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Influence of complete denture use on respiratory function - An *in vivo* study

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Abstract:
The vertical dimension of occlusion, face height, mandible rotation and oropharyngeal muscles are among the major anatomical changes imposed by complete dentures, which may have an impact on the upper airways' volume and functionality. Therefore, it is of interest to evaluate the influence of complete denture use on respiratory function by assessing respiratory capacity (FEV_1/FVC ratio) and peripheral oxygen saturation before denture insertion and at 3, 6 and 9 months after treatment in 52 completely edentulous individuals. We evaluated respiratory capacity using a Spirobank Smart spirometer and peripheral oxygen saturation via a Dr Trust pulse oximeter across all intervals. Results revealed that peripheral oxygen saturation remained completely stable throughout the study, showing no statistically significant differences between genders. Thus, data shows that conventional complete denture therapy is physiologically safe, as it does not adversely affect respiratory capacity or systemic oxygenation.

Keywords: Complete denture, edentulism, respiratory function, oxygen saturation, spirometry

Background:
Edentulism is a widespread oral health condition that has a significant impact on individuals worldwide, with an emphasis on elderly patients **[1]**. OHRQoL (Oral Health-Related Quality of Life) can be used as a supplement to clinical examination results, particularly in the elderly, where oral health is closely linked to subjective and psychosocial factors. Nevertheless, dental therapies in the elderly tend to be unpredictable and demanding and an enhancement in OHRQoL is rarely indicative of an improvement in HRQoL and well-being. Consequently, the potential consequences of complex and aggressive dental procedures should be taken into account in this age group **[2]**. The effective functioning of an artificial denture can be dependent on a variety of variables. Some of these factors might encompass the psychological makeup of the patient, the biological parameters, the role of aesthetics, the functional determinants and technique sensitivity during formal treatment processes **[3]**. The psychology of the patient includes the patient's mental attitudes and preparedness for artificial teeth, their rapport with the dentist and trust, her fundamental intellect and propensity to adapt to the use of new dentures and primarily, her innate personality. A prosthodontist should prioritise the development of a detailed understanding of the patient in order to encourage patients to recognise the type of prosthesis they require **[4]**. As we age, our predisposition to infections, as well as the emergence of lung diseases, is exacerbated by numerous intricate alterations in pulmonary function and immunity **[5]**. Consequently, pulmonary function tests (PFTs) are an indispensable tool for the physiological evaluation of the respiratory system and the diagnosis of certain pathogenic conditions **[6]**. There are numerous tests, which vary from basic non-invasive oximetry to advanced invasive blood gas evaluation. The spirometric test has several significant advantages over other PFTs, including its ease of use and non-invasive nature. The test evaluates the lung volume and capacity to determine the efficiency and rate at which the lungs can be evacuated and filled. Consequently, spirometry offers clinically pertinent parameters regarding the patient's functional state. Volume or flow as a function of time is the primary variables determined by spirometry. Forced vital capacity (FVC) and forced expiratory volume (FEV) are the primary outcomes of spirometry. The spirometry technique consists of three phases: maximal inspiration, a "blast" of exhalation and sustained complete exhalation until the conclusion of the test **[7]**. Complete dentures impose significant anatomical alterations, including the vertical dimension of occlusion, face height, mandible rotation and oropharyngeal muscles, which may influence the volume and function of the upper airways **[8]**. Therefore, it is of interest to report the assessment of respiratory capacity and oxygen saturation in patients before and after they began using complete dentures.

Materials and Methods:
The investigation was conducted at the Mahe Institute of Dental Sciences and Hospital's Department of Prosthodontics, Crown & Bridge and Implantology. The Institutional Ethical Committee granted ethical approval for the study prior to its commencement (Ref. No: MINDS/MEC-IX/15042024/PG-11). All individuals who consented to take part in the investigation provided written informed consent. With a 5% level of significance, 80% power and an effect size of 0.5, a minimum sample size of 52 (26 per group) was necessary. The software G*power version 3.1 was employed to determine the sample size. A total of 52 individuals were included based on the inclusion and exclusion criteria. The inclusion criteria were: elderly subjects aged between 40 and 70 years, completely edentulous individuals who were willing to wear complete dentures, non-smokers, absence of any respiratory disease, FEV_1/FVC ratio above 0.70 and oxygen saturation level between 95% and 100%. The exclusion criteria were those with a history of respiratory diseases or who were unable to wear a complete denture. The subjects who met the inclusion criteria were further divided into two groups based on sex: the male and female groups. Before the fabrication of the complete denture prosthesis, each individual was subjected to a spirometry test (FEV1/FVC) followed by pulse oximetric analysis. Each individual was provided with complete denture prosthesis. The spirometry test and the oximetric analysis were repeated for each patient at intervals of 3 months, 6 months and 9 months. The difference in the FEV1/FVC Ratio and Oxygen saturation

was evaluated and compared. Change in oxygen levels may indicate alterations in respiratory function, which could be influenced by denture use. Monitoring oxygen levels can provide valuable insights into the respiratory effects of complete denture use.

Statistical analysis:
The statistical software SPSS version 22.0 was employed for analysing the data. The pre- and post-follow-up were compared using a paired samples t-test. The parameters were compared between males and females using an independent samples t-test. The categorical data were analysed using the Chi-square test. A p-value of ≤0.05 was regarded as significant.

Results:
The findings showed that at all four time periods, there was a statistically insignificant difference between the groups in relation to oxygen levels and the mean oxygen levels were nearly identical among both genders. The results obtained show that at baseline, 3 months and 6 months' time periods, there was a statistically insignificant difference in the respiratory capacity observed between the genders. On the contrary, at 9 months' time period, we observed a statistically significant difference in the respiratory capacity (p=0.0361) between the genders, with females having a significantly higher respiratory capacity when compared with males **(Table 1).** The results obtained for oxygen levels and respiratory capacity among males **(Table 2)** and females **(Table 3)** show that at four different time periods, there was a very negligible difference seen, with a statistically insignificant difference observed between the time periods. There were statistically insignificant variations observed between the time periods with respect to both oxygen levels as well as respiratory capacity **(Table 4).**

Table 1: Comparison of Mean oxygen level and respiratory capacity between males and females at various time points of the study using unpaired t-test

Time periods	Variables	Males	Females	t-value	P- Value
Baseline	Mean oxygen level	97.78±1.09	97.71±1.23	0.2	0.845
	Mean respiratory capacity	87.13±3.17	87.71±4.05	−0.53	0.5945
3 months	Mean oxygen level	97.87±1.10	97.71±1.23	0.45	0.6607
	Mean respiratory capacity	86.96±3.43	88.67±3.73	−1.58	0.1208
6 months	Mean oxygen level	97.55±1.22	97.76±1.14	−0.59	0.5516
	Mean respiratory capacity	87.65±3.28	89.62±3.61	−1.89	0.0654
9 months	Mean oxygen level	97.68±1.46	97.86±1.06	−0.47	0.6562
	Mean respiratory capacity	88.04±3.52	90.33±3.48	−2.17	0.0361*

p<0.05 - statistically significant; p>0.05 - statistically insignificant

Table 2: Intra-group comparison of mean oxygen levels and respiratory capacity among males at various time intervals of the study using ANOVA test

Parameter	Baseline	3 months	6 months	9 months	f-value	P-value
Oxygen levels	97.78±1.09	97.87±1.10	97.55±1.22	97.68±1.46	0.29	0.8319
Respiratory capacity	87.13±3.17	86.96±3.43	87.65±3.28	88.04±3.52	0.5	0.6808

p>0.05 - statistically insignificant

Table 3: Intra-group comparison of mean oxygen levels and respiratory capacity among females at various time intervals of the study using ANOVA test

Parameter	Baseline	3 months	6 months	9 months	f-value	P-value
Oxygen levels	97.71±1.23	97.71±1.23	97.76±1.14	97.86±1.06	0.08	0.9758
Respiratory capacity	87.71±4.05	88.67±3.73	89.62±3.61	90.33±3.48	1.97	0.1259

p>0.05 - statistically insignificant

Table 4: Intra-group comparison of mean oxygen levels and respiratory capacity overall at various time intervals of the study using ANOVA test

Parameter	Baseline	3 months	6 months	9 months	f-value	P-value
Oxygen levels	97.75±1.14	97.80±1.15	97.65±1.17	97.77±1.17	0.073	0.947
Respiratory capacity	87.41±3.58	87.77±3.64	88.59±3.55	89.14±3.65	0.99	0.106

p>0.05 - statistically insignificant

Discussion:
This *in vivo* study was carried out to evaluate the effect of complete denture therapy on respiratory function by measuring respiratory capacity through spirometry (FEV_1/FVC ratio) and peripheral oxygen saturation (SpO_2) before denture insertion and at 3, 6 and 9 months after denture insertion. Restoration of the oral structures with complete dentures may alter the position of the tongue, lip, mandible and surrounding musculature and this may have subsequent effects on the morphology of the upper airway and respiratory mechanics **[9]**. However, the present study found that oxygen saturation was remarkably stable throughout the study period and did not exhibit considerable differences between both genders. Further, there was an insignificant difference in respiratory capacity between males and females in baseline, 3-month and 6-month assessments, suggesting that complete denture treatment did not cause impairment of respiratory physiology in healthy edentulous subjects. Edentulism has been associated with several anatomic and functional changes including the loss of occlusal vertical dimension, reduced lower facial height, posterior displacement of the mandible and tongue and upper airway narrowing. These changes have raised much interest in the possible relation between rehabilitation with complete dentures and respiratory function **[10]**. Restoration of vertical dimension with complete dentures has a theoretical advantage of improvement in airway patency by repositioning the tongue and support to the perioral tissues. However, the extent of these anatomic alterations may not be sufficient to result in clinically

meaningful alterations in pulmonary function or systemic oxygenation in otherwise healthy individuals. The physiological explanation is affirmed by the findings of the current investigation, in which oxygen saturation remained stable after denture insertion. Recent evidence has also concluded that although complete dentures may change upper airway dimensions, the available evidence does not consistently show clinically important changes in pulmonary function as measured by spirometry **[11, 12]**. We chose pulse oximetry as a non-invasive, reliable and reproducible method of measuring systemic oxygenation. The efficiency of pulmonary gas exchange and cardiovascular compensation maintains oxygen saturation within a narrow physiological range in healthy adults. Complete dentures restore mainly oral functions and have no direct effect on pulmonary ventilation. Therefore, it is not expected to have a significant change in SpO2 in healthy subjects **[13, 14]**. The present results support this physiologic concept because the mean values of oxygen saturation were not significantly different during the study period. Similar observations have been reported in prior studies evaluating cardiorespiratory effects of complete dentures where the oxygen saturation was not much altered despite prosthetic rehabilitation **[13-15]**. A notable finding of the present study was that there did not exhibit considerable gender-related variations in oxygen saturation. Although males usually have greater lung volumes, respiratory muscle strength and absolute spirometric values than females, arterial oxygen saturation depends more on alveolar gas exchange and haemoglobin oxygen affinity than solely on lung size **[16]**. Therefore, oxygen saturation in healthy males and females is generally similar under resting conditions. The similar SpO_2 values found in the present study suggest that oxygenation is not differentially affected by complete denture therapy according to gender. Moreover, the ratio of FEV_1/FVC, used for the assessment of respiratory capacity, did not show significant differences between males and females, at baseline and in the following follow-up periods. Among spirometric indices, the FEV1/FVC ratio was considered one of the most useful for evaluation of airway obstruction, since it minimises the effect of anthropometric differences between individuals. In healthy adults, the absolute values for FEV_1 and FVC are usually higher in males, but the ratio between these parameters is usually similar **[17]**. Thus, the lack of gender-related differences found in the present study suggests that they are due to normal physiological variation and not to the influence of complete denture therapy. The longitudinal design of the present study further adds strength to the presented observations. Respiratory assessment was performed immediately before denture insertion and again at 3, 6 and 9 months, thus allowing both the immediate adaptation period and the longer-term prosthetic use to be evaluated. The stability of oxygen saturation in all follow-up periods supports the fact that patients adapt well to complete dentures without clinically significant impairment of respiratory efficiency. This finding is clinically important because many elderly edentulous patients are concerned about their comfort in breathing after being fitted with complete dentures. The present results suggest that properly constructed complete dentures do not have an impact on systemic oxygenation during normal usage. The results also support the findings of a recent systematic review performed by Neves *et al.* **[14]**, which evaluated the impact of complete denture wearing on respiratory capacity. The authors analysed the available clinical evidence and concluded that complete dentures do not produce clinically relevant alterations in spirometric parameters and that existing evidence is insufficient to recommend modification of routine spirometry protocols based solely on denture use. Along the same lines, Vila-Nova *et al.* **[18]** performed a systematic review on the use of complete dentures at night in patients with obstructive sleep apnoea. Even if some studies detected minor changes in oxygen saturation, the overall evidence suggested that cardiorespiratory parameters are minimally influenced by complete dentures **[19]**. The authors underlined that the association between denture use and respiratory physiology is multifactorial and depends on airway anatomy, sleep-related factors and patient characteristics rather than on prosthesis use. These results are consistent with the present investigation, which showed that the oxygen saturation was stable during the observation period. In the past, some clinical studies have reported slight reductions in spirometric parameters with complete dentures, especially in long-term wearers. Bukhari *et al.* showed a statistically significant decrease in FVC, FEV_1, peak expiratory flow and FEF25-75 in chronic denture users. The authors hypothesised that the differences may be due to changes in the dynamics of oral airflow **[13]**. However, the reductions remained relatively small and their clinical significance was uncertain. The differences between that study and this investigation may be due to differences in study design, duration of denture use, characteristics of the participants and the spirometric parameters assessed. Recent randomised clinical evidence has also shown that complete dentures may improve some spirometric parameters related to airflow and increase upper airway volume without significant effects on oxygen saturation or respiratory rate **[11]**. The results indicate that prosthetic rehabilitation may induce anatomical changes in the upper airway, while maintaining overall respiratory homeostasis. Thus, the present evidence suggests that complete dentures have a minimal effect on resting pulmonary function despite changes in oral and pharyngeal structures. From a clinical perspective, the present findings are reassuring for prosthodontists and geriatric dentists. Conventional complete denture therapy remains the standard treatment for complete edentulism and concerns regarding adverse respiratory effects should not discourage its use in medically healthy individuals. Proper denture fabrication, accurate restoration of vertical dimension, balanced occlusion and regular follow-up continue to be essential for maintaining optimal oral function without compromising respiratory physiology **[13]**. Strengths of the present study are its prospective longitudinal design, the use of standardised spirometric and pulse oximetric measurements and repeated measurements over 9 months. However, some limitations should be acknowledged. The sample size was limited and only healthy edentulous subjects were considered. The study excluded patients with respiratory diseases, which

limited the generalisability of the findings. Furthermore, only resting spirometric parameters and oxygen saturation were evaluated. Future investigations incorporating polysomnography, cone-beam computed tomography for airway assessment, dynamic airway imaging and larger multicentre cohorts might reveal insight into a more comprehensive understanding of the relationship between complete denture therapy and respiratory physiology. The findings of the present study suggest that, in general, complete denture rehabilitation does not lead to clinically relevant changes in oxygen saturation or respiratory capacity and these parameters are similar between males and females in the first 9 months of use of the prosthesis. The findings suggest that conventional full dentures are physiologically safe for healthy edentulous individuals in terms of respiratory function, while emphasising the need for further well-designed longitudinal studies of patients with compromised respiratory health.

Conclusion:

Complete denture usage did not result in any statistically significant variation in oxygen saturation levels, with the 9-month follow-up period, irrespective of gender. Respiratory capacity was similar in males and females at baseline, 3 months and 6 months, with a significant increase only in females at the 9-month assessment. The results suggest that complete dentures do not adversely affect the respiratory function of healthy edentulous subjects, but chronic denture wearers should be encouraged to perform appropriate respiratory exercises to promote optimal pulmonary health.

Advancement to knowledge:

The study suggests that complete denture use does not significantly affect respiratory function or oxygen saturation in healthy edentulous individuals, indicating it is physiologically safe

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