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CLINICAL RESEARCH

Impact of complete dentures on pharyngeal volumes of edentulous individuals with obstructive sleep apnea: A pilot clinical study

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ABSTRACT

Statement of problem. Evidence remains scarce regarding the impact of complete denture use on velopharyngeal (VP), oropharyngeal (OP), hypopharyngeal (HP), and total pharyngeal (TP) volumes in edentulous patients, as assessed by 3-dimensional imaging.

Purpose. This pilot clinical study evaluated the effects of complete denture use on VP, OP, HP, and TP volumes in edentulous participants with obstructive sleep apnea (OSA) using magnetic resonance imaging (MRI).

Material and methods. Edentulous participants using complete dentures with mild (OSA-1, n=11), moderate (OSA-2, n=9), and severe OSA (OSA-3, n=10) were evaluated. Anthropometric parameters (neck length, neck circumference, and body-mass index [BMI]) and Mallampati classification (MC-12 and MC-34) were recorded. Three-dimensional T2-weighted sagittal MRI scans (2 mm slice thickness) were obtained without dentures (WOD) and with dentures in place (WID). Digital Imaging and Communications in Medicine (DICOM) images were analyzed using the ITK-SNAP software program to measure VP, OP, HP, and TP volumes. WOD and WID values were compared using paired t tests (α=.05), and Pearson correlation analysis was performed for anthropometric variables.

Results. A positive, moderate correlation was found between neck height and WID-OP, WID-HP, and WID-TP (r=0.436, r=0.492, and r=0.423; P=.016, P=.006, and P=.020, respectively). In the MC-12 group, WID significantly increased OP volume (P=.014), whereas in the MC-34 group, OP and TP volumes decreased significantly (P=.003 and P=.043, respectively). The OSA-1, OSA-2, and OSA-3 groups showed statistically significant differences in OP values under WOD and WID conditions (P=.014, P<.001, and P=.001, respectively).

Conclusions. Complete dentures may induce significant volumetric changes in specific pharyngeal regions depending on certain anthropometric features, oropharyngeal morphology, and OSA severity. (J Prosthet Dent xxxx;xxx:xxx-xxx)

The proportion of older adults within the global population is increasing.[1–3] Age-related oral and systemic changes predispose individuals to partial or complete edentulism, which still affects 3% to 21% of the elderly despite a global decline.[2–6] Edentulism results in craniofacial alterations, including loss of vertical dimension,

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Clinical Implications

The findings of this pilot study suggest that prosthetic rehabilitation in edentulous patients with OSA should be evaluated not only in terms of function and esthetics but also in terms of its potential effects on airway patency and respiratory health.

Acronyms

AHI	apnea hypopnea index
BMI	body mass index
HP	hypopharyngeal
MC	mallampati classification
MRI	magnetic resonance imaging
NC	neck circumference
NH	neck height
OP	oropharyngeal
OSA	obstructive sleep apnea
TP	total pharyngeal
T1	in MRI, *T1* refers to the *T1 relaxation time*
VP	velopharyngeal
WID	with dentures
WOD	without dentures
3D	three dimensional

reduced oral cavity volume, and changes in tongue position.[7–12] Age-related loss of pharyngeal muscle tone and skeletal support leads to retropharyngeal narrowing, producing obstructive sleep apnea (OSA)-like findings, and recent studies have highlighted the relationship between complete edentulism and OSA.[11,13,14]

OSA has been characterized by recurrent upper airway collapse during sleep, leading to apnea and hypopnea events with oxygen saturation.[9,12,15–17] Severity can be determined by the apnea/hypopnea index (AHI) or oxygen desaturation index (ODI). Individuals have been categorized as healthy (AHI<5), mild OSA (5≤AHI<15), moderate OSA (15≤AHI<30), or severe OSA (AHI≥30).[9,12,18,19]

Due to their proximity to the oropharynx and their volumetric characteristics, the potential effects of conventional complete dentures on airway patency have been examined under 2 areas: studies have focused on the effect of nocturnal denture use on cardiorespiratory parameters and AHI/ODI in patients with OSA[9,13,20–22] and studies have examined pharyngeal volumes, usually using 2-dimensional imaging or computed tomography.[10,14,23–25]

Although the Mallampati classification and anthropometric factors have been reported to influence pharyngeal opening,[12,19,26–29] these variables have not been comprehensively addressed in previous studies.[6,9,13,14,22,23,30–34] The authors are unaware of studies examining the effects of complete denture use on pharyngeal volumes in edentulous individuals with OSA using magnetic resonance imaging (MRI) without ionizing radiation. This pilot study was designed to address this gap. The null hypothesis was that the use of complete dentures would not significantly alter pharyngeal volumes, independent of anthropometric variables or Mallampati classification.

MATERIAL AND METHODS

This study had been approved by the Ethics Committee of Cappadocia University and conducted in accordance with the principles of the Declaration of Helsinki (1964), as revised in Fortaleza, Brazil, in 2013. Written informed consent was obtained from all participants prior to enrollment.

The study was carried out in 4 stages: participant selection, MRI acquisition under WOD and WID conditions, volume and length measurements, and statistical analysis.

The complete dentures of 88 edentulous participants with OSA were evaluated by 4 prosthodontists (B.P., A.U., I.A., and N.B.) among the researchers in accordance with the Nevalainen et al criteria.[35] Based on the Nevalainen et al criteria[35]—including a well-constructed occlusal plane, unchanged vertical dimension of occlusion, satisfactory retention and stability, and the absence of any condition requiring denture replacement—80 participants were selected for evaluation.

Inclusion criteria were polysomnography (PSG)-confirmed diagnosis of OSA, non-smoking status, absence of pharyngeal surgery or inflammation that could alter oropharyngeal anatomy, absence of medications that could affect muscle tone, and no MRI contraindications or claustrophobia. Thirty-five participants were excluded from the study based on the assessment of 1 of the researchers, an oral radiologist (S.Ö.).

MRI examinations were conducted under the supervision of an oral radiologist (S.Ö.) (Philips Achieva 3.0 T TX-Series; Philips Electronics) with a 32-channel neurovascular head coil (Philips Electronics). All scans were performed while participants were awake and lying in the supine position. Participants were instructed to breathe quietly through the nose, minimize swallowing, and remain motionless during the procedure. Respiratory synchronization was maintained throughout the image acquisitions. Following the acquisition of the scout images to confirm proper positioning, T2-

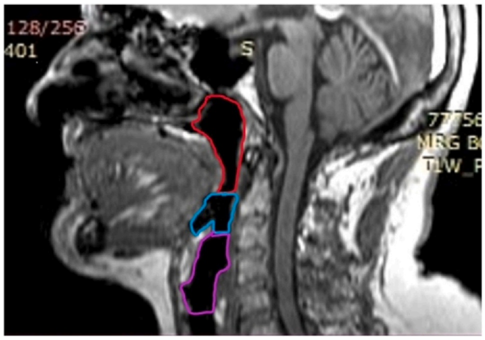

Figure 1. Sagittal plane T1-weighted MRI; nasopharynx (*red area*), oropharynx (*blue area*), and hypopharynx (*purple area*). MRI, magnetic resonance image; T1, in MRI refers to T1 relaxation time.

weighted sagittal images were obtained (TR, 1002.3 to 1331 ms; TE, 80 ms; matrix, 276×220; flip angle, 90 degrees; field of view, 480×480 mm) from the roof of the nasopharynx to the inferior border of the sixth cervical vertebra, with a slice thickness of 2 mm. WOD images were acquired with the upper and lower lips closed, while WID images were obtained with the artificial maxillary and mandibular teeth in the intercuspal position. Scans were repeated when participant movement was observed. Eight participants who could not complete the MRI procedure, and 1 participant in whom a tumor was detected between the uvula and epiglottis, were excluded from the study.

MRI datasets were processed using a dedicated platform for visualization, segmentation, and quantitative analysis of medical images in digital imaging and communications in medicine (DICOM) format (ITK-SNAP; Cognitica). The pharyngeal airway was subdivided into 3 compartments: velopharyngeal (VP), oropharyngeal (OP), and hypopharyngeal (HP). For consistency, the VP was defined as the space between the superior margin of the hard palate and the inferior margin of the soft palate; the OP as the region extending from the inferior margin of the soft palate to the tip of the epiglottis; and the HP as the segment confined between the superior and inferior margins of the epiglottis (Fig. 1). Segmentation boundaries were manually traced. Three-dimensional (3D) volumes were extracted across axial, sagittal, and coronal planes (Fig. 2). Total pharyngeal (TP) volume was calculated as the sum of VP, OP, and HP volumes. Neck height measurement was performed in the sagittal plane in the craniocaudal direction, using the tip of the odontoid process of the second cervical vertebra and the lower anterior corners of the seventh cervical vertebra as reference points. Neck circumference measurements were made at skin level at the level of the hyoid bone while the participant was in a vertical position. All these procedures were performed in collaboration with 3 anatomists (R.Ö., T.U., and K.D.), and with an oral radiologist (S.Ö.), and 2 medical radiologists (M.İ.I. and F.C.) who were among the researchers. Volumetric measurements of segments and other measurements were made by 2 medical radiologists (M.İ.I. and F.C.) with 5 and 15 years of experience, respectively. Intra-rater reliability was assessed using the intraclass correlation coefficient (ICC). The analysis was performed with an absolute agreement definition and a 2-way mixed-effects model.[36] The ICC was 0.955 (95% CI: 0.939-0.967; P<.001), indicating excellent reliability (0.75 to 1.00) according to the Cicchetti classification.[37] Because of the repeated measurements, inter-rater reliability was also assessed using ICC. The ICC between 2 medical radiologists (M.İ.I. and F.C.) was 0.920 (95% CI: 0.908 to 0.945; P<.001), indicating excellent agreement according to Cicchetti.[37]

MRI images of 6 participants were rendered unusable because of excessive swallowing, which prevented accurate measurement of pharyngeal volumes; consequently, these participants were excluded. Thus, the study, initially enrolling 81 participants, was completed with a total of 30 participants: 11 with mild, 9 with moderate, and 10 with severe OSA.

Descriptive statistics were calculated for baseline characteristics, including age, sex, body-mass index (BMI), neck circumference, neck length, and MC values, as well as for pharyngeal volume changes under WOD and WID conditions. Normality of continuous variables was assessed using the Kolmogorov-Smirnov test. Comparisons between paired groups were performed with paired t tests for normally distributed variables and Wilcoxon signed-rank tests for non-normal variables.

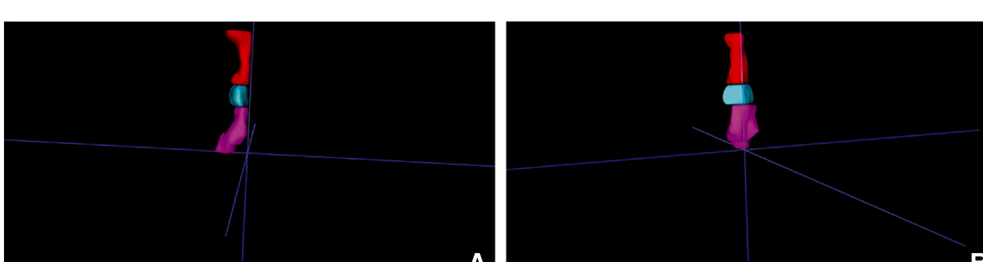

Figure 2. Three-dimensional image of the nasopharynx (*red area*), oropharynx (*blue area*), and hypopharynx (*purple area*). A, Sagittal plane, B, Coronal plane.

Table 1. Baseline characteristics of participants according to age, sex, BMI, neck circumference, neck height, Mallampati classification, and AHI values

	Mean ±SD	Minimum-Maximum
Age (Years)	67.57 ±7.58	52-79
Male	11 (36.7%)	
Female	19 (63.3%)	
BMI (kg/m^2)	29.57 ±5.93	20.03-47.27
Neck Circumferences (cm)	44.45 ±5.78	34.74-56.25
Neck Height (cm)	11.61 ±0.97	9.93-13.43
MC-12 group	12 (40%)	-
MC-34 group	18 (60%)	-
AHI	21.0 ±10.48	

AHI, apnea hypopnea index; BMI, body mass index; MC, Mallampati classification; SD, standard deviation.

Relationships between variables were evaluated using Pearson correlation coefficients, interpreted as follows: 0.00 to 0.19 (very weak), 0.20 to 0.39 (weak), 0.40 to 0.69 (moderate), 0.70 to 0.89 (strong), and 0.90 to 1.00 (very strong). All analyses were conducted using a statistical software package (IBM SPSS Statistics, v21; IBM Corp) (2-sided α=.05).

RESULTS

The neck circumference, neck length, height, and weight of all participants were measured, and their BMIs were calculated by 1 of the researchers (S.Ö.). Based on BMI, 9 participants were classified as normal weight (BMI <25 kg/m^2), 11 as overweight (BMI 25 to 30 kg/m^2), and 10 as obese (BMI>30 kg/m^2). Participants were further categorized according to oropharyngeal anatomy using the MC in relation to OSA risk: those with MC-I and MC-II anatomy, considered to confer a lower risk for OSA,[27] were grouped as MC-12 (n=12), whereas those with MC-III and MC-IV anatomy, considered to confer a higher risk for OSA, were grouped as MC-34 (n=18).[28]

The demographic and anthropometric characteristics, along with the AHI values of the 30 participants, are presented in Table 1.

Descriptive analyses of VP, OP, HP, and TP volumes were conducted for all 30 participants under both WOD and WID conditions. Paired t tests were then conducted to compare WOD and WID measurements at each volume. The results are summarized in Table 2. No significant differences in pharyngeal volumes were observed between WOD and WID conditions across all 30 participants, regardless of sex, BMI, or MC (P>.05).

To assess the effect of sex, VP, OP, HP, and TP volumetric differences between WOD and WID conditions were compared in male (n=11) and female (n=19) participants. Normal variables meeting normality assumptions were analyzed using the Student t test. In contrast, nonnormal variables violating these assumptions were assessed with the Mann-Whitney U test, and descriptive values along with the corresponding statistical outcomes are summarized in Table 3. No statistically significant differences were observed between sexes in VP, OP, HP, or TP volumes (P=.533, .232, .307, and .350, respectively).

Descriptive analyses of VP, OP, HP, and TP volumes under WOD and WID conditions were performed, and statistical significance was assessed using paired t tests. The corresponding means, standard deviations, and P values are presented in Table 4. While between WOD and WID conditions did not significantly affect pharyngeal volumes in the normal or overweight group, the obese group demonstrated significant differences in OP and TP volumes (P=.044 and .039, respectively).

Pearson correlation analysis was conducted to evaluate the associations of neck circumference and neck height with VP, OP, HP, and TP measurements in 30 participants. The corresponding correlation coefficients and P values are presented in Table 5. Positive, moderate correlations were identified between neck height and WID-OP, WID-HP, and WID-TP (r=0.436, r=0.492, and r=0.423, respectively). All correlations reached statistical significance (P=.016, P=.006, and P=.020, respectively).

Following grouping by MC, changes in VP, OP, HP, and TP volumes between WOD and WID conditions were analyzed. Paired t tests were used for the normally distributed MC-12 group, whereas Wilcoxon Signed-Rank tests were used for the non-normally distributed MC-34 group. The results are presented in Table 6. Significant changes were observed only in OP volumes in the MC-12 group (P=.014) and in both OP and TP volumes in the MC-34 group (P=.003 and P=.043, respectively).

Table 2. Descriptive statistics: mean, median, minimum, maximum, standard deviation, and paired t test results

	Mean	Median	Minimum	Maximum	SD	P
WOD-VP	5154	4486	1141	9723	2545	.787
WID-VP	5278	4358	1149	9881	2534	
WOD-OP	4591	4427	1240	9416	1980	.563
WID-OP	4309	4132	930	8582	2010	
WOD-HP	4958	5154	1134	9273	2174	.869
WID-HP	5034	5107	1022	9518	1825	
WOD-TP	14 703	13 669	8703	24 389	4069	.919
WID-TP	14 620	14 013	8344	23 679	3969	

HP, hypopharyngeal; OP, oropharyngeal; SD, standard deviation; TP, total pharyngeal; VP, velopharyngeal; WID, with dentures; WOD: without dentures.

Table 3. Sex-stratified volumetric differences in VP, OP, HP, and TP between WOD and WID conditions with means, medians, ranges, standard deviations, and corresponding *P* values

	Sex	Mean	Median	Minimum	Maximum	SD	*P*
VP	Women	96.26	−28.00	3553.00	5048.00	1892.96	.533
	Men	−503.36	146.00	−7639.00	5083.00	3334.84	
OP	Women	−70.79	574.00	−7342.00	2356.00	2190.58	.232
	Men	891.09	1475.00	−4730.00	5369.00	3296.43	
HP	Women	−568.47	200.00	−8037.00	2559.00	2470.91	.307
	Men	776.64	651.00	−2130.00	6301.00	2327.99	
TP	Women	−543.00	−209.00	−13 239.00	6209.00	4730.98	.350
	Mean	1164.36	1884.00	−4858.00	6541.00	3778.99	

HP, hypopharyngeal; OP, oropharyngeal; SD, standard deviation; TP, total pharyngeal; VP, velopharyngeal; WID, with dentures; WOD: without dentures.

Table 4. Descriptive and statistical analysis values across 3 different BMI groups

	Normal Weight (BMI <25 kg/m²)			Overweight (BMI 25-30 kg/m²)			Obese (BMI>30 kg/m²)		
	Mean	SD	*P*	Mean	SD	*P*	Mean	SD	*P*
WOD-VP	5312.78	2385.87	.700	4249.09	2209.26	.225	6007.20	2923.11	.479
WID-VP	4991.44	2463.42		5308.73	2480.07		5501.60	2886.24	
WOD-OP	3752.22	1952.63	.427	4678.45	2163.47	.922	5249.10	1688.32	.044
WID-OP	4546.56	2681.17		4594.45	1942.14		3780.90	1405.93	
WOD-HP	4019.11	2375.37	.311	5569.09	1916.96	.497	5131.80	2181.57	.880
WID-HP	5059.67	2581.44		4995.36	1627.59		5052.20	1362.68	
WOD-TP	13 084.11	4222.70	.494	14 496.64	2418.32	.702	16 388.10	5016.66	.039
WID-TP	14 597.67	5544.44		14 898.55	3158.22		14 334.70	3489.39	

BMI, body mass index; HP, hypopharyngeal; OP, oropharyngeal; SD, standard deviation; TP, total pharyngeal; VP, velopharyngeal; WID, with dentures; WOD: without dentures.

Table 5. Pearson correlation coefficients (r) and *P* values for the associations of NC and NH with VP, OP, HP, and TP under WOD and WID conditions

		WID				WOD			
		VP	OP	HP	TP	VP	OP	HP	TP
Neck circumference	*r*	0.356	0.014	−0.184	0.150	0.097	0.132	0.343	0.308
	P	0.054	0.942	0.330	0.430	0.608	0.485	0.064	0.097
Neckheight	*r*	−0.038	0.436	0.492	0.423	−0.055	0.122	0.348	0.211
	P	0.840	0.016	0.006	0.020	0.773	0.522	0.059	0.263

HP, hypopharyngeal; NC, neck circumference; NH, neck height; OP, oropharyngeal; TP, total pharyngeal; VP, velopharyngeal; WID, with dentures; WOD: without dentures.

To determine whether the effect of complete denture use on pharyngeal volumes depended on OSA severity, the 30 participants were divided into 3 groups: OSA-1 (mild), OSA-2 (moderate), and OSA-3 (severe). The statistical significance of changes in WOD and WID values across groups was assessed using paired *t* tests. Descriptive analysis results and *P*-values are presented in Table 7. In the OSA-1, OSA-2, and OSA-3 groups, statistically significant differences in OP values were observed under WOD and WID conditions (P=.014, P<.001, and P=.001, respectively). No significant differences were found in other values (P>.05).

Table 6. VP, OP, HP, and TP volumetric changes under WOD and WID conditions in MC-12 and MC-34 groups with corresponding parametric or nonparametric test results

	MC-12 Group			MC-34 Group		
	Mean	SD	*P*	Mean	SD	*P*
WOD-VPWID-VP	5141.08	2581.77	.256	5163.00	2594.54	.560
	4799.42	2461.68		5596.78	2601.38	
WOD-OPWID-OP	4114.17	1918.53	.014	4908.56	2009.93	.003
	5521.67	1910.78		3500.39	1673.91	
WOD-HPWID-HP	5218.08	2518.94	.791	4785.17	1969.15	.822
	5506.67	1980.34		4718.22	1696.43	
WOD-TPWID-TP	14 473.33	4823.92	.285	14 856.72	3622.28	.043
	15 827.75	3546.65		13 815.39	4125.96	

HP, hypopharyngeal; MC, Mallampati classification; OP, oropharyngeal; SD, standard deviation; TP, total pharyngeal; VP, velopharyngeal; WID, with dentures; WOD: without dentures.

Table 7. Descriptive statistics and paired *t* test results for pharyngeal volume measurements under WOD and WID conditions across OSA severity groups

		n	Mean	Median	Minimum	Maximum	SD	*P*
OSA-1 Group Values	WOD-VP	11	4479.00	4220.00	1307.00	8508.00	2179.17	.441
	WID-VP	11	4818.00	4325.00	1149.00	9693.00	2588.13	
	WOD-OP	11	3580.45	3550.00	1240.00	6228.00	1874.52	.014
	WID-OP	11	5751.27	6237.00	2147.00	8582.00	2089.06	
	WOD-HP	11	5277.09	5567.00	1481.00	8914.00	2184.73	.831
	WID-HP	11	5507.27	5406.00	1022.00	9518.00	2216.50	
	WOD-TP	11	13 336.55	12 952.00	8703.00	20 632.00	4000.65	.108
	WID-TP	11	16 076.55	15 275.00	10 269.00	23 679.00	4131.86	
OSA-2 Group Values	WOD-VP	9	6466.11	6850.00	2715.00	9723.00	2659.41	.129
	WID-VP	9	5365.67	4348.00	3494.00	9881.00	2095.17	
	WOD-OP	9	4354.78	3852.00	1704.00	6845.00	1715.05	<.001
	WID-OP	9	3549.78	3341.00	930.00	6515.00	1853.60	
	WOD-HP	9	4742.33	5091.00	1134.00	9273.00	2650.25	.991
	WID-HP	9	4733.33	4715.00	2497.00	6773.00	1473.80	
	WOD-TP	9	15 563.22	13 453.00	11 110.00	24 389.00	5167.57	.107
	WID-TP	9	13 648.78	12 117.00	8344.00	20 871.00	4689.57	
OSA-3 Group Values	WOD-VP	10	4716.30	4486.00	1141.00	9620.00	2609.22	.388
	WID-VP	10	5704.60	6083.50	1233.00	9337.00	2980.67	
	WOD-OP	10	5914.60	5664.00	4147.00	9416.00	1692.63	.001
	WID-OP	10	3405.50	3310.50	121.00	4760.00	1046.20	
	WOD-HP	10	4802.10	4376.50	1500.00	8257.00	1866.70	.960
	WID-HP	10	4782.80	4894.50	1230.00	7281.00	1703.76	
	WOD-TP	10	15 433.00	15 988.00	10 473.00	19 324.00	2865.03	.139
	WID-TP	10	13 892.90	13 787.00	9351.00	18 636.00	2850.97	

HP, hypopharyngeal; OP, oropharyngeal; OSA, obstructive sleep apnea; SD, standard deviation; TP, total pharyngeal; VP, velopharyngeal; WID, with dentures; WOD: without dentures.

DISCUSSION

In this study, when BMI, neck circumference, neck height, MC, and OSA severity were not considered, complete dentures did not produce significant changes in pharyngeal volumes. However, in edentulous participants with specific anthropometric and anatomical characteristics, dentures induced significant alterations in distinct pharyngeal compartments; thereby, the null hypothesis that the use of complete dentures would not significantly alter pharyngeal volumes, independent of anthropometric variables or Mallampati classification was rejected. Previous studies on pharyngeal ventilation have demonstrated that anthropometric heterogeneity and anatomical variability, particularly neck circumference, BMI, and oropharyngeal soft tissue characteristics, substantially influence outcomes in patients with OSA.[14,18,28]

The authors are unaware of previous investigations where the impact of neck height on pharyngeal volumes was examined. However, as also reported by Inamoto et al,[33] definitive normative reference values for pharyngeal structures have not yet been established. Therefore, participants could not be stratified normatively based on anthropometric measures such as neck height or circumference. Instead, in edentulous patients under WID conditions, the relationship between neck height and pharyngeal volumes was assessed via correlation analysis. A statistically significant increase in OP, HP, and TP volumes was observed, with moderate correlations (r=0.436, r=0.492, and r=0.423, respectively; P=.016, P=.006, and P=.020, respectively). The same analysis under WOD conditions revealed no significant changes in VP, OP, HP, and TP volumes (r=−0.055, r=0.122, r=0.348, and r=0.211, respectively; P=.773, P=.522, P=.059, and P=.263, respectively). However, Chen et al[14] reported that as the mandibular plane–-hyoid distance decreases, fat pads concentrate within a narrower area, a pattern particularly evident in patients with OSA. These findings suggested that with increasing neck height, the fat pads surrounding the pharynx may spread over a broader region, thereby preventing further reductions in pharyngeal volumes. The relatively low standard deviation of neck height (±0.97 cm) in the present study also indicated a highly homogeneous distribution among participants. Nevertheless, the significant increase in pharyngeal volumes with denture use as neck height increased may be attributed to the more proportionate distribution of pharyngeal fat pads in individuals with longer necks. Compared to individuals with shorter necks, the vertical dimension of occlusion restored by the dentures exerted a greater effect on pharyngeal volumes in individuals with longer necks. In the current study, neck circumference was observed to have no significant effect on pharyngeal volumes, regardless of denture status.

In the comparison based on BMI, no significant volumetric changes were observed between the WOD and WID conditions in the normal and overweight groups. However, in the obese group, statistically significant reductions in OP and TP volumes were detected (P=.044 and P=.039, respectively). These findings were largely consistent with the results reported in numerous similar studies.[17,29,34,38] Similar limitations have also been defined for mandibular advancement devices, which aim to increase pharyngeal volume by advancing the jaw. Tsuiki et al[29] reported that these devices were insufficient to prevent pharyngeal narrowing in OSA patients with MC-34, high BMI, and significant airway constriction. In the present study, the most likely explanation for the significant reductions observed in OP and TP volumes among obese participants was that, despite the increase in the vertical dimension of occlusion provided by the complete dentures positioned anterior to the oral cavity, the effect of pharyngeal crowding first described by Chen et al[14] was compounded by the dentures. Consequently, smaller pharyngeal volumes were obtained under WID conditions in these participants.

The Mallampati test classifies oropharyngeal anatomy into 4 categories.[26] In the present study, the effects of complete denture use on pharyngeal volumes were examined separately in the MC-12 group, which exhibited the highest pharyngeal patency, and the MC-34 group, which exhibited the greatest pharyngeal crowding. In the MC-12 group, OP volumes were significantly higher under WID than WOD conditions (P=.014). This difference may be because the occlusal vertical dimension, reinstated by the insertion of complete dentures, increased OP volume in MC-12 participants with minimal pharyngeal crowding.

One of the most striking findings of this pilot study was that the effect of complete dentures on pharyngeal volumes varied with OSA severity. OP volume increased in mild OSA but decreased in moderate-to-severe disease, with no significant changes observed in other compartments. However, Tripathi et al[23] reported volume increases in all compartments in 17 edentulous patients with moderate OSA in their CBCT study. These differences may have stemmed from differences in denture evaluation criteria, as Tripathi et al[23] assessed only fit and comfort, whereas in the present study, a more comprehensive evaluation was applied based on Nevalainen et al.[35]

Anthropometric differences among participants may also have contributed to the contrasting results. In the present cohort, only OP volume changed significantly, which was consistent with the findings of Chen et al[14] who reported that the pharynx adopted an hourglass-shape as OSA severity increased. As the OP generally corresponded to the widest part of this shape and complete dentures were positioned just anterior to it, major volume changes in the HP and VP compartments were less likely.

Limitations of this study included that, although the sample size was adequate for a pilot study, it remained insufficient to draw definitive conclusions. Another key limitation was the inherent participant heterogeneity typical of studies of this nature, which was difficult to quantify. Additionally, all MRI scans were acquired while participants were awake, and swallowing artifacts interfered with the evaluation of some scans, thereby reducing the number of analyzable participants.

Larger-scale studies are needed to enable the creation of anthropometric subgroups to reduce participant heterogeneity and to validate pharyngeal volume changes with polysomnography measurements made during sleep.

CONCLUSIONS

Based on the findings of this pilot clinical study, the following conclusions were drawn:

1. The use of complete dentures in edentulous participants with OSA was associated with pharyngeal volume changes, which depended on anthropometric and anatomical factors.
2. Increased neck length was correlated with significant expansion of pharyngeal volumes, whereas in obese participants, denture use was associated with measurable reductions in specific pharyngeal compartments.
3. The effects of complete dentures on pharyngeal volumes varied according to the MC and the severity of OSA; significant volumetric increases were observed in participants with relatively greater pharyngeal patency, whereas reductions were observed in those with marked pharyngeal crowding.

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