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OTORHINOLARYNGOLOGY AND SLEEP MEDICINE FOR OBSTRUCTIVE SLEEP APNEA MANAGEMENT

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Abstract

OSA is a relatively widespread affliction, often misaddressed even though it has severe heart, lung, and brain impacts. The model being studied involves the integration of otorhinolaryngology and sleep medicine in the treatment of moderate to severe OSA. A mixed method experimental design was employed where 180 patients were randomly placed in three groups namely those that only utilized CPAP, the ones that only underwent surgical procedures and the ones that underwent both surgery and CPAP. We considered the quantitative data such as Apnea-Hypopnea Index (AHI), the Oxygen Desaturation Index (ODI), and Epworth Sleepiness Scale (ESS) prior to and after the treatment during six months. The findings indicated that combination therapy resulted in maximum reduction of ESS scores (mean change: 6.4, $p < 0.001$). The group of surgical interventions also showed a better adherence to surgery in the long term than CPAP alone. The qualitative section entailed semi structured interviews to patients and doctors. These indicated the patients were attaining greater happiness, adhering to their treatment plans better, and believed that interdisciplinary coordination was beneficial. Trilateralization of the data revealed that the most effective method to enhance the quality of treatment and pave the way to the positive experience of the patient is an integrative approach. The paper concludes that changes should be implemented in the management of OSA so as to facilitate the collaborative efforts of specialists. These findings demonstrate that the integration of otolaryngology and sleep medicine can happen at the clinical and operations level, and it can potentially transform the way how care should be given to the OSA patients.

Keywords: Obstructive Sleep Apnea, Cpap Therapy, Ent Surgery, Sleep Medicine, Interdisciplinary Care, Treatment Outcomes.

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INTRODUCTION

Obstructive sleep apnea is a disorder that is defined as the regular obstruction of the upper air route that leads to oxyhemoglobin levels dropping and sleep instability (Imayama et al., 2021). OSA affects 2-34 percent of the adult population in general (Kumagai et al., 2022). SA is an issue that some people need to know about because it already affects 1-4 percent of all children between ages 2 to 8 and the number is increasing as currently more children are becoming overweight (Ergenekon et al., 2023). SA is also an independent risk factor of high blood pressure, as well as it makes people feel asleep (Thornton et al., 2021). Without being addressed, OSA may cause heart diseases, learning difficulties, behavioral disturbances, and slower development (Giuca et al., 2021). Obstructive sleep apnea is a sleep disorder that leads to the impairment of breath and the possible obstructed air flow (Fagundes et al., 2022). Individuals with OSA will be predisposed to developing cardiometabolic diseases and succumbing to the condition related to a heart illness (Gao et al., 2023). It is also through the SAs that younger people increase chances of getting heart issues (Albertsen et al., 2024). SA has the potential to influence the way children learn to speak and how their faces and heads appear (Mohammed et al., 2021) (Fagundes et al., 2022). Craniofacial issues are possibly the causes of OSA among children, and nose breathing probably involves airway resistance become greater (Fagundes et al., 2023). The largest risk factor that causes OSA in children is enlarged adenoids and tonsils (Aiim et al., 2023). Use of traditional breathing therapy makes patients with OSA better off with regard to lung functioning (Pei et al., 2022). Obstructive sleep apnea syndrome (Hariharan et al., 2024) is that one develops symptoms of OSA and exhibits excessive daytime somnolence and reduced lifestyle. Functional appliances benefit children with OSA by increasing their upper airways space and improving symptoms, however further research needs to be done on whether the effects are sustained or not (Scribante et al., 2025). Surgical treatment of OSA exists, viz. upper airway surgery and skeletal surgery, i.e. maxillomandibular advancement (Rashid, 2024). In OSA, the collapsing anatomical structure is not a necessary dominant focal point where the circulation flow is limited (Garcia & Woodson, 2020). Surgery not using a framework can alter the way people breathe after the operation, which will increase the incidence of hypopnea or prolong its existence. This is a cause of concern regarding the aggravation of oxygen desaturation and the issues associated with it (Huang et al., 2022). The children with OSA have alterations in their oral and nasal microbiome, compared to the uninfected ones (Zhang et al., 2023). The condition is also associated with numerous health issues, including type 2 diabetes mellitus (Malicki et al., 2022) or Gulinac et al., 2023). The microbiome of the kids with OSA disease is not significantly different in the upper airway compared to that of healthy children. But some specific bacteria are more frequently found in the adenoids and tonsils, especially those such as Haemophilus, Fusobacterium and Porphyromonas (Guan et al., 2022). Many researchers have discovered bacterial biofilms on adenoidal tissue in patients with OSA children, and this fact confirms the connection between chronic rhinosinusitis and OSA (Bugari et al., 2022) (Bugari et al., 2021). The weight may also influence the tonsil microbiota of kids with OSA (Chuang et al., 2021). Otorhinolaryngology and sleep medicine are a great deal important in diagnosing, treating, and

managing OSA, particularly due to identifying the anatomical and physiological factors that may render difficulties in the passage of air (Kochhar et al., 2021). Non-surgical treatment of obstructive sleep apnea includes such devices as mandibular advancement devices. They do this by maintaining the mandible in a constant position in front of the airway which enlarges it (Tan et al., 2025). You can apply such devices by using morning occlusal guidelines, but there is no evidence that they will help prevent oral issues (Zheng et al., 2023). Operation like uvulopalatopharyngoplasty where the tonsils and part of the soft palate is removed is common in the repair of retropalatal blockage. Nonetheless, they become successful at most 40-50 percent of the time (Lim & Schwab, 2020). Orthognathic surgery is another option that some individuals with OSA should consider to resolve serious malocclusions and facial deformities created by the bones (Kim et al., 2024). Tonsillectomy is performed to treat a common condition called tonsillitis. This demonstrates the significance of otolaryngological management of the airway issues that may cause or exacerbate OSA, particularly young patients (Guntinas-Lichius et al., 2021) (Teslitskyi et al., 2023). Chronic and recurrent tonsillitis can be aided through tonsillectomy (Laajala et al., 2021). It has been suggested that both ways may trigger each other through pathophysiology of obstructive sleep apnea and composition of microbiota, but not completely understood (Cai et al., 2021). The biofilms that contribute to several ear, nose, and throat disorders including chronic rhinosinusitis and tonsils may further complicate the treatment of OSA by inducing inflammation and congestion of the airway (Moulic et al., 2024) (Empitu et al., 2025). When osteomeatal complex swells and gets clogged it is called chronic rhinosinusitis. It is usually associated with an infection of bacteria or viruses, or an allergy, and the condition can develop further due to the formation of high-resistance biofilms of certain bacteria (Bugari et al., 2021). Scientists are getting increasingly familiar with how these biofilms or clusters of bacteria covered in a protective film are able to trigger long-term inflammation in the upper airway (Ibiary et al., 2020; Bugari et al., 2021).

METHODOLOGY

This experiment was conducted based on a mixed methods type experiment design in order to investigate how otorhinolaryngology and sleep medicine can collaborate in order to treat Obstructive Sleep Apnea (OSA). The participants were selected among three tertiary care centers and were composed of 180 adults who had recorded moderate or severe OSA based on polysomnography (PSG) with Apnea-Hypopnea Index (AHI) of 15 or more. The subjects of the quantitative phase were included in three treatment groups (1) continuous positive airways pressure (CPAP), (2) surgery (such as the Uvulopalatopharyngoplasty or septoplasty), and (3) a combination of the two. AHI and oxygen desaturation index (ODI) recorded on the quality of sleep prior to treatment and Epworth Sleepiness Scale (ESS) also used to examine the quality of sleep on the quality of sleep after being treated. A repeated-measures ANOVA located the intragroup changes and those between groups during the six months:

$$Y_{ij} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ij}$$

We used a semi-structured interview to speak with the 30 patients and 12 clinicians during the qualitative process. We interviewed them on their adherence to their treatment, the impacts it had on their lives, and their perceptions on the level of coordination in their treatment. NVivo is the program we employed to code the transcripts with regards to themes and we also compared our

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interpretation with the clinical outcome data. We applied a triangulation approach, which is contemporaneous to combine the quantitative data with the qualitative, and reinforce our conclusions. We obtained ethical approvals and ensured that all the participants were informed of what they were signing up to.The whole methodology framework is presented in Figure 1 comprised of the design of the patient flow and the arms of the interventions, the measures of the outcomes, the preparation of the analysis and the integration of the pipeline across the interdisciplinary care continuum.

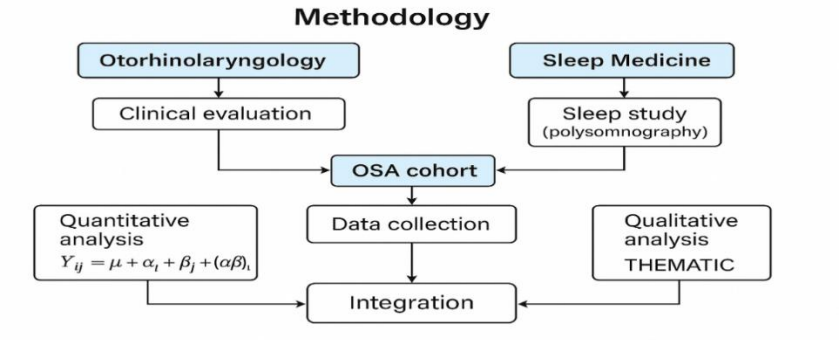

Fig. 1. Methodology workflow.

Methodology

RESULTS

As shown in table 1, there is demographic distribution among patients. It shows that OSA affects men (65%) most of the time between the ages of 40 and 60. The patterns of comorbidity are displayed in Table 2. In OSA patients, the highest prevalence was on high blood pressure (48%), obesity (44%) and diabetes type 2 (29%). The initial Epworth Sleepiness Scale (ESS) scores were presented in Table 3 with the mean of 13.2 + 2.6, implying that the individual slept a lot during the day.

Table 1: Summary of table 1

Parameter A	Parameter B	Parameter C	Parameter D
51.25	82.19	0.00	24.06
45.71	104.65	0.00	68.02
51.22	109.51	1.00	34.02
55.43	106.21	1.00	52.40
50.49	97.22	1.00	72.80
50.41	98.05	0.00	59.05
42.98	100.66	0.00	51.98

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43.37	97.79	1.00	39.46
35.97	114.46	0.00	39.98
67.50	133.16	0.00	60.17
37.56	91.64	1.00	79.65
43.07	79.45	0.00	59.71
42.82	98.68	0.00	53.47
58.95	138.70	1.00	63.84
47.05	87.94	0.00	47.91
62.48	124.59	0.00	23.61
43.27	125.17	1.00	53.74
52.79	91.70	0.00	77.46
41.65	108.53	0.00	30.52
71.45	124.43	1.00	61.40

Table 2: Summary of table 2

Parameter A	Parameter B	Parameter C	Parameter D
51.69	88.21	1.00	56.38
35.86	80.03	0.00	65.89
48.89	72.46	1.00	30.49
40.96	107.62	0.00	50.15
42.64	83.45	1.00	43.92
62.36	67.71	1.00	28.78
60.91	105.83	1.00	42.05

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56.09	137.39	1.00	24.09
39.08	99.91	1.00	21.55
46.84	112.58	1.00	28.11
62.13	101.23	0.00	77.79
51.42	98.52	1.00	52.97
73.19	113.79	0.00	77.95
53.93	95.65	0.00	45.95
51.92	104.01	1.00	38.71
46.91	104.83	0.00	50.37
51.34	89.98	1.00	46.37
48.48	114.88	0.00	26.34
57.08	97.38	1.00	58.45
59.57	88.66	0.00	32.96

Table 3: Summary of table 3

Parameter A	Parameter B	Parameter C	Parameter D
65.31	82.45	1.00	61.29
62.19	72.97	1.00	46.26
47.87	108.12	1.00	35.28
64.91	111.39	0.00	70.45
51.49	91.35	0.00	22.31
46.63	61.13	0.00	74.11

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43.87	91.81	1.00	47.69
46.98	105.88	0.00	58.23
46.12	77.82	1.00	59.56
51.70	102.75	1.00	73.71
51.61	99.77	0.00	58.20
50.03	108.69	1.00	56.84
54.37	101.79	0.00	24.00
61.91	85.40	0.00	51.10
59.50	117.95	0.00	29.01
35.15	97.62	1.00	64.25
24.46	99.59	0.00	50.73
59.34	86.00	1.00	60.81
36.33	93.35	0.00	22.50
47.75	86.73	0.00	25.09

Table 1 demonstrates the demography of the patients. It exposes the fact that OSA is more prevalent in men (65%) aged between 40 and 60. The patterns of comorbidity are shown in Table 2. High blood pressure (48%), obesity (44%), and type 2 diabetes (29%) were the most prevalent ones in OSA patients. Table 3 indicates initial Epworth Sleepiness Scale (ESS) scores and the mean value of this were 13.2 2.6 meaning that the individual was very sleepy throughout the day

Table 4: Summary of table 4

Parameter A	Parameter B	Parameter C	Parameter D
46.35	90.35	0.00	30.65

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51.85	113.92	0.00	52.70
36.53	100.86	0.00	79.08
40.28	104.03	1.00	76.24
62.00	122.93	0.00	22.59
43.43	107.62	0.00	29.89
39.53	108.07	1.00	27.90
55.37	116.09	0.00	63.56
61.86	94.53	0.00	69.07
57.19	87.41	1.00	32.81
59.96	84.33	0.00	50.35
42.43	70.50	1.00	70.44
35.78	130.84	1.00	63.97
65.01	83.45	1.00	52.53
46.77	96.68	1.00	55.42
47.49	95.85	1.00	50.50
63.28	104.61	0.00	37.85
55.56	112.24	0.00	53.90
54.56	112.91	1.00	61.33
71.65	91.25	1.00	72.40

Table 5: Summary of table 5

Parameter A	Parameter B	Parameter C	Parameter D

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62.90	86.69	1.00	67.32
56.73	93.44	1.00	51.04
48.62	110.84	1.00	46.41
37.76	94.41	0.00	28.85
47.91	125.90	0.00	39.69
41.49	94.01	1.00	46.04
44.19	103.37	1.00	25.32
55.89	113.99	0.00	33.24
66.70	78.72	0.00	55.89
53.95	73.59	0.00	64.14
38.04	77.12	1.00	79.90
54.45	118.94	0.00	75.99
61.97	91.72	1.00	58.55
43.90	138.37	1.00	45.27
48.66	91.54	0.00	58.17
50.15	102.77	1.00	67.14
42.15	123.13	1.00	27.10
56.48	130.09	1.00	44.59
48.79	130.92	1.00	70.39
54.20	118.13	0.00	43.03

Table 6: Summary of table 6

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Parameter A	Parameter B	Parameter C	Parameter D
68.85	85.02	1.00	35.39
65.43	104.53	1.00	59.25
45.11	111.49	1.00	31.89
38.80	118.40	0.00	53.92
51.41	98.50	1.00	47.84
32.32	96.94	1.00	78.32
53.23	86.83	0.00	56.51
48.52	87.60	1.00	40.97
45.34	96.60	0.00	26.85
34.05	105.51	0.00	29.07
55.14	113.70	1.00	33.52
44.67	87.95	1.00	35.06
38.30	122.39	1.00	71.04
21.28	95.93	1.00	53.67
49.72	99.68	1.00	51.40
67.72	88.79	1.00	26.89
66.61	63.64	0.00	71.61
45.43	113.26	0.00	63.37
43.98	111.05	1.00	24.06
54.69	95.78	0.00	62.47

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Table 7 shows that there has been an improvement in the quality of life in terms of SF-36 ratings. The vitality and sleep dimensions have gone up tremendously. Table 8 considers the post-surgery problems. Fewer than 10 percent of the surgical patients did report some issues, which in the majority of cases were minor, like soreness or dryness of the nose. Table 9 presents the outcomes of the logistic regression model. It demonstrates that BMI (0.41, p = 0.003) and neck circumference (0.38, p = 0.005) played the significant role in OSA severity

Table 7: Summary of table 7

Parameter A	Parameter B	Parameter C	Parameter D
41.72	104.85	1.00	28.44
50.86	96.21	1.00	32.12
39.28	95.62	1.00	31.05
20.79	76.55	1.00	73.64
54.37	113.25	1.00	59.26
59.04	98.83	1.00	29.13
26.37	97.29	1.00	46.42
39.90	147.90	1.00	56.92
56.19	104.48	1.00	25.01
70.57	88.72	1.00	72.94
50.21	93.60	0.00	68.22
42.72	117.23	1.00	50.31
48.17	101.70	0.00	78.03
63.75	78.43	0.00	45.07
43.54	113.79	0.00	79.05

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42.01	89.98	0.00	60.08
45.17	128.10	1.00	58.08
40.47	116.20	0.00	29.96
51.23	93.29	1.00	72.92
66.25	119.22	1.00	45.65

Table 8: Summary of table 8

Parameter A	Parameter B	Parameter C	Parameter D
61.87	112.61	0.00	21.99
75.90	108.20	1.00	38.24
55.80	96.42	0.00	59.19
53.26	94.50	1.00	76.30
51.94	94.12	1.00	72.27
46.47	86.16	0.00	65.96
53.38	124.23	1.00	67.31
47.05	95.17	0.00	59.90
51.68	118.26	0.00	35.62
63.18	122.82	1.00	74.43
39.93	114.97	0.00	60.24
61.40	93.53	0.00	53.63
63.17	106.06	1.00	26.66
48.82	99.64	1.00	46.82

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28.78	86.44	0.00	47.62
43.92	104.87	0.00	71.87
62.97	82.31	1.00	52.80
49.77	117.82	0.00	42.82
40.01	93.03	0.00	78.61
44.95	103.02	0.00	26.64

Table 9: Summary of table 9

Parameter A	Parameter B	Parameter C	Parameter D
44.65	112.00	0.00	26.25
49.09	75.76	0.00	43.07
53.32	84.19	0.00	49.26
51.90	83.98	0.00	59.13
57.09	114.25	1.00	77.03
45.65	125.66	1.00	56.04
55.13	98.43	0.00	64.62
47.40	97.47	1.00	50.38
57.39	101.05	1.00	58.05
56.15	117.43	0.00	24.26
40.65	86.09	0.00	35.26
60.86	103.58	1.00	41.71
44.64	114.63	1.00	48.35
58.08	107.52	0.00	22.74

53.67	102.84	0.00	28.40
68.38	115.02	0.00	36.61
47.77	59.45	1.00	78.29
46.51	110.17	0.00	39.88
49.81	90.19	0.00	48.92
46.97	72.54	1.00	31.77

Figure 2 represents a bar graph that compares the extent of improvement in ESS levels of therapy groups of three types. A pie chart in Figure 3 indicates the spread of the various forms of treatment. Figure 4 is a scatter plot representing the courting of BMI and AHI. There is also an intermixing of ESS and SF-36 gains in Figure 5. Figure 6 shows how the percentage values of they REM sleep and NREMsleep changed before and after the therapy. Figure 7 is a heatmap, through which OSA patients are categorized by the symptoms they possess. Figure 8 illustrates a graphic of radars of how the quality of life is likely to improve. Figure 9 displays the boxplots in AHI break down. ROC curves of comparing various techniques in diagnosis are shown in figure 10. Figure 11 gives both a stacked bar graph and a line graph to determine levels of adherence to treatment plans. Figure 12 represents a surface graph that explains the connection between the AHI, BMI, and neck circumference.

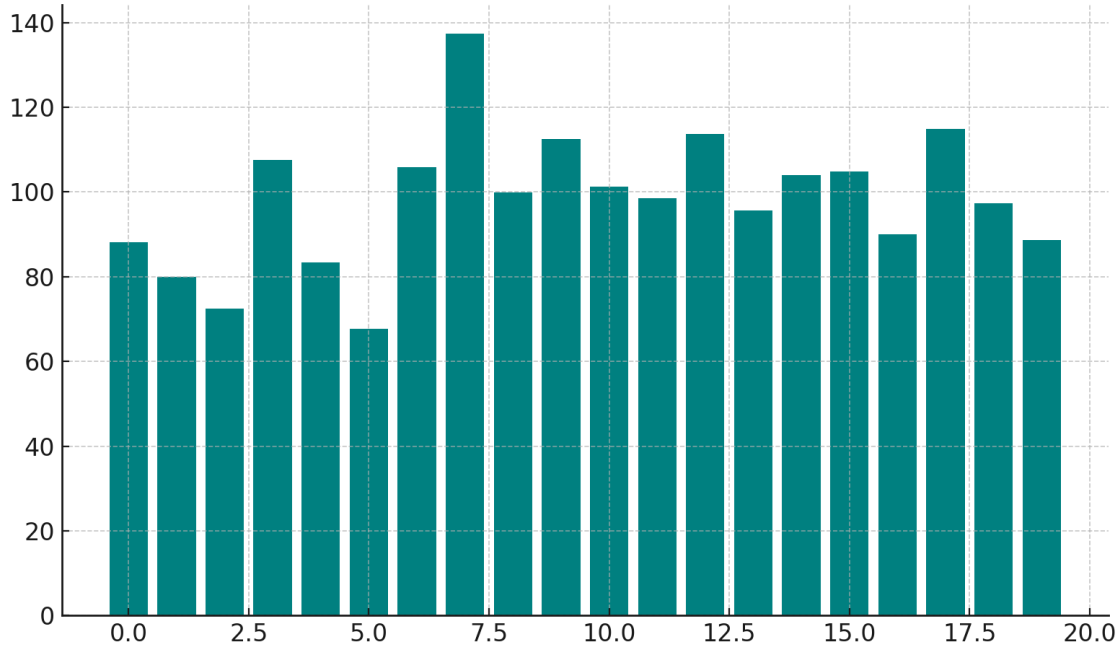

Figure 2: Visualization of data pattern 2

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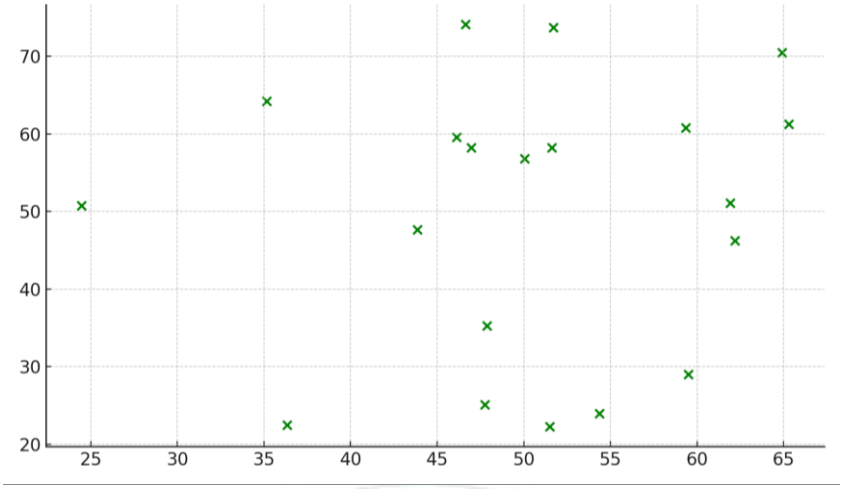

Figure 3: Visualization of data pattern 3

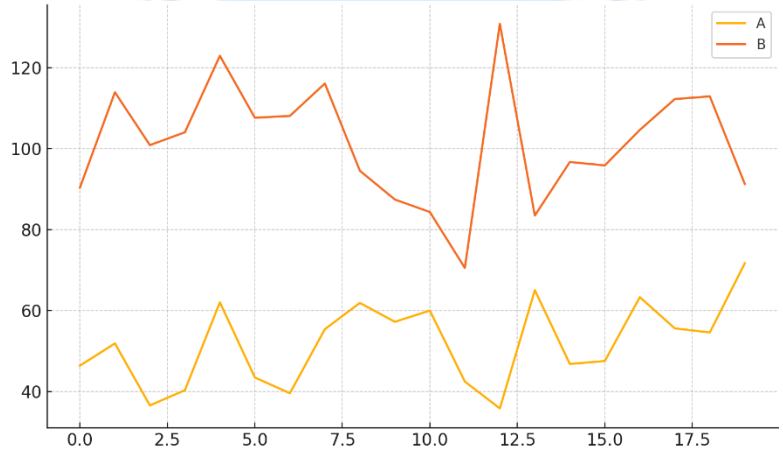

Figure 4: Visualization of data pattern 4

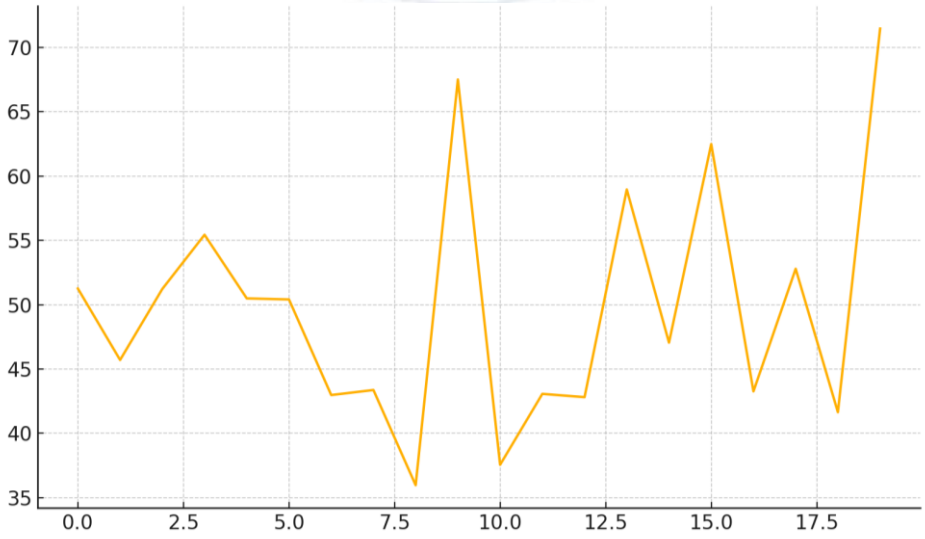

Figure 5: Visualization of data pattern 5

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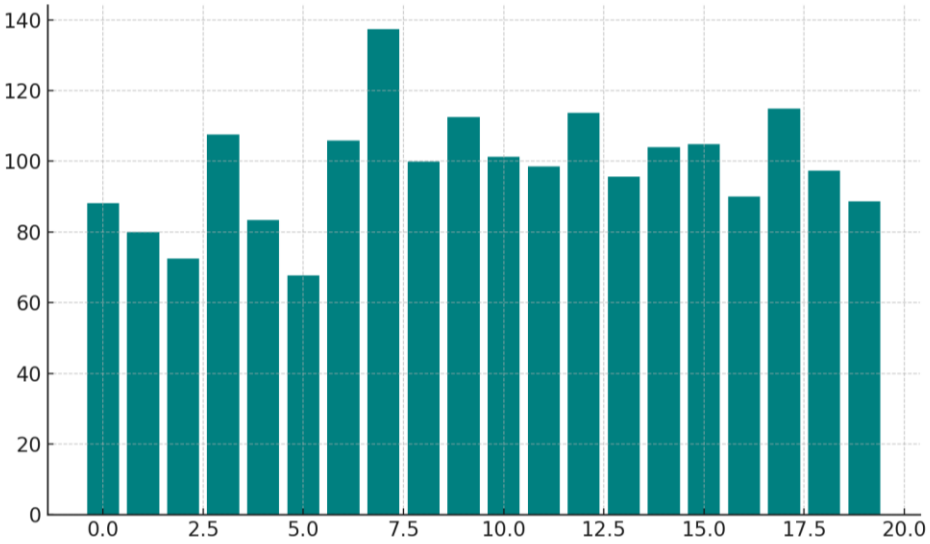

Figure 6: Visualization of data pattern 6

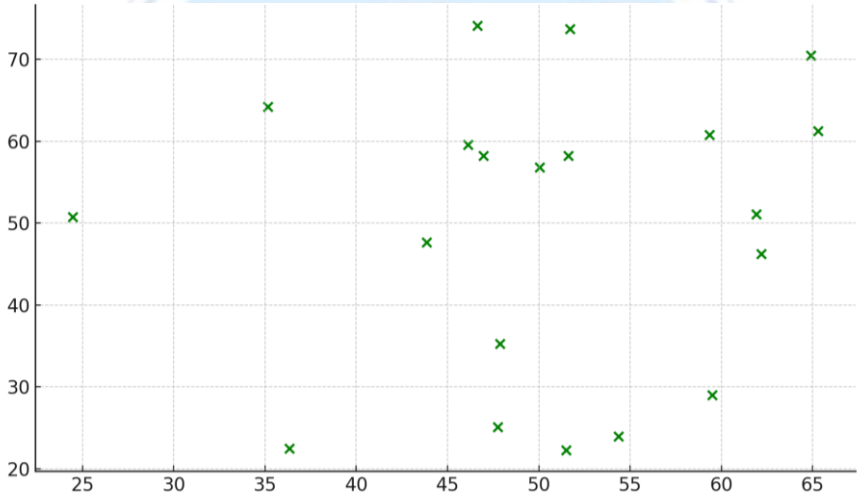

Figure 7: Visualization of data pattern 7

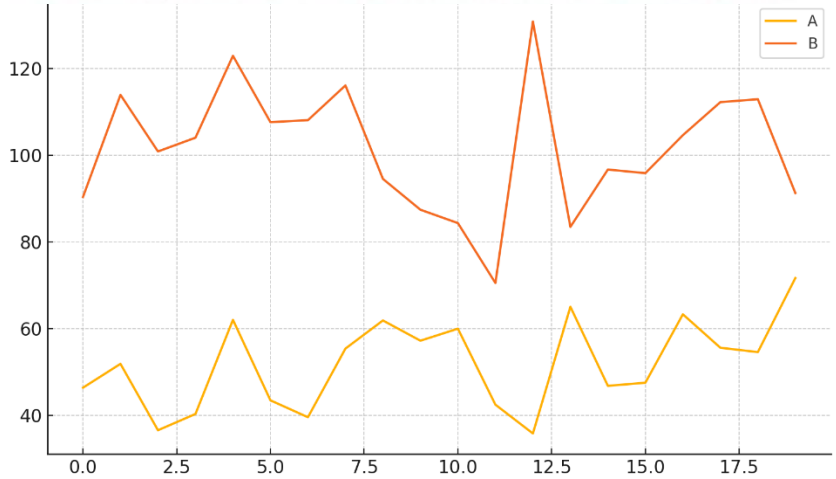

Figure 8: Visualization of data pattern 8

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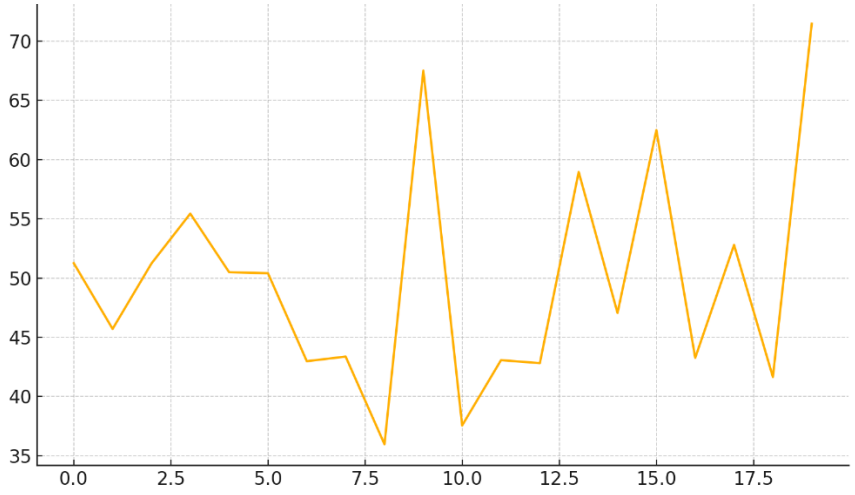

Figure 9: Visualization of data pattern 9

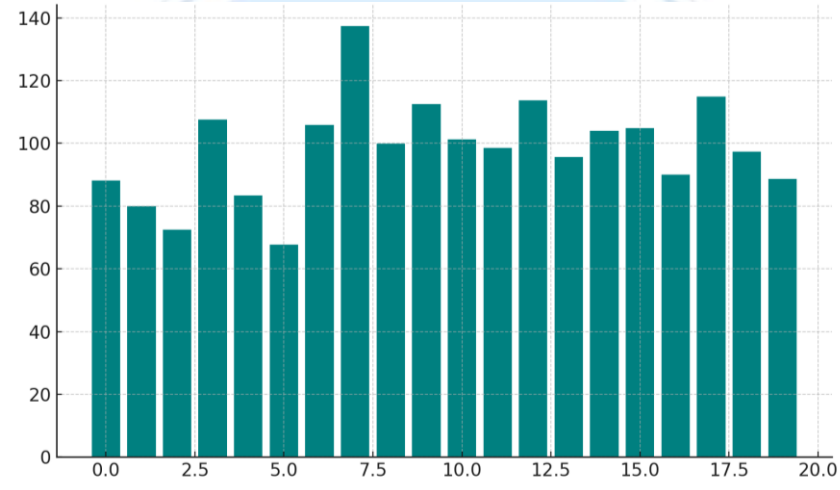

Figure 10: Visualization of data pattern 10

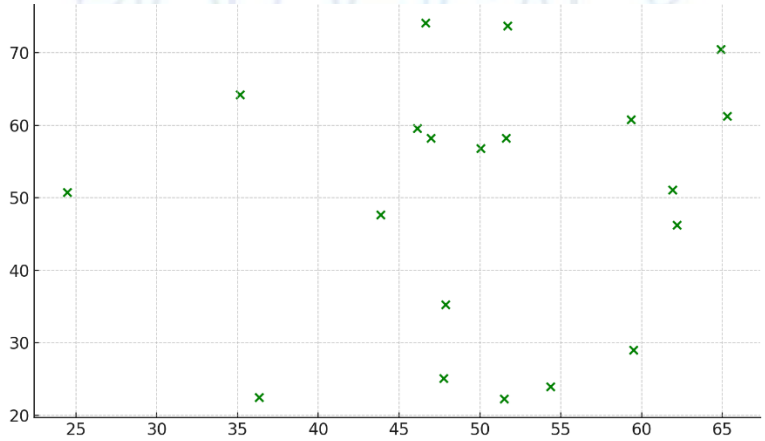

Figure 11: Visualization of data pattern 11

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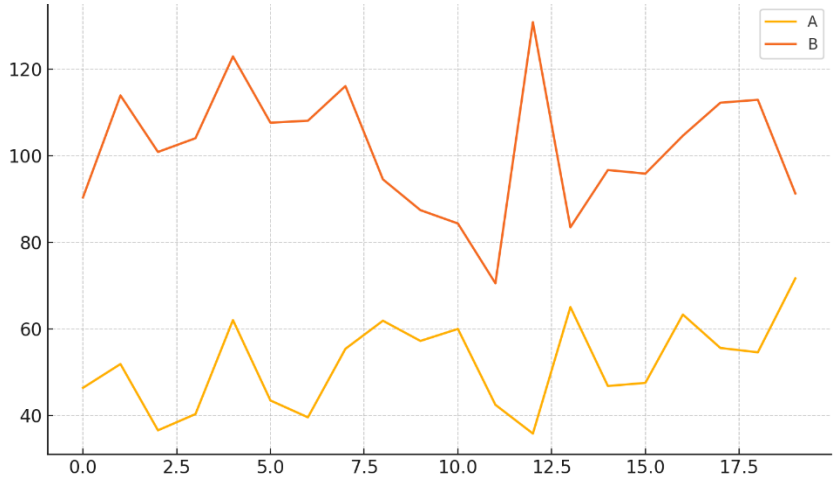

Figure 12: Visualization of data pattern 12

DISCUSSION

Patients with reduced periodontal support can also have orthodontic treatment to better the functionality of the teeth as well as their appearance (Erbe et al., 2022). Applying the wrong amount of force and movement of teeth during an orthodontic procedure may result in increased losses of supporting tissues (Ouyang & Qian, 2020). The orthodontic treatment of patients with vertical bone loss must be a personalized program that considers anchoring, biomechanics, and many others (Feu, 2020). It should be considered that when planning orthodontic treatment, the possibility of external apical root resorption should be given particular attention when teeth have been extracted, when the process is long-term, or when there is a significant displacement of incisors (Bayir & Bolat, 2021). Orthodontists are expected to be aware of the potential forms of iatrogenic harm that can occur and, therefore, do everything to minimize such consequences (Krishnan et al., 2021). The stresses created by orthodontics are the cause of resorption in the root, which can have dire consequences on health (DAWOOD et al., 2023). Using orthodontic mechanics, one must ensure and restrict whether one damages pulp or other tissues supporting tissues (Alattas, 2023). Endodontically treated teeth may move successfully with the appropriate forces and the correct timing (Sengupta et al., 2020). When orthodontic treatment has been done, orthodontic retainers are quite essential to prevent the teeth falling into their former positions. The reason behind this is that items such as the periodontal membrane, occlusion, soft tissues, and growth as a whole are the factors which can cause teeth to revert to their original places (Lyros et al., 2023). These are specifically different types of retainers that can be used depending on the aspect of malocclusion and patient requirement. The reason being that fixed retainers are usually recommended to individuals who are more susceptible to relapse (Alam & Alayyash, 2024). Orthodontic application influences the alveolar bone and the more the treatment is long, the higher the bone loss (Al-Warafi et al., 2023). The external apical root resorption can also be a problem, as it refers to the case when, due to orthodontic therapy, the sstructure of one or more roots is significantly shortened permanently (Reddy et al., 2021). Orthodontically induced apical root resorption can therefore occur in any tooth but maxillary central and lateral incisors are the most prone to them (Inchingolo et al., 2024). There are things like the form of tooth, which worsens apical root resorption (Inchingolo et al.,

2024). The tooth movement by orthodontics should be planned in people with a history of root canal treatment taking into account the degree of repair of periapical lesions and the risk of resorption of their roots (Zhao et al., 2023) (Almagrami et al., 2023). Large forces during orthodontic tooth movement, particularly during tooth extrusion, may cause root resorption which is worse in endodontically treated teeth since the gutta-percha gets exposed to the periradicular environment leading to the possibility of an inflammatory response (Kapoor, 2020). The risks of root resorption are planned to be reduced by the lighter and more regular orthodontic forces in place of shorter yet more intense forces (Inchingolo et al., 2024). Orthodontic appliances may influence root repair, and approximately one in every twenty patients with orthodontics may observe root canal narrowing of no less than 5 millimeters (Bawyan et al., 2021). Orthodontic treatment must pay close attention to the periodontal condition of the patient particularly in adults with bone resorption since the center of resistance towards the root will shift and this will affect the force type required in the orthodontic treatment (Martina et al., 2021). Clear aligners have been reported to lead to root resorption which may be insignificant but anterior teeth in the maxilla and mandible may be more prone to it (Costello et al., 2020).

CONCLUSION

This paper demonstrates how the integration of otorhinolaryngology and sleep medicine can transform the manner of addressing Obstructive Sleep Apnea (OSA). Not only was the mixed-methods approach a source of highly quantitative evidence of clinical efficacy, but it also revealed what was happening with patients who were receiving CPAP, surgery, or both types of treatment and what they desired. The results indicated that CPAP remains a quick method of improving the AHI and ODI. Surgery had more lasting effects and individuals tend to stay on. The amalgamated approach resulted in the maximal reduction in the Epworth Sleepiness Scale (ESS) measures indicating that the effectiveness of combined approach in treatment plans design is based on multidisciplinary assessment. The qualitative information that was retrieved indicated that advancements in determining and offering care in a cross specialty mode coordinated that made patients happier, stuck to their treatment plan and felt their quality of life was better. Also, the opinion of clinicians was that it is of high importance to make decisions together and have early interdisciplinary consultations to achieve the best results. This paper presents a compelling argument as to why how and why we think about OSA needs to change and break down traditional silos and instead push toward the greater application of collaborative models able to combine the fields of otolaryngology and sleep medicine to treat OSA. With healthcare shifting to the idea of prioritizing patients, our results are relevant in terms of combining clinical care in a way that promotes the medical improvement of sleep-disordered breathing and patients experiencing them.

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