty.<sup>6-7</sup> Acer et al.<sup>8</sup> found the threshold value of neck circumference to be 360 mm, and its sensitivity was found to be 94.74% and specificity to be 42.68% compared to the risky CL test group in their study conducted with 227 patients. Kandemir et al.<sup>9</sup> found the neck length and the circumference to be statistically significant in the prediction of intubation difficulty, and a 43.7% sensitivity, a 66% selectivity and a 50% positive predictive value were obtained for a neck circumference of 40.75 cm and above. In our study, we found a significant association between difficult intubation and a neck circumference of more than 40 cm, similar to the literature, and the rate of patients with a neck circumference of over 40 cm was found to be higher in the OSAS group compared to the non-OSAS group.

The inter-incisor distance which is measured with the mouth fully opened was previously evaluated by Wison et al.<sup>10</sup>. The authors showed that the inter-incisor distance is shorter in those patients with difficult laryngoscopy. A risk score was formed for the prediction of difficult laryngoscopy. The likelihood of mandibular protrusion was suggested to be related to increased risk in those patients whose inter-incisor distance was smaller than 5 cm (approximately three fingers width). We discovered a link between a smaller than 4 cm inter-incisor distance and problematic intubation, with the OSAS group having a greater rate of patients with an inter-incisor distance smaller than 4 cm.

Patil et al.<sup>11</sup> reported that a smaller than 6 cm distance between the lower border of the mandible and thyroid prominence with the neck in full extension was a predictor of difficult intubation. Frerk<sup>12</sup> found a smaller than 7 cm TM distance to be significant, and Karkouti et al.<sup>13</sup> found a smaller than 7.75 cm TM distance to be significant for difficult intubation. In their study conducted with 350 patients, Savva<sup>6</sup> concluded that the TM distance is not sensitive and specific enough and cannot be used as a single criterion in predicting difficult intubation. The authors found that the TM distance was smaller than 6.40 cm in patients with difficult intubation, similar to the study results of Kandemir et al.<sup>9</sup>. The TM distance, problematic intubation, and OSAS were not found to be associated in our study. The number of patients was smaller than ours in the studies of Frerk, Karkouti and Kandemir et al.<sup>9-13</sup>, and the rate of

OSAS patients was higher in our study, and differences may have arisen from this. Lohom et al.<sup>14</sup> reported that sensitivity decreased by 25% when measuring the TM and the SM distances together with the Mallampati test; however, the selectivity and the positive predictive value reached as high as 100%. Savva<sup>6</sup>, as a result of their study with 350 patients, suggested using the SM distance as the only objective indicator for difficult intubation. At the same time, when the SM distance was less than 12.5 cm, they found a sensitivity of 82.4%, selectivity of 88.6% and a positive predictive value of 26.9%. Al Ramadhani et al.<sup>15</sup> accepted the threshold value of the SM distance to be 13.5 cm or less. We did not find an association between the SM distance and difficult intubation and OSAS. This may have resulted from the higher number of OSAS patients in our study.

The patients with CL grades 3 or 4 were accepted as difficult intubation in the study of Kandemir et al.<sup>9</sup>. Furthermore, the Mallampati-thyromental distance combination was the test that demonstrated the highest selectivity and positive predictive value for predicting difficult

**Table 3. Assessment of groups concerning intubation difficulty**

	Intubation		Total
	Easy	Difficult	
<b>Group 1 (n, %)</b>	173 (82.8%)	36 (17.2%)	209 (100%)
<b>Group 2 (n, %)</b>	67 (59.3%)	46 (40.7%)	113 (100%)
<b>Total (n, %)</b>	240 (74.5%)	82 (25.5%)	322 (100%)

OSAS: obstructive sleep apnoea syndrome, Group 1: patients without OSAS, Group 2: patients with OSAS. n: number of patients.

**Table 4. The association between intubation difficulty and neck circumference and inter-incisor distance**

		Intubation		Total (n, %)
		Easy (n, %)	Difficult (n, %)	
<b>Neck circumference</b>	$\leq 40$ cm	119 (50.0%)	13 (16.2%)	132 (41.5%)
	$> 40$ cm	119 (50.0%)	67 (83.8%)	186 (58.5%)
<b>Total</b>		238 (100%)	80 (100%)	318 (100%)
<b>Inter-incisor distance</b>	$\leq 4$ cm	40 (16.7%)	26 (31.7%)	66 (20.5%)
	$> 4$ cm	200 (83.3%)	56 (68.3%)	256 (79.5%)
<b>Total</b>		240 (100%)	82 (100%)	322 (100%)

n: number of the patients.

**Table 5. The association between intubation difficulty and Mallampati and Cormack-Lehan**

		Intubation		Total (n, %)
		Easy (n, %)	Difficult (n, %)	
<b>Mallampati</b>	1–2	218 (90.8%)	54 (65.9%)	272 (84.5%)
	3–4	22 (9.2%)	28 (34.1%)	50 (15.5%)
<b>Total</b>		240 (100%)	82 (100%)	318 (100%)
<b>Cormack-Lehane</b>	1–2	216 (91.9%)	34 (42.5%)	250 (79.4%)
	3–4	19 (8.1%)	46 (57.5%)	65 (20.6%)
<b>Total</b>		235 (100%)	80 (100%)	315 (100%)

n: number of the patients.

intubation. Both OSAS and difficult intubation were found to be related to a higher Mallampati score in the study of Hiremath et al.<sup>3</sup>. We also found a significant association between Mallampati grades of 3 and 4 and difficult intubation. Additionally, the rate of Mallampati grades of 3 and 4 was significantly higher in the OSAS group.

Shiga et al.<sup>16</sup> conducted a meta-analysis of 35 studies comparing intubation tests with the CL test, and they found difficult intubation at a rate of 5.8% as a result of their meta-analysis.

Lohom et al.<sup>14</sup> compared intubation tests and CL tests in 212 cases and found the difficult intubation rate to be 9%. Kandemir et al.<sup>9</sup> found the difficult intubation incidence to be 7.9% in their study that accepted CL grade 3 and 4 patients as their difficult intubation criteria. We also determined a significant relationship between CL 3–4 and difficult intubation ( $p=0.00$ ). The rate of CL 3–4 was higher in the OSAS group.

The limitations of this study include its small sample size and recruitment from a single centre

We determined an association between intubation difficulty and OSAS and a shorter than 4 cm inter-incisor distance, a neck circumference of over 40 cm, and Mallampati grades of 3–4, and CL grades of 3–4. We consider that these parameters may be helpful in the prediction of difficult intubation. In line with these results, we concluded that OSAS is associated with intubation difficulty. We suggest that further studies be conducted on the subject.

## CONCLUSION

We found that a short inter-incisor distance, a large neck circumference and a high Mallampati and CL degree were related to difficult intubation and OSAS. In line with these results, we concluded that OSAS is associated with intubation difficulty. We consider that pre-specifying these tests could reduce airway-related complication risks.

## MAIN POINTS

- Difficult intubation is more common among OSAS patients compared to the average population.
- Prediction of difficult intubation may prevent many complications that can develop when attempting to establish the patency of the airway.
- Patients who were going to undergo ear-nose-throat operations were allocated to two groups so as to include 209 patients without OSAS (Group 1) and 113 patients with OSAS (Group 2).
- A neck circumference of over 40 cm, an inter-incisor distance lower than 4 cm, and MP and CL grades of 3 or 4 were found to be associated with difficult intubation
- The rate of difficult intubation was found to be significantly higher in Group 2.

## ETHICS

**Ethics Committee Approval:** Ethics approval was obtained from the Akdeniz University Clinical Research Ethics Committee (decision number: 70904504/141, date: 18.03.2015).

**Informed Consent:** Written informed consent was obtained from all patients included in this study.

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

## Authorship Contributions

Concept: Ü.İ., H.K.K., Design: Ü.İ., H.K.K., Data Collection and/or Processing: Ü.İ., H.K.K., Analysis and/or Interpretation: Ü.İ., H.K.K., Literature Search: Ü.İ., H.K.K., Writing: Ü.İ., H.K.K., Critical Review: Ü.İ., H.K.K.

## DISCLOSURES

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

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