REVIEW ARTICLE

Influence of Complete Denture Use on Respiratory Capacity: A Systematic Review

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Abstract

Aim and objective: This study aimed to determine whether the use of complete dentures has an influence on the respiratory capacity, assessed by the spirometry examination.

Materials and methods: A systematic review was conducted following the Preferred Reporting Items for Systematic Review and Meta-Analysis and registered in the International Prospective Register of Systematic Reviews (CRD42021255224). The PICO question (population/exposure/comparison/outcome) was "Does the use of complete dentures influence the respiratory capacity of a toothless subject?" A search strategy was adapted for the PubMed/MEDLINE, The Cochrane Library, OpenGrey, Lilacs, Scopus, and Embase databases. Inclusion criteria were prospective and retrospective studies. The new castle ottawa (NOS) scale and the Methodological Index for Non-randomized studies were selected to assess the quality of the included studies.

Results: Four studies were selected, totalizing the evaluation of 242 participants, aged ranging from 40 to 73 years old. Two studies concluded that the use of complete dentures can negatively affect the respiratory capacity. One study stated that it did not interfere regardless of its use during spirometric measurements, and the other reported that dental prosthesis was required in cases of evaluation of the extrathoracic airways.

Conclusion: The use of complete dentures did not represent relevant changes from the reference values for pulmonary function in the spirometry test. Considering the results of this review, it is not yet possible to establish a clinical protocol for the use of complete dentures during the test.

Clinical significance: Oral rehabilitation with conventional complete dentures is widely used for the treatment of edentulism, especially in elderly patients. In addition, with aging, many complex changes in immunity and respiratory function contribute to the increase in the development of lung diseases. Therefore, it is important to establish a guidance regarding the use or not of the removable dental prostheses in the respiratory capacity test through spirometry examination.

Keywords: Airways, Denture, Respiratory function tests, Spirometry.

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Introduction

Edentulism, a common problem in oral health, significantly affects individuals worldwide, especially geriatric patients.[1] It has undeniable effects on an individual's physiological, esthetic, social, and psychological conditions.[2] The therapeutic solutions used to provide a better quality of life range from the most complex to conventional treatments.[3]

With aging, many complex changes in immunity and respiratory function contribute to increased susceptibility to infections, including the development of lung diseases.[4] Thus, pulmonary function tests (PFTs) are valuable tools for the physiological assessment of the respiratory system and diagnosis of some pathologies.[5] They include several tests, ranging from simple noninvasive oximetry to sophisticated invasive blood gas analysis.[6]

Spirometry is the most common PFT and plays a role in the detection of respiratory disease in patients with symptoms such as shortness of breath at rest or on exertion, wheezing, coughing, stridor, or chest tightness. In addition, it is used to assess respiratory disorders, including chronic obstructive pulmonary disease (COPD), pneumonia, and asthma. Compared with other PFTs, the spirometric test has

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some important advantages, such as being noninvasive and easy to use.[7] The test assesses the lung volume and capacity to quantify the effectiveness and speed at which the lungs can be emptied and filled.[7] Thus, spirometry provides clinically relevant parameters of the patient's functional status.[8]

The use of complete dentures establishes prominent anatomical changes, such as the vertical dimension of occlusion, face height, mandible rotation, and oropharyngeal muscles, which can influence the volume and function of the upper airways.[9,10] Some studies recommend the removal of the prosthesis during the spirometric test, while others encourage its use. As there has been no systematic review performed to date, this study aimed to determine whether the use of complete dentures has an influence on the respiratory capacity, assessed by the spirometry examination.

Materials and Methods

Protocol and Registration

This review was conducted following the Preferred Reporting Items for Systematic Review and Meta-analysis[11] and registered in the International Prospective Register of Systematic Reviews under the registration number CRD42021255224.

Eligibility Criteria

The selected studies were conducted following the PICO strategy. Therefore, the research question was, "Does the use of complete dentures influence the respiratory capacity of a toothless subject?" The following elements were included: (P) Population: complete dentures users; (I) Intervention: spirometry test in subjects with complete dentures; (C) Comparison: spirometry test in subjects without complete dentures; and (O) Outcome: respiratory capacity.

The following inclusion criteria were used: (1) prospective and retrospective studies (randomized clinical trials, controlled clinical trials, cohort studies, case–control studies, and cross-sectional studies). The exclusion criterion was as follows: studies that did not evaluate respiratory capacity with or without dental prosthesis on the spirometry examination.

Information Sources

The electronic databases searched were PubMed/MEDLINE, the Cochrane Library, OpenGrey, Lilacs, Scopus, and Embase, using the association between terms by Boolean operators. The manual search was also made in the following journals: *American Journal of Respiratory and Critical Care Medicine, Respiratory Care, Respiratory Medicine, Respiratory Research, the European Respiratory Journal, the Lancet Respiratory Medicine, Multidisciplinary Respiratory Medicine, The Journal of Contemporary Dental Practice,* and *Gerodontology*. Reference lists were verified in the included articles. The entire search was carried out in February 2021 and updated in May 2021, without any language restrictions or date of articles published. The detailed search strategy used for each database is presented in Table 1.

Selection of Studies and Data Collection

Two independent researchers (BRN and RSL) performed electronic searches, initially selecting studies based on titles and abstracts. Subsequently, the selected studies were read in full and selected according to the exclusion and inclusion criteria. In case of disagreement, a third researcher (SLDM) was consulted.

Data collection was performed by one researcher (BRN) and verified by a second researcher (RSL). The following information for each selected study was included in a Microsoft Office Excel (Microsoft Corporation, USA) table: author, year, type of study, number of participants, average age or age, sex, groups, inclusion and exclusion criteria, measurement protocol and equipment, evaluated parameters, main results, and conclusion.

Risk of Bias in Individual Studies

The assessments were made by a researcher (BRN) and verified by another researcher (RSL). The NOS[12] scale for cohort studies and the

Table 1: Detailed search strategy used for each database

Databases	*Search strategy*
PubMed/MEDLINE	(complete denture OR denture OR dentures OR prosthodontics OR dental prosthesis OR edentulism OR edentulous patient OR edentulous OR total toothless OR toothless) AND (respiratory performance OR breath measurement OR spirometric evaluation OR respiratory capacity OR spirometry)
Embase	('complete denture'/exp OR 'complete denture' OR 'denture, complete' OR 'denture'/exp OR 'conventional denture' OR 'denture' OR 'dentures' OR 'prosthodontics'/exp OR 'dental prosthetics' OR 'prostho-dontics' OR 'prosthodontics' OR 'tooth prosthesis'/exp OR 'dental prostheses' OR 'dental prosthesis' OR 'denture prosthesis' OR 'prostheses, dental' OR 'prosthesis, dental' OR 'tooth prosthesis') AND ('edentulousness'/exp OR 'edentulous patient' OR 'edentulous state' OR edentulism OR edentulous OR toothless) AND (perfomance OR respiratory OR spirometric OR 'spirometry'/exp OR 'breath measurement' OR 'spirometry' OR capacity)
Scopus	ALL (denture OR prosthodontics OR dental AND prosthesis OR edentulism OR edentulous OR toothless) AND (respiratory AND performance OR breath AND measurement OR spirometric AND evaluation OR respiratory AND capacity OR spirometry)
OpenGrey	denture OR prosthodontics OR dental AND prosthesis OR edentulism OR edentulous OR toothless AND respiratory AND performance OR breath AND measurement OR spirometric AND evaluation OR respiratory AND capacity OR spirometry
Lilacs	complete denture OR "prótese total" OR "dentadura completa" OR dental prosthesis OR "prótesis dental" OR "prótese dentaria" OR edentulous OR "arcada edêntula" OR "maxilares desdentados" AND respiratory OR "respiratório" OR "respiratorio" OR "Respiração " OR respiration OR "respiración" OR "testes respiratórios" OR breath tests OR "pruebas respiratorias" OR "espirometria" OR spirometry OR "espirometría"
The Cochrane Library	All text: (complete denture OR denture OR dentures OR prosthodontics OR dental prosthesis OR edentulism OR edentulous patient OR edentulous OR total toothless OR toothless) AND (respiratory performance OR breath measurement OR spirometric evaluation OR respiratory capacity OR spirometry)

methodological index for non-randomized studies (MINORS)[13] were selected to assess the quality of the included studies.

Summary Measures

Quantitative analysis was performed based on two continuous outcomes forced vital capacity (FVC) and volume of air exhaled during the first second of expiration (FEV_1) using the mean difference (MD) and 95% confidence interval (CI).[14] The Comprehensive Meta-Analysis software (Software version 3.0—Biostat, Englewood, New Jersey, USA)[15] was used for the meta-analysis and creation of the forest plots. A *p*-value of less than 0.05 was considered statistically significant.

Additional Analysis

In the defined electronic databases, the kappa coefficient was calculated to determine the agreement in the initial selection of articles.

Results

Selection of Studies

In the initial search, 1,107 articles were found. They were distributed as follows: PubMed/Medline (192), Embase (237), Scopus (150), OpenGrey (345), Lilacs (155), and the Cochrane Library (28). The duplicates were removed, and 742 articles remained. After reading the title and abstract, 10 were selected for full reading and application of the inclusion and exclusion criteria. Finally, six articles were excluded, of which five did not assess the objective of the review and one because they used the same sample also found in another article already included. Thus, four articles were selected from 2001 to 2018 for the analysis (Flowchart 1). The kappa test was performed and indicated high agreement among researchers for PubMed/MEDLINE (kappa = 0.89), Embase (kappa = 0.86), Scopus (kappa = 0.83), OpenGrey (kappa = 1.0), Lilacs (kappa = 1.0), and the Cochrane Library (kappa = 1.0).

Characteristics of the Included Studies

The main characteristics of the four selected studies are listed in Table 2. There are three longitudinal studies[1,6,16] and one clinical study.[17] In total, 242 individuals with ages ranging from 40 to 73 years were evaluated. Of them, 40 had COPD or interstitial lung disease. Finally, 118 males and 104 females were analyzed, but one study did not report sex.[17] All studies evaluated participants without complete dentures (control) and with complete dentures.[1,6,16,17] Two studies[1,6] have also evaluated only the upper or lower prosthesis.

The parameters evaluated were FVC,[1,6,16,17] peak expiratory flow (PEF),[1,6] the volume of air exhaled during the first second of expiration (FEV_1),[1,6,16,17] forced expiratory flow between 25 and 75% ($FEF_{25–75\%}$),[1,6] peak inspiratory flow rate (PIFR) during inspiration,[17] expiratory and forced inspiratory flow –50% (FEF50% and FIF50%),[16] volume forced inspiration during the first second (FIV),[16] and peak expiratory flow rate (PEFR) during expiration.[16] Two studies followed the guidelines of the American Thoracic Society (ATS) for performing the spirometry examination,[6,16] and two studies did not report the guidelines followed.[1,17]

The quantitative results of the parameters evaluated in the mean values are shown in Tables 3 to 5. Regarding the comparison of the use and not of complete dentures, the study by Bucca[16] revealed an increase in the means with the use of dentures; however, there was only a significant difference in PEFR, FEF50%, and FIF50%. The study by Gupta[17] also reported a similar increase in means; however, it presented a significant difference only in the PIFR, which represents the extrathoracic airways. Finally, two studies showed the lowest mean with the use of prostheses.[1,6] In one study,[1] significant differences were found in the parameters FVC, FEV_1, and $FEF_{25–75\%}$. Thus, two studies concluded that the use of complete dentures can negatively affect the respiratory capacity.[1,6] One study stated that it did not interfere regardless of its use during spirometric measurements[16] and the other reported that dental prosthesis was required in cases of evaluation of the extrathoracic airways[17] (Table 3).

Two studies evaluated participants who had complete dentures but performed the spirometric test comparing dentures using only upper or lower dentures. In the study by Bulent,[6] a significant difference was found in the parameters FVC ($p = 0.003$), FEV_1 ($p = 0.001$), and $FEF_{25–75\%}$ ($p = 0.003$) between those without prostheses and those with upper prosthesis and in the parameters FVC ($p = 0.001$) and PEF ($p = 0.003$) between those without prosthesis and those with lower prosthesis. In the previous study by Indrakamur,[1]

Flowchart 1: Flow diagram of article selection

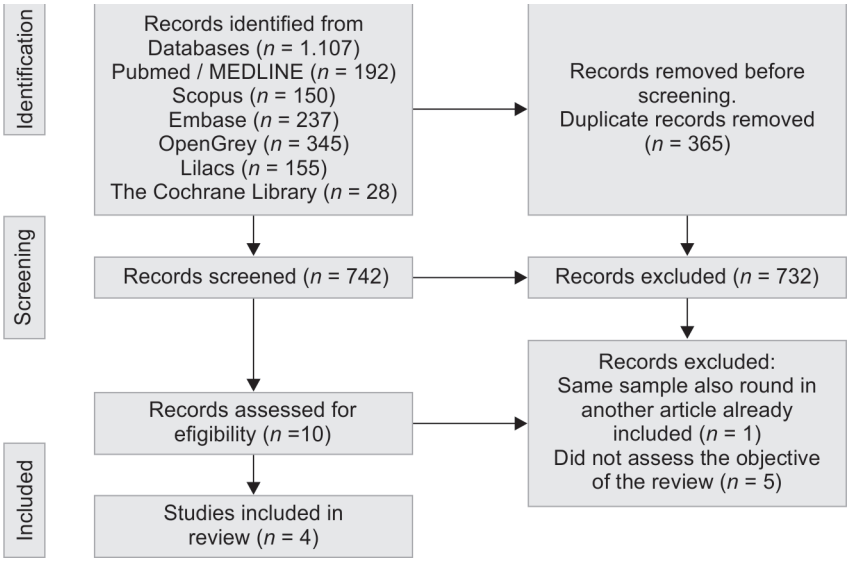

Table 2: Summary of qualitative characteristics of the included studies

Author, year	*Type of study*	*Number of participants*	*Average age or age group*	*Sex*	*Groups*	*Inclusion criteria*	*Exclusion criteria*	*Measurement protocol and equipment*	*Evaluated parameters*
Bucca et al., 2001[16]	Cohort	36 22 with COPD 18 with interstitial lung disease	69 ± 1 73 ± 2 60 ± 4	18M/18W 19M/3W 12M/6W	- without complete dentures (control) - with complete dentures	NR	Combined obstructive and restrictive pattern, with recent exacerbation of bronchopulmonary disease, with poor retention and stability of dentures, and who were not able to perform repeated respiratory efforts	Guideline of the American Thoracic Society – equipment spirometer BAIRES system, Biomedin, Padua, Italy	(1) FVC, (2) FEV1, (3) PEFR, (4) FEF50%, (5) FIV1, (6) FIF50%
Gupta et al., 2011[17]	Clinical	20	40–70 years	NR	- without complete dentures (control) - with complete dentures	Age group ranging between 40 and 70 years; healthy subjects with no systemic involvement, especially respiratory diseases; residual alveolar ridge should be well formed/average	NR	NR	(1) FVC, (2) FEV1, (3) FEV1/ FVC, (4) PIFR
Bulent, 2012[6]	Cohort	46	60.6	27M/19W	- without complete dentures (control) - with complete dentures - only upper denture - only lower denture	Wearing existing complete dentures <4 years; absence of any complaints and faults from existing dentures; having Mallampati Class I soft palate–tongue–oropharynx relationship; non-smoker; absence of any respiratory, cardiovascular, or systemic disorders	NR	Guideline of the American Thoracic Society - equipment Jaeger Flowscreen spirometer (North Rhine, Westphalia, Germany)	(1) FVC, (2) PEF, (3) FEV1, (4) FEF25-75
Indrakumar et al., 2018[1]	Cohort	100	52.4	42 M/58W	- without complete dentures (control) - with complete dentures - only upper denture - only lower denture	Historic of regular wearing of complete denture for a minimum time period of 5 years; absence of any complaints and faults from existing dentures; presence of Mallampati class I relationship of oral soft tissues	Patients with a history of any systemic illness; historic of any respiratory disease; historic of smoking	NR – equipment spirometer Technocare Medisystems, India	(1) FVC, (2) PEF, (3) FEV1, (4) FEF25-75

NR, not reported; COPD, chronic obstructive pulmonary disease; M, man; W, woman; FVC, forced vital capacity; PEF, peak expiratory flow; FEV1, the volume of air exhaled during the first second of expiration; FEF25-75, forced expiratory flow between 25 and 75%; PIFR, peak inspiratory flow rate; FEF50%, forced expiratory flow –50%; FIF50%, forced inspiratory flow –50%; FIV, volume forced inspiration during the first second; PEFR, peak expiratory flow rate

Table 3: Summary of quantitative characteristics of the included studies with and without prosthesis in individuals without lung diseases

		Main results		
Author, year		*Without prosthesis*	*With prosthesis*	*Conclusion*
Bucca et al., 2001[16]	**FVC, L**	2.85 ± 0.11*	2.96 ± 0.13	The use or no use of dentures in edentulous subjects during spirometric measurements does not have clinical relevance and will not likely impact patient management
	FEV1, L	2.20 ± 0.09	2.31 ± 0.10	
	PEFR, L/s	4.42 ± 0.24	5.31 ± 0.23	
	FEF50%, L/s	2.82 ± 0.18	3.33 ± 0.22	Without prosthesis – significant decrease PEFR (p <0.001) FEF50% (p <0.001) FIF50% (p <0.01)
	FIV1, L	2.49 ± 0.12	2.75 ± 0.12	
	FIF50%, L/s	2.76 ± 0.16	3.22 ± 0.17	
Gupta et al., 2011[17]	**FVC** (%)	76.75	77.35	Should always use dentures for assessment of extrathoracic airways
	FEV1 (%)	76.30	77.40	
	FEV1/FVC (%)	94.40	94.80	Comparing with and without prosthesis: PIFR (p = 0.002)
	PIFR (%)	2.39	2.93	
Bulent et al., 2012[6]	**FVC**	3.05 (0.8)*	2.98 (0.9)	Complete dentures may unfavorably affect spirometric values of edentulous subjects
	PEF	5.73 (2.38)	5.51 (2.44)	
	FEV1	2.35 (0.82)	2.31 (0.81)	
	FEF25–75	2.7 (1.4)	2.56 (1.41)	
Indrakumar et al., 2018[1]	**FVC**	3.10	3.02	Complete dentures may unfavorably affect spirometric values of edentulous subjects
	PEF	5.79	5.60	
	FEV1	2.39	2.35	Comparing with and without prosthesis: FVC (p = 0.02) FEV1 (p = 0.04) FEF25–75 (p = 0.01)
	FEF25–75	2.79	2.62	

*Mean ± standard deviation (SD), FVC, forced vital capacity; PEF, peak expiratory flow; FEV1, the volume of air exhaled during the first second of expiration; FEF25-75, forced expiratory flow between 25 and 75%; PIFR, peak inspiratory flow rate; FEF50%, forced expiratory flow –50%; FIF50%, forced inspiratory flow –50%; FIV, volume forced inspiration during the first second; PEFR, peak expiratory flow rate

a significant difference was observed in the parameters of FVC (p = 0.01), PEF (p = 0.02), FEV_1 (p = 0.02), and $FEF_{25-75\%}$ (p = 0.02) using only the upper prosthesis and in the parameters of FVC (p = 0.03), PEF (p = 0.01), and FEV_1 (p = 0.04) with only lower dentures compared to not using complete dentures (Table 4).

Only one study[16] evaluated healthy individuals and unhealthy participants (interstitial lung disease and COPD) with and without the use of complete dentures. Thus, the removal of prostheses decreased lung volume and airflow rates in healthy individuals and subjects with interstitial lung disease. For healthy individuals with PEFR, FEF50% and FIF50% were significantly lower (p <0.001, p <0.001, and p <0.01, respectively) (Table 3). For subjects with interstitial lung disease, the parameters of PEFR and FEF50% (both p <0.05) were also significantly reduced with the removal of complete dentures. However, subjects with COPD had similar results with and without the use of prostheses (Table 4).

Finally, two articles evaluated the retropharyngeal space of participants with and without prostheses using cephalometry. In the study by Bucca,[16] including five healthy participants, four subjects with interstitial lung disease, and five subjects with COPD reported a significant reduction in the retropharyngeal space with the removal of complete dentures (1.52 ± 0.07 to 1.16 ± 0.09 cm, p <0.0001). Gupta[17] also demonstrated significant changes in this space with the use of dentures (mean increase of 2.16 mm with p <0.05) compared to individuals without complete dentures.

Risk of Bias in Studies

In the NOS assessment scale, the three studies were of high quality (score ≥6), with a total of six points. However, these studies did not score on three criteria: representativeness of the exposed cohort (Indrakamur[1] with a selected group of users and the Bucca[16] and Bulent[6] studies without description); demonstration that outcome of interest was not present at the start of study; and assessment of outcome (not reported) (Table 5).

According to the MINORS scale, the study by Gupta[17] was classified as good quality (>11), with a total of 16 points. Only items five (impartial assessment of study outcome), six (appropriate follow-up period), seven (loss to follow-up less than 5%), and eight (prospective calculation of study size) were not reported in this study; therefore, they received a score of 0 (Table 6).

Quantitative Analysis

Two studies[6,16] were part of the meta-analysis performed on the values of the FEV_1 parameters (MD, 0.11; 95% CI, 0.15–0.07) (MD, 0.04; 95% CI, 0.29–0.37) (Fig. 1) and FVC (MD, 0.11; 95% CI, 0.17–0.05) (MD, 0.07; 95% CI, 0.28–0.42) (Fig. 2). Given the results, significant differences were observed in the FEV_1 parameter as favorable to the group that did not use complete dentures and the FVC parameter favorable to the group of subjects who used dentures in spirometry (p <0.001).

Discussion

In spirometry or PFTs, flow and volume are measured; however, the ATS does not recommend the use of instantaneous flow measurements because they present great variability that results in interpretation difficulties.[18] Therefore, the main volumes for interpretation are FVC, which corresponds to the total amount of

Table 4: Summary of quantitative characteristics of the included studies with upper or lower denture in individuals with and without lung diseases

		Individuals without lung diseases		*Individuals with lung diseases*			
				Interstitial lung disease		*COPD*	
Author, year of publication	*Parameters*	*Upper denture*	*Lower denture*	*With prosthesis*	*Without prosthesis*	*With prosthesis*	*Without prosthesis*
Indrakumar et al., 2018[1]	**FVC**	2.93/(p = 0.01)	2.90/(p = 0.03)		NA		NA
	PEF	5.48/(p = 0.02)	5.40/(p = 0.01)				
	FEV1	2.32/(p = 0.02)	2.33/(p = 0.04)				
	FEF25–75	2.670/(p = 0.02)	2.68				
Bulent et al., 2012[6]	**FVC**	2.91 (0.93)*/(p = 0.003)	2.93 (0.89)/(p = 0.001)		NA		NA
	PEF	5.41 (2.16)	5.36 (2.19)/(p = 0.003)				
	FEV1	2.28 (0.82)/(p = 0.001)	2.29 (0.82)				
	FEF25–75	2.6 (1.51)/(p = 0.003)	2.62 (2.47)				
Bucca et al., 2001[16]	**FVC, L**	NA		2.58 ± 0.18*	2.50 ± 0.19	2.59 ± 0.13	2.58 ± 0.13
	FEV1, L			2.00 ± 0.13	1.98 ± 0.14	1.39 ± 0.09	1.42 ± 0.09
	PEFR, L/s			5.37 ± 0.37	4.97 ± 0.40/(p <0.05)	3.72 ± 0.29	3.79 ± 0.24
	FEF50%, L/s			3.03 ± 0.26	2.85 ± 0.26/(p <0.05)	0.84 ± 0.11	0.92 ± 0.12
	FIV1, L			2.41 ± 0.20	2.25 ± 0.17	2.25 ± 0.14	2.36 ± 0.14
	FIF50%, L/s			3.37 ± 0.26	3.35 ± 0.30	2.79 ± 0.20	3.10 ± 0.23

*Mean ± standard deviation (SD), FVC, forced vital capacity; PEF, peak expiratory flow; FEV1, the volume of air exhaled during the first second of expiration; FEF25-75, forced expiratory flow between 25–75%; COPD, chronic obstructive pulmonary disease; FEF50%, forced expiratory flow –50%; FIF50%, forced inspiratory flow –50%; FIV, volume forced inspiration during the first second; PEFR, peak expiratory flow rate; *p*-value, statistically significant; NA, not applicable

air that can be expelled from the full lungs, and FEV1, which is the amount expelled during the first second of this maneuver. The first is the most relevant PFT because during expiration, there is a limit to the maximum flow that can be achieved in any lung volume and it is very sensitive to the most common pathologies affecting the lung. Meanwhile, FEV_1 is the most clinically important measure of lung function, showing greater reproducibility because it is more effort independent.[19] The FEV_1/FVC ratio is also a valuable indicator of respiratory disease and allows for the separation of ventilatory abnormalities into "restrictive" patterns or "obstructive" because it allows characterizing the disproportionate flow reduction to the volume.

Another factor to consider is the participant's profile in carrying out the test. Respiratory condition, subject compliance, physical conditioning, medical history, and body mass index can interfere with spirometric measurements.[20] The included studies established inclusion and exclusion criteria to make the sample more homogeneous for evaluation. In addition, since most participants were elderly men, it was also seen that sex and age are influential in measures that evaluate breathing pattern and thoracoabdominal movement, respectively.[21] Thus, it is important that the procedure is recommended by the ATS to be a pattern, minimizing other aspects that can interfere with the spirometry results, such as the individual's position. These criteria were met in the studies of Bucca[16] and Bulent,[6] which were included in the quantitative assessment.

In a qualitative analysis of the studies included in this systematic review, the study by Bucca,[16] despite the increase in means with the use of prostheses, there was no significant difference in FVC and FEV_1. Parameters that have a significant value do not directly influence respiratory capacity; that is, they do not interfere with the use of dentures; however, it is important to note an increase in the retropharyngeal space by cephalometry with the use of complete dentures. Similar to the study by Bucca,[16] Gupta's[17] study also showed an increase in means, but only a significant difference in PIFR, which was influenced by the upper airways because of the increase of the retropharyngeal space with the use of prostheses. Conceptually, dental prostheses, far beyond esthetics, provide indispensable support for the adequacy of orofacial structures, especially in the reestablishment of the vertical dimension, which is important for orofacial functions, as edentulism favors pharyngeal collapse due to reduced size and tone of the pharyngeal muscles.[16,22] Thus, the increase in the retropharyngeal space without significant changes in the FEV_1 and FVC patterns, as in these two studies, can be explained by the influence of the increase in vertical dimension provided due to the use of prostheses in the extrathoracic and not intrathoracic airways, which influence FVC and FEV_1. Therefore, it is recommended to use prostheses for the evaluation of obstructive sleep apnea, paratracheal tumors, paratracheal lymphadenopathy, and laryngeal inflammation (extrathoracic airways). However, when spirometric tests are used to differentiate obstructive from restrictive diseases, the use of a prosthesis would become optional (intrathoracic airways).[17]

Considering respiratory assessment in healthy individuals and subjects with lung diseases, the removal of prostheses produced a decrease in airflow rates for healthy individuals and subjects with interstitial lung disease. In healthy individuals, the improvement in flow can be explained by the increase in retropharyngeal space with the use of prostheses. In the case of subjects with interstitial lung disease, there is a greater limitation in the possible justification because it is a large group of lung diseases that should have been presented in more detail. Finally, subjects with COPD had similar

Table 5: Newcastle–Ottawa—Cohort study

Criteria	*Selection 1*	*Selection 2*	*Selection 3*	*Selection 4*	*Comparability 1a*	*Comparability 1b*	*Outcome 1*	*Outcome 2*	*Outcome 3*	*Total*
Bucca et al., 2001[16]		*	*		*	*		*	*	6
Bulent et al., 2012[6]		*	*		*	*		*	*	6
Indrakumar et al., 2018[1]		*	*		*	*		*	*	6

Selection: (1) Representativeness of the exposed cohort; (2) Selection of the non-exposed cohort; (3) Ascertainment of exposure; (4) Demonstration that outcome of interest was not present at start of study. Comparability: (1a and 1b) Comparability of cohorts on the basis of the design or analysis. Outcome: (1) Assessment of outcome; (2) Was follow-up long enough for outcomes to occur; (3) Adequacy of follow up of cohort

Table 6: MINORS

Criteria	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*Total*
Gupta et al., 2011[17]	2	2	2	2	0	0	0	0	2	2	2	2	16

A clearly stated aim; (2) Inclusion of consecutive patients; (3) Prospective collection of data; (4) Endpoints appropriate to the aim of the study; (5) Unbiased assessment of the study endpoint; (6) Follow-up period appropriate to the aim of the study; (7) Loss to follow up less than 5%; (8) Prospective calculation of the study size; (9) An adequate control group; (10) Contemporary groups; (11) Baseline equivalence of groups; (12) Adequate statistical analyses

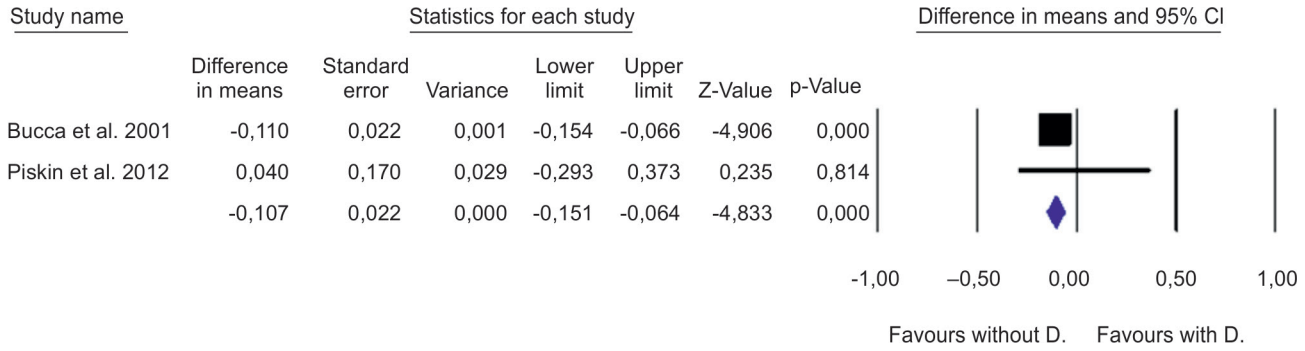

Fig. 1: Subjects without dental prosthesis vs subjects with dental prosthesis (FEV_1)

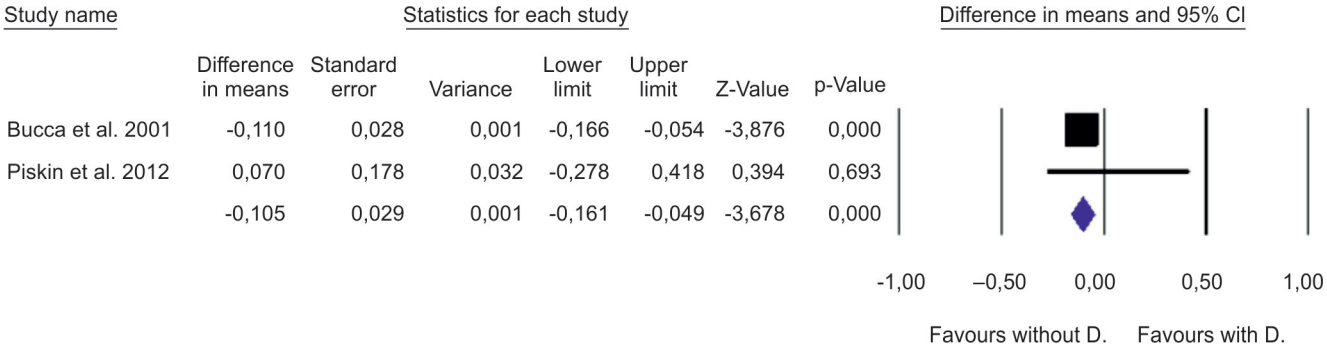

Fig. 2: Subjects with dental prosthesis vs subjects without dental prosthesis (FVC)

results with and without the use of prostheses, possibly because they have a chronic ventilatory disorder; therefore, they already have relevant changes in spirometry, with or without the prosthesis.

Studies by Bulent[6] and Indrakamur[1] found a decrease in the means of spirometric parameters, including those of the intrathoracic airways, with the use of a prosthesis that interfered negatively. Furthermore, significant differences were observed in the parameters FVC[1,6] and FEV_1[1] when evaluating upper or lower dentures separately compared to those who did not use complete dentures. Although the prosthesis provides the necessary structural support for the orofacial structures, it is necessary to consider muscle weakness in this group of individuals who have several muscle compensations involving the tongue, buccinators, and chin that can affect the adaptation of the prostheses. In edentulous subjects, the tongue usually changes its normal posture to compensate for the vertical dimension of the occlusion, interposing with the alveolar ridges to stabilize the mandible and favor functions, such as swallowing. After some time in this condition, the tongue

becomes enlarged, making it difficult to adapt the prosthesis, and retracts into the oropharynx (reducing the oropharyngeal space) after prosthesis.[23] The adaptation of the lower prosthesis is more complicated because it is easily displaced due to the condition of the alveolar ridge, muscle tension in the region that circumscribes the area of the prosthetic seating, and the mobility of the tongue. Therefore, it is important to ensure that the prosthesis does not interfere negatively with the examination. It must be well adapted to the ridge and peripheral muscle regions, allowing the mobility of the lips and tongue to favor the spirometry test.

In the quantitative analysis presented in this systematic review, a meta-analysis to evaluate the expired air during the FEV_1 was favorable for the group without complete dentures. In the case of FVC, the group with prosthesis was better. In both analyses, although the study by Bulent[6] has a larger sample, the study by Bucca[16] has a greater influence due to its high statistical weight because of its low standard deviation; that is, all data had low variability.

A possible explanation is that in the first second (FEV_1), the prosthesis had a negative influence; then, with the adaptation to the test, it improved the breathing pattern in spirometry. However, there was still a small difference in the clinical evaluation as the groups (with and without prostheses) included in the meta-analysis result in values close to or within the reference standard for spirometry (FVC = 3.14 L [adults]/2.14 L [elderly]).[19] Overall, these quantitative results need to be interpreted with caution, as some limitations are seen. Due to a lack of complete data, a small number of studies were included in the meta-analysis; thus, more studies are needed with a well-defined sample size calculation to verify whether the statistical difference presented in the meta-analysis is compatible with the inclusion of new studies as the data dispersion values are high from one study to another.

Furthermore, although the studies included in this review are classified as high/good quality, homogeneous, and with a representative sample, due to the small number of studies in the literature, more studies with a more detailed sample and high technical rigor are required because all clinical measures, including function tests, are subject to influences related to the instrument and how spirometry is performed. In addition to spirometry tests, tests assess the upper airways, such as acoustic rhinometry and rhinomanometry (including modified anterior rhinomanometry), which also provide findings of the nasopharyngeal area that could help better understand the results with spirometry. We conclude that lung function is affected by several characteristics of individuals, with sex and height being the main ones, and it is important that future research in the area tends to delineate these two parameters. Subjective findings, such as the analysis of respiratory complaints through questionnaires or validated scales, and myofunctional assessment of oropharyngeal structures, can contribute to verifying the clinical findings and their impact on the analysis of the studies.

Finally, considering the qualitative and quantitative findings of the studies included in this systematic review and that this survey is based on the literature available on the subject, it is currently not possible to determine a clinical protocol for the use of total dentures in the spirometry test. Therefore, it is suggested that the professionals responsible for the test evaluate the prosthesis clinically and observe an adequate adaptation such that a negative condition does not limit the subject. In addition, we think it is pertinent to consider that patients with complete dentures are included for this test and are adapted to perform their daily functions with the dentures. If necessary, for greater stabilization of the dentures, the use of a denture adhesive may be indicated, creating a comfortable and safe environment for the patient during the examination. It is also worth noting that considering the vast number of lung diseases and the prevalence of edentulism in 18% of individuals over 60 years of age, which is expected to remain constant for several decades,[24] there is a need for further studies in this area, given the scarcity of information on this topic.

Conclusion

The use of complete dentures did not represent relevant changes from the reference values for pulmonary function in the spirometry test. Considering the results of this review, it is not yet possible to establish a clinical protocol for the use of complete dentures during the test.

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Author Contribution

Bruna Rocha Neves participated in study design, literature search, data collection and interpretation; and wrote, reviewed, and approved the manuscript. Rafaella Souza Leão participated in study design, literature search, data collection, and interpretation; and wrote, reviewed, and approved the manuscript. Andressa Sharllene Carneiro da Silva helped in data interpretation; wrote and reviewed the manuscript; and approved the final manuscript. Joel Ferreira Santiago Júnior performed the analysis; helped in data interpretation; and approved the final manuscript. Belmiro Cavalcanti do Egito Vasconcelos reviewed and approved the final manuscript. Eduardo Piza Pellizzer reviewed and approved the final manuscript. Sandra Lúcia Dantas Moraes participated in study design; helped in data interpretation; and reviewed and approved the final manuscript.

References

1. Indrakumar HS, Venkatesh D, Adoni VV, et al. Spirometric assessment of impact of complete dentures on respiratory performance: an in vitro study. J Contemp Dent Pract 2018;19(2):177–180. DOI: 10.5005/JP-JOURNALS-10024-2233.
2. Lee DJ, Saponaro PC. Management of edentulous patients. Dent Clin North Am 2019;63(2):249–261. DOI: 10.1016/j.cden.2018.11.006.
3. El Osta N, Haddad E, Fakhouri J, et al. Comparison of psychometric properties of GOHAI, OHIP-14, and OHIP-EDENT as measures of oral health in complete edentulous patients aged 60 years and more. Qual Life Res 2021;30(4):1199–1213. DOI: 10.1007/s11136-020-02709-w.
4. Lowery EM, Brubaker AL, Kuhlmann E, et al. The aging lung. Clin Interv Aging 2013;8:1489–1496. DOI: 10.2147/CIA.S51152.
5. Beeckman-Wagner L-AF, Freeland D. Spirometry quality assurance: common errors and their impact on test results. Department of Health and Human services [En ligne] 2012;200(8):E70–E88. DOI: 10.1164/rccm.201908-1590ST.
6. Bulent P, Cumhur S, Omer K, Arzu A, Faruk C, et al. Effects of complete dentures on respiratory performance: Spirometric evaluation. Gerodontology 2012;31(1):19–24. DOI: 10.1111/j.1741-2358.2012.00687.x.
7. Pierce R. Spirometry: an essential clinical measurement. Aust Fam Physician 2005;34(7):535–539. PMID: 15999163.
8. Behr J, Furst DE. Pulmonary function tests. Rheumatology 2009;47(SUPPL. 5):65–67. DOI: 10.1093/rheumatology/ken313.
9. Douglass JB, Meader L, Kaplan A, et al. Cephalometric evaluation of the changes in patients wearing complete dentures: a 20-year study. J Prosthet Dent 1993;69(3):270–275. DOI: 10.1016/0022-3913(93)90105-W.

10. Murali Mohan S, Mahesh Gowda E, Banari AS. Obstructive sleep apnea (OSA): a prosthodontic perspective. Med J Armed Forces India 2015;71(0):S395–S399. DOI: 10.1016/j.mjafi.2013.09.007.
11. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372. DOI: 10.1136/bmj.n71.
12. van Westrhenen A, Muskens IS, Verhoeff JJC, et al. Ischemic stroke after radiation therapy for pituitary adenomas: a systematic review. J Neurooncol 2017;135(1):1–11. DOI:10.1007/s11060-017-2530-9.
13. Slim K, Nini E, Forestier D, et al. Methodological index for non-randomized studies (Minors): development and validation of a new instrument. ANZ J Surg 2003;73(9):712–716. DOI: 10.1046/j.1445-2197.2003.02748.x.
14. Santiago Junior JF, Biguetti CC, Matsumoto MA, et al. Can genetic factors compromise the success of dental implants? A systematic review and meta-analysis. Genes (Basel) 2018;9(9):1–15. DOI: 10.3390/genes9090444.
15. Borenstein, M, Hedges LV, Higgins JPT, et al. Introduction to meta-analysis. Chichester, United Kingdom: Wiley, Ltd; 2009. DOI: 10.1002/9780470743386.
16. Bucca CB, Carossa S, Colagrande P, et al. Effect of edentulism on spirometric tests. Am J Respir Crit Care Med 2001;163(4):1018–1020. DOI: 10.1164/ajrccm.163.4.2005022.
17. Gupta P, Thombare R, Pakhan AJ, et al. Cephalometric evaluation of the effect of complete dentures on retropharyngeal space and its effect on spirometric values in altered vertical dimension. ISRN Dentistry 2011;2011:1–9. DOI: 10.5402/2011/516969.
18. Culver BH, Graham BL, Coates AL, et al. Recommendations for a standardized pulmonary function report. An official American Thoracic Society technical statement. Am J Respir Crit Care Med 2017;196(11):1463–1472. DOI: 10.1164/rccm.201710-1981ST.
19. Pereira CA de C. Espirometry. J Pneumol 2002;28(3).
20. De Castro Pereira CA, Sato T, Rodrigues SC. New reference values for forced spirometry in white adults in Brazil. J Bras Pneumol 2007;33(4):397–406. DOI: 10.1590/s1806-37132007000400008.
21. Parreira VF, Bueno CJ, França DC, et al. Breathing pattern and thoracoabdominal motion in healthy individuals: influence of age and sex. Rev Bras Fisioter 2010;14(5):411–416. DOI: 10.1590/S1413-35552010000500010.
22. Choi JK, Hur YK, Lee JM, et al. Effects of mandibular advancement on upper airway dimension and collapsibility in patients with obstructive sleep apnea using dynamic upper airway imaging during sleep. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;109(5):712–719. DOI: 10.1016/j.tripleo.2009.11.034.
23. Pauloski BR. Rehabilitation of dysphagia following head and neck cancer. Phys Med Rehabil Clin N Am 2008;19(4):889-x. DoI:10.1016/j.pmr.2008.05.010.
24. Douglass CW. Prosthodontics. Clinical practice–delivery of services. Review of the literature. J Prosthet Dent 1990;64(3):275–283. DOI: 10.1016/0022-3913(90)90007-Y.