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The effect of scaling and root planning on the periodontal condition in hemodialysis patients: A clinical trial study

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Abstract

Background and Aims: Periodontitis is very common in kidney patients undergoing hemodialysis. The two diseases interact with each other so that kidney failure exacerbates periodontal disease and periodontal disease increases the severity of the renal failure. This study aimed to compare the effect of scaling and root planning on the periodontal status of hemodialysis patients and the healthy control group.

Methods: A clinical trial study of 60 subjects, 30 subjects in the dialysis group with chronic periodontitis, and 30 with chronic periodontitis who were systemically healthy was conducted. After a health education session, gingival pocket depth (PD) measurement, and clinical attachment level (CAL), scaling was performed for both groups. Then, the mentioned indices were measured consequently, at 4 and 8 weeks of treatment. Improvement in both groups was analyzed by Mann–Whitney and paired sample *t*-test at the significance level of 0.05 by SPSS software.

Results: In both groups, the decrease in PD and CAL was steadily observed from the first to the third time and the changes from the first to the second and the first to the third time were significant however it was not significant between the second and third time. Mean PD and CAL in the dialysis group were higher than in the nondialysis group, which was significant ($p < 0.001$) for the mean PD. The mean improvement of PD and CAL in dialysis patients was 14.31 ± 10.48 and $17.60 \pm 7.83\%$, respectively, and the mean improvement of PD in the nondialysis group was significantly higher than in the dialysis group ($p = 0.008$).

Conclusion: Periodontal treatment (scaling) causes more improvement in periodontal clinical parameters in healthy people with periodontitis than in dialysis patients.

KEYWORDS

CAL, chronic periodontitis, hemodialysis, PD, scaling

1 | INTRODUCTION

Due to advancements in medical science, dentists are more likely to encounter systemic disease and its issues. Therefore, necessary information on oral symptoms and their special considerations to achieve the desired treatment are of great importance.[1] One of the systemic diseases that affect the periodontal and oral tissues is end-stage renal disease (ESRD). At this stage of renal impairment, patients must undergo dialysis, which is a life-saving method and properly reduces the incidence of mortality rate in these patients.[2]

According to the Annual Iranian Dialysis Report, in 2016, the number of dialysis patients in Iran was estimated at 30,800, 95% of whom are undergoing hemodialysis, and 4%–5% is increased annually.[3] Fisher et al. in a comprehensive study of 11,955 adults over the age of 18 reported that in addition to underlying risk factors for ESRD, including high and low blood pressure; also periodontal disease could worsen kidney disorders due to rising levels of inflammatory cytokines in response to periodontal lipid polysaccharides in periodontitis. Thus, he suggested periodontal status as an indicator of the risk of developing kidney disease.[4] Various studies have demonstrated that more than 90% of patients with kidney disease have oral manifestations.[2] Numerous common risk factors for renal failures, such as high blood pressure and diabetes, are also cited as predisposing factors for periodontitis.[5] In a study that examined the periodontium status among these individuals, severe gingivitis and periodontitis were observed in large numbers of patients who had undergone dialysis.[6]

Oral symptoms in patients with renal failure and hemodialysis patients include: increased salivary gland volume, decreased saliva, dry mouth, urea-like odor, metallic taste sensation, increased plaque, gingivitis, gingival bleeding, periodontitis, candidiasis infection, glossitis, loss of trabeculae, absence of lamina, ground-glass appearance in jawbones, view of giant cell lesions, loose teeth, and gingival resorption.[7]

Periodontal disease is a term that encompasses all pathological conditions of periodontal tissue or tooth-supporting structures, including the gums, cementum, periodontal fibers, and alveolar bone; and its best treatment includes health education and scaling or mechanical debridement.[8] The purpose of scaling is to remove the mass and biofilm formed on the root and scaling is to prevent the reaccumulation of plaque and the reformation of mass.[9] Removal of these pathological materials results in biological compatibility between the root surface and new connective tissue adhesions.[10] Periodontitis and gingival diseases worsen the kidney disease of people undergoing dialysis and consequently, aggravation of renal failure worsens the periodontal condition of these patients in the case of an untreated situation, this cycle causes the development of renal failure and delays in the healing process.

According to the high prevalence and severity of periodontal disease in hemodialysis patients and the interrelationship between hemodialysis and periodontitis; improving the periodontal condition of dialysis patients is more important and scaling is the most common periodontal treatment.[11,12] Therefore, it is essential to know the success rate of scaling and the periodontal tissue response of dialysis patients in the long term and according to the severity of periodontitis. The current study compared the success rate of scaling and root planning in dialysis patients and the healthy group.

Key points

- Kidney failure and periodontal disease interact with each other and one aggravates the other
- The implementation of oral and dental health education programs and performing scaling and root planning will improve the oral and dental health of dialysis patients.

2 | METHODS AND MATERIALS

2.1 | Study type and sample size

In the current clinical trial, the sample size was calculated by comparing the two means formula and based on the study of Tabibzadeh Nouri and Mohajeri Tehrani.[13] With regarding the mean PI in the experimental group at the initiation (1.80 ± 0.76) and the end of the study (1.10 ± 0.92), the significance level of 0.05 and test power of 80%, sample size obtained as 23 participants but to increase the power of the study, 30 participants were selected.

Therefore, out of 125 hemodialysis patients referred to Birjand Special Diseases Center in 2016, after conducting interviews and reviewing their medical records, 41 were recognized as eligible to participate in the intervention, of which 30 (15 men and 15 women) were randomly selected as a case.

All available individuals over 18 years of age with at least 3 months of dialysis (intervention group) who needed scaling treatment (presence of moderate to advanced periodontitis) who were willing to participate in the investigation were included in the study with the following conditions:

- For dialysis patients, platelet (PLT) count was more than 73,000 and prothrombin time (PT) was less than 16 and partial thromboplastin time (PTT) was less than 49, bleeding time (BT) was less than 4 min and international normalized ratio (INR) was less than 4.[14–16]
- At least one molar tooth in each jaw and one first premolar tooth in each jaw and two anterior teeth in each jaw.
- At least 1 area with a PD of 3 mm and more in at least two quadrants of the mouth.
- At least one area with clinical attachment level (CAL) of more than 2 mm.[17,18]
- Having a plaque index below 30% (after health education and before recording the parameters, patients were matched in terms of microbial plaque index.)

Dialysis patients with PLT count less than 73,000, PT higher than 16, PTT higher than 49, BT more than 4 min, and INR greater than

4 min; pregnant women; smokers, and patients with systemic disease affecting periodontal status (kidney disease is an exception in the intervention group) were excluded.

The severity of periodontitis was classified according to the classification proposed in Newman and Carranza's Clinical Periodontology 2019.[19]

2.2 | Intervention

Patients were educated in flossing twice a day with a soft toothbrush and toothpaste before starting treatment. One week later, clinical calculations included pocket probing depth (PPD) and CAL, and gingival analysis in millimeters on six surfaces (mesiobuccal, buccal, distobuccal, mesiolingual, lingual, and distolingual) of six Rumford teeth (Teeth 16, 21, 24, 36, 41, and 44) were performed. All calculations were carried out by an examiner (educated dental student) using a Williams calibrated periodontal probe, mirror, and under the light of a dental unit. If one of the teeth was not present, adjacent and similar teeth were evaluated, for instance in the absence of the desired tooth, the second molars were used instead of the first molars, the second premolars were used instead of the first premolars, and the lateral teeth were used instead of the central teeth. They then received scaling and leveling treatments of the roots in one session by a clinician using an ultrasonic device (Quitron). The measurements were repeated at 4 and 8 weeks after treatment with the same clinician again.

2.3 | Measurements

2.3.1 | Gingival recession

The distance from the cement-enamel junction (CEJ) to the free gingival margin in millimeters, measured with a periodontal probe.

2.3.2 | PPD

The distance from the free gingival margin to the bottom of the gingival groove in millimeters, measured with a periodontal probe.

2.3.3 | CAL

The distance between the CEJ and the floor of the gingival groove in millimeters, measured with a periodontal probe. It equals the amount of gingival resorption and the depth of the probe.

2.4 | Data analysis method

Descriptive and analytical analysis was performed by Mann–Whitney *U*, and paired sample *t*-test at the significance level of 0.05 through using SPSS software version 22.

2.5 | Ethical considerations

A written informed consent form was obtained for those eligible to enter the study. This study has also been registered with the ethics code IR. BUMS.REC.1397.326 in the National Ethics Committee in Biomedical Research on 2019-01-28.

3 | RESULTS

In this study, 60 participants including 23 women (38.3%) and 37 men (61.7%) with a mean age of 37.7 ± 11.2 years and an age range of 19–63 years were examined for PD and CAL at three different times in two groups of dialysis and nondialysis groups. Details of demographic information are given in Table 1:

TABLE 1 Baseline characteristics of hemodialysis and nonhemodialysis groups.

Characteristic	Hemodialysis group (*n* = 30)	Healthy group (*n* = 30)	Total	*p*-values[a]
Sex				0.605[a]
Male	15/30 (50%)	13/30 (43.3%)	28/60 (46.7%)	
Female	15/30 (50%)	17/30 (56.7%)	32/60 (53.3%)	
Age (years)				<0.001[b]
Mean	43	32.4		
SD	9.66	10.28		
Min	28	19		
Max	63	58		
Median	41	30		

[a]Chi-square test; $\chi^2 = 0.27$.
[b]Mann–Whitney *U* test; $Z = 3.68$.

TABLE 2 Comparison of pocket probing depth (PPD) and clinical attachment level (CAL) indexes before repair with 4 months and 8 months after repair in hemodialysis and nonhemodialysis groups.

					p-value[a]		
Periodontal indexes	**Group**	**Baseline**	**4 months**	**8 months**	**Baseline-4 months**	**4–8 months**	**Baseline-8 months**
Pocket depths (PD) (mm)	Hemodialysis	2.69 ± 0.37	2.29 ± 0.35	2.29 ± 0.37	$p < 0.001$	$p = 0.855$	$p < 0.001$
					$T = 10.377$	$T = 0.183$	$T = 9.790$
	Healthy	2.50 ± 0.50	1.88 ± 0.22	1.87 ± 0.25	$p = 0.002$	$p = 0.08$	$p = 0.009$
					$T = 8.199$	$T = 1.762$	$T = 8.041$
Connective tissue attachment (CAL)	Hemodialysis	3.65 ± 0.89	2.98 ± 0.66	2.98 ± 0.64	$p < 0.001$	$p = 0.632$	$p < 0.001$
					$T = 9.038$	$T = 0.484$	$T = 9.076$
	Healthy	3.10 ± 0.58	2.50 ± 0.42	2.49 ± 0.42	$p < 0.001$	$p = 0.139$	$p < 0.001$
					$T = 15.492$	$T = 1.500$	$T = 15.287$

[a]Paired samples *t*-test.

In the dialysis group, 15 (50%) were male and 15 (50%) were female and in the nondialysis group 13 (43.3%) were male and 17 (56.7%) were female. In general, gender distribution in the study groups did not differ significantly ($p = 0.605$). The lowest age was in the nondialysis group and the highest age was observed in the dialysis group (Table 1). The age range (changes between the youngest and oldest age) was lower in the dialysis group than in the nondialysis group. The mean age was 43 ± 9.66 years in the dialysis group and 32.4 ± 10.28 years in the nondialysis group which was significantly higher than the nondialysis group ($p < 0.001$). Because the mean age was not the same in the two groups, age was considered a confounder, and the results were presented by controlling age.

3.1 | Comparison of changes in PD and attachment percentage between the two groups over time

3.1.1 | Compare the PD at different times considering the group

According to the results of the analysis of variance with repeated measures, the interaction between time and group was not significant ($p = 0.313$). Therefore, the change of indices in each group over time was examined by paired sample *T*-test. The decrease in PD from the first to the third time continued and the changes from the first to the second and the first to the third time were significant in both groups, however, the changes between the second and third times were not significant. The mean PD in the dialysis group was always significantly higher than in the nondialysis group ($p < 0.001$) (Table 2).

3.1.2 | Comparison of CAL at different times by group

The results of the analysis of variance with repeated measures demonstrated that the interaction between time and group was not significant ($p = 0.652$). Therefore, changes in indices over time were examined by paired sample *T*-test. In both groups, the decrease in CAL continued from the first to the third time, and although, the changes from the first to the second and the first to the third time were significant in both groups, the changes between the second and third time were not significant. A comparison of groups showed that the mean CAL in the dialysis group was always higher than in the nondialysis group, but this difference was not significant ($p = 0.277$) (Table 2).

3.1.3 | Comparison of PD and CAL improvement status in both groups

In this section, the improvement of two variables between the two groups is compared. It should be noted that the improvement was calculated through the difference between the first and third time and the result was divided by the amount of the first time and then multiplied by 100 for each participant (74).

As an illustration, to achieve improvement in PD:

100 × (PD at the first time) (PD at the third time − PD at the first time) − Improvement.

3.1.4 | PD improvement from the first to the third time

Table 3 demonstrated that the lowest and highest PD improvements in the nondialysis group were from 8.03% to 46.93%, while in the dialysis group, they were from −2.05% to 32.2%. The mean PD recovery was 23.52 ± 12.29% in the nondialysis group and 14.31 ± 10.48% in the dialysis group. The mean PD improvement in the nondialysis group was significantly higher than in the dialysis group ($p = 0.008$).

3.1.5 | CAL improvement from the first to the third time

Table 3 revealed that the improvement of CAL in the dialysis group ranged from 3.95% to 27.20%, while in the nondialysis group, it was

TABLE 3 Comparison of the improvement of pocket probing depth (PPD) and clinical attachment level (CAL) indices of hemodialysis and nonhemodialysis groups between baseline and 8 months after.

Indexes	Group	Mean	SD	Min	Max	Median	*p*-value[a]
Treatment of pocket depths (PD)	Hemodialysis	14.31	10.48	−2.05	32.20	14.14	$Z = 2.66$
	Healthy	23.52	12.29	8.03	46.93	22.28	$p = 0.008$
Treatment of connective tissue attachment (CAL)	Hemodialysis	17.60	7.83	3.95	27.20	19.85	$Z = 0.622$
	Healthy	19.13	7.71	7.57	32.20	18.57	$p = 0.534$

[a]Mann–Whitney *U* test.

7.57% to 32.20%. The mean improvement of CAL in the dialysis group was 17.60 ± 7.83% and in the nondialysis group was 19.71 ± 7.71%. The mean improvement of CAL in the dialysis group was not significantly different from the nondialysis group ($p = 0.534$).

4 | DISCUSSION

In this interventional study, changes in periodontal parameters (PD and CAL percentage) in dialysis and healthy individuals after scaling were compared. In this study, PD was 2.69 ± 0.37 mm in dialysis patients and 2.50 ± 0.50 mm in healthy individuals before scaling which was in agreement with the findings of Mortazavi et al. (study $p < 0.000$).[20] Furthermore, Monchai et al. found that the PD index in dialysis patients before scaling was 3.52 ± 1.32 which was higher than the result of the present study.[21] This difference may be attributed to the higher average age and inclusion criteria of the participants in the Monchai et al. study since patients with heart disease, diabetes, hypertension, and so on were not excluded. Because these diseases tend to be observed in older age, they can affect the average age and mean PD. In addition, aging is considered one of the factors causing periodontal disease and increasing PD.[22]

In the present study, the depth of the probe was reduced to 2.29 ± 0.37 mm in dialysis patients and to 1.87 ± 0.25 mm in healthy individuals 8 weeks after scaling (dialysis $p < 0.001$, healthy $p = 0.009$), indicating the effect of scaling and health education on the improvement of periodontal health. The greatest decrease was observed in the first month and the second month, the rate of change was very low in both groups. Meanwhile, in the second month in the dialysis group, a slight increase in PD was observed, which could be related to the lack of continued hygiene due to many dialysis-related activities. This result is consistent with the result of Gunpinar et al.,[23] Gundala et al.,[24] and Wu et al.[25] The results of those studies showed increased knowledge and awareness about periodontal diseases and their consequences, including systemic effects, intrinsic motivation, and improved oral hygiene of patients with periodontitis. Also, consistent with Eivazi et al results which indicated that scaling and root planning improved periodontal disease indices and salivary TNF-α and interleukin (IL)-1α levels.[26]

Pocket improvement in the dialysis group was 14.31 ± 10.48% after 8 weeks and in the healthy group was 23.52 ± 12.29%, indicating that the PD improvement in dialysis patients was significantly lower than that of healthy individuals ($p = 0.008$) which is consistent with the findings of Fang, Fuchun et al. study, which showed that the mean PD and CAL were 3.09 and 3.61, respectively in patients with ESRD. The most changes were observed in the first follow-up, which was 6 weeks after scaling then decreased by 0.47 and 0.53, respectively, but in the subsequent follow-up 3 and 6 months after scaling, there were no significant changes.[27]

The mean CAL in hemodialysis patients before scaling treatment was 3.65 ± 0.89 which was reduced to 2.98 ± 0.648 weeks after treatment, these values in healthy individuals increased from 3.10 ± 0.58 to 2.49 ± 0.42. Although the mean CAL in the dialysis group was always higher than in the nondialysis group, the difference was not significant ($p = 0.277$). On the other hand, it is stated that improvement of periodontitis improves kidney function in patients with chronic kidney disease (CKD). Chung et al. study showed that dental scaling was significantly associated with a lower risk of ESRD (adjusted hazard ratio [aHR]: 0.83, 95% confidence interval [CI]: 0.77–0.90) in CKD patients. In addition, there was a dose-dependent relationship between the frequency of dental scaling and a reduced risk of ESRD. Dental scaling was also linked to reduced risks of major adverse cardiovascular events (aHR: 0.91, 95% CI: 0.87–0.95), sepsis (aHR: 0.81, 95% CI: 0.77–0.85), and all-cause mortality (aHR: 0.81, 95% CI: 0.76–0.87). they stated that regular dental scaling may serve as a prophylactic measure for kidney function decline.[28]

The mean improvement of CAL in the eighth week compared to pretreatment was lower in the dialysis group (17.60 ± 7.83%) than in the healthy group (19.13 ± 7.71%) which was not significant ($p = 0.534$). The lower percentage of CAL improvement compared to PD in healthy individuals is due to gingival resorption which was effective in the CAL parameter, and after periodontal treatment, a PD decrease was usually observed, while gingival resorption was rarely reduced. This result may be due to the interrelationship between CKD and periodontitis pathophysiology.[29]

A study by Tasdemir et al., which compared the periodontal status of three groups of healthy, diabetic, and continuous ambulatory peritoneal dialysis (CAPD) before and 3 months after scaling, examined the effect of periodontal treatment on dialysis patients with renal insufficiency due to diabetes. They observed the highest PD in the dialysis group with CAPD before treatment which was not significant ($p = 0.314$). The highest significant decrease in PD was seen in all three groups after 3 months, which was observed more in dialysis patients than healthy individuals; But this reduction rate did not differ significantly between the groups ($p = 0.983$). In all three groups, CAL decreased significantly after 3 months and the rate

of change was higher in the healthy group than in the dialysis group, But these changes were not significant ($p = 0.254$). The findings of this study were consistent with our study except for changes in PD, which were higher in dialysis patients than in the healthy group.[30]

Artese et al., who compared the effect of nonsurgical periodontal treatment on the submandibular microbial flora in CKD (predialysis) patients with healthy individuals reported that both PD and CAL were significantly reduced, before scaling and in 3-month follow-up. These changes in PD and CAL in healthy individuals were more than those in the predialysis group but were not significant, which is consistent with CAL findings in the present study.[31]

The majority of the studies reported healthy dialysis subjects showed a significant reduction in probe depth and CAL after scaling. According to various studies, different contradictory findings in mean PD or CAL before treatment can be due to poor study design, heterogeneity of clinical study methodology, use of different probes, and the impact of this feature on clinical parameters. Several investigations demonstrated that the behavioral paradigm of biofilm and tissue response to SRP depends on the health and type of tissue. Due to the presence of various systemic diseases in dialysis patients, these factors cause sometimes different and even contradictory results in periodontal studies in these patients. (70) Therefore, to achieve an accurate and successful examination, it is necessary to control the age of the patients, duration of dialysis, medications, systemic diseases, and other risk factors affecting periodontal status. Another factor influencing the results of the studies is the degree of cooperation of patients and the level of their oral hygiene during the study, which usually decreases over time. In addition, the skill of the clinician and the manner of SRP and probing can affect the results of studies. Another factor influencing the success of treatment is the severity of periodontitis and periodontal disease, which was not identified in most studies.

5 | CONCLUSION

Although the effect of scaling and root planning on hemodialysis patients is less than on healthy people. However, it seems that the implementation of oral and dental health education programs and performing scaling and root planning will improve the quality of life and survival of dialysis patients.

AUTHOR CONTRIBUTIONS

Vajehallah Raeesi: Conceptualization; data curation; funding acquisition; project administration; validation; writing—original draft; writing—review and editing. **Marzieh Mohammadi Moghaddam**: Conceptualization; data curation; formal analysis; Investigation; methodology; project administration; supervision; visualization; writing—original draft; writing—review and editing. **Ali Naghavi**: Data curation; writing—review and editing. **Ghazale Mozafari**: Data curation; writing—review and editing.

CONFLICTS OF INTEREST STATEMENT

The authors declare no conflict of interest. All authors have read and approved the final version of the manuscript Marzieh Mohammadi Moghaddam had full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

DATA AVAILABILITY STATEMENT

Data are available on request from the authors.

TRANSPARENCY STATEMENT

The lead author Marzieh Mohammadi Moghaddam affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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