Periodontitis as Significant Comorbiditiy in Chronic Kidney Disease: A Cross Sectional Study

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Introduction: Chronic Kidney Disease (CKD) is a progressive disorder associated with the gradual loss of kidney function over time. It is a significant public health concern worldwide and has been linked to a range of comorbidities, including periodontitis. Periodontitis is a common oral disease characterized by an inflammatory response to bacteria living in dental plaque. This review reveals the evidence for the association between periodontitis and CKD.

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Materials and Methods: A prospective study that was conducted in department of medicine at MLN Medical College India from July 2021 to June 2022 in which 50 chronic kidneys patient were included on the basis of inclusion and exclusion criteria. Blood samples were taken and sent for serum interleukin-6, serum procalcitonin, serum vitamin D,CRP, serum creatinine and other relevant investigations. Clinical periodontal examination was performed and classified it by using CDC-AAP classification.

Results: Out of 50 Chronic kidney disease patients, 80% patients presented with periodontitis changes which was considered as cases while 20% patients did not show any sign of periodontitis and was considered as control. In cases percentage of severe periodontitis was found more. We also observed that increased severity of periodontitis was more associated with higher stages of CKD and that was statistically significant (p value -0.012). Inflammatory markers were found statistically significant with pocket depth of periodontitis in cases with respect to control but only serum vitamin d was statistically significant with clinical loss of attachment.

Conclusion: Therefore present review showed that maximum number of CKD patients had periodontitis changes and these changes which were showed by pocket depth and clinical loss of attachment were directly associated with increased inflammatory markers and they indirectly affect the prognosis of CKD patient and management.

1. INTRODUCTION

Chronic Kidney Disease (CKD) is a worldwide public health concern that affects millions of people. CKD often progresses over time and damages the kidneys, leading to a range of complications and comorbidities. These comorbidities affect various organs and systems, including the cardiovascular, nervous, and immune systems, among others. One such comorbidity that has received attention in recent years is periodontitis. Periodontitis is a chronic oral condition characterized by the destruction of the supporting tissues around the teeth, including the periodontal ligament, cementum, and alveolar bone, due to a dysregulated host immune response to bacterial plaque accumulation on the teeth (De Souza CM et al, 2019). Periodontitis and CKD share many pathophysiologic mechanisms, including inflammation, oxidative stress, and endothelial dysfunction (Tonetti MS, 2013). Inflammation has been identified as a driver of CKD progression and a contributing factor to the development and progression of periodontitis. Evidence suggests that patients with CKD have a heightened inflammatory response due to the presence of periodontitis (Choudhury ES, 2010) but due to insufficient study regarding how much it affect we designed this study for measuring the inflammatory burden which were developed by periodontitis, which may exacerbate pre-existing periodontal inflammation. Periodontitis can also contribute to oxidative stress, which is a critical factor in renal injury in CKD patients. This occurs through the release of bacterial toxins and associated inflammatory cytokines into the bloodstream, leading to endothelial dysfunction and vascular damage (Khader YS et al, 2011). The prevalence of periodontitis in CKD patients is high, with studies suggesting that the prevalence of periodontitis is two to three times higher in CKD patients than in the general population (United States Renal Data System, 2019). Several studies have also identified an increased likelihood of developing periodontitis in individuals with comorbidities such as diabetes, hypertension, and cardiovascular disease, all of which are known risk factors for CKD. The presence of periodontitis in CKD patients has been linked to several adverse outcomes. Periodontitis has been shown to worsen glycemic control in diabetic patients, leading to an increased risk of microvascular and macrovascular complications. Additionally, several studies have found a positive association between periodontitis and the incidence of cardiovascular disease, as well as all-cause and cardiovascular mortality, in CKD patients (Shirzad A et al, 2018). Therefore, identifying periodontitis as a comorbidity in CKD patients is essential for effective patient management which is aim of our study. The National Kidney Foundation has identified the management of oral health in CKD patients as an essential component of disease management. This includes routine dental visits, prophylaxis, and targeted periodontal therapy for patients with periodontitis. Additionally, interdisciplinary collaboration between nephrologists, primary

care providers, and dental professionals is needed to ensure comprehensive care for CKD patients. Further research is needed to identify effective interventions aimed at reducing the risks of periodontitis, particularly in those with CKD, and to promote the integration of oral health care within the comprehensive care of CKD patient.

2. MATERIALS AND METHODS

2.1 Study Design

This prospective study comprised of patients visited to nephrology department from July 2021 to June 2022 at SRN Hospital Prayagraj. All adults (age>18 years), male and female patients, were recruited after informed consent. Inclusion criteria: Previously diagnosed CKD patient was evaluated and recorded. Exclusion Criteria comprised of: individual who underwent periodontal therapy, Malignancy, HIV, Hepatitis Upper respiratory tract infections, pregnant and lactating women, other systemic infection like AKI and Pancreatitis.

2.2 Study Procedure

Medical history and clinical Examination was taken and recorded. CKD & its stages were evaluated by eGFR and USG abdomen. Laboratory assays of serum BUN, serum creatinine and inflammatory markers like serum interleukin-6, serum vitamin D, CRP and serum procalcitonin was measured and assessment of dental and periodontal status by two dentists who were blinded to CKD status (Sachin Singh et al, 2023). Periodontal measures were done on randomly assigned half-mouths, one upper quadrant and one lower quadrant selected at the beginning of the examination. The buccal and mesial-buccal aspects of each tooth were scored separately for each periodontal measure: gingival bleeding, calculus, gingival recession, and pocket depth. Loss of attachment was derived from two measurements made at each site: (1) the distance from the free gingival margin to the cemento-enamel junction, and (2) the distance from the free gingival margin to the bottom of the sulcus (pocket depth). When the gingival margin had receded and cemento-enamel junction was exposed, the first number was scored as a negative value and was an indication of gingival recession. The loss (level) of attachment variables was calculated by subtracting the recorded distance of the free gingival margin to cemento-enamel junction (1) from the recorded distance of the free gingival margin to the base

of the sulcus (2). Periodontal disease was defined based on the Centers for Disease Control and prevention (CDC) criteria (Sachin et al, 2023).

2.3 Statistical Analysis

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean and Standard deviations. Quantitative variables were compared using Mann WhitneyU test/Unpaired T test as appropriate between two groups. Qualitative variables were compared using Chi –Square test and fischer exact test as appropriate. To measure the strength of Association between two scale parameters using spearman correlation coefficient as appropriate. A P value of <0.05 was considerely statistically significant. The data was entered in MS Excel spreadsheet and analysis was done using statistical package for Social Science Version 23.0.

3. RESULTS

Out of 50 CKD patient, 40 CKD patients showed periodontitis changes considered as cases and 10 CKD patients had no periodontitis changes considered as control. Table 1 and Fig. 1 depicted below distribution of periodontitis status in cases.

In cases percentage of periodontitis on the basis of severity as mild, moderate, severe were 17.5%,12.5%, and 70% respectively which was showed by (Table 1 and Fig. 1). Table 2 and Fig. 2 illustrated below showed the distribution of CKD stages on the basis of severity of periodontitis status.

Table 2 and Fig. 2 explained that as the severity of periodontitis increases the ckd stages also progress and we found statistically significant (P value= 0.012). Ckd stage 5 more associated with periodontitis irrespective of severity of periodontitis. Table 3 and Fig. 3 depicted below distribution of parameters of peridontitis in study population.

Table 1. Distribution of periodontal status in cases group

Periodontal status	N	%
Mild	7	47.5%
Moderate	5	27.5%
Severe	28	25.0%

Table 3 and Fig. 3 explained that pocket depth was more in cases as compared to control and statistically significant p value<0.001

and we did not comment on CAL due to absence of CAL in control. Table 4 illustrated below correlation of inflammatory marker with pocket depth.
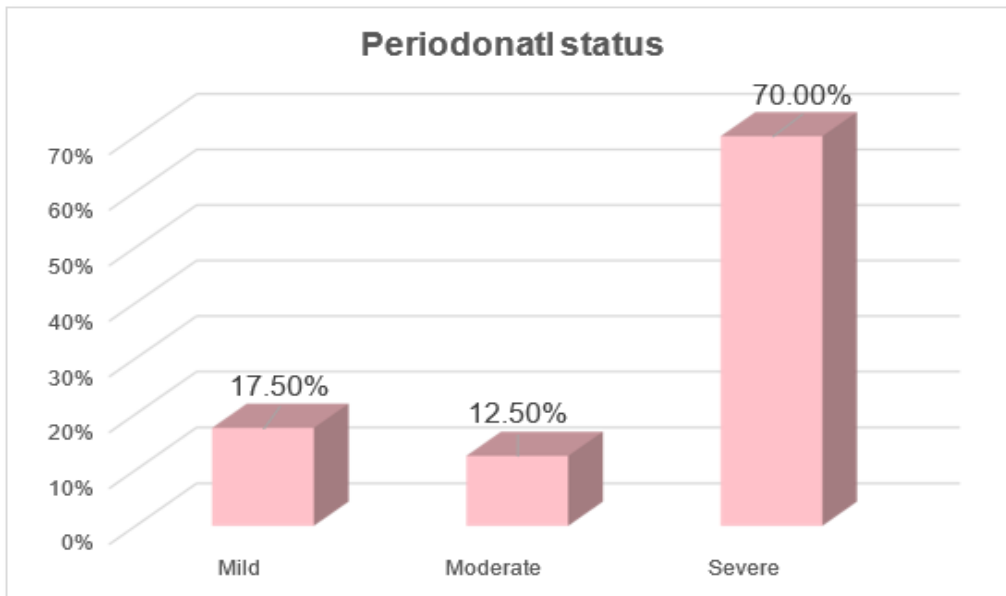

Fig. 1. Bar graph showing the frequency of periodontal status on the basis of severity in cases

Table 2. Showing distribution of CKD stage according to the periodontal status in cases

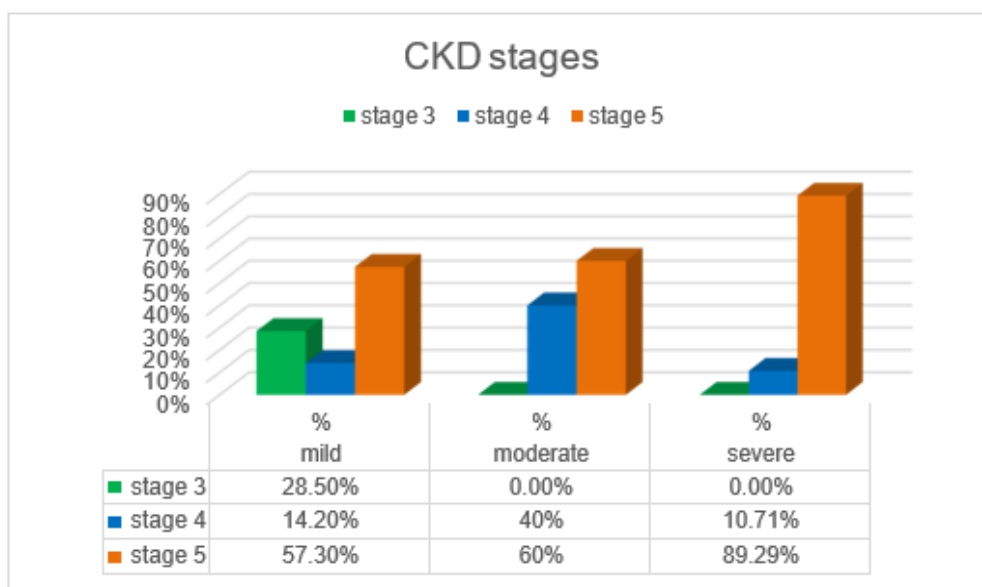| CKD stage	Periodontal status						χ² value (df)	p-value
	mild		moderate		severe			
	N	%	N	%	N	%		
stage 3	2	28.5%	0	.0%	0	.0%	12.86 (4)	0.012
stage 4	1	14.2%	2	40%	3	10.71%		
stage 5	4	57.3%	3	60%	25	89.29%		

Courtesy 5

Fig. 2. Showing distribution of CKD stage according to the periodontal status in cases
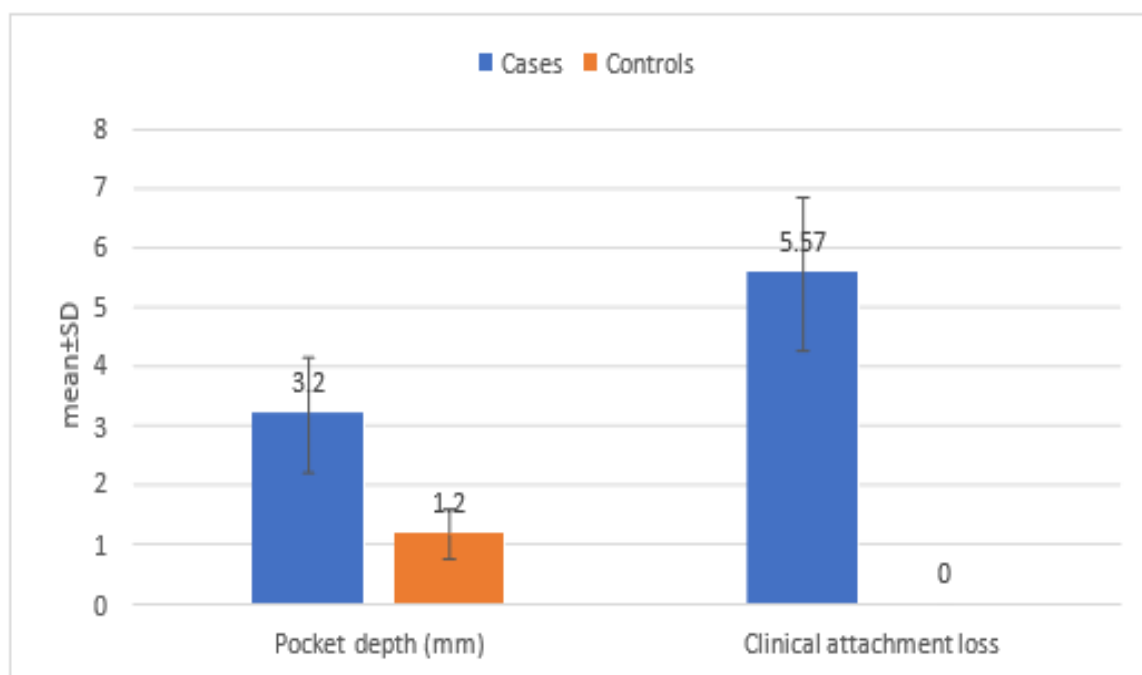
Fig. 3. Bar graph showing the mean distribution of pocket depth & clinical attachment loss of teeth in cases & controls

Table 3. Distribution of pocket depth (mm), and Clinical attachment loss based on their groups

	Groups						Mann Whitney U test	
	Cases		Controls		Total		Z value	p-value
	Mean	SD	Mean	SD	Mean	SD		
Pocket depth (mm)	3.20	0.97	1.20	.42	2.80	1.20	-4.792	**<0.001**
Clinical attachment loss	5.57	1.29	.	.	5.57	1.29	NA	NA

Table 4. Correlation with pocket depth (mm)

Parameter	Case		controls	
	Spearman's rho Correlation Coefficient	p-value	Spearman's rho Correlation Coefficient	p-value
IL-6	0.746	<0.001	0.298	0.402
Serum procalcitonin	0.377	0.016	-0.664	0.036
Serum vitamin D	0.335	0.034	-0.091	0.803
CRP	0.317	0.046	0.299	0.401

Courtesy 6

Table 4 explained that serum il-6, serum procalcitonin, serum vitamin d and CRP were statistically significant with probing pocket depth of cases but in control we observed that serum pct were statistically significant which can be due to sepsis in ckd patient and other markers were not statistically significant in control. Table 5 mentioned below showed the correlation between inflammatory markers and clinical loss of attachment in study population.

Table 5 and Fig. 4 to 7 explained that inflammatory markers not statistically significant with CAL in cases except serum vitamin d which was statistically significant negative correlation with CAL whose p value (0.029). CAL was absent in control so we didn't comment it.
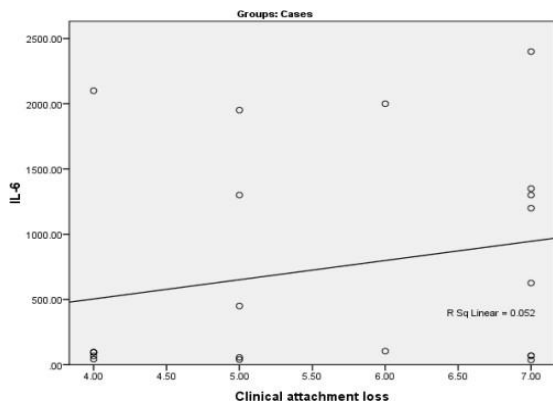
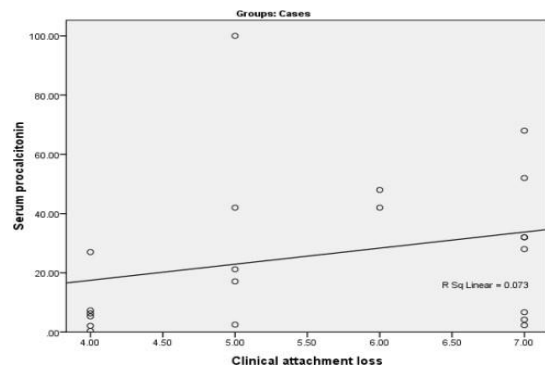**Fig. 4. Scatter plot showing the correlation between IL-6 & CAL in case population**

Fig. 5. Scatter plot showing the correlation between Serum procalcitonin & CAL in case population
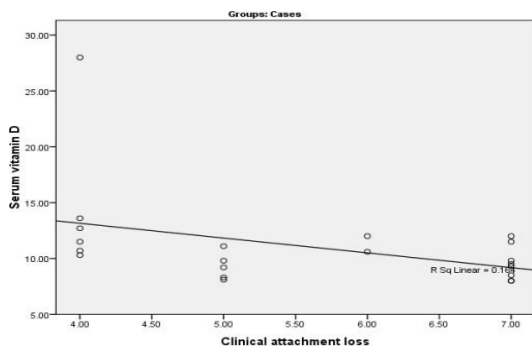

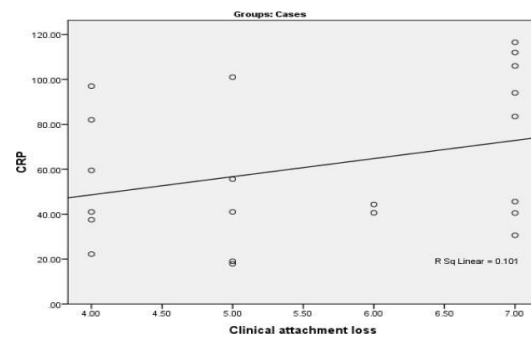**Fig. 6. Scatter plot showing the correlation between Serum vitamin D & CAL in case population**

Fig. 7. Scatter plot showing the correlation between CRP & CAL in case population

Table 5. Correlation with Clinical Attachment Loss (CAL)

Parameter	Case	
	Spearman's rho Correlation Coefficient	**p-value**
IL-6	0.196	0.395
Serum procalcitonin	0.381	0.088
Serum vitamin D	-0.476	**0.029**
CRP	0.295	0.194

Courtesy 6

4. DISCUSSION

The relationship between periodontitis and chronic kidney disease (CKD) is well established, with numerous studies demonstrating the prevalence of periodontitis in CKD patients as well as the detrimental effects of periodontitis on the overall health outcomes of these patients. In this discussion, we will explore the implications of periodontitis in CKD patients, including the increased risk of complications and comorbidities and the importance of early and effective management. One of the main clinical implications of periodontitis in CKD patients is the increased risk of complications and comorbidities (Oyetola EO et al, 2015). Several studies have found a positive association between periodontal disease and an increased risk of cardiovascular disease (CVD) in CKD patients.

A 2015 study published in the Journal of Clinical Periodontology found that CKD patients with periodontitis were more likely to develop cardiovascular events, including myocardial infarction, stroke or death, compared to CKD patients without periodontitis (Deshpande K et al, 20221). Furthermore, periodontitis has been

consistently shown to worsen glycemic control in diabetic patients, increasing the risk of microvascular and macrovascular complications in patients with CKD (Christie H et al, 2022). Additionally, a 2016 study published in the Journal of Periodontology found that periodontitis was associated with a higher incidence of all-cause mortality compared to periodontally healthy CKD patients (Siribamrungwong M, 2015). Together, these findings underscore the importance of identifying and managing periodontal disease in CKD patients to prevent the development of comorbidities and reduce the risk of complications.In addition to the increased risk of complications and comorbidities, periodontitis has been shown to be a significant contributing factor to the progression of CKD which was showed by our study as comparable a 2015 study published in the Journal of Clinical Periodontology demonstrated that periodontitis was independently associated with a decline in renal function in CKD patients over a two-year period (Siribamrungwong M, 2015). Furthermore, a 2019 study published in the Journal of Periodontology found that periodontitis increased the risk of incident CKD in older adults without pre-existing CKD, suggesting that the inflammatory response associated with periodontal disease may contribute to the development of CKD (Dietrich P et al, 2019) which was same as our study but different study population. These findings highlight the need for early and effective management of periodontal disease in CKD patients to slow the progression of the disease and improve overall outcomes, so in this respect our study was unique because we used different inflammatory markers like interleukin-6 serum vitamin d Crp and serum procalcitonin and observed that these marker were statistically significant in periodontitis with ckd patients and they can be used as follow up marker and also prognostic marker. Effective management of periodontitis in CKD patients requires an interdisciplinary approach, involving nephrologists, primary care providers, and dental professional and in addition to it these marker can be gamechanger in management. The National Kidney Foundation has identified the management of oral health as an essential component of disease management in CKD patients, emphasizing the importance of routine dental visits, prophylaxis, and targeted periodontal therapy for patients with periodontitis so in this respect our study will be beneficial (National Kidney Foundation, 2000, Sachin Singh et al, 2023, Sachin Singh et al, 2023).

5. CONCLUSION

Our review clearly states that, the early identification and management of periodontitis in CKD patients is essential to improve outcomes and prevent the development of comorbidities. An interdisciplinary approach, involving nephrologists, dental professional primary care providers, inflammatory markers is necessary to facilitate effective management of periodontal disease in CKD patients to improve the quality of life.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

We hereby declare that generative AI technologies such as ChatGPT used in some part of introduction to make understandable.

CONSENT

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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