Introduction:

Breathing is the only means of supply of oxygen to our body which is vital for our survival. The aging process inevitably affects all organs of the body and the supporting structures. One of the fallouts of ageing is edentulism. Edentulism is a debilitating and irreversible condition and is described as the “final marker of disease burden for oral health”. Tooth loss may adversely affect the general and oral health of the elderly. It results in anatomical changes, such as loss of vertical dimension of occlusion, resulting in loss of lower facial height and mandibular rotation. It is a lesser known fact that edentulism produces a decrease in the size and tone of the pharyngeal musculature which may result in breathing difficulties in the older population.[1]

One of the objectives of complete denture rehabilitation is to provide support to the hard and soft tissues. Hence, it may be postulated that complete dentures may extend the support beyond the oral cavity into the pharyngeal spaces. They can possibly aid in improving the patency of the various structures through which air passes and continues to the pharyngeal airway.

 Few studies in literature demonstrates trivial link between complete dentures and its effect on breathing efficiency, but the results are inconclusive. [1,2]

**AIMS:** The present study was designed to evaluate the influence of complete dentures on the retropharyngeal space and lung volumes.

The objectives of my study were:

1. To compare the changes in retropharyngeal spaceand lung volumes with and without complete dentures in old denture wearers.
2. To compare the changes in retropharyngeal spaceand lung volumes with complete denture in old denture wearers receiving new dentures.
3. To compare the changes in retropharyngeal spaceand lung volumes with and without complete dentures in first time denture wearers.
4. To compare the changes in retropharyngeal spaceand lung volumes with complete dentures in first time denture wearers after two weeks.

**METHODS:**

The study was conducted in the Department of Prosthodontics, Crown & Bridge, Department of Oral Medicine and Radiology JSS Dental College and Hospital & Department of Physiology, JSS Medical College, Mysore.

SOURCE OF DATA:

The study group comprised of 20 patients of either sex, of which ten patients were experienced denture wearers wearing dentures for not less than 4 years and ten patients were first time denture wearers without prior experience of denture. Patients were selected from out patients visiting the Department of Prosthodontics. The eligibility criteria were as follows:

Inclusion criteria:

Patient willing to undergo cephalometric and spirometric procedures and sign the informed consent, Healthy subjects from both genders, Age group 45-65 years, Well or average formed alveolar ridge, acceptable vertical dimension of occlusion, nonsmoker.

Exclusion criteria:

Patients suffering from cardiac, neurological and respiratory diseases, History of asthma, allergic rhinitis, recent history of acute upper or lower airway infection, Patients undergoing radiation therapy.

Ethical clearance was obtained from the Institutional Ethical Committee prior to conducting the study. The patients who satisfied the eligibility criteria were explained in detail about the procedure .and the study was performed as follows.

Patients were divided into two groups comprising of ten patients each.

Group A: experienced denture wearer (patient numbered a-j)

Group B: first time denture wearer (patient numbered a-j)

Protocol for Group A patients:

Two Lateral cephalograms (LC) and spirometric readings(S) were recorded on the 0 day .i.e. without dentures and with their old dentures.

Prior to the making of radiographic exposure, the patients were instructed to remove any dental appliances or metal ornaments from the head and neck region that could come in the way of exposure and cause artifacts. The patient was positioned within the Cephalostat with the sagittal plane of the head vertical and parallel to image receptor and horizontal to the Frankfurt plane.

Patients were instructed to swallow and keep the lips in a relaxed position when the radiograph was made without dentures, and bite in centric occlusion (maximum intercuspation) while making the radiograph with dentures.

For the spirometric procedures, it was ensured that the patients were comfortably seated, the test was started by explaining the procedure. Some practice sessions were done by the patients. Patient’s sex, age and height were recorded .This was needed so that FEV1 and FVC could be compared with predicted normal values.

Measuring lung volumes:

• Clean, disposable, one-way mouthpiece to the spirometer was attached (a fresh one for each patient).

• Patients were asked to breathe in as deeply as possible (full inspiration).

• The patient were cautioned to hold their breath just long enough to seal their lips.

• The patients were instructed to blow the breath out, forcibly, as hard and as fast as possible, until there was nothing left to expel.

Three readings were recorded of which the best that was within 100ml, or 5%, of each other were selected.

 The following parameters were recorded:

1. Forced vital capacity (FVC)

2. Forced expiratory volume in a second (FEV1)

3. Ratio of forced expiratory volume in a second to vital capacity (FEV1/FVC)

4. Peak expiratory flow rate (PEFR)

 Complete dentures were fabricated using standard procedures on a three point articulator. Lateral cephalometric and spirometric recordings were repeated on the day of insertion as previously explained.

Protocol for Group B patients:

Lateral cephalogram (LC) and spirometry (S) was recorded on 0 day .i.e. without denture. Complete dentures were fabricated using standard procedures. The lateral cephalometric and spirometric recordings were repeated on the day of insertion and on the 15th day follow up appointment.

After obtaining all the radiographs following cephalometric reference points were identified and traced using Adobe Photoshop CS2.

(i) Lp—point on anterior wall of oropharynx,

(ii) Mp—point on posterior wall of oropharynx

(iii) Cv2ia—the most anteroinferior point on the corpus of the second cervical vertebrae

 Mp-Lp (Retropharyngeal space [RPS])—the smallest distance between the anterior (Lp) and posterior wall of oropharynx.

Tracings were performed similarly for all lateral cephalograms.

The results were tabulated, subjected to statistical analysis and compared.

All statistical analysis were carried out using SPSS for Windows (version 20.0)

**Results:**

The evaluation of the lateral cephalographs was carried out for all the patients and values recorded were compared. Applying descriptive statistics, Paired‘t’ test, and Pearson’s product moment correlation, significant variations (p <0.05) were found in the retropharyngeal space and lung volumes (FVC, FEV1, FEV1/FVC ratio & PEFR).

**Discussion:**

 Respiration is one of the most vital functions of the human body for survival. It can be described as the exchange of gases between the living organism and the atmosphere to meet the metabolic demands of the body. Even though it is believed that the lungs play a major role in breathing, the entry and exit of the air depends on the nasal and the oral cavity. These structures form a passage for movement of the air from the nose to the lungs through pharyngeal airway.

Human teeth play a crucial part in maintenance of an affirmative personality. Our masticatory system performs the functions like chewing, smiling, yawning, swallowing and talking. In healthy young individuals the teeth acts as vertical stops and maintain the vertical dimensions of the face thus maintaining the tissue tonicity which helps to maintain the integrity of various associated structures. As we age the integrity of these structures become challenging.

Tooth loss is associated with, loss in oro-pharyngeal coordination and impaired osseoperception. The removal of intra-dental and periodontal mechano receptors accompanying tooth loss changes the fine proprioceptive control of jaw function and influences the precision of magnitude, direction, and rate of occlusal load application.

The main anatomical changes caused by the loss of natural teeth consist of loss of the vertical dimension of occlusion, reduction of the lower face height and rotation of the mandible. As the patients become edentulous the center of rotation of the mandible shifts from the temporomandibular region to the pre molar region which leads to overclosure of the mandible causing loss of space in the oral cavity.

Edentulism is a debilitating and irreversible condition and is described as the “final marker of disease burden for oral health”. Present knowledge suggests that edentulism acts through complex mechanisms, ranging from simple anatomical changes to impairment of neural reflexes and neuromuscular activity.[3]

Moreover, long lasting edentulism causes abnormal tongue position and impairs tongue motor skill. Unlike most other organs, the tongue continues to expand because of inadequate lateral stops which may lead to macroglossia. As the tongue fills the space of missing natural teeth it may predispose to retrolingual space obstruction.[4] Studies show age-related changes in the generation of lingual pressure. Older individuals have reduced isometric tongue pressures compared with younger individuals which may result in deterioration of the swallowing function in elderly persons.

Swallowing in young individuals is faster with shorter apnea period which gives them more time for respiration. Recent research suggests that swallowing changes occur with aging. Swallowing in the elderly occurs more slowly over a longer duration of time, which further increases the time of swallowing and apnoea. This senescent change may be associated with greater risk for airway penetration or aspiration. These changes may favor upper airway collapse by impairing the activation of the pharyngeal dilators in response to upper airway stimuli .[5,6,7]

Previous studies have shown that the process of swallowing changes with aging, a phenomenon known as presbyphagia. These subtle and subclinical age-related changes make older adults more vulnerable to dysphagia.[8]

Respiration and swallowing are indistinguishably linked by using the structures requiring fine coordination for the two processes. The most important physiological change associated with ageing of respiratory system is the decrease in static elastic recoil of the lung, which effects its respiratory performance and reduces compliance of the chest wall, resulting in increased work of breathing. (Janssens, 2005)

A lesser known fact is that the rehabilitation of edentulous patient with complete denture to an extent can improve the oral and respiratory functions.

Complete dentures are the most common treatment which is globally offered to the edentulous patients. The main objective of the complete denture therapy is to replace the missing teeth as well as to support the associated structures. They structurally redefine potential spaces in the oral cavity. Many factors are involved in the designing of the complete dentures and not even a single factor can be overlooked as it can lead to a complete failure of the denture.

 Poorly designed prostheses that fail to accommodate anticipated muscular function may result in compromised situations. On the other hand, when optimally contoured, complete dentures occupy space in the oral cavity, within the physiologic limits and help to support the soft tissues.

As dentures provide adequate support to the surrounding hard and soft tissues, its absence may adversely affect the structures surrounding it, resulting in collapse of vertical dimension, reduced intra oral space leading to decreased airway dimensions, incompetent breathing etc.

The present study was designed to evaluate weather complete dentures improve the airway spaces and lung volumes which may lead to improved breathing.

The assessment of the airway spaces can be done anatomically and physiologically. Most studies that examine changes in the pharyngeal airway use lateral cephalometric radiograph for measurement of the airway spaces. Physiological measurement can be done by pulmonary function tests (PFTs) using spirometer.

 There is an immense need to understand the role of complete dentures in the improvement of oral and systemic health of the patients. With the above hypothesis, the present study was designed to evaluate the influence of complete denture on retropharyngeal space and lung volumes.

The present study demonstrated significant changes in retropharyngeal space with wearing of complete dentures (mean increase of 4.8mm with “p” value 0.000) in comparison to edentulous patients when lateral cephalogram were made for Group A patients (experienced denture wearers). These changes were found to be more significant in the same subjects after the insertion of new dentures (mean increase of 1.84 mm with “p” value 0.000). (Table 3)

Similarly in group B patients there was a significant increase in the retropharyngeal space with wearing of new denture (mean increase of 6.13mm with “p” value 0.000) in comparison to edentulous patients. The changes were further noticed on the 15th day follow up (mean increase of 0.33 mm with “p” value 0.002)(table 4)

A similar study carried out in past with 6 edentulous patients showed that removal of dentures lead to a striking decrease in retropharyngeal space from 15mm to 6mm, leading to increased severity of apnea-hypopnea events.[9]

Similar results were obtained in another study in which the authors hypothesized that edentulism might act in creating the apnea condition by modifying anatomy and thereby affecting the functions of the pharyngeal airway thus favoring inflammatory edema.[10]

 Results obtained were consistent with a study done by Prachi et al that showed a significant reduction in the retropharyngeal space (RPS) and posterior airway space (PAS) in edentulous state. In same edentulous subjects, after wearing complete dentures having acceptable VDO, the retropharyngeal space (RPS) and posterior airway space (PAS) were found to be increased which was due to restored vertical dimension of occlusion. [11]

 The probable explanation for the results obtained in the present study could be due to the fact that with aging, there is a significant decrease in the

• negative pressure reflex

• increased deposition of parapharyngeal fat in both sexes

• lengthening of the soft palate, and

• Change in the bony shape surrounding the pharynx.ah

 Literature review suggests that the pharyngeal airway of the older population has a less negative closing pressure (more collapsible) than that of the younger population. [12,13]The probable increase in the retropharyngeal space after insertion of complete denture could be due to the fact that, the complete dentures helps to restore and maintain the contours and integrity of the surrounding structures.

Few studies have reported the advantage of using dentures in edentulous patient during sleep which resulted in reducing apnea-hypopnea events in edentulous obstructive sleep apnea patient. The conclusion was, wearing dentures induces modifications in the position of the jaw, tongue, soft tissue, and pharyngeal airway space which may contribute to the reduction of apnea events.

According to the findings from the present study, spirometric values for pulmonary function testing were affected by wearing complete dentures. It was observed that forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), ratio of (FEV1/FVC) and peak expiratory flow rate (PEFR), significantly increased by 8.19%, 11.92%, 2.7% and 5.5% respectively in Group A patients after the insertion of dentures as compared to their values in edentulous state. (table 5)

 There was an increase in the values of forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), ratio of (FEV1/FVC) and peak expiratory flow rate (PEFR) by 13.2%, 11.92%, 2.5% and 10.52 % respectively in Group B patients when they were inserted with new denture as compared to their edentulous state. (table 6)

It was also noted that the changes were more prominent when the patients shifted to new dentures from old dentures in Group A and there was a significant improvement in the lung volumes on 15th day follow up in Group B patients suggesting that wearing complete dentures has significant effect on the extra thoracic airway including the retropharyngeal space. The results of this study is in agreement with findings of previous studies

 A similar study conducted earlier reported that the spirometric values significantly changed when assessed with the wearing of complete denture with acceptable vertical dimension of occlusion and with increased vertical dimension of occlusion. It was observed that peak inspiratory flow rates (PIFR) were increased significantly in both intervention groups as compared with the values in edentulous state of the subjects. However, there were no significant changes in forced vital capacity, forced expiratory volume in 1 second, and FEV1% in intervention groups in comparison to edentulous subjects.[11]

Results of this study are in accordance with studies conducted by Bucca et al which showed that lung functions improved with dentures in mouth. They reported that in asymptomatic and interstitial lung disease patients (ILD), the pulmonary performance slightly improved when complete dentures were in the mouth. According to the author PEFR, FIF50 and FEF50 values increased in asymptomatic patients and PEFR and FEF50 values increased in ILD patients. No significant difference was determined for FVC and FEV1 values in any patient groups. [1,10]

Contrarily to the results obtained in the present study, a study done by Almeida et al. where polysomnographic evaluation of edentulous patients with obstructive sleep apnea was done. They observed that wearing complete dentures during sleep significantly increased apnea hypo apnea index (AHI) scores.[14]

In the present study statistically significant co relation was seen between the retropharyngeal space values obtained on the lateral cephalogram and lung volumes namely forced vital capacity and forced expiratory volume in 1 second in both group A and Group B patients, which suggests that there is a direct proportionality between these variables. As the retropharyngeal space increased the values of FVC and FEV1 increased accordingly.

There was no statistical significance between the retropharyngeal space and the ratio of forced expiratory volume to forced vital capacity and peak expiratory flow rate.

The results thus obtained in the present study was in agreement with the hypothesis that complete dentures influence the retropharyngeal space and lung volumes. We concluded that rehabilitation of edentulous patients with complete dentures supports not only the hard and soft tissues of the oral cavity, it also extends its support posteriorly to the soft palatal and the pharyngeal region which may lead to the improvement in the amount of air passing through. The further study in this field may lead to a new paradigm on effect of dentures on respiratory and other body functions.

Conclusions:

Within the limitations of this study following conclusions can be drawn:

* In edentulous patients, the retropharyngeal space and lung volumes were observed to be reduced.
* In the edentulous patients, after wearing their old complete dentures the retropharyngeal space increased by 28%. Lung volumes including FVC, FEV1, ratio of FEV1/FVC and PEFR increased statistically by 8.19%,11.92%, 2.7% and 5.2% respectively.
* Experienced denture wearers after fabrication with new dentures showed an increase of 8.41% in the retropharyngeal space and an increase of 7.27%, 11.06%, 3%, and 10.52% in the values of FVC, FEV1, and ratio of FEV1/FVC and PEFR respectively.
* In the first time denture wearers, after insertion of complete dentures an increase of 33.56% in the retropharyngeal space was seen. Lung volumes including FVC, FEV1, ratio of FEV1/FVC and PEFR showed a statistically significant increase of 13.2%, 11.92%, 2.5%and 10.52% respectively.
* An increase of 1.46% in the retropharyngeal space was seen on 15th day follow up in first time denture wearers. There was a marginal increase in the lung volumes FVC, FEV1, ratio of FEV1/FVC and PEFR by 2.27%, 4%, .9% and 5.5 % respectively.

References:

1. [Bucca CB](http://www.ncbi.nlm.nih.gov/pubmed?term=Bucca%20CB%5BAuthor%5D&cauthor=true&cauthor_uid=11282782), [Carossa S](http://www.ncbi.nlm.nih.gov/pubmed?term=Carossa%20S%5BAuthor%5D&cauthor=true&cauthor_uid=11282782), [Colagrande P](http://www.ncbi.nlm.nih.gov/pubmed?term=Colagrande%20P%5BAuthor%5D&cauthor=true&cauthor_uid=11282782), [Brussino L](http://www.ncbi.nlm.nih.gov/pubmed?term=Brussino%20L%5BAuthor%5D&cauthor=true&cauthor_uid=11282782), [Chiavassa G](http://www.ncbi.nlm.nih.gov/pubmed?term=Chiavassa%20G%5BAuthor%5D&cauthor=true&cauthor_uid=11282782), [Pera P](http://www.ncbi.nlm.nih.gov/pubmed?term=Pera%20P%5BAuthor%5D&cauthor=true&cauthor_uid=11282782), [Rolla G](http://www.ncbi.nlm.nih.gov/pubmed?term=Rolla%20G%5BAuthor%5D&cauthor=true&cauthor_uid=11282782), [Preti G](http://www.ncbi.nlm.nih.gov/pubmed?term=Preti%20G%5BAuthor%5D&cauthor=true&cauthor_uid=11282782). Effect of edentulism on spirometric tests. [Am J Respir Crit Care Med.](http://www.ncbi.nlm.nih.gov/pubmed/11282782) 2001 Mar; 163**(4)**:1018-20.
2. Ciavarella D, Guida L, Battista G. Edentulism and Obstructive Sleep Apnea: A Case Report. The Open Otorhinolaryngology Journal, 2012; **6**: 7-12.
3. Gupta prachi *et al*, Obstructive sleep apnea and edentulism role of complete denture and oral appliance from prossthodontic prespective: a review. Indain journal of sleep medicine 2010; 5(**4**)116-119.
4. Ivanhoe JR, Cibirka RM, Lefebvre CA, Parr GR. Dental considerations in upper airway disorders: A review of the literature. J Prosthet Dent. 1999; **82**:685-698.
5. Garzino M, Ramieri G, Panzica G, Preti G. Changes in the density of protein gene product 9.5-immunoreactive nerve fibres in human oral mucosa under implant-retained overdentures. Arch Oral Biol 1996; 41:1073-1079.
6. Klineberg I, Murray G: Osseoperception: sensory function and proprioception. Adv Dent Res 1999, **13**:120-129.
7. Malhotra A, Pillar G, Fogel RB, Beauregard J, Edwards JK, Slamowitz DI, Shea SA, White DP: Genioglossal but not palatal muscle activity relates closely to pharyngeal pressure. Am J Respir Crit Care Med 2000, **162**:1058-1062.

# [Wang CM](http://www.ncbi.nlm.nih.gov/pubmed?term=Wang%20CM%5BAuthor%5D&cauthor=true&cauthor_uid=25257507), [Chen JY](http://www.ncbi.nlm.nih.gov/pubmed?term=Chen%20JY%5BAuthor%5D&cauthor=true&cauthor_uid=25257507), [Chuang CC](http://www.ncbi.nlm.nih.gov/pubmed?term=Chuang%20CC%5BAuthor%5D&cauthor=true&cauthor_uid=25257507), [Tseng WC](http://www.ncbi.nlm.nih.gov/pubmed?term=Tseng%20WC%5BAuthor%5D&cauthor=true&cauthor_uid=25257507), [Wong AM](http://www.ncbi.nlm.nih.gov/pubmed?term=Wong%20AM%5BAuthor%5D&cauthor=true&cauthor_uid=25257507), [Pei YC](http://www.ncbi.nlm.nih.gov/pubmed?term=Pei%20YC%5BAuthor%5D&cauthor=true&cauthor_uid=25257507) [Geriatr Aging-related changes in swallowing, and in the coordination of swallowing and respiration determined by novel non-invasive measurement techniques. Gerontol Int. 2014 Sep 26.](http://www.ncbi.nlm.nih.gov/pubmed/25257507%22%20%5Co%20%22Geriatrics%20%26%20gerontology%20international.)

1. C. Bucca, S. Carossa, S. Pivetti, V. Gai, G. Rolla, G. Preti. “Edentulism and worsening of obstructive sleep apnoea.” The Lancet. 1999; 353( **9147**): 121–122.
2. Bucca C, Cicolin A, Brussino L *et al*. Tooth loss and obstructive sleep apnoea. Respiratory Research. 2006; **7**:8.
3. Gupta P *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; Article ID 516969.
4. Heft M, Cooper B, O’Brien K, et al. Aging effects on the perception of noxious and non-noxious thermal stimuli applied to the face. Aging 1996; **8**:35–41.
5. Erskine R, Murphy P, Langton J, Smith G. Effect of age on the sensitivity of upper airway reflexes.Br J Anaesth 1993;**70**:574–575.
6. [Fernanda R, Almeida](http://link.springer.com/search?facet-author=%22Fernanda+R.+Almeida%22), [Hui Chen](http://link.springer.com/search?facet-author=%22Hui+Chen%22), [Lia Rita Bittencourt](http://link.springer.com/search?facet-author=%22Lia+Rita+Bittencourt%22).Complete denture wear during sleep in elderly sleep apnea patients—A preliminary study. [Sleep and Breathing](http://link.springer.com/journal/11325). September 2012; 16(**3**): 855-863.