

Assessment of the Effects of Occluding Pairs of Teeth on Oral Health-related Quality of Life among Dialysis Patients

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ABSTRACT

Aim: To determine oral health-related quality of life (OHRQoL) in hemodialysis patients and assess if location and distribution of teeth had perceived oral impacts.

Materials and methods: Face-to-face interviews and oral examinations were conducted among 96 patients in southwest Florida. Sociodemographic data in addition to self-reported medical conditions were collected. OHRQoL was determined using the Geriatric Oral Health Assessment Index (GOHAI-12). Presence of decayed teeth, missing teeth, anterior occluding pairs (AOPs) and posterior occluding pairs (POPs), and community periodontal index were ascertained through oral examinations.

Results: Mean age was 64.81 ± 12.9 years. Mean number of teeth present was 20.12 ± 10.8 . Nearly half (48%) of the participants had ≥ 1 decayed teeth. Among those examined for periodontal health, 86% had some form of periodontal disease. Mean AOP was 4.4 ± 2.3 and mean POP was 4.2 ± 3.1 . Median GOHAI-12 score was 52. Limiting the kinds or amounts of food ($p = 0.040$), trouble biting or chewing ($p = 0.010$), feeling uncomfortable eating in front of people ($p = 0.024$), and pleased with looks ($p = 0.038$) were statistically significant for AOP groups. Only trouble biting or chewing ($p = 0.044$) and pleased with looks showed significant association with POP groups ($p = 0.038$). In adjusted regression analyses, participants with AOPs 0 to 2 had 86% lower odds of reporting GOHAI-12 scores above 40 (25th percentile) than the group with AOPs 3 to 6 (odds ratio = 0.14; 95% confidence interval = 0.04–0.58).

Conclusion: The study highlights fewer AOP to have a larger effect than POP not only in the psychosocial dimension but also in the functional abilities. Lower GOHAI-12 scores were associated with AOP 2 or less than 2 in the study sample.

Clinical significance: While treatment and management of oral health problems in dialysis patients are complicated by the presence of co-morbidities, age-related changes in the mouth, and issues of access to dental care, identification, repair, or replacement of strategically important teeth using the "shortened dental arch principle" to maintain oral function among hemodialysis patients are recommended.

Keywords: Dental health surveys, Dental prosthesis, Dialysis, Oral health, Quality of life, Tooth loss.

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INTRODUCTION

Oral status and systemic health are bidirectionally related. Systemic changes in patients with chronic diseases affect oral health and vice versa.¹ The maintenance of general health is complex among hemodialysis patients due to increased susceptibility to infections as well as a chronic inflammatory state. Co-morbidities, associated with the need for hemodialysis, frequently exacerbate the inflammatory cascade leading to a more severe materialization in the oral cavity. Dialysis patients in previous studies²⁻⁴ have shown to have periodontal diseases, high decayed, missing, filled teeth (DMFT) index, and accumulation of calculus. While the prevalence of oral diseases may be higher in dialysis patients, objective assessment in terms of frequency and severity of diseases fails to capture health status. It does not adequately describe functional and psychosocial aspects of oral health as well as perceived treatment needs of the individuals.^{5,6} As such, investigation of contextual factors that contribute to the bidirectional relationship between oral and general may provide guidance for future intervention efforts.

Quality of Life (QoL) has gained recognition as a significant contributor to treatment outcomes in individuals with various conditions.^{7,8} The adaptive ability (resiliency) and personal characteristics influence an individual's response to chronic diseases.⁹ QoL concept applied to oral health has largely focused on untreated caries, periodontal diseases resulting in tooth loss that affect masticatory abilities, social interactions, and esthetics.¹⁰

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Studies¹¹⁻¹⁴ have shown perceived oral health status, and treatment needs to vary widely with such clinical measures. While clinical indicators such as number of decayed teeth or presence of

periodontal diseases did not significantly affect perceived oral impacts, perception of oral function and social well-being were significantly associated with the number and location of missing teeth such as missing teeth or anterior/posterior occluding pair (AOP/POP) of teeth.¹¹⁻¹⁴ Thus, the association of location and distribution of occluding pairs and its association with Oral Health-Related Quality of Life (OHRQoL) represents an important area of investigation. To date, OHRQoL has been assessed using several validated questionnaires, yet the Geriatric Oral Health Assessment Index (GOHAI-12) has been widely used.^{15,16}

Evaluation of the extent to which clinical indicators such as occluding pairs that measure functionality accurately affect perceived oral health in dialysis patients has not been adequately explored.^{12,13,17-20} Therefore the objective of the study was to determine OHRQoL in hemodialysis patients and assess if location and distribution of teeth had an impact on subjective experiences.

METHODS

Study Population

Patients above the age of 18 years receiving hemodialysis from five different dialysis centers in southwest Florida were invited to participate. Patients reporting a past medical history of neurological, cognitive, or psychiatric conditions were excluded. Of 160 patients recruited, 96 consented to participate. However, two opted to not partake of an oral examination and one did not complete face-to-face interview. A *priori* power calculation indicated a sample size of 96.^{3,11} The study was approved by the institutional review boards at two institutions of higher education and a kidney care provider. Local approvals were obtained from individual dialysis centers and written consent from dialysis patients was obtained prior to participation in the study.

Data Collection

Data were collected from the GOHAI-12 questionnaire by two interviewers and clinical oral examinations were carried out by dental personnel. The 12 items in GOHAI-12 assess impacts associated with oral diseases in physical function, pain and discomfort, and psychosocial function. Participants were asked if they have always, very often, often, sometimes, seldom, or never experienced any of those problems. Responses were scored on a scale ranging from 0 (always) to 5 (never) except for three positively directed questions that were scored 5 (never) to 0 (always). The total scores ranged from 0 to 60 with higher scores indicating better health. Cronbach's alpha for GOHAI-12 items was 0.90. In addition to GOHAI-12 items, the face-to-face interviews included sociodemographic data such as sex, age, race/ethnicity, self-reported data such as the presence of morbidities, for instance, diabetes, hypertension, cancer, heart disease, and finally, number of years on dialysis. Age was categorized as less than 65 years and 65 years or more. The number of years on dialysis was grouped as 0 to 3 and greater than 3 years.

Dental personnel performed oral examinations the same day as the face-to-face interviews took place. Portable lights and prepackaged sterilized instruments were used. The examinations based on 28 teeth looked for DMFT. Dental decay was determined if a lesion in a tooth had a definite cavity, undermined enamel, or a softened floor or wall.²² Community Periodontal Index (CPI) ranging from 0 to 4 (0 = healthy; 1 = bleeding on probing; 2 = calculus; 3 = pocket 4 to 5 mm; 4 = pocket 6 mm or more) was ascertained in the six sextants of the oral cavity except in

those cases where there were no index teeth to examine. The highest value noted in the six sextants was considered the overall CPI.²² In case of missing natural teeth, the presence and types of prostheses (fixed or removable) were recorded.²² Filled teeth were determined if teeth had restorations and were categorized into four groups: No fillings, 1 to 3 teeth, 4 to 8 teeth, and 9 and above. The number of teeth present was dichotomized into two groups, less than 19 and 20 or more based on the evidence that oral function greatly diminishes with less than 20 teeth.^{23,24} Occluding pairs of teeth were defined as opposing pairs of natural or restored teeth as well as fixed and removable (functional) prostheses. Postcanine opposing pairs were POP while opposing pairs in the anterior region were defined as AOP. Carious teeth with extensive coronal destruction were excluded in the occluding pair calculation. AOPs were categorized as 0 to 2 and 3 to 6 while posterior teeth were divided into two groups 0 to 3 and 4 to 8.¹² Previous studies^{12,25} on occluding pairs suggest more oral health impacts experienced in individuals with 0 to 2 AOP and 0 to 3 POP.

Data Analysis

The statistical analysis was done using SPSS software (IBM Corp., version 26, Armonk, NY). Descriptive statistics are presented as counts and percentages in various demographic and clinical categories. Since GOHAI-12 scores were not normally distributed, Mann-Whitney *U* tests were conducted to compare item scores and GOHAI-12 dimensions with AOP and POP groups. To conduct binary logistic regression, the sample was dichotomized in terms of GOHAI-12 scores into those who had a GOHAI-12 score below 25th percentile and those with total score above 25th percentile. This was based on the frequency distribution and the assumption that those with GOHAI-12 scores below 25th percentile had higher prevalence of oral impacts. Multiple logistic regression analyses were conducted to examine the associations between dichotomized GOHAI-12 and one clinical variable at a time such as number of teeth, decayed teeth, filled teeth, AOP, and POP for the effect of age, sex, race/ethnicity, presence of co-morbidities, and years on dialysis. Only those clinical variables that showed statistically significant associations in bivariate analyses were included in the adjusted regression analyses.

RESULTS

Table 1 shows demographic, general, and oral health status. The mean age of the patients was 64.81 ± 12.9 years. There were more males (60%) than females (40%). Forty-eight percent of the participants reported nonHispanic white race/ethnicity, 37.5% nonHispanic black, 11.5% Hispanic, and 2.1% American Indian. Mean years on dialysis was 4.34 ± 6.6 years. Approximately 60% reported having one condition while 40% reported having more than one medical condition. Hypertension and diabetes were the most commonly reported medical conditions followed by the presence of both diabetes and hypertension. Mean number of teeth present was 20.12 ± 10.8 . Mean number of decayed teeth was 1.5 ± 2.7 . Nearly half (47%) of the participants had one or more decayed teeth. Among the 58 patients examined for periodontal health, 86% had some form of periodontal disease. Nearly 47% of the participants had no fillings with mean filled teeth of 2.74 ± 4.2 . Approximately 77% had 3 to 6 AOP while only 58% had 4 to 8 POP. Mean AOP was 4.4 ± 2.3 and mean POP was 4.2 ± 3.1 . Out of the 94 participants, 14 (15%) were edentulous of which 8 wore complete dentures.

Table 1: Demographics and dentition status

Variable	N (%)
Sex	
Males	56 (58.3)
Females	37 (38.5)
Missing	03 (3.2)
Race/ethnicity	
American Indian/Alaskan native	02 (2.1)
African American	36 (37.5)
White	46 (47.9)
Hispanic or Latino	11 (11.5)
Missing	01 (1.0)
Years on dialysis	
0–3	56 (58.3)
>3	39 (40.6)
Missing	01 (1.0)
Mean	4.34 ± 6.6
Age (years)	
<65	42 (43.8)
≥65	51 (53.1)
Missing	03 (3.1)
Mean	64.81 ± 12.9
Co-morbidities	
1	56 (58.3)
More than 1	37 (38.5)
Missing	03 (3.1)
Teeth present	
0–19	38 (39.6)
20–32	56 (58.3)
Missing	02 (2.1)
Mean	20.12 ± 10.8
Decayed teeth	
0	49 (51.0)
≥1	45 (46.9)
Missing	02 (2.1)
Mean	1.52 ± 2.72
Filled teeth	
No fillings	45 (46.8)
1–3 teeth	17 (17.7)
4–8 teeth	15 (15.6)
9 and above	12 (12.5)
Missing	07 (7.3)
Mean	2.74 ± 4.2
CPI	
0	8 (8.5)
1–4	50 (53.2)
Missing	36 (38.3)
POPs	
0–3	39 (42.4)
4–8	53 (57.6)
Mean	4.2 ± 3.1
AOPs	
0–2	22 (23.4)
3–6	72 (76.6)
Mean	4.4 ± 2.3

Table 2 presents the association between AOPs and individual GOHAI-12 items and GOHAI-12 dimensions. Median GOHAI-12 score was 52 with an interquartile range (IQR) of 40 and 56. Two item scores within physical dimension—limiting the kinds or amounts of food ($p = 0.040$) and trouble biting or chewing any

Table 2: Comparison of GOHAI-12 item scores by AOP among patients receiving hemodialysis

GOHAI-12 items	AOP 0–2	AOP 3–6	p value
	N = 22	N = 71	
	Median (IQR)	Median (IQR)	
Physical function	15.5 (11.5, 20)	18 (15, 20)	0.067
Limit the kinds or amounts of food you eat	3 (2, 5)	5 (3, 5)	0.040*
Trouble biting or chewing any kinds of foods	2 (2, 5)	5 (3, 5)	0.010*
Swallow comfortably	5 (5, 5)	5 (5, 5)	0.920
Prevented from speaking	5 (2.75, 5)	5 (5, 5)	0.221
Pain and discomfort	11.5 (8, 15)	13 (9.5, 15)	0.248
Eating anything without feeling discomfort	3 (2, 5)	5 (2, 5)	0.209
Use medicates to relieve pain or discomfort	5 (3, 5)	5 (4, 5)	0.354
Teeth or gums sensitive to hot, cold, or sweets	5 (3, 5)	5 (3, 5)	0.672
Psychosocial impacts	19 (13.25, 22)	22 (18, 25)	0.041*
Worried or concerned	3 (1.75, 5)	5 (3, 5)	0.316
Feel nervous or self-conscious	5 (2, 5)	5 (3, 5)	0.415
Feel uncomfortable eating in front of people	4.5 (2, 5)	5 (5, 5)	0.024*
Pleased or happy with looks	2 (1, 4)	4 (2, 5)	0.038*
Limit contact with people	5 (4.5, 5)	5 (5, 5)	0.832

* $p < 0.05$ Mann–Whitney U Test

kinds of foods ($p = 0.010$)—were significantly associated with AOP; participants with AOPs 0 to 2 had lower median scores in the above items than participants with AOPs 3 to 6. Within psychosocial impacts ($p = 0.041$), feeling uncomfortable eating in front of people ($p = 0.024$) and pleased with looks ($p = 0.038$) were statistically significant for AOP groups.

Table 3 presents the association between POP and individual GOHAI-12 items and dimensions. Within physical function, only trouble biting or chewing any kinds of foods were significantly associated with POP ($p = 0.044$); participants with POPs 0 to 3 had a lower median score and IQR of 3 (2, 5) as compared to participants with POPs 4 to 8 that had a median score and IQR of 5 (3, 5). Within psychosocial impacts, only pleased with looks showed significant association with POP groups ($p = 0.038$); participants with POPs 0 to 3 had lower median scores of 2 (1, 5) in this item than participants with POPs 4 to 8 who had median scores of 4 (2, 5), and this difference was statistically significant.

Table 3: Comparison of GOHAI-12 item scores by POP among patients receiving hemodialysis

GOHAI-12 items	POP 0–3 N = 39	POP 4–8 N = 52	p value
	Median (IQR)	Median (IQR)	
Physical function	16 (13, 20)	18 (15, 20)	0.225
Limit the kinds or amounts of food you eat	5 (2, 5)	5 (3, 5)	0.410
Trouble biting or chewing any kinds of foods	3 (2, 5)	5 (3, 5)	0.044*
Swallow comfortably	5 (5, 5)	5 (5, 5)	0.832
Prevented from speaking	5 (3, 5)	5 (5, 5)	0.293
Pain and discomfort	12 (9,15)	13 (9.25, 15)	0.598
Eating anything without feeling discomfort	4 (2, 5)	4 (2, 5)	0.966
Use medicates to relieve pain or discomfort	5 (3, 5)	5 (5, 5)	0.264
Teeth or gums sensitive to hot, cold or sweets	5 (3, 5)	5 (3, 5)	0.800
Psychosocial impacts	20 (16, 24)	22 (18, 25)	0.153
Worried or concerned	5 (2, 5)	4.5 (3, 5)	0.910
Feel nervous or self-conscious	5 (3, 5)	5 (3, 5)	0.860
Feel uncomfortable eating in front of people	5 (3, 5)	5 (5, 5)	0.253
Pleased or happy with looks	2 (1, 5)	4 (2, 5)	0.038*
Limit contact with people	5 (5, 5)	5 (5, 5)	0.832

*p <0.05 Mann-Whitney U Test

After adjusting for the effects of sex, age, race/ethnicity, presence of co-morbidities, and years on dialysis (Table 4), participants with AOPs 0 to 2 had 86% lower odds of reporting GOHAI-12 scores above 40 (25th percentile) than group with AOPs 3 to 6 (odds ratio (OR) = 0.14; 95% confidence interval (CI) = 0.04–0.58). However, none of the adjusted relationships between dichotomized GOHAI-12 and number of teeth, filled teeth, decayed teeth, or POPs was statistically significant.

Fig. 1 shows the distribution of the dental status of each tooth. The proportion of teeth present was higher for anterior teeth than posterior teeth in the upper arch while the proportion of teeth present in the lower arch was higher for anterior teeth and premolars as compared to molars. The proportion of fixed or removable prostheses replacing natural teeth was slightly higher for anterior teeth and premolars than posterior teeth in both upper and lower dental arches.

Table 4: Relationship between GOHAI-12 scores* and clinical status in hemodialysis participants

Variables	N	OR (95% CI)	p value
Number of teeth			
0–19	37	0.4 (0.13–1.13)	0.084
20 and above	51	1	
Filled teeth			
No fillings	45	1	
1–3 teeth	16	0.78 (0.22–2.78)	0.697
4–8 teeth	14	6.09 (0.7–53.7)	0.104
9 and above	12	4.42 (0.47–41.26)	0.193
Decayed teeth			
No decayed teeth	46	1	
≥1 decayed teeth	42	0.36 (0.13–1.06)	0.063
AOPs			
0–2	22	0.14 (0.04–0.58)	0.006^
3–6	66	1	
POPs			
0–3	37	0.39 (0.13–1.20)	0.099
4–10	49	1	

*GOHAI-12 score dichotomized using the 25th percentile (GOHAI-12 score = 40); adjusted for sex, age group, race/ethnicity, presence of co-morbidities, and years on dialysis; ^p <0.05

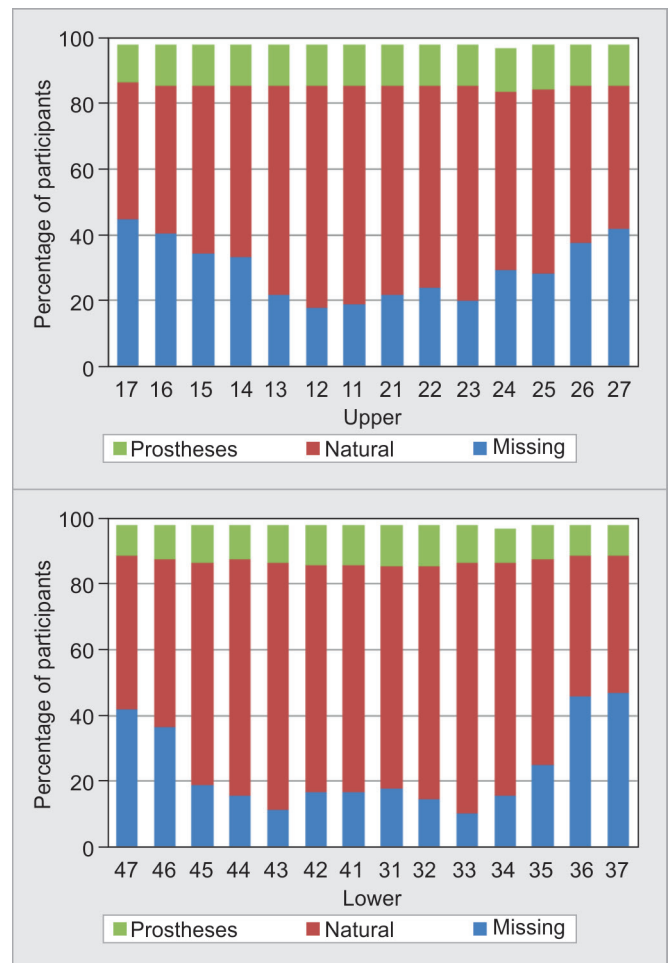


Fig. 1: Distribution of dental status at individual teeth

DISCUSSION

The bidirectional relationship between oral and general health can have profound effect on management and treatment outcomes among patients on hemodialysis. Beyond the pain and discomfort, of poor oral health, the effect on eating, and thereby dietary adherence as well as communication can influence the individual's social roles. The study demonstrated an association between occluding pairs of teeth and subjective measures of OHRQoL among patients receiving hemodialysis. After adjusting for sex, age, race/ethnicity, presence of co-morbidities, and years on dialysis, patients with AOP 2 or fewer than 2 had 86% lower odds of reporting GOHAI-12 score above 40. The significant association between AOP and OHRQoL is in agreement with findings of the previous studies^{12,14,26} where subjective experiences of higher oral impact were associated with AOP. Our study observed that fewer AOP have a larger effect than POP not only in the psychosocial dimension but also in the functional abilities. To our knowledge, this study is one of the first few studies to look at location and distribution of occluding pairs with subjective experiences in dialysis patients in the United States.

Locker²⁶ and Tsakos *et al.*¹² emphasize that the presence of disease does not necessarily affect subjective experience of wellness, and even when it does, its effect is influenced by the nature of the disease, the context of culture, and value systems in which individuals live and access to financial, social, and psychological resources. Patients undergoing dialysis reported a high median GOHAI-12 score of 52 which did not reflect the poor oral health that the clinical examinations revealed. Nearly 48% had at least one decayed tooth and 86% of those examined for periodontal health had some form of periodontal disease. This suggests that in our sample, dental caries or presence of gingival bleeding, calculus, or pockets do not affect subjective experiences of well-being also aligning with previous studies that showed the presence of periodontal diseases or dental caries to have no or minimal effect on subjective experiences of oral impacts.^{11,28,29} Oral diseases leading to ultimate tooth loss affect OHRQoL when tooth loss impacts social well-being and limits oral functions. This finding reconfirms the difference between disease and health.¹² As Vingilis and Sarkella²⁹ assert clinical indicators measure disease while subjective experiences of wellness and the absence of functional disabilities define health. Oral diseases such as dental caries and periodontal disease remain latent before causing symptoms. People are unlikely to experience functional limitations, pain, or discomfort until the disease has progressed to symptomatic stage. Dental diseases are cumulative and it is the ultimate loss of tooth that affects subjective well-being or functional impairment.¹²

In the study sample of dentate patients, the average missing teeth were 8.4 ± 7.2 . Patients may have accrued tooth loss over a period of time. They are likely to have adapted to their oral impairments and may have made gradual dietary changes as Millwood *et al.* in their study point out³⁰ Also, with more serious general health concerns, their health priorities are not focused on oral health.^{28,32} In our study, we observed that the loss of anterior teeth had a greater impact than the loss of posterior teeth and that patients experienced psychosocial impact in addition to physical impairments. GOHAI-12 scores were significantly lower for patients with AOP 2 or less than 2 for two psychosocial impacts (not happy with looks and uncomfortable eating in front of others) and two physical functions (limiting foods and trouble biting/chewing). Patients with POP 3 or less than 3 reported significantly lower GOHAI-12 scores for unhappy with looks and trouble biting/chewing. This finding is congruent with previous studies^{33,34} that

found psychological impacts to be reported alongside physical oral impairments even with instruments like GOHAI-12 that gives greater weight to functional dimensions of oral impacts.

While this study enhances our understanding regarding the relationship between patients' oral health and general health, it was not without limitations. While evidence suggests POP to be associated with some items within GOHAI-12 in bivariate analyses but not in regression analyses, it may be that the study did not have enough statistical power to investigate all exposures. Generalization warrants some caution as convenience sampling of hemodialysis patients may not be true for all hemodialysis patients. Social desirability may have incorporated some response bias in the study and finally, even though the dental hygienist and dental assistant were calibrated, inter- and intra-rater reliability were not determined given the nature of the setting in which the data collection took place and to minimize the burden on dialysis patients. History of tooth loss in edentate patients was not elicited and recorded.

This study highlights AOP (location and distribution of teeth) to affect subjective experiences among hemodialysis patients. The implications for clinical practice, research as well as public health policy lend to the need for a comprehensive assessment of subjective health in concert with objective measures. Care pathways may help inform public policy for oral health care in hemodialysis patients as recommended by Pretty *et al.*³⁴ Oral health prevention and promotion programs aimed at reducing tooth loss need to be reinforced among those living with chronic diseases. Using the common risk factor approach and targeting common risk factors, preventive strategies should be prioritized by policymakers as suggested by Peterson and Yamamoto.¹ An increasing number of older adults are retaining their natural teeth for a longer period in life and living with chronic diseases. Not only will dentists see more patients living with chronic diseases but also there will be greater demand for conservative treatment aimed at preserving teeth.^{1,36,37} Further, while treatment and management of oral health problems in dialysis patients are complicated by the presence of co-morbidities, age-related changes in the mouth, and issues of access to dental care, identification, repair, or replacement of strategically important teeth using the "shortened dental arch principle" to maintain oral function among hemodialysis patients are recommended,^{35,38-40} yet the effectiveness of preventive strategies and economic analyses of tooth repair and replacement strategies will require further research.

CONCLUSION

Lower GOHAI-12 scores were associated with AOP 2 or less than 2 in the study sample. Maintenance and improvement of oral function through oral health prevention and promotion programs as well as purposeful replacement of important teeth using the "shortened dental arch principle" are recommended in dialysis patients.

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