American Journal of Alzheimer's Disease & Other Dementias®
2014, Vol. 29(6) 498-502

DOI: 10.1177/1533317514549650
aja.sagepub.com

Periodontal Health Condition in Patients With Alzheimer's Disease

Santosh S. Martande, MDS[1], A. R. Pradeep, MDS[2], Sonender Pal Singh, MDS[2], Minal Kumari, MDS[3], Deepak Kumar Suke, MDS[2], Arjun P. Raju, MBBS, MD[4], Savitha B. Naik, MDS[5], Priyanka Singh, MBBS, MD[6], C. N. Guruprasad, MDS[2], and Anirban Chatterji, MDS[7]

Abstract

Objective: To compare periodontal health status in individuals with and without Alzheimer's disease (AD). **Methods:** A total of 58 individuals with AD and 60 cognitively normal (ND) adult individuals, ranging in age from 50 to 80 years, were assessed for periodontal health status. Individuals with AD were further divided as mild, moderate, and severe, based on degree of cognitive impairment as evaluated using Mini-Mental State Examination. Gingival index (GI), plaque index (PI), probing depth (PD), clinical attachment level (CAL), and percentage of bleeding sites (%BOP) were evaluated. **Results:** All the evaluated periodontal parameters were higher in individuals with AD than that in ND individuals, and the periodontal status deteriorated with the progression of AD. There were significant differences in mean GI, PI, PD, CAL, and %BOP between all the groups. **Conclusion:** The periodontal health status ofindividuals with AD deteriorates with disease progression and was closely related to their cognitive function.

Keywords

Alzheimer's disease, dementia, chronic periodontitis, oral health

Introduction

Alzheimer's disease (AD) is the most common type of dementia affecting the elderly people. Alzheimer's disease is characterized by progressive degeneration in the central and peripheral neurological system[1] and presents with progressive memory loss and cognitive impairments.[2] Memory loss involves not only difficulty in remembering recent events but also impairments in holding information in mind over short periods of time.[3,4] Alzheimer's disease is thought to progress uniformly from the earliest signs of impaired memory to severe cognitive loss, terminating inevitably in complete incapacity and death.[5]

According to World Alzheimer's report 2010, there are an estimated 35.6 million people with dementia worldwide. This number will nearly double every 20 years and much of the increase will be in developing countries. About 58% of people with dementia live in developing countries. The fastest growth in the elderly population is taking place in China, India, and their South Asian and Western Pacific neighbors. Alzheimer's disease mainly affects people older than 65 years, with a greater predilection for women, although there is a growing awareness of cases that start before the age of 65.[6]

Patients with AD experience limitations in medical and social conditions which may also complicate overall personal and medical care.[7] Deficiencies in the care of these elderly patients may result in several systemic and intraoral health problems including malnutrition, hygiene defects, pressure ulcers, and respiratory disturbances.[8,9] Impaired cognition may severely affect daily activities, and poor oral hygiene execution may lead to caries and eventual loss of teeth.[10-12] Chronic periodontitis (CP) is a peripheral, infectious disease and is one of the leading cause for tooth loss.[13] According to the Third National Health and Nutrition Examination Survey (NHANES

[1] Department of Periodontics, Dr. D. Y. Patil Dental College and Hospital, D. Y. Patil Vidyapeeth, Pune, Maharashtra, India
[2] Department of Periodontics, Government Dental College and Research Institute, Bangalore, Karnataka, India
[3] Department of Periodontics, Vydehi Institute of Dental Sciences and Research Centre, Bangalore, Karnataka, India
[4] Department of Radiology, Government Medical College, Haldwani, Uttaranchal, India
[5] Department of Conservative Dentistry and Endodontics, Government Dental College and Research Institute, Bangalore, Karnataka, India
[6] Department of Opthalmology, JJ Medical College and Hospital, Mumbai, Maharashtra, India
[7] Department of Periodontics, Oxford Dental College and Research Institute, Bangalore, Karnataka, India

Corresponding Author:
A. R. Pradeep, MDS, Department of Periodontics, Government Dental College and Research Institute, Bangalore-560002, Karnataka, India.
Email: periodonticsgdcri@gmail.com

III), gingival bleeding and loss of periodontal attachment (indexes of periodontal disease) were significantly associated with lower cognitive function and are thought to be a risk factor for AD.[14,15] Clinical CP has been linked to other systemic inflammatory conditions such as cardiovascular disease,[16] diabetes mellitus,[17] and other neurodegenerative conditions like Parkinson's disease.[18]

To the best of our knowledge, there are no studies evaluating the periodontal health status in individuals with AD and assessing the effect of progression of AD on periodontal health in Asian population. With growing concerns regarding increasing incidences of AD and related dementia and its effect on periodontal health, this study aimed to evaluate the periodontal health status in individuals with AD, in order to find the influence of progression of AD on CP.

Materials and Methods

Study Population

This was a cross-sectional study, conducted from November 2011 to May 2012, in which 58 individuals with AD and 60 nondemented (ND) or cognitively normal adult individuals, ranging in age from 50 to 80 years, were selected from the Department of Neurology, National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore, India. Ethical approval for the study was obtained from institutional ethical committee, Government Dental College and Research Institute, Bangalore.

Inclusion and Exclusion Criteria

The diagnosis of ND individuals and individuals with AD was done by medical/neurological evaluations, psychiatric behavioral assessments, and neuropsychological evaluation. All participants received extensive diagnostic screening to rule out confounding medical, neurological, and psychiatric conditions. The neurological tests carried out to confirm the diagnosis and progression of AD include magnetic resonance imaging and computed tomography scan. These neuroimaging modalities help in proper diagnosis of AD and differential diagnosis of non-AD brain lesions. Individuals with AD and ND individuals were free from other systemic conditions known to affect cognition. Individuals with psychiatric or behavioral conditions (eg, depression or substance abuse) or taking medications that affect cognition (eg, benzodiazepines) were excluded. The minimum number of scorable natural teeth required was 12. Edentulous individuals or those with <12 natural teeth present were excluded from the study.

The diagnosis of AD was in accordance with the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) workgroup recommendations.[19] The degree of cognitive impairment was evaluated using Mini-Mental State Examination (MMSE). The MMSE is a 30-point scale for assessing attention, orientation, registration, and calculation. The MMSE scores were classified using the system developed by Mungas.[20] Those participants scoring 26 or more (out of 30) were categorized as within normal cognitive range, those scoring from 21 to 25 had mild dementia, those scoring from 11 to 20 had moderate dementia, and those scoring 10 or less had severe dementia. Accordingly individuals were classified into 4 groups: group 1: normal individuals; group 2: mild AD, n = 22 (13 females and 9 males); group 3: moderate AD, n = 18 (10 females and 8 males); and group 4: severe AD, n = 18 (9 females and 9 males). Written informed consent was obtained from all individuals. In severe cases, consent was obtained from the caregiver or any relative accompanying the individuals.

Periodontal Examination

A full-mouth comprehensive examination of periodontal condition was done for all individuals. Individuals were clinically evaluated in the outpatient section of Neurology department, NIMHANS. Patients with severe AD were examined in the outpatient section or respective hospitalized wards of NIMHANS with due help from the caretakers. Two examiners (SSM and SPS) blinded to the objectives of the study performed all dental examinations under the supervision of chief examiner ARP. Several calibration exercises were conducted before the start of the study and throughout the study period to control and minimize examiner drift. The examiners were calibrated on all periodontal measures used including plaque index (PI), gingival index (GI), and probing measures. Examiners calculated absolute agreement and relative agreement for probing measures in 10 patients and converted the continuous probing measures into categorical entities to calculate the κ-index value. For categorical probing measures, the κ-index values for intraexaminer agreement ranged from 0.81 to 0.95, which was higher than κ-index value for interexaminer agreement that ranged from 0.64 to 0.78.

The examination was done using a mouth mirror and a standardized periodontal probe (UNC 15 periodontal probe, Hu Friedy, Illinois) by the same examiner who was blinded to the neurological state of the patient. The periodontal parameters were recorded at 6 sites per tooth, namely mesiobuccal, buccal, distobuccal, mesiolingual, lingual, and distolingual. The parameters evaluated were (1) PI,[21,22] (2) GI,[23] (3) probing depth (PD) taken from the gingival margin to the bottom of the pocket, (4) clinical attachment level (CAL) measured to the nearest millimeter from the cementoenamel junction to the deepest probeable point,[24] and (5) percentage bleeding on probing (% BOP) sites. The BOP was scored positive if a site bled immediately after pocket probing or if a site bled at completion of the probing of a jaw quadrant.

Statistical Analysis

Statistical analysis was performed with statistical software (SPSS version 10.5, SPSS, Chicago, Illinois). The values of different parameters collected are expressed as mean ± standard deviation (SD). Unpaired *t* test was used to compare

Table 1. Demographic and Neurological Characteristics of Individuals With AD and ND Individuals.

	AD Group (n = 58)	ND Group (n = 60)	*P* Value
Age (mean ± SD)	65.2 ± 7.3	64.5 ± 9.4	NS
Females	32/58 = 55.2%	34/60 = 56.7%	NS
Males	26/58 = 44.8%	26/60 = 43.3%	NS
Num of teeth present	15.8 ± 3.6	16.2 ± 4.2	NS
Oral hygiene status			
Good	2/58 = 3%	8/60 = 13%	NS
Fair	16/58 = 27.5%	18/60 = 30%	NS
Poor	40/58 = 69%	34/60 = 57%	NS
MMSE scores	14.2 ± 8.4	28.5 ± 1.2	<.001[a]

Abbreviations: NS, not significant; AD, Alzheimer's disease; ND, nondemented; SD, standard deviation; Num, number.
[a]Statistically significant at ($P < .05$); unpaired *t* test.

Table 2. Clinical Parameters (mean ± SD) and *P* Values.

Parameter	Group 1	Group 2	Group 3	Group 4	*P* Value
PI	1.37 ± 0.29	1.96 ± 0.18	2.62 ± 0.12	3.47 ± 0.27	<.01[a]
GI	0.64 ± 0.21	1.15 ± 0.21	1.68 ± 0.22	2.31 ± 0.26	<.01[a]
PPD	2.39 ± 0.5	3.18 ± 0.35	3.99 ± 0.32	5.02 ± 0.56	<.01[a]
CAL	2.76 ± 0.55	3.58 ± 0.37	4.52 ± 0.38	5.58 ± 0.58	<.01[a]
%BOP sites	29.17 ± 5.43	37.09 ± 5.24	55.44 ± 7	67 ± 12.36	<.01[a]

Abbreviations: ANOVA, analysis of variance; GI, gingival index; PI, plaque index; PPD, probing pocket depth; CAL, clinical attachment level; %BOP, percentage bleeding on probing; SD, standard deviation.
[a]Statistically significant at ($P < .05$); single factor ANOVA.

Table 3. Intergroup Relation for Clinical Parameters (Mean ± SD).

	Group 1 Vs Group 2	Group 1 Vs Group 3	Group 1 Vs Group 4	Group 2 Vs Group 3	Group 2 Vs Group 4	Group 3 Vs Group 4
PI	0.59 ± 0.08[a]	1.25 ± 0.07[a]	2.10 ± 0.11[a]	0.66 ± 0.07[a]	1.51 ± 0.11[a]	0.85 ± 0.10[a]
GI	0.51 ± 0.07[a]	1.04 ± 0.08[a]	1.67 ± 0.10[a]	0.53 ± 0.10[a]	1.16 ± 0.11[a]	0.63 ± 0.11[a]
PPD	0.80 ± 0.14[a]	1.60 ± 0.14[a]	2.64 ± 0.21[a]	0.81 ± 0.15[a]	1.84 ± 0.22[a]	1.03 ± 0.22[a]
CAL	0.82 ± 0.15[a]	1.76 ± 0.16[a]	2.82 ± 0.22[a]	0.94 ± 0.17[a]	2.00 ± 0.22[a]	1.06 ± 0.23[a]
%BOP	7.92 ± 1.87[a]	26.28 ± 2.54[a]	37.83 ± 4.24[a]	18.35 ± 2.82[a]	29.91 ± 4.41[a]	11.56 ± 4.7[a]

Abbreviations: GI, gingival index; PI, plaque index; PPD, probing pocket depth; CAL, clinical attachment level; %BOP, percentage bleeding on probing; SD, standard deviation.
[a]Statistically significant at ($P < .05$); unpaired *t* test.

demographic characteristics and different clinical parameters between 2 groups. Single factor analysis of variance was performed to examine the differences between the 4 groups for different parameters; conventional *P* values <.05 were regarded as statistically significant. The sample size was determined in order to achieve study power of greater than 80%.

Results

Basic demographic and neurological features of the individuals in the study (AD) and control (ND) groups are presented in Table 1. Mean ± SD for ages of the individuals in the study (65.2 ± 7.3 years) and control groups (64.5 ± 9.4 years) were similar, and there were no differences found between individuals with AD and ND individuals with respect to gender. There were not much significant differences in the number of teeth present in individuals with AD (15.8 ± 3.6) and ND (16.2 ± 4.2) individuals and in the oral hygiene status between these groups. Significant differences were found in MMSE scores between individuals with AD and ND individuals. The mean MMSE score for AD was 14.2 ± 8.4 when compared to 28.5 ± 1.2 for ND individuals.

Table 2 shows periodontal parameters assessed for individuals with AD and ND individuals, while the intergroup relation for the periodontal parameters is summarized in Table 3. Individuals with AD showed higher values of periodontal parameters when compared to ND individuals, while the periodontal condition worsened as the disease level progressed from mild to severe, as illustrated by increase in the parametric values from group 1 to group 4. Individuals with AD showed higher GI and PI values, higher values of PD, higher loss of attachment, and greater percentage of bleeding sites. The mean values for GI and PI also showed statistically significant difference between individuals with AD and ND individuals ($P < .01$), and the difference reached to a level of statistical significance from group 1 to group 4, when intergroup comparisons were considered. The mean PD and CAL values were

higher in individuals with AD and showed a statistically significant difference between individuals with AD and ND individuals ($P < .01$), while there was a significant increase in values from group 1 to group 4. The mean %BOP sites were much higher in individuals with AD when compared to ND individuals, and there was a significant difference between them ($P < .01$). The intergroup comparisons for %BOP sites also showed significant increase from group 1 to group 4.

Discussion

The results of the current study showed that individuals with AD showed a greater amount of periodontal breakdown when compared to the ND individuals. The mean values for all periodontal parameters (PD, CAL, GI, PI, and %BOP sites) were much higher in AD groups when compared to ND individuals. Moreover, the periodontal status of individuals with AD deteriorates as the disease progressed from mild to severe stage. Alzheimer's disease is a well-known disease, related to altered cognitive function which is thought to alter daily activities. Cognitive and motor deficits are accompanied by a gradual inability to perform adequate oral hygiene.[25] Impaired cognition, apathy, and apraxia in the middle stages of the disorder are liable for a disinterest and an inability to execute proper oral hygiene techniques, permitting food debris and plaque to remain undisturbed in the proximal and cervical areas of the residual dentition.[26] This can be considered as the major factor for the deteriorated periodontal health status in individuals with AD. There are few studies suggesting declined oral health status in individuals with AD and related dementia. A study by Syrjälä et al[27] showed that individuals with AD and those with other types of dementia had an increased likelihood of having carious teeth, teeth with deep periodontal pockets, and poor oral and denture hygiene, compared with nondemented persons. Another study by Chalmers et al[28] showed that individuals with dementia had significantly higher experiences of oral diseases and conditions at baseline and 1 year compared to participants without dementia: decreased use of dentures, increased prevalence of denture-related oral mucosal lesions, increased plaque accumulation, increased prevalence and experiences of coronal and root caries, and increased numbers of decayed retained tooth roots. These higher experiences of oral diseases and conditions were related to dementia severity. Individuals with AD have been shown to have poor oral hygiene by Ship.[29] In a large population survey that included over 6000 individuals (NHANES III) with a broad age range (20-59 and $\geq$70), associations were found between measures of periodontal disease (extent of bleeding on probing and extent of attachment loss $\geq$ 3 mm) and cognitive function.[13,14] In accordance with these studies, our results suggest a declined periodontal health status in individuals with AD.

The results of the present study are in accordance with few other studies in which there was deterioration in oral health status of patients with AD. In a study by Machado et al,[30] patients with mild, moderate, and severe AD demonstrated poor oral health status, but there was no association between severity of their disease and the presence of oral health problems. In another study, oral condition in patients with mild dementia was found to be poor than that in patients with normal cognitive function, thus suggesting that an alteration in cognitive function may negatively influence oral health status.[31] Moreover, Lee et al,[32] demonstrated that impaired cognitive function may adversely affect oral health status and overall quality of life. Thus, as the cognitive function declines from mild to severe AD, periodontal condition was found to deteriorate in the current study.

Tooth loss is considered as one of the risk factors associated with higher incidence of dementia.[33] Impaired cognition in AD may severely affect daily activities, and poor oral hygiene execution may lead to caries,[10-12] periodontitis,[27-29] and eventual loss of teeth. A study reported in monozygotic twins suggested a strong association between tooth loss and the presence of AD.[34] Another study, examining oral health in a longitudinal study of aging in Catholic Nuns, reported that a lower number of teeth increased the risk of dementia.[33] Tooth loss may occur due to multiple factors including CP.[13] Other causes may include carious lesions, trauma, and extractions due to prosthetic/orthodontic indications or impacted teeth. Periodontitis is the single major risk factor for tooth loss, and moderate to severe periodontitis may further complicate status of AD and related dementia. Thus, the results showed increased periodontal destruction in individuals with AD and also increase in severity of periodontal breakdown with progression of AD, supportive to this concept. Thus, it can be stated that individuals with AD have a declined periodontal status, and progression of AD severely affects the periodontal status. When treating individuals with AD, oral health care providers must develop timely, preventive, and therapeutic strategies compatible with the patient's physical and cognitive ability for prevention, early detection, and prompt treatment of periodontal disease. This was a preliminary study which took into consideration the clinical findings and the uncontrolled variables, including socioeconomic status, education, changes in oral hygiene regimens as dementia progresses, dietary changes, and access to dental care, need evaluation and could be considered in further studies. Further longitudinal, multicentered studies with larger sample sizes are required in future to confirm these findings and also to find a possible association between AD and CP.

Conclusion

Periodontal health status of the individuals with AD is closely related to their cognitive function. Cognitive and motor deficits are accompanied by a gradual inability to perform adequate oral hygiene. Individuals with AD show a greater extent of periodontal destruction which increases as the disease progression occurs. Thus, the individuals with AD require special attention toward overall oral health care, and the individuals and especially the caregivers must be educated regarding the same.

Acknowledgments

We wish to thank Dr P. Satish Chandra, Director/Vice-chancellor, NIMHANS, and Dr S. Chandra, Head of Department, Department of Neurology, NIMHANS, Bangalore, for their unstinting help. We also warmly thank the patients and controls for their participation. The

authors also express their thanks to Mr Manjunath Sharma, Bangalore, for carrying out the required statistics. The authors report no conflicts of interest related to this study.

Authors' Note

Periodontal health status deteriorates with progression of Alzheimer's disease.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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