

Periodontal Status among Patients with and Without Chronic Obstructive Pulmonary Disease

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ABSTRACT

Background: Numerous studies show a strong link between oral and systemic health. Oral pathogens and periodontal inflammation may contribute to systemic inflammation, increasing the risk of chronic diseases such as COPD. This study aims to provide evidence that supports integrated prevention and treatment approaches, emphasizing bidirectional relationship between oral health and COPD.

Methods: A comparative cross-sectional study was conducted at Outpatient Department of Pulmonary Medicine and Critical Care, Chitwan Medical College, from October 2023 to March 2025. Ninety-seven COPD patients and 97 age-matched non-COPD caregivers fulfilling inclusion criteria were evaluated for periodontal status using various indices including oral hygiene index-simplified (OHI-S), gingival bleeding index (GBI), and periodontal index for risk of infectiousness (PIRI). Periodontal parameters, including probing pocket depth (PPD) and clinical attachment loss (CAL), were also assessed. A non-probability consecutive sampling technique was applied. Data were analysed in SPSS version 27.0.

Results: The mean scores of OHI-S (1.9 ± 0.7 vs. 2.8 ± 0.89), GBI (20.03 ± 10.19 vs. 33.1 ± 16.2), PIRI (2.1 ± 1.9 vs. 6.2 ± 2.7), PPD (4.4 ± 2.6 vs. 7.6 ± 1.3), and CAL (2.3 ± 1.0 vs. 4.5 ± 1.1) for non-COPD and COPD groups, respectively, demonstrate that non-COPD participants had significantly better periodontal health compared to those with COPD (P value < 0.001).

Conclusions: Patients with COPD showed poorer oral hygiene status, more gingival bleeding, and weaker periodontal health than those without COPD. Thus, it is crucial to emphasize on proper oral hygiene practices to prevent oral and periodontal diseases in these patients.

Keywords: Chronic obstructive pulmonary disease; oral hygiene status; periodontal status.

INTRODUCTION

The association between periodontitis and chronic obstructive pulmonary disease (COPD) has been widely investigated.¹⁻³ The anatomical continuity between lungs and oral cavity makes the latter a potential reservoir of respiratory pathogens.⁴ COPD and periodontitis share several risk factors and also have similar pathophysiology, characterized by inflammation, recruitment of neutrophils and release of proteolytic enzymes, resulting in destruction of pulmonary alveolus or destruction of periodontal tissues.⁵

COPD is a major global health burden with its increasing prevalence in Nepal. To our knowledge, no studies

have been conducted in Nepal to know the relationship between periodontitis and COPD. Thus, this comparative cross-sectional study was conducted among 194 participants, equally divided into COPD and non-COPD groups with aim to evaluate the relationship between severity of COPD and periodontal disease extent, identify potential confounding factors such as smoking, age, and oral hygiene practices, and provide evidence-based recommendations for incorporating periodontal assessment into COPD management.

METHODS

This was a comparative cross-sectional study conducted in patients visiting Outpatient Department of Pulmonary

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Medicine and Critical Care, Chitwan Medical College and Teaching Hospital, Nepal from October 2023 to April 2025 after obtaining the ethical approval (Ref No.X-IRC/080/081-022) from Institutional Review Committee of the same institute.

Non-probability consecutive sampling technique was done.

In order to have an equal distribution of sample size among two groups, a sample size of 97 in each group of COPD and non-COPD patients was taken into consideration. Thus, a total sample size of 194 was calculated.

Inclusion criteria were systemically healthy subjects with age group of 35-70 years. Likewise, ambulatory patients of similar age diagnosed as COPD by the chest physician were also participated for a study. Dentate patients with at least 16 permanent teeth and complied with all the study requirements, self-willed to participate in the study and able to follow verbal or written oral hygiene instructions were included.

Exclusion criteria were subjects with a history of other pulmonary diseases such as bronchiectasis and cystic fibrosis, etc. Patient suffered from any other systemic illnesses or those in critical conditions or admitted to intensive care units were also excluded. Patients under any medication known to influence periodontal tissue like antibiotics, anti-inflammatory, antiplatelet, antihypertensives or immunosuppressants therapy before the commencement of study for at least the previous three months were also excluded. Patients who had undergone any periodontal therapy within the period of six months before the commencement of a study, with any orthodontic appliances or on extensive prosthetic rehabilitation were also excluded.

Before commencing the study, ethical approval was taken from the Institutional Review Committee of Chitwan Medical College and Teaching Hospital. Patients were fully explained about the nature of study, following which verbal and written consent was obtained. Participation was voluntary and utmost confidentiality and personal identity of all the participants were assured.

The study consisted of pulmonary assessment, interview and periodontal examination. A standard proforma consisting of name, age, gender, chief complain, thorough medical history, dental history, personal history and smoking status were recorded for both the groups. Smokers were stratified according to their smoking status Cigarette smoking status was defined as non smoker,

current smoker, and former smoker. As per the centers for disease control and prevention criteria, current smokers are defined as those who had smoked ≥ 100 cigarettes over their lifetime and smoked at the time of interview, former smokers as those who had smoked ≥ 100 cigarettes over their lifetime but are not currently smoking, and nonsmokers as those who had not smoked ≥ 100 cigarettes in their lifetime.⁶

A thorough medical history of duration, exacerbations, and symptoms of COPD were recorded by the chest physician. The diagnosis of COPD was considered in anyone over the age of 35-40 years who has shortness of breath, a chronic cough, sputum production, or frequent winter colds and a history of exposure to various risk factors for the disease. As a part of diagnosis, chest radiographs was taken and spirometric assessment was further carried out to confirm the diagnosis.

Spirometry was performed in patients who did not have confirmed COPD diagnosis with post-bronchodilator ratio between forced expiratory volume persecond and vital capacity (FEV1/FVC) < 0.7 was taken as confirmed diagnosis. Severity classification into mild, moderate, severe and very severe was done as per GOLD recommendation 2025 as shown in table 1.⁷

Table 1. GOLD Grades and Severity of Airflow Obstruction in COPD Patients. (Based on Post-bronchilator FEV1)⁸
Note: FEV1/FVC is < 0.7 in COPD patients.

GOLD Staging	Severity of Airflow Obstruction	Post-bronchilator FEV1
GOLD 1	Mild	FEV1 $\geq 80\%$ predicted
GOLD 2	Moderate	FEV1 $< 80\%$ but $50\% \geq$ predicted
GOLD 3	Severe	FEV1 $< 50\%$ but $30\% \geq$ predicted
GOLD 4	Very severe	FEV1 $< 30\%$ predicted

The periodontal examination was performed by the single examiner to avoid the inter-examiner variability using a mouth mirror, William’s graduated probe under artificial light. Patient’s periodontal status was assessed with the help of OHI-S, probing pocket depth (PPD), and clinical attachment loss (CAL). Periodontal health was assessed by measuring PPD from the crest of gingival margin to the base of periodontal pocket and CAL from cemento enamel junction to base of the periodontal

pocket. Six surfaces (distofacial, facial, mesiofacial, mesiolingual/ mesiopalatal, lingual/ palatal, and distolingual/ distopalatal) of the tooth were examined for measuring periodontal pocket and loss of attachment. Except the third molar, all the teeth present in the mouth were examined and the tooth having ≥ 4 mm of pocket depth was considered as diseased.

The measurement of pocket depth was done at six sites for each tooth and the mean value was taken as the mean pocket depth of the tooth. Likewise, the mean pocket depth was calculated for all the teeth present. The mean pocket depth of all the pathologically involved teeth was calculated, which was considered as the mean pocket depth for that individual. The calculation of mean CAL was done in a similar way. The presence of periodontal disease was characterized by the presence of four or more teeth with a probing depth of at least 4 mm and a clinical attachment loss of at least 2 mm, as well as bleeding on probing at 35% or more of tooth sites.

Oral Hygiene Index-Simplified (OHI-S) by Greene and

Vermillion was used to assess the oral hygiene status of a patient. In periodontal chart, debris and calculus scores for teeth #16, 11, 26, 46, 31, 36 were recorded and simplified oral hygiene index was determined. Likewise, Gingival Bleeding Index, and Periodontal Index for Risk of Infectiousness (PIRI) were also utilized.

The collected data was coded, entered into Microsoft excel sheet and further tabulated and analysed using SPSS v27.0 (Statistical Package for Social Sciences software version 27, IBM, New York, USA). All the variables were continuous variables which were summarized as mean and standard deviation (SD). Kolmogorov-Smirnov test was used to check the normalcy of the data. Smoking exposure was tested by Pearson's Chi-square test. Comparison of PPD, CAL, and OHI in accordance to the severity of respiratory obstruction in COPD subjects was tested by Kruskal- Wallis test, and pairwise Post hoc comparison was done subsequently. The P value < 0.001 was considered statistically highly significant; P value < 0.05 as significant and P value > 0.05 as not significant.

RESULTS

Individuals of both gender with an age ranging from 35-70 years were selected for the study. The mean age of COPD and non-COPD participants was 50.5 ± 4.05 and 52.5 ± 4.3 respectively as depicted in Table 1. The smoking status of the individual is also summarized in Table 2.

Table 2. Socio Demographic Variables.

Variables	Total (N=194)	COPD (N=97)	NCO (N=97)
Age (years \pm SD)	51.5 \pm 4.3	50.5 \pm 4.05	52.5 \pm 4.3
Gender			
Male, n (%)	96(49.5)	54 (55.7)	42(43.3)
Female, n (%)	98(50.5)	43 (44.3)	55 (56.7)
Smoking status			
Current smoker	49(25.3)	24 (24.7)	29 (29.9)
Former smoker	47(24.2)	32(33.0)	38 (39.2)
Non-smoker	98(50.5)	41(42.3)	30 (30.9)

The mean scores of OHI-S, GBI, PIRI, PPD and CAL were found to be significantly higher in COPD patients in comparison to non-COPD as tabulated in Table 3.

Table 3. Periodontal Parameters of COPD and Non-COPD Group.

Periodontal Parameters	NCOPD	COPD	P value
Simplified oral hygiene index (OHI-S)	1.9 \pm 0.7	2.8 \pm 0.89	.000
Gingival bleeding index (GBI)	20.03 \pm 10.19	33.1 \pm 16.2	.000
Periodontal index for risk of infectiousness (PIRI)	2.1 \pm 1.9	6.2 \pm 2.7	.000
Probing pocket depth (PPD)	4.4 \pm 2.6	7.6 \pm 1.3	.000
Clinical attachment loss (CAL)	2.3 \pm 1.0	4.5 \pm 1.1	.000

The mean values of various periodontal parameters increase with the severity of respiratory obstruction as depicted in Table 4.

Table 4. Periodontal Parameters According to Severity of Respiratory Obstruction.

Obstruction Severity	Total	OHI-S	GBI	PIRI	PPD	CAL
Mild	14	2.5±0.8	32.1±11.8	2.3±0.6	6.0±0.8	3.3±0.9
Moderate	42	2.6±0.7	32.4±16.7	5.1±1.6	7.1±0.8	4.1±1.0
Severe	34	2.9±1.0	32.8±17.8	8.3±1.6	8.6±0.9	5.2±0.8
Very severe	7	3.3±1.0	41.4±12.9	9.4±1.0	9.3±0.5	5.7±0.5

There were no significant differences between OHI-S and GBI in accordance to the severity of obstruction. The post hoc comparisons of mean PIRI, PPD and CAL are shown in Table 5, 6 and 7 respectively.

Table 5. Post hoc Comparison of Mean PIRI based on GOLD Stages.

Obstruction Severity	Mean±SD	Mild	Moderate	Severe	Very Severe
Mild	3.3±0.9	-	**	**	**
Moderate	4.1±1.0	**	-	**	**
Severe	5.2±0.8	**	**	-	-
Very Severe	5.7±0.5	**	**	-	-

Table 6. Post hoc Comparison of Mean PPD based on GOLD Stages.

Obstruction Severity	Mean±SD	Mild	Moderate	Severe	Very Severe
Mild	2.3±0.6	-	*	**	**
Moderate	5.1±1.6	*	-	**	**
Severe	8.3±1.6	**	**	-	-
Very Severe	9.4±1.0	**	**	-	-

Table 7. Post hoc Comparison of Mean CAL based on GOLD Stages.

Obstruction Severity	Mean±SD	Mild	Moderate	Severe	Very Severe
Mild	6.0±0.8	-	-	**	**
Moderate	7.1±0.8	-	-	**	*
Severe	8.6±0.9	**	**	-	-
Very Severe	9.3±0.5	**	*	-	-

DISCUSSION

In our study, COPD seemed to negatively influence the periodontal status of an individual. Contemporary studies of the association of periodontal diseases with systemic disorders and their mutual cause-effect relationships are one of the main areas of research in periodontology.^{1,9} Recent evidence suggests an association between COPD and periodontal disease, though the precise nature of any causal relationship is unclear.¹⁰

COPD is a common, preventable and treatable disease and constitutes a major cause of morbidity and mortality with an increasing burden and is among the top three causes of death worldwide.¹¹ COPD and periodontitis share several risk factors such as age, smoking, stress and ethnicity.⁵ The diseases also have similar pathophysiology, characterized by inflammation, recruitment of neutrophils and release of proteolytic enzymes, resulting in the destruction of the pulmonary alveolus or destruction of the periodontal tissues.¹²

Periodontitis has been proven to enhance the risk of developing the respiratory disease, including COPD, thus, periodontitis can have a significant role in the prevention of these systemic diseases.

Our study showed higher mean OHI-S score (2.8 ± 0.89) suggestive of poor oral hygiene status reflecting a high degree of oral uncleanliness in COPD patients as compared to non-COPD individuals (1.9 ± 0.7) and this difference was found to be statistically highly significant ($P < 0.001$) in accordance to a study conducted by Jung ES et al.¹³ Shenoy et al in an observational study found that participants with COPD had poor oral health that compromised their quality of life, probably precipitating an acute exacerbation and concluded that incidence of COPD can be reduced by good oral hygiene measures.¹⁴ A study by Sepolia et al concluded that patients suffering from COPD demonstrate the poor status of oral hygiene along with a high prevalence of periodontitis. There is a profound lack of awareness as well as negligence towards oral hygiene and health that showed a concomitant increase in severity of COPD.¹⁵ Few studies showed no difference in oral hygiene status between two groups in contradictory to the findings of our study.^{16,17}

Chun et al. observed that those with COPD suffered from poor periodontal health more when compared to control subjects.¹⁸ Patients with confirmed COPD have lower tooth brushing frequency which may hasten deposition of local irritants such as debris and calculus and poorer periodontal health than comparable control groups.^{19,20}

Poor oral hygiene may be the contributing factor for the colonization of dental plaque by respiratory pathogens, and elevated level of antibody against key periodontal pathogens including *Fusobacterium nucleatum* and *Prevotella intermedia* have also been noticed in the sputum of patients with an acute exacerbation of chronic bronchitis, further supporting a role for oral bacteria in lung infections.²¹

The results of our study showed mean GBI score of COPD

group significantly higher ($P < 0.001$) as compared to non-COPD group suggesting an increased incidence of gingivitis in COPD patients in concordance with other studies.^{22,23}

The periodontal index for risk of infectiousness (PIRI) is an individual index that takes into account the number of periodontal pockets per patient as well as their depth. Hence, the PIRI gives an indirect quick and rough estimation of the surface area of contact between the subgingival bacterial biofilm and the epithelial walls of the periodontal pockets and is representative of the risk of release of pro-inflammatory mediators (such as endotoxins) from the periodontal sites into the bloodstream. It suggests that the periodontal status may serve as a useful risk marker to identify persons at higher risk for various pulmonary diseases.²⁴

The highest proportion of the study population was categorized as high-risk category, followed by medium risk category, and the least as low-risk category based on the PIRI scores. PIRI scores for patients afflicted with COPD were significantly higher than those without the disease indicating that periodontal disease which may act as a risk factor for COPD can have major implications. Such associations could also be accountable for the hypothesis that the co-occurrence of COPD and periodontal disease may be due to a common underlying host susceptibility factor. The release of bacterial endotoxins from periodontal pockets in the bloodstream supports the hypothesis that periodontal disease could play a causative role in the development of systemic pathologies.²⁵

In our study, statistically higher PIRI score was found in COPD patients and PIRI score was proportional to the severity of obstruction. Similarly, statistically significant differences in mean probing pocket depth (PPD) and mean clinical attachment loss were observed between both groups. These observations have been supported by findings of various other studies.²⁶⁻²⁸

The results of the study by Deo et al. 2009 indicated that poor periodontal health status is associated with an increased severity of COPD. It was found that patients with a history of COPD had more mean clinical attachment loss than those without COPD. The risk for COPD appeared to be significantly elevated when attachment loss was found to be severe. Also, lung function appeared to diminish as the amount of attachment loss increased. Similarly, the oral hygiene scores and percentage of gingival bleeding sites were found to be significantly associated with the severity of COPD.²⁹

Similarly, Prasanna et al (2011) in their observational study also found a significant association between pulmonary disease and periodontal health.²⁵ Si et al (2012) also found a strong correlation existed between periodontitis and COPD Chinese population.² Peter et al in their observational study on 501 subjects concluded that the severity status of pulmonary obstruction may increase subsequently with worsening of periodontal indices.³⁰

There are few limitations of this study which include lack of long-term evaluation. Thus, further longitudinal studies can be conducted recruiting multicentered population in future. This study is of cross-sectional design, known to preclude the establishment of a definite cause and effect relationship. Only clinical evaluation was done though radiographs is widely considered as a reliable tool for an assessment of alveolar bony changes.

CONCLUSIONS

The present study demonstrated that individuals with chronic obstructive pulmonary disease exhibited poorer oral hygiene, greater gingival inflammation, and more severe periodontal disease compared to non-COPD participants, with periodontal severity increasing alongside COPD severity. These findings highlight the need for targeted oral health awareness and intervention programs for COPD patients. Future longitudinal and interventional studies are warranted to further explore this association, as improving oral health may potentially contribute to slowing the progression of COPD and reducing respiratory complications.

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