

Association between periodontal health and respiratory diseases – A case control study

Deepak Thomas^{1,*}, Rajesh K S², Shashikanth Hegde³, Arun Kumar M S⁴

¹Senior Lecturer, Dept. of Periodontology, Annoor Dental College, Muvattupuzha, ^{2,4}Professor, ³Professor & Head, Dept. of Periodontology, Yenepoya Dental College, Mangalore

***Corresponding Author:**

Email: drthomasdeepak@gmail.com

Abstract

Introduction: It has been found there is a two way association between many of the systemic diseases and periodontal health. Respiratory diseases are responsible for a significant number of mortality and morbidity in humans. The diseases include COPD, asthma, pleural effusion, tuberculosis etc. A genuine association between the respiratory diseases and periodontal health has been described by many of the studies.

Aims and Objectives: To explore the relevant relationship between periodontal health and respiratory diseases.

Materials and Method: 100 patients with pulmonary diseases and 100 age, sex and race matched control group with normal pulmonary function were selected from Yenepoya Dental and Medical College. Lung disease was confirmed by spirometry. Clinical parameters such as gingival index, plaque index, community periodontal index and loss of attachment was assessed and compared between cases and controls. The data collection was done to carry out the statistical analysis.

Statistical analysis: The analysis was performed by means of Students unpaired 't' test, Kruskal Wallis 't' test and Mann Whitney test.

Results: Patients with respiratory diseases exhibited poor periodontal health manifested as increased gingival inflammation, deeper probing depths and greater loss of attachment when compared to control group with normal pulmonary function.

Conclusion: The findings of the present study support a significant association between periodontal health and respiratory diseases.

Keywords: Respiratory, Periodontal, Pathogens, COPD, Treatment, Risk, Systemic

Introduction

Respiratory diseases are responsible for a significant increase in the mortality and morbidity rates in humans. These diseases are widely prevalent. Lower respiratory tract infections were considered to be the third cause of mortality in 1990 and chronic obstructive pulmonary disease (COPD) held the sixth position for the same.⁽¹⁾ The two way association between periodontal health systemic diseases are being widely investigated. Respiratory diseases include COPD, asthma, pleural effusion, tuberculosis etc. Studies have shown that there lies a strong link between the periodontal health and pulmonary diseases. Respiratory infections involve aspiration of potentially disease causing bacteria from the oropharynx into lower respiratory tract. Therefore promotion of good oral hygiene and periodontal health could play an important role in prevention and treatment of pulmonary diseases. This study was carried out to investigate the relationship between periodontal health and respiratory diseases.

Materials and Method

Subjects for this study were selected from both inpatient and, outpatients of Department of General medicine, Yenepoya medical college & outpatients of Department of Periodontics, Yenepoya Dental College Hospital, Mangalore, who gave informed consent to participate in this study. A total of 200 patients were

selected for the study. 100 patients with respiratory diseases were included in the test group and control group consisted of 100 patients with normal pulmonary function.

The patients of age group ranging from 16 to 64 years, who had more than 15 teeth were included in the study. The patients who had the influence of any other systemic diseases, those who have undergone antibiotic therapy in the past 3 months and who have undergone periodontal therapy in the past six months were excluded from the study.

The ethical committee of Yenepoya University approved the study.

Procedure

The following clinical parameters were evaluated.

- Gingival index (Loe modification -Loe and Silness., 1967)
 - Plaque index ((Loe modification - Silness and Loe.,1967)
 - Community periodontal index (WHO.,1982)
- Measuring Probing Pocket depth and Loss of Attachment were performed using WHO probe.

Lung function was measured using spirometry. The spirometric measurements were done by trained and certified technicians.

Statistical analysis: Data were analysed using Students unpaired 't' test, Kruskal Wallis 't' test and Mann

Whitney test. p value of less than 0.05 was considered to be statistically significant.

Results

The mean age of respiratory patients was 44 and that of control patients was 36.23. The mean of all the patients was 42.83. There were 67 males and 33 females in case group with respiratory diseases. The control subjects consisted of 62 males and 38 females. The brushing frequency did not show much variation among the two groups. In both the groups 46% of the subjects brushed once daily. In the case group, 45% of

the subjects brushed twice and in the control group 49% did the same. The frequency of brushing more than twice was seen in less than 10% of both the groups.

The gingival status was assessed using gingival index scores. The comparison of the gingival index scores was performed and the mean values were 1.90 for cases and 1.52 for controls. The p value was found to be 0.000 (less than 0.05), which is statistically highly significant. It was seen that respiratory patients were having higher gingival index scores when compared to the subjects with normal pulmonary function. (Table 1)

Table 1: Gingival index

Group	N	Minimum	Maximum	Mean	Std. Deviation	Median	diff(%)	t value	p value
Cases	100	1.07	3.00	1.90	.50	1.83	24.77	6.127	.000
Controls	100	0.71	2.57	1.52	.36	1.50			HS

The plaque index scores were compared between both the groups and the mean value of cases and controls were found to be 2.09 and 1.66 respectively. The results showed high statistical significance (p value 0.000). The plaque scores of respiratory patients were significantly high when compared to the non-respiratory group. (Table 2).

Table 2: Plaque Index

Group	N	Minimum	Maximum	Mean	Std. Deviation	Median	diff(%)	t value	p value
Cases	100	1.32	3.00	2.09	.43	2.10	26.01	7.26	.000
Controls	100	1.00	2.53	1.66	.33	1.59			HS

The periodontal status was assessed using Community Periodontal index (CPI). The mean value of cases and controls were 2.37 and 2.18 respectively. The p value was 0.042, which is found to be statistically significant. The mean CPI scores were high in the case group when compared to the controls group. (Table 3)

Table 3: CPI score

Group	N	Minimum	Maximum	Mean	Std. Deviation	Median	diff(%)	Mann whitney test z value	p value
Cases	100	1	4	2.37	.69	2.00	8.72	2.037	.042
Controls	100	0	4	2.18	.82	2.00			Sig

The comparison of Loss of attachment scores were done to assess the amount of periodontal destruction among cases and the controls. The CPI- Loss of attachment scores were statistically analysed. The mean values of cases and controls were found to be 1.68 and 0.79 respectively. The p value (0.120) was greater than 0.000, which is statistically highly significant. Here also, the mean CPI-LOA scores were high in cases when they were compared with the control group with normal pulmonary function. The high CPI-LOA scores in respiratory patients showed more periodontal destruction with respect to that group, when compared to the non-respiratory group. (Table 4)

Table 4: CPI-Loss of attachment score

N	Minimum	Maximum	Mean	Std. Deviation	Median	diff(%)	Mann whitney test z value	p value
100	0	4	1.68	1.24	2.00	112.66	5.200	.000
100	0	3	.79	1.03	.00			HS

The smoking status also showed significance. The subjects were divided into non smokers, current smokers and past smokers. The current smokers in the cases and controls were 13 and 19 respectively. The p value was found to be 0.247 which is statistically insignificant. The past smokers were 32 and 11 in cases and controls respectively.

Here the p value was found to be 0.00. This shows high statistical significance. The smokeless tobacco usage and alcohol consumption did not show statistical significance.

The mean values for all the clinical parameters recorded among different respiratory diseases were found to be highest in the COPD cases (Table 5). The post hoc analysis was done. It is done in order to trace which respiratory disease is responsible for the high significance that has been obtained. It was seen that COPD showed the maximum value for all the clinical parameters recorded and it is responsible for the highly significant association in this study which included all the respiratory diseases.(Table 6)

Table 5: Association of various respiratory diseases and clinical parameters

diagnosis	N	Minimum	Maximum	Mean	Std. Deviation	Median	Kruskal-Wallis Test χ^2 value	p value
GI	Asthma	36	1.14	2.85	1.77	.36	20.865	.000 HS
	copd	36	1.30	3.00	2.21	.52		
	TB	7	1.20	2.65	1.79	.51		
	Bronchitis	3	1.13	1.74	1.39	.31		
	Other	18	1.07	2.65	1.68	.44		
	Total	100	1.07	3.00	1.90	.50		
PI	Asthma	36	1.41	2.70	2.03	.36	31.007	.000 HS
	copd	36	1.82	3.00	2.38	.37		
	TB	7	1.35	2.62	1.91	.45		
	Bronchitis	3	1.32	1.71	1.48	.20		
	Other	18	1.36	2.54	1.81	.35		
	Total	100	1.32	3.00	2.09	.43		
CPI	Asthma	36	1	4	2.19	.62	11.629	.020 sig
	copd	36	2	4	2.67	.68		
	TB	7	1	3	2.14	.69		
	Bronchitis	3	2	3	2.33	.58		
	Other	18	1	4	2.22	.73		
	Total	100	1	4	2.37	.69		
LOA	Asthma	36	0	4	1.25	1.13	26.999	.000 HS
	copd	36	0	4	2.53	1.06		
	TB	7	0	2	1.14	.69		
	Bronchitis	3	0	2	1.00	1.00		
	Other	18	0	4	1.17	1.15		
	Total	100	0	4	1.68	1.24		

Table 6: The post HOC analysis

Post hoc analysis

		GI		PI		CPI		LOA	
		Mannwhitney test Z value		Mannwhitney test Z value		Mannwhitney test Z value		Mannwhitney test Z value	
Asthma	copd	.000	HS	.000	HS	.000	HS	.000	HS
	TB	.908	NS	.430	NS	1.000	NS	.945	NS
	Bronchitis	.077	NS	.015	sig	.558	NS	.763	NS
	Other	.283	NS	.038	sig	.828	NS	.753	NS
copd	TB	.040	sig	.008	HS	.096	NS	.002	HS
	Bronchitis	.019	sig	.004	HS	.415	NS	.030	sig
	Other	.001	HS	.000	HS	.032	sig	.000	HS
TB	Bronchitis	.210	NS	.087	NS	.696	NS	.805	NS
	Other	.607	NS	.650	NS	.890	NS	.799	NS
Bronchitis	Other	.366	NS	.108	NS	.728	NS	.916	NS

Discussion

Evidences suggest that oral disorders like periodontal disease may influence the development and

exacerbation of respiratory diseases. Hereby the role of oral bacteria in the process of respiratory infection is being investigated.⁽¹⁾

In high risk subjects, a potential link between poor periodontal health and pulmonary diseases have been suggested by many of the recent epidemiological studies. The mouth of high risk patients were found to be rich with COPD pathogens. It has been seen that an alteration to oral hygiene significantly lowered the rate of lower respiratory tract infections in institutionalized subjects.⁽²⁾ Studies by Scannapieco et al. (1998) and Scannapieco et al. (2001) made the suggestion that a potential association exists between poor oral health and COPD inspite of controlling other confounding factors such as smoking, age, gender and sex.^(3,4) Periodontitis is a chronic inflammatory reaction to bacterial infections that results in the destruction of the supporting connective tissue and the alveolar bone. Oral pathogens and inflammatory cytokines from periodontal lesions induce systemic inflammation, which may contribute to the pathogenesis of COPD.⁽⁵⁾

Recent reports have implicated that periodontitis is associated with many other systemic diseases like Type 2 diabetes mellitus, cardiovascular diseases and respiratory diseases.^(6,7) Severe periodontal diseases significantly increased the risk of COPD in subjects who were current smokers.⁽⁸⁾

The present study aimed at comparing the periodontal status of healthy patients with that of respiratory patients to find out the association between the two. Several possible mechanisms have been proposed to explain the potential link between periodontal disease and the lung function.

Respiratory tract infections involve aspiration of bacteria from the oropharynx into lower pulmonary tract, leading to the progression and exacerbation of respiratory disease. The results obtained in the study showed that there is a significant relationship between periodontal and pulmonary diseases.

Several mechanisms can be explained to show the role of oral bacteria in the causation of the pathogenesis of respiratory infections

1. The oral pathogenic microorganisms may be aspirated into the lungs to cause infection.
2. The mucosal surfaces get modified by the periodontal disease associated enzymes to promote adhesion and colonization by respiratory pathogens.
3. The salivary pellicles on pathogenic bacteria get destroyed by the periodontal disease associated enzymes.
4. The respiratory epithelium may be altered by the cytokines originating in the periodontal tissue which would thereby promote the infection by the respiratory pathogens.⁽¹⁾

Data obtained from a longitudinal study of more than 1100 men revealed that alveolar bone loss was associated with the risk of COPD. Over a 25 year period, 23% of the subjects were diagnosed with COPD. Subjects who had severe bone loss at the

baseline dental examination had a significantly elevated risk of subsequently developing COPD when compared to subjects with less bone loss.^(9,10)

The observations of the present study is in accordance with the Sharma et al(2011) study. The study showed that the patients with respiratory disease had poor periodontal health showing greater plaque and gingival Index scores along with deeper pockets and greater value for Loss of attachment.⁽¹¹⁾

The study also showed similar results with that of Wang et al⁽¹²⁾ study which made it clear that poor periodontal health along with oral care were significantly associated with a higher risk of developing COPD. Wang et al in their study stressed the importance of dental care promotion and oral health awareness that can be integrated into the prevention and treatment aspects of COPD.

The study by Kowalski et al also showed the positive relationship between dental plaque index, probing depth and COPD.⁽¹³⁾

The present investigation results showed resemblance with Scannapieco et al study⁽⁴⁾ which was a cross sectional retrospective study of NHANES with a study population of 13792 subjects where it was concluded that the lung function tend to diminish with the increasing loss of attachment.

The present study yielded higher plaque index scores which showed a close agreement to Mojon et al⁽¹⁴⁾ study which showed that the dentate subjects with a history of respiratory tract infection(RTI) had higher plaque score (p = 0.02).

Cigarette smoking has been identified as an effect modifier for both periodontal diseases and COPD.⁽¹⁵⁾

It is an independent risk factor for the medical conditions that have been linked to the periodontal disease including Coronary heart disease, COPD, stroke, and low birth weight.⁽¹⁶⁻²⁰⁾

The Third National Health and Nutrition Examination Survey (NHANES III) investigated the possible role of smoking in the relationship between these two periodontal health and COPD. The results suggested that smoking may be a co-factor in the relationship between periodontal disease and COPD.⁽¹⁵⁾

Tobacco smoking suppresses the production of protective immunoglobulin G2 antibodies and blocks phagocytosis and the killing of bacteria by neutrophils.⁽²¹⁾ Tobacco smoking also paralyzes the ciliary action and hampers lung clearance, enhancing the risk for respiratory disease by over four-fold.

Hujoel et al have suggested that the periodontitis and systemic relationship should be studied among healthy never-smokers.⁽²²⁾ It is recommended to carry out future studies of periodontal and systemic diseases including a separate analysis of never smokers to confirm its significance. Lot of focus was given to assess the effects of good periodontal status with systemic status of the patients. A substantial regression in many systemic diseases was observed following

proper maintenance of the periodontal status.⁽²³⁾ There are evidences showing that mortality from pneumonia in fragile elders can be prevented by maintaining good oral hygiene.⁽²⁴⁾

In Watando et al study, elderly nursing home patients were randomly assigned to the intervention and control group with the intention of measuring the cough reflex sensitivity to citric acid. The caregivers dealt with the oral hygiene maintenance of intervention group and the control group performed their oral care themselves. After 30 days, there was an elevated cough reflex in the intervention group than the control group. Therefore it was seen that improved cough reflex could reduce the incidence of pneumonia in elderly nursing home subjects.⁽²⁵⁾ Studies have shown that the improvement of oral health care reduced the risk of developing aspiration pneumonia and the risk of mortality from aspiration pneumonia directly. Few studies also showed that the adequate oral health care decreased the amount of virulent respiratory pathogens and suggested a reduction in the risk of aspiration pneumonia by improving the swallowing reflex and cough reflex sensitivity.⁽²⁶⁾

Even though many studies proved the association between periodontal health and systemic health, it was seen that very few steps have been undertaken for integrating oral health care measures into public health systems. Dental caries & periodontitis, are responsible for a vast number of systemic diseases which are prevalent worldwide. The failure to accept oral care as a part of medical prophylaxis resists any attempts made to close the gap between oral & systemic health.⁽²³⁾

It was seen that COPD showed the maximum value for all the clinical parameters recorded and it is responsible for the highly significant association in this study which included all the respiratory diseases.(Table A.13). Chronic periodontitis is an inflammatory disorder and enzymes from the neutrophil granules are involved in the causation of the disease.⁽²⁷⁾

Environmental factors play an important role in both these diseases. Smoking is considered as a risk factor for developing COPD. However the disease affects only a minority of smoking population which clearly shows the importance of intrinsic and genetic factors that may give additional impact to the effect of smoking.⁽²⁸⁾

Also, a complex interaction between environmental and genetic factors takes place in the pathogenesis of periodontal disease.⁽²⁹⁾ Despite some variations in the triggers and susceptibility factors, the pathogenesis of both these diseases converges on activating and utilizing neutrophils. The neutrophils released have the potential ability to cause the pathological changes in connective tissue in both these diseases.⁽³⁰⁾

Oxidative stress is also a significant feature of both these diseases. In COPD, current smoking habit is associated with elevated hydrogen peroxide levels in

exhaled breath condensate than both the former smokers with COPD and never smokers.⁽³¹⁾

It has been shown that there is a positive interrelationship exists between oral health behaviour (such as time spend for tooth brushing and supra-gingival scaling) and the frequency of COPD exacerbation.⁽³²⁾

Kucukcoskun et al conducted a prospective study on COPD patients. Half the group received periodontal therapy while the other half did not receive. It was seen that there was a reduction in the exacerbation of COPD in the group who received the periodontal therapy. The other group (no treatment group), showed an increase in the frequency of exacerbation of the disease.⁽³³⁾

COPD and periodontitis are believed to share a similar pathophysiology which ultimately results in the destruction of connective tissue. The neutrophils play an important role in the inflammatory response to both the diseases and its proteases and reactive oxygen species continue to propagate the inflammation which results in the destruction of the connective tissue components. These degradative proteins and their inhibitors show an imbalance to cause the pathology. Nowadays the research is focused on the factors leading to this imbalance. There is an abnormal neutrophil function in COPD which is mainly responsible for its causation, but it's not clearly known whether such a defect exist in periodontal disease. More investigations should be carried out to look for the presence of shared pathologic processes and the effect of specific interventions in either disease on the other. This will shed more light on their interrelationship.⁽³⁴⁾

In light of the complexity and multifactorial nature of respiratory disease, a demonstration of a dose effect for the association between periodontitis and respiratory disease is unlikely. Hence, plaque accumulation or periodontal disease does not directly trigger the causation of respiratory or other systemic diseases. They may aggravate these systemic diseases in susceptible and high-risk individuals. The need for rigorous plaque control and treatment of oral infections, particularly in these risk groups, is highly justified.⁽⁸⁾

Conclusion

It is concluded that a potential association exist between periodontal health and respiratory diseases. The assessment of the risk factors along with patient education regarding the risk should be done so that suitable intervention strategies can be implemented. It is not argued that poor oral health alone is responsible for respiratory diseases. Poor oral health along with other factors such as smoking, pollution etc. may exacerbate the progression of respiratory diseases. Further investigations would establish the role of periodontal health in the development of respiratory diseases. It is believed that improved oral health may prevent the respiratory disease progression.

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